Toolbox DEIS

VEGETATION MANAGEMENT REPORT

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Introduction

Forested lands within the Toolbox project area are considered part of the Basin and Range physiographic province. They lie within the rain shadow created by the Cascade mountain range and grow on soils that are predominantly volcanic in nature. Precipitation within the project area averages 12-35 inches annually, with most of that falling as snow. The topography of the area could be characterized as primarily gently sloping lands that feature a few volcanic cinder cones, such as Hager Mountain and Foster Butte. Elevations range between approximately 4,450 feet to 7,200 feet (top of Winter Ridge), rising gradually toward the eastern boundary of the project area, which is generally coincident with Winter Rim. Winter Rim is a large fault-block rim that rises about 3,600 feet above the Summer Lake Valley, which lies to the east of the rim. Several relatively flat stream channels cross the project area. Some segments of these streams flow through small basalt canyons characterized by fairly steep rimrock. Other common landscape features include dry scabrock flats, grass meadows, and small springs, seeps or marshes.

Ponderosa pine, a relatively drought-tolerant tree species, provides the most common forested habitat type found within the project area. At higher elevations, white fir and mixed ponderosa pine/white fir habitat types are also abundant. Lodgepole pine is found on the wetter sites, the sites with pumice soil types, or both, within the project area. Western juniper can also be found on south-facing slopes and other drier sites within the project area. Fire suppression efforts in the last 100 or so years across the Fremont National Forest (including the Silver Lake Ranger District and the Toolbox project area) have resulted in the expansion of all three of these forest types—white fir, lodgepole pine, and western juniper—into areas that previously featured pure, widely-spaced stands of ponderosa pine. The discussion of historic and existing vegetative conditions that comes later in this section provides more detail about the ecological consequences of this expansion.

Key Issues:

Recovery using a limited-intervention approach vs. Recovery using a full range of active management practices, including commercial salvage.

Issue Statement: This issue embodies divergent public input on which overall approach to recovery best accomplishes actual recovery and restoration. Some commenters believe that recovery and restoration would be better achieved through an approach that did not include the proposal to commercially salvage fire damaged trees. Others believe recovery and restoration would be better achieved through an approach that allows for commercial harvest of salvage-eligible fire damaged trees.

Measurement Indicator: Since recovery of sustainable forests in areas that have burned depends on reforesting those areas, either through natural means or planting, one indicator of responsiveness to this issue is the method of reforestation used (planting or natural regeneration), its degree of success, and its contribution to sustainable Late and Old Structure (LOS) conditions (measured in acres).

The suitability of using an active or a passive recovery strategy depends on several factors:

- What is the natural regeneration strategy of the species involved? Is the disturbance event within the range of adaptability to recover in a manner similar to the pre-fire suppression functionality of the type?
- Is the amount of dead wood in the stand compatible with the natural functionality of the stand?
- What is the post incident regeneration capacity of the stand?

Characteristics of most of the forested acres in the Toolbox fire area pre-fire suppression:

- They were in a system that maintained a continuous canopy of Ponderosa pine, with variations in density, of mature ponderosa pine at a generally open stand condition. At low density periods individual tree vigor was sufficient to produce adequate seed crop to regenerate the area (Arno 2000).

- The low density, open park-like stand conditions were maintained by frequent (5-20 years), low-intensity fires. These fires occasionally killed a large tree, but more importantly killed almost all of the young tree reproduction, burned down branches and trees, and burned off the tops of brush and grasses.

- Most of the seed produced by a ponderosa pine does not disperse much farther than the height of the cone on the mother tree (Barrett 1966). Ponderosa seeds do have wings, but are a heavy seed, and do not travel far from the tree. So to maintain a Ponderosa stand openings created by fire or insect/disease mortality would have rarely been greater than one acre.

- Down wood generally would have been very little to absent. Since most PP lived to 200-500+ years, and stand density would range between 5-20 or so trees per acre. Pulses of mortality leading to snag creation and then down wood were caused by bark beetle events. These events had a periodicity of every 60-100 years. Reported bark beetle events did cause mortality of 50-60% of the stand. Creating at most 10 snags per acre, and as these fell or were burned that much large wood would be on the ground, probably until the next fire occurred in 10-15 years. But then there would be almost no down wood, or snags, present for another 60-100 years.

- Natural Regeneration of Ponderosa pine occurs in infrequent pulses of regeneration and that regeneration occurs in areas of abundant seed trees (Cleary 1978). Predation by small mammals both, greatly reduces the amount of available seed for reproduction, and provides some seed dissemination. Barrett reported little ponderosa pine seed dissemination more than 100 feet from the seed source, but that in a clear setting with strong prevailing winds seed can be blown 528 feet (Barrett, 1966). The residual unmerchantable dead material in the Toolbox fire area does not equate to a clearcut. The residual dead component in these areas will provide a physical barrier to seed dissemination.

- The pulses of regeneration, which created the overstocked stands of today, were the result of:

    - A fully stocked stand of mature seed producing trees,
    - An open stand condition which allowed for unobstructed seed dispersal,
    - Periodic light fires which prepared a more favorable seedbed,
    - Good moisture year and a good seed production year all occurring simultaneously.

These above listed conditions are not present in the Toolbox fire post fire stand condition. The post fire Toolbox conditions are best characterized as:

- A high variation of green tree stocking is present, but in understocked areas few seed trees are present and they are not well distributed throughout the area.
- The understocked stands have a large amount of dead standing material which will be a barrier to seed dispersal. By the time most of the standing dead will have fallen, the mineral soil seedbed prepared by

the fire, and preferred for PP regeneration, will have become occupied with competing vegetation and not be a favorable seedbed.

- Good moisture and seed production years are highly variable.

One reason that a large amount of seed is necessary to support any natural regeneration is that small mammals eat most of the seed (Hobbs, et. al P.264.). Natural regeneration of Ponderosa pine has shown varying levels of success even with an apparently adequate seed source (Sackett 1984).

I feel that all action alternatives meet this objectively equally, as each alternative equally uses passive restoration methods where there is a chance of success with those methods.

Vegetative development projections with a limited intervention approach:

1-25% vegetative mortality

First 30 years:
Conifer Component still overstocked for sustainable condition, essentially all dead has fallen resulting in increased fuel loading, by end of period 1-3" fuels is deteriorating. Stress related mortality is slowly killing larger trees.
Dense young regeneration has developed adjacent to live trees, interspersed with heavy fuels. Significant damage to young regeneration but little mortality from falling dead.
The small mortality pockets from the fire have mostly seeded in with conifers, but also have abundant grass/shrub component.
Additionally multiple wildfires would have occurred in this time period which would have caused additional pockets of mortality and potentially soil damage in pockets of heavier down fuel.

30-60 years post fire

Conifer component is highly stocked with trees less than 8" DBH, few larger trees are present. By the end of this period much of the 3-8" fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. Very high small tree conifer stocking is present across essentially all of the area. The fire-killed pockets have been regenerated and the continuing stress related mortality has only killed the larger trees, leaving the reproduction. The ponderosa is mostly in a stagnated state. Aspen is nearly absent. Shrub and herbaceous vegetation is nearly absent. Most of the existing reproduction is too highly stocked to produce cones with significant viable seed. Only the occasional tree growing under less competition is developing large tree structure and is capable of reseeding the immediate area if necessary. Wildfires have continued to occur. Fire risk is high and many fires of various sizes have occurred. Creating patches of various sizes that are mostly shrubs, some aspen and herbaceous vegetation.

26-50% vegetative mortality

First 30 years:
Patches of Conifer Component still overstocked for sustainable condition, Bark beetle mortality has continued for many years. Many of these stands now have greater than 50% mortality from a combination of fire and insects. Essentially all dead has fallen resulting in increased fuel loading, by end of period 1-3" fuels is deteriorating.
Dense young regeneration has developed adjacent to live trees, interspersed with heavy fuels. Significant damage to young regeneration but little mortality from falling dead.
The mortality pockets from the fire have abundant grass/shrub component Some conifer establishment has occurred at the edge of the burned area where seed trees were present.
Depending of the virulence of the bark beetle activity many additional larger trees have been killed and more of these acres have moved into the 50% mortality category.

Aspen regeneration is present in areas of high mortality that are subwatered, but less abundant that in the 50%+ mortality areas.

Additionally multiple wildfires would have occurred in this time period which would have caused additional pockets of mortality and soil damage (Hall, 2003) in pockets of heavier down fuel.

30-60 years post fire

Conifer component is highly stocked with trees less than 8" DBH, few larger trees are present. By the end of this period much of the 3-8" fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. Very high small tree conifer stocking is present across essentially all of the area. The fire-killed pockets have been regenerated and the continuing stress related mortality has only killed the larger trees, leaving the reproduction. The ponderosa is mostly in a stagnated state. Aspen is nearly absent. Shrub and herbaceous vegetation is nearly absent. Most of the existing reproduction is too highly stocked to produce cones with significant viable seed. Only the occasional tree growing under less competition is developing large tree structure and is capable of reseeding the immediate area if necessary.
Wildfires have continued to occur. Fire risk is high and many fires of various sizes have occurred. Creating patches of various sizes that have regenerated mostly to shrubs, some aspen and herbaceous vegetation.

51-85% vegetative mortality

First 30 years:
Only small patches of residual live mature conifers remain, Many larger conifers succumbed to fire damage, and the remaining ones received concentrated bark beetle attacks from broods that developed in the recently dead trees. Most of the area has little conifer stocking, but does have an abundant, vigorous shrub component growing in a heavy fuel bed from the down trees. Aspen regeneration in subwatered areas is abundant. Surviving mature conifers are receiving competition stress from the immediately adjacent natural regeneration. Essentially all dead has fallen resulting in increased fuel loading, by end of period 1-3" fuels is deteriorating.

Prescribed fire cannot safely be reintroduced into the stand to kill the excess regeneration due to the high fuel loading. At the end of the 30-year period the remaining LOS trees are slowing dying due to the stress provided by the regeneration from that mother tree. Fuel loadings range from 60-120 tons (Hall, 2003). Due to the expense only a few small areas have been precommercially thinning and had fuels treatment. Additionally multiple wildfires would have occurred in this time period which would have caused additional pockets of mortality and soil damage (Hall, 2003) in pockets of heavier down fuel.

30-60 years post fire
The majority of the area is shrubs, aspen, herbaceous vegetation. There are small patches of highly stocked conifers, generally with trees less than 8" DBH, few larger trees are present. By the end of this period much of the 3-8" fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. The fire killed pockets have regenerated to shrubs, aspen and herbaceous vegetation. Wildfires have continued to occur. Fire risk is high and many fires of various sizes have occurred. Creating patches of various sizes that have regenerated mostly to shrubs, some aspen and herbaceous vegetation.

Providing opportunities for salvaging burned timber while it retains some merchantable value.

Survival potential of fire damaged trees is central to many of these issue including salvage opportunities. Unfortunately many trees do not immediately visibly display their demise from fire damage. The major factors influencing post fire survival are:

- The date of the fire. The earlier in the growing season the greater the susceptibility.
- Tree growth rate and site potential. The more vigorous the tree, and generally younger, the better the chance for survival.
- Tree damage, bud and twig, foliage kill, bark and cambium kill.
- Crown Damage, crown condition the year following the fire
- Bark Beetle attack
- Seed production on damaged trees, the production of a heavy cone crop draws on nutrients that would otherwise aid in recovery of the parent tree, making it more susceptible to mortality. (Wagener, p.2-5, 1961)

For many years the standard of 30% live green crown was used on the Fremont-Winema area. The 30% (for mature trees which have achieved much of their height growth potential) standard came from modification of *Guidelines for estimating the survival of fire-damaged Trees in California* Wagener, 1961. Their minimum criteria for survival of ponderosa pine in a late season fire is 50% live crown, or reduced to 35% for early season fire. Further reduction was made in response to concerns that trees that might survive were being cut. Most of these fires were salvaged the first winter. In the last decade varying standards of live crown have been used in fire salvage activities. Subsequent post fire and post salvage mortality has consistently supported a conclusion that for larger, mature trees, a greater than 30-40% live crown ratio, and no bole or root damage, is necessary for survival for more than a few years post fire. In addition to the following information, one very important factor is that trees in this area are not found with less than a 30-40% crown ratio.

For example, the Quick Fire on the adjacent Chiloquin Ranger District burned in June 1994. Trees with greater than 20% green crown were marked as leave trees and the trees with less than 20% green crown were removed in salvage logging activity. Additionally trees greater than 21" DBH with less than 20% green crown were marked but not salvaged. The marking was done the spring after the fire. By November, 1995, 90% of the trees greater than 21" that had less than 20% green crown the previous spring, had died. Also 9% of trees of all sizes that had greater than 20% green crown in the spring were dead by fall 1995. (Moore, 2002). While no additional monitoring was done it is important to consider that Quick Fire example was only for the first year post fire. In the Lone Pine fire are, which burned in August, where a 30% green crown standard was used, mortality of the very few leave trees had continued for many years. The few live trees today in the Lone Pine

fire area consistently have large, full crowns. Locally I do not find examples of mature live trees with less than 30-40% crowns under any circumstance.

The standard of 20% bright green crown at time of harvest combined with a likely harvest date of summer 2004 will not capture all of the fire related mortality, especially with an active bark beetle population in the area. Observations on local fires have shown that mortality continues for several years. Needles change color to brown during the first period of active growth that occurs after the tree has actually died. This normally occurs from early summer through fall if enough soil moisture is present that tree has not become totally dormant. As Toolbox/Silver was a relatively early season fire, starting on July 12, some mortality did begin to show in fall of 2002. The 20% bright green crown standard for the Toolbox area also approximates a summary of the factors found by Scott, when adjusted for the Toolbox area, to be a high probability of mortality (Scott 2002). When the variables considered by Scott, especially tree vigor, season of fire, site quality, bark beetle pressure, adjusted tree heights and other factors are applied to the Toolbox area the combination results in generally greater than the 20% bright green crown standard.

All alternatives meet the same standard of which trees to harvest. So the measure of meeting this issue is estimated salvage volume. The estimated salvage volumes, as of 9/2002. Are:

	Alt. A	Alt. C	Alt. D	Alt. E	Alt. G	Alt. H
Commercial Salvage	0	14441	6367	11490	14419	13031
Total Volume (MMBF – million bd. ft)	0	73.3	33.7	66.1	73.2	63.8
% of potential (Alt C in this case)		100%	46%	90%	99%	87%

Reducing the likelihood of reburn and potential additional habitat loss and soil damage resulting from intense fire.

The activities that reduce the likelihood of reburn and potential habitat loss and soil damage are those which remove the larger fuels and reduce or treat the smaller fuels to create a condition that do not support active fire behavior. Timber harvest activities are the most effective at removing the large boles. The larger boles are the most pronounced source of damage to soils and residual live vegetation due to the long-term resident heat they produce. Currently it is very obvious where a large log was on the ground after a fire as that will be an area of changed soil color. Longer heat residence is a greater cause of mortality for surface fires than short-term flames. See further discussion of this issue in the long-term sustainability section.

So the measure for meeting this alternative is a combination of harvest acres and fuels treatment. The greater the combined acres the better this alternative addresses this issue.

Alternative	Harvest AC	Fuels AC	Total	% of best potential (Alt G in this case)
Alt A	0	0	0	0
Alt C	14441	10244	24,685	79%
Alt D	6367	5680	12,047	38%
Alt E	11490	6723	19,213	61%
Alt G	14419	16,950	31,369	100%
Alt H	13031	9070	22,101	70%

		Alt. A	Alt. C	Alt. D	Alt. E	Alt. G	Alt. H
Commercial Salvage		0	14441	6367	11490	14419	13031
Total Volume (MMBF – million bd. ft)		0	73.3	33.7	66.1	73.2	63.8
Precommercial Thinning - Acres		0	2214	2214	0	2214	2214
Fuels Treatments and Reductions - Acres	Addl. Treatment w/i Salv. Units	0	10244	5680	6723	11354	9070
	Addl. Treatment o/s Salvage Units, within ¼ Mi of PVT Boundary	0	0	0	0	5596	0
	Site Prep	0	5301	10603	5330	3580	4695
Reforestation - Acres	Fuels Treatment (in Refo. areas only. This is a subset of the Fuels Treatment above)	0	8642	4776	5759	11350	7535
	Planting (net)	0	20906	20743	20753	20728	20721

Reducing current and future damage to riparian areas resulting from the Toolbox Complex.

Effects of the wildfire have been and/or will be beneficial to the regeneration of riparian vegetation. Conifer competition has been a major negative impact to the health and vigor of riparian hardwood and surface vegetation for some time. In these types absence of fire or other disturbance events allows conifers to dominate the riparian areas at the expense of the native riparian vegetation, notably aspen, willow, black cottonwood and a wide variety of wet-site grasses, forbs and rushes.

Most of the riparian areas burned quite hot, resulting in a high degree of conifer mortality. This will stimulate a strong regenerative response from the riparian vegetation. Most riparian species maintain their root crown during average intensity fires, and regenerate post fire quite easily.

The risk to the longevity and structural development of the riparian vegetation is the risk related to the dead trees which will fall to the ground and become fuel. A heavy fuel loading in a narrow canyon can produce a very hot fire. This fire may be outside the range of adaptability for the riparian species, especially in areas of higher fuel concentration. A subsequent reburn is not a question of if but of when. The more time that passes allowing the fuel to decay will reduce the damage from a reburn. However there will still be damage to the shade producing riparian vegetation and potentially consumption of the in-channel course woody debris. This would lead to a riparian condition deficient in both shade and large wood. However the extent of this is open to speculation, depending on the reburn situation.

The upland vegetation condition does have some effect on the condition of the riparian communities. The mortality from the fires again provided the greatest benefit in reduction of the conifer component, and large shrub, which will result in more subsurface water moving into the riparian areas.

There is not a great difference between alternatives in meeting this objective in a vegetation sense. See other reports describing direct riparian projects for that piece of the story.

The riparian vegetation should respond naturally. Planting of some species would accelerate that recovery, and provide a short-term benefit. Conifer planting is not planned within the riparian areas in any alternatives.

Most of the alternatives do not treat fuels in the riparian area. Alternative C is the one exception that would have some harvest and fuels treatment in the outer edge of the riparian area. Alternative C would better meet that aspect of this objective.

Reducing the likelihood that severe insect infestations associated with fire-killed timber will create significant mortality in the remaining live stands.

Ongoing mortality was present prior to the fires. Mortality is expected to continue. Techniques to reduce insect mortality in pine stands include:

- Increase of individual tree vigor through harvest and/or precommercial thinning activities that reduce competition and provides for increased water to each tree so that it can drown out the beetles with their pitch.
- Removal of trees colonized by bark beetle broods so that they are not in the stand when they emerge in the summer and attack new trees.
- Stripping and burning of bark from trees colonized by bark beetles.
- Insecticide treatments for individual trees.

And sometimes populations just collapse. And the mortality stops, or greatly slows as the populations drop to endemic levels.

None of these alternatives cut green trees of the size that are attacked by bark beetles. The only green trees to be cut are precommercial thinning size trees in plantations. Their cambium layer is too small for bark beetles to successfully attack and colonize.

The standard of cutting trees with 20% or less bright green crown should accomplish removal of some beetles. These trees would be very low vigor and very susceptible to attack and colonization. More of these trees that are cut and removed from the area should take some of the bark beetles from the area and reduce the best habitat for reproduction. Bark beetles reproduce best in the poorest vigor trees, just before they die.

So the measure of meeting this objective would be the more acres of partially burned stands, as those would include the most removal of trees that the bark beetles are still able to colonize.

	Alt. A	Alt. C	Alt. D	Alt. E	Alt. G	Alt. H
Commercial Salvage	0	14441	6367	11490	14419	13031
% of Potential (Alt C In this case)	0%	100%	44%	80%	99%	90%

Promoting re-forestation/re-vegetation that facilitates the long term development of sustainable forest conditions.

There are three components to success in meeting this objective.

- Success of reforestation activities in achieving the desired stocking levels with a minimal cost
- Success at removal of dead material which will create the future fuel loading which will be a most significant barrier to restoration of natural processes and development of sustainable stands.

Reforestation with an objective of developing large old structure (LOS) stands is planned under varying circumstances. For the types in the Toolbox fire area Ponderosa pine is the species that both dominated the sites in a pre-fire suppression situation, and is the species that is best adapted to maintain a sustainable stand. Planting activities will focus on reestablishment of ponderosa pine. White fir is locally expected to regenerate naturally, as generally is lodgepole pine. If lodgepole pine does not naturally regenerate after a period of time in true lodgepole areas it will be planted. These are the only species affected by the fire.

Natural Regeneration of Ponderosa pine occurs in infrequent pulses of regeneration and occurs in areas of abundant seed trees (Barrett1983). Predation by small mammals both greatly reduces the amount of available seed for reproduction and provides some seed dissemination. Barrett reported little ponderosa pine seed dissemination more than 100 feet from the seed source, but that in strong prevailing winds seed can be blown 528 feet into a clearcut (Barrett, 1966). The residual unmerchantable dead material in the Toolbox fire area does not equate to a clearcut. The residual dead component in these areas will provide a physical barrier to seed dissemination. The pulses of regeneration, which created the overstocked stands of today, were the result of a fully stocked stand of mature seed producing trees, an open stand condition which allowed for unobstructed seed dispersal, periodic light fires which prepared a more favorable seedbed, good moisture year and a good seed production year all occurring simultaneously. These conditions are not present in the post fire stand condition. One reason that a large amount of seed is necessary to support any natural regeneration is the animals eat most of the seed (Hobbs, et. al P.264.).

The fire behavior in higher vegetative mortality areas of Toolbox/Silver Fires was outside the range of historical fire behavior for the ponderosa pine type in this area. The resulting mortality in these areas is also outside the range of adaptability of ponderosa pine to naturally reforest the area. The reproduction strategy of ponderosa pine in its pre-fire suppression process is to limit its reproduction success. Natural regeneration will not reforest areas of complete mortality greater than a few acres in size, actual size somewhat dependent on shape, distance from seed producing trees, and wind direction.

Reforestation will be predominately by planting as most areas do not have adequate seed trees to reforest the area naturally. Planting densities will be low, with an establishment objective of 100 seedlings per acre. The first seedlings for this area will be available in spring 2005. Depending on site conditions, and especially the degree of development of competing vegetation, 130-300+ seedlings per acre will be planted to achieve the target stocking objective from the forest plan. Young Ponderosa pine seedlings are poor competitors against almost

any established vegetation (McDonald 1989), and therefore planting densities will need to be increased in later years and more replants would be expected.

The planting density will be based on past and expected reforestation success. Reforestation success is based on:

- A combination of site factors; soil type, vegetation type, and moisture regime.
- Type and quality of planting stock
- Quality and timing of planting operations
- Animal damage losses
- Soil moisture when planting and temperature/rain for 1-2 months after planting
- Degree of competing vegetation

Refer to the reforestation soils section later in this report for breakdown of soils capability and prescription specifics. However in general the initial planting density will be determined by estimating mortality based on the above factors and past local example. Plantation survival on favorable soils and sites have consistently been 90% or greater. An analysis was done to determine the survival on poorer soil types within the burn. Data is from the forest SAT layer and activity cards. Plantations were selected at random and also included older plantations, which were planted with poorer nursery stock and less well-developed planting methods than are used today. Results for the poor sites were:

Low capability regeneration sites reforestation survival %:

Fire Area	Low regen capability soils	Low to moderate regen capability soils	Moderate regen capability soils
	Average % survival		
Silver	65%	89%	89%
Toolbox	61%		59%*

* these plantations were mostly located on the Top of Winter Rim, which is an area known for regeneration difficulty, this type represents a small amount of the Toolbox fire reforestation need.

In the partially burned areas, especially the 1-25% mortality, if mortality does not significantly increase, Natural Regeneration of Ponderosa pine should occur. It may even result in stocking excessive to a sustainable condition unless prescribed burns or fire use fires are allowed to remove it.

In the moderately burned areas, 25-50% mortality, a combination of natural regeneration, planting, and follow up precommercial thinning and reintroduction of fire will be necessary to facilitate long term sustainable conditions. Alternatives, which provide greater amounts of both commercial harvest and fuels treatment, will better address this issue.

Economic efficiency

One obvious measure of economic efficiency is recovery of timber stumpage value. And that will be addressed elsewhere. However there are several other measures to consider.

Reforestation costs:

The most economical time to achieve reforestation success is immediately after an activity that has provided growing space without competition for the young seedlings. Tree seedlings are very poor competitors until well established. How long this takes is dependent on the condition of the competing vegetation.

Future fuel treatment costs:

The future down fuel loading from the fire killed trees that will not be removed by harvest, or immediate fuels treatment will be considerable. The most economical time to do any type of fuels treatment is prior to establishment of the next stand. After seedlings are established they will need protection from damage in future activities. This situation precludes the opportunity to use prescribed fire to reduce these if they were to be felled. This often would be the most economical method in areas of complete, or nearly complete, mortality. Mechanical or hand methods would be the only opportunity for fuels treatments after planting of these stands. The cost of all of these methods is more expensive if they need to protect young seedlings.

Future costs of thinning to develop sustainable stand conditions:

This is relative to the previous statements on fuels treatments. The expectation for the planted stands is that they will be planted at a light enough density that the planted trees themselves should not generate a precommercial thinning need. However the progeny of the planted trees, and the residual green trees, will need stocking level control. One factor of light planting densities is that the ponderosa seedlings will start producing viable seed at far younger ages than seen in the heavily stocked stands. They could start producing some seed by ten years of age, and producing significant quantities by 20 years of age. Ponderosa pine has many self-limiting factors to natural regeneration, that will limit reproduction somewhat. But still there will be years when the seed crop, seedbed and climatic conditions are all favorable to generating a large pulse of regeneration. If that regeneration is allowed to persist it will compromise the future development of the stand. The natural process of this type of stand would be that periodic light fire would occur and eradicated most of the young reproduction. However with heavy fuel loading from the fire-killed trees, there opportunity for natural fire is nil. As it would be too hot a fire and would lead to stand replacement mortality, at least especially of the 20 or so year old planted trees. By ten years post fire, most of the fire-killed trees will have fallen. Grass and shrubs will have regrown. This combination could create a very active fire behavior.

So the measure for meeting this alternative is a combination of harvest acres and fuels treatment. The greater the combined acres, the better the alternative addresses this issue.

Alternative	Harvest AC	Fuels AC	Total	% of best potential (Alt G in this case)
Alt A	0	0	0	0
Alt C	14441	10244	24,685	79%
Alt D	6367	5680	12,047	38%
Alt E	11490	6723	19,213	61%
Alt G	14419	16,950	31,369	100%
Alt H	13031	9070	22,101	70%

Purpose and Need

Two components of the purpose and need identified for this proposed project area especially relevant to forested plant communities:

- Develop a long-term sustainable forest that is maintainable by natural fire functions.
- Reduce insect infestation by removing breeding habitat for bark beetles (recent fire killed or beetle killed trees).

The estimated effect of the alternatives on forested plant communities will be examined with a focus on how the alternatives would affect the development of sustainable forests, at both a stand and landscape level.

Regulatory Framework

Guidance for conducting this project analysis is provided by a complex layering of laws and regulations developed over the past century. The National Forest Management Act of 1976 is the basic law that governs vegetation management treatments on National Forest System lands. Several sections in the Act and its accompanying regulations (USDA Forest Service, 1982) specifically address terms and conditions relevant to the vegetation resource. These include sections on timber suitability, and management requirements for vegetative manipulation, including tree regeneration time frames and Regional opening size limits. The Code of Federal Regulations (CFR) is a codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government. The minimum specific management requirements to be met in accomplishing goals and objectives for the National Forest System are set forth in 36 CFR 219.27, which are the implementing regulations for the National Forest Management Act of 1976. Management requirements relevant to silvicultural practices are summarized as follows:

- Section (a) Resource Protection: Management prescriptions shall (3) be consistent with resource values involved, and prevent long lasting hazards and damage from pest organisms, utilizing principles of integrated pest management. Under this approach all aspects of a pest-host system should be weighed to determine situation-specific prescriptions which may use a combination of techniques including, as appropriate, natural controls, harvesting, use of resistant species, maintenance of diversity, removal of damaged trees, and judicious use of pesticides. The basic principle in the choice of strategy is that, in the long-term, it be ecologically acceptable and compatible with the forest ecosystem and the multiple use objectives of the plan; (5) provide for and maintain diversity of plant and animal communities to meet overall multiple-use objectives.
- Section (b) Vegetative Manipulation: Management prescriptions shall (1) contain multiple-use goals that are consistent with Forest Plan goals and standards; (2) assure that lands treated can be adequately restocked based on prior reforestation efforts in the Toolbox project area; and (3) that lands are not chosen for greatest dollar return; (4) potential effects on residual trees and adjacent stands must be considered; (5) avoid permanent impairment of site productivity; (6) provide desired effects on all resources; (7) be practical in terms of transportation and harvest requirements, and costs of preparation and administration.
- Section (c) Silvicultural Practices: Management prescriptions must (1) be suitable; (2) provide allowable sale quantity; (3) provide for restocking; (4) allow cultural treatments; (5) allow for change in harvest levels; (6) provide for even-aged regeneration harvests while protecting other resources; (7) prevent increases of forest pests.
- Section (g) Diversity: Treatment activities designed to maintain the diversity expected in a natural forest might be modified slightly to meet the desired future condition of the area.

The National Forest Management Act of 1976 directed each National Forest to prepare a Forest Plan to guide management activities for lands within its jurisdiction. The Fremont National Forest Land and Resource Management Plan was published in 1989.

In 1994 and again in 1995 the Forest Plans of all Eastside Pacific Northwest Region National Forests were amended by the Regional Forester to provide additional interim standards for managing fish, wildlife and old growth habitats, pending completion of the Interior Columbia Basin Ecosystem Management Plan (Regional Forester's Eastside Forest Plans Amendment 1 Alternative 3, adopted May 20, 1994 and Regional Forester's Forest Plan Amendment #2, adopted August, 1995). The interim standards, which established additional protection requirements for these habitat components, remain in effect today (see Chapter 1 for more details).

In 1995 the Regional Forester also adopted the Inland Native Fish Strategy (INFISH), intended to provide additional interim protection for native fish populations. INFISH focuses on riparian areas and provides governing direction for these areas that supersedes the riparian direction in the other two Regional Amendments. (See Chapter 1 and the Watershed/Fisheries section of Chapter 3 for more detail.)

Current Forest Plan management direction (subject to the above amendments) relevant to the Toolbox project analysis is summarized as follows:

Management Direction

The direction from the Regional Forester's Eastside Forest Plans Amendment 1 Alternative 3, as adopted, 5/94, and the Regional Forester's Forest Plan Amendment #2, 8/95 that pertain to the Toolbox project are found in the Interim Ecosystem and Wildlife Standards. This direction affects all management areas within the project area and applies primarily to the planning and design of timber sales. The Regional Amendment direction is primary when any conflict with Forest Plan direction occurs, *unless* the Forest Plan direction is more restrictive, in which case the more restrictive standard applies. In summary, these amendments direct the forested environment to be managed:

- In a sustainable condition which mimics historical process and function.
- To develop and maintain Late and Old Structure (LOS) forest stands.
- To maintain specific wildlife habitats.
- To maintain specific down wood levels.

Defining Historic Conditions

Natural resource managers increasingly rely on the "range of natural variation," "historic condition," or (in the Pacific Northwest Region) the "historic range of variability" to analyze and develop projects that move lands toward the range of ecological and evolutionary conditions appropriate for an area. This information is used to understand the past conditions and processes and provides context and guidance for managing ecological systems.

The Regional Forester's Amendment directs project analysis for timber sales to "characterize the proposed timber sale and its associated watershed for patterns of stand structure by biophysical environment, and compare to the Historic Range of Variability (HRV)." It states further that HRV "should be based on conditions in the pre-settlement era; however, 1900-s photography may be acceptable. HRV should be developed for large landscapes across which forest types, environmental settings, and disturbance regimes (fire and insects/disease) are relatively uniform. Each component watershed should not be expected to reflect the average conditions for the larger landscape, but the sum of conditions across watersheds within the area for which HRV is developed should reflect ranges of conditions determined in the HRV evaluation."

Interim Ecosystem Standard:

This standard from the Regional Amendment directs that any analysis of a proposal to harvest timber should:

- Characterize the Historic Range of Variability (HRV) for the area.
- Compare current conditions to the HRV.
- Describe the dominant historical disturbance regime.

- Apply direction from one of two habitat management scenarios (A or B, described in the interim wildlife standard), depending on whether the forest type is above or below HRV.

Interim Wildlife Standard:

The interim wildlife standard directs that one of two management scenarios be applied to govern any timber harvest proposal, depending on the HRV within the watershed. Scenario A is to be used whenever one type of LOS is below HRV. Use Scenario B whenever one type of LOS is above HRV.

Scenario A

- No net loss of LOS stages.
  - Some timber sale activities can occur within LOS stages that are within or above HRV in a manner to maintain or enhance LOS within that biophysical environment. It is allowable to manipulate one type of LOS to move stands into the LOS stage that is deficit if this meets historical conditions.
  - Outside of LOS the intent is to maintain and/or enhance LOS components by adhering to the following standards.
    - Maintain all live trees greater than or equal to 21" diameter breast height (dbh).
    - Manipulate vegetative structure that does not meet LOS in a manner that moves it toward these conditions as appropriate to meet HRV.
    - Maintain open park-like stand conditions where this condition occurred historically. Manipulate vegetation in a manner to encourage the development and maintenance of large diameter, open canopy structure.
  - Maintain connectivity and reduce fragmentation of LOS stands, maintain or enhance the current level of connectivity between LOS stands and old growth habitats.
  - Connect within each other by at least two different directions.
  - Connectivity corridor stands - medium or larger trees are common and canopy closures are within top 1/3 of site potential.
  - Goshawks - protect goshawk nest site habitats; 30 acres of suitable nesting habitat and 400 acres Post Fledging Area (PFA). While harvest activities can occur within this area, retain the LOS stands and enhance younger stands towards LOS condition as possible.

Scenario B

- Timber harvest can occur in those areas that are above HRV. (This condition is not encountered for this project analysis and will not be discussed further.)

Summary of Toolbox Project Area HRV Analysis

A more detailed analysis of the Historic Range of Variability within the Toolbox Project Area appears later in the Forested Communities section. In general, the results of the analysis can be summarized as follows:

- The project area, as a whole, is considered below the Historic Range of Variability because it is deficient in stands exhibiting Late and Old Structure (LOS).
- In the Ponderosa pine type, there is an excess of multi-storied stands, and a deficiency of single-storied mature stands.
- In the Lodgepole pine type, there is an excess of conifer type and a deficiency of non-conifer type, such as meadow, grassland, and inclusions of scattered large ponderosa pine.

- The currently classified mixed conifer/white fir type (CW) has become dominated with white fir due to fire exclusion. Compared to HRV for this forest type, there are too many multi-storied stands and too few single-storied mature stands.

The results of the HRV analysis for the Toolbox project area indicate that the interim ecosystem/wildlife standards from Scenario A are to be applied. Thus, in all alternatives considered for the project area, no live trees greater than 21" dbh were proposed for harvest. Regeneration and precommercial thinning prescriptions in all action alternatives were designed to meet the objectives of Scenario A. Connectivity corridors were established in the more lightly burned areas. More details on the wildlife corridors can be found in the Wildlife section of Chapter 3.

Forest Plan Direction Relevant to Silvicultural Practices within the Toolbox Project Area

Forest wide Standards for Timber Management:

Timber Harvest:

- Long-term site productivity will be considered in all silvicultural prescriptions. Items to be integrated into the prescription will include, but are not limited to, maintenance of small and large woody debris to act as a nutrient reservoir, wildlife habitat and erosion impediments; soil compaction, displacement, erosion potential; and effect of frequency of harvest entries on insect and disease occurrence.

Regeneration:

- Minimum stocking of seedlings, unless amended by site–specific guidelines, will be 100 trees per acres.
- Stocking level control will be done on stands, commensurate with Earned Harvest Effect requirements. Earned Harvest Effect is a concept that considers the effects of future management techniques that will accelerate future growth, as a factor in shaping present or current management harvest designs.
- Integrated pest management strategies will be used to manage pests within the constraints of laws and regulations and to meet Forest management objectives.
- Stands may require protection from biological agents in order to meet stocking and growth.

Management area 1 – Mule Deer Forage and Cover on Winter Range

The majority of winter range is non-forested. Cover is present in pine and juniper stands. Optimum spacing between cover and forage areas seldom occurs. Both the quantity and quality of food and cover on most winter range is significantly below its potential.

Management for mule deer on winter range will emphasize the improvement of forage, thermal cover and maintenance of at least 80 percent of the potential habitat effectiveness where site capabilities allow. Emphasis will be placed on creating and maintaining an adequate forage base. Cover and forage will be managed through habitat effectiveness. On forested areas the timber management program will be the major tool used to improve food and cover. Site preparation will be used and managed to create an adequate forage base of shrubs, forbs and grasses.

Forage – Forage conditions will be maintained or improved with emphasis on increasing the forb and grasses available for forage and on a mixture of age classes of shrubs.

Cover – The cover component for project areas shall be a mixture of thermal, hiding, and fawning cover with emphasis on thermal cover. Thermal cover stands should range from 5 to 20 acres. On timber land under uneven-aged management, approximately 15 percent of the area in residual thickets of saplings, pole timber, and small sawtimber will be left unthinned to help meet at least 80 percent HE. On those acres capable of producing thermal cover, 40 to 50 percent of the area should be managed for thermal cover. On areas not

capable of producing 40 to 50 percent thermal cover, lesser amounts would be left and other mitigating measures used to meet at least 80 percent HE.

Management Area 2 – Endangered and Threatened Species

Manage the habitat of federally listed endangered and threatened animals to obtain population increases consistent with the Final Bald Eagle Recovery Plan. And the Pacific coast Recovery Plan for the Peregrine Falcon.

Bald Eagles

Timber will be under a managed system with partial yields. Timber harvest will be used as a management tool to enhance and perpetuate bald eagle habitat where necessary and appropriate. Silvicultural prescriptions will be designated to meet specific habitat needs, rather than traditional descriptions of even or uneven-aged management systems.

Fuel treatment by the fire bald eagle areas will take place only if objectives for treatment would benefit bald eagle habitat.

Fuel treatment by fire around active nest sites will take place outside nesting season (March 1 to July 15) if fire activities and smoke would affect nesting eagles.

Peregrine Falcon

Follow applicable peregrine falcon management plan.

Management Area 3 – Old-growth Habitat for Dependent Species Above the Management Requirement Level.

Provide Additional areas of Old Growth for better habitat distribution and quality in the Klamath Basin. Additional pine and pine-associated sites will be dedicated old growth.

Old growth lodgepole pine stands will be managed on a 120-year rotation.

Salvage operations will take place only when catastrophic events occur (such as wildlife, insect infestations, windthrow etc.) and the affected old growth stand is no longer considered suitable old-growth habitat. A new old-growth stand should be delineated to replace the original habitat.

Natural fuels management will take place in old growth areas only to meet old growth habitat objectives.

Management Area 5 – Timber and Range Production

Comment for this project, Most of the acres proposed for harvest are in MA 5.

Manage for commercial production of sawtimber and forage for domestic livestock on appropriate lands within established standards and guidelines.

Management area emphasizes commercial timber production and forage for domestic livestock. Management activities will follow standards and guidelines designed to produce timber and livestock forage, while meeting environmental requirements for soil, water quality, air, and wildlife habitats. A range of management prescriptions and intensities can be used, depending on stand conditions and management objectives.

Mature and overmature stand predominate on the forested lands within this management area. Timber management will emphasize converting these unmanaged stands to managed conditions. The objective of this conversion is to create a variety of age classes, with all stands achieving their optimum growth potential. Stand treatments will include controlling stocking levels and species mix; improving growth rates, protecting stands from insects, disease and other damage; and regenerating old stands no longer showing optimum growth rates.

Prescriptions:

Uneven-aged Management is applicable in stands where:

- the end result will be a stand predominantly stocked with ponderosa pine, western white pine or sugar pine.
- where there is reasonable assurance that natural regeneration will occur within 10 to 15 years. Planting or interplanting is appropriate to maintain acceptable genetic quality, dominance by early success ional species, or to assure timely regeneration under extremely harsh site conditions.
- where the total area impacted by detrimental soil compaction, erosion, or displacement can be restricted to less than 20 percent of the stand.
- where stands are free from dwarf mistletoe. Where stands are lightly infected, uneven-aged management is applicable only where dwarf mistletoe can be confined to the lower half of the tree crowns and within a single canopy layer. The objective here is to maintain stand growth within 80 percent of its disease-free potential.
- Where stands are free from root rots. Where stands are lightly infected, uneven-aged management is applicable only where root rot can be managed to maintain stand growth within 80 percent of its disease-free potential. Root rot centers should be managed using even-aged systems.

Treatment areas will be coordinated with wildlife habitat needs for game hiding cover. Approximately 15 percent of the area in residual thickets of saplings, pole timber and small saw timber would be left unthinned in order to accommodate habitat needs.

Management Area 6 – Scenic Viewsheds.

Provide high to moderately high visual quality concerns within selected viewsheds on the Forest. Manage the visual corridor to retain to create the desired forest character in an attractive sequential arrangement over time and space. Provide for managing the necessary supporting vegetative size classes and distribution of successional stages to maintain the desired visual character indefinitely.

Prescription.
This prescription applies to viewsheds selected from sensitivity level I and II scenic areas. Timber harvest activities may be planned in foreground Retention and partial Retention areas if they will create and/or maintain desired visual characteristics. In middleground visual zones, timber harvest is planned to maintain the natural appearance as well as meet other resource objectives.

Foreground Retention – middleground partial retention (sensitivity level I);
This management intensity provides that the highways, forest roads, foreground areas adjacent to developed recreation sites, specified waterways, and specified trails will be managed to retain an attractive, natural-appearing forest character. Important landscape elements include large trees, distinctive bark, spring and fall color, variety of tree species having age class diversity, shrubs and ground covers.

Foreground Partial Retention – middleground modification (sensitivity level II);
This management intensity provides that the highways, forest roads, foreground areas adjacent to developed recreation sites, high-use dispersed sites, and specified trails will be managed to provide an attractive, natural-appearing forest character. Important landscape elements are moderately large trees, distinctive bark, spring and fall color, variety of tree species having age class diversity, shrubs and ground covers.

S&Gs applicable to all intensities:
Scenic road corridors will generally have visual foreground zones extending ¼ to ½ mile out from the centerline of the road and will be managed for retention or partial retention. Designated middleground areas will extend from the foreground zone to five miles from the observer and will be managed for partial retention.

S&Gs applicable to specific intensities:
Foreground Retention – Middleground Partial Retention.
Temporary departure from assigned VQOs may be necessary in areas highly susceptible to insect or disease epidemics in order to protect long-term values. Suppress pests when outbreaks threaten managed resources and/or users. Use methods that minimize site disturbance. Manual, mechanical and silvicultural methods are emphasized.
Foreground Retention;
Stumps should generally be cut flush to the ground. Reshape visible landings, and establish ground cover.

Management Area 9 – Semiprimitive Recreation

There are no activities proposed in Management Area 9 for this project.

Goal: Provide for a spectrum of dispersed recreation experience opportunities from semiprimitive nonmotorized to semiprimitive motorized through the management of user activities and natural resource settings.

Management Area 12 – Special Use Sites

Special use sites, such as utility corridors, electronic sites, and railroads comprise this MA. The objective of the MA is to provide for the sage and efficient operation of these facilities, while minimizing environmental impacts and encouraging compatible resource uses.

Management Area 13 – Developed Recreation

To provide convenient recreational opportunities at readily accessible and appropriately designed developed sites.

Timber harvest will not be scheduled in developed recreation sites, although some timber management activities may be used in order to improve scenic quality and safety. Remove hazardous trees.

Prescribed fire is permitted only under an approved vegetative management plan. Prescribe burn before or after season of use.

Management Area 14 Old-Growth Habitats to Provide Management Requirements for Dependent Species.

Manage stands of old growth on the Forest to Maintain minimum viable populations of dependent, native vertebrate species.
Dedicated – Old-growth pine and pine associated stands will be dedicated, i.e. receive no timber management; however, these stands may have wildlife habitat enhancement project to maintain or enhance old-growth habitat.

Managed;
Old growth lodgepole pine stands will be managed to a 120 year rotation. Maintain stands as long as possible without treatment. Select and place under management replacement stands, with emphasis on stand with the earliest replacement potential.

TM S&G

Salvage operations will take place only when catastrophic events occur (such as wildlife(sic), insect infestations, windthrow etc) and the affected old growth stand is no longer considered suitable old-growth habitat. A new old-growth stand should be delineated to replace to original habitat.
See Wildlife report for locations of replacement Old Growth Stands for this project. Within the scope of this project all activities meet an objective of developing LOS stands on all acres, not only MA 14.

Fire Management
Natural fuels management will take place in old-growth areas only to meet old-growth habitat objectives.

Management Area 15 – Fish and wildlife Habitat and Water Quality.

The Forest Plan amendment for Infish has significantly amended the standards and guides for this management area. Infish alternative D applies to this project area. This established Interim Riparian Habitat Conservation Areas (RHCAs) where riparian dependent resources receive primary emphasis.
Standard Widths (principle, applicable) defining RHCAs
Cat 1 – Fish Bearing Streams; 300′ slope distance or outer edge of riparian vegetation.
Cat 2 – Permanently flowing non-fish-bearing streams: 150′ slope distance or outer edge of riparian vegetation.
Cat. 3 – Ponds/wetlands > 1 acre. 150′ slope distance or outer edge of riparian vegetation. From the edge of the maximum pool elevation.
Cat 4 – Seasonally flowing streams or wetlands < 1 ac. Not priority watershed, 50′ slope distance or edge of the riparian vegetation.
In non-forested ecosystems, the RHCA width for permanently flowing streams in Cat 1 & 2 is the extent of the 100 year flood plain.

INFISH S&Gs.

Timber Management
Prohibit timber harvest, including fuelwood cutting, in RHCAs except as described below:

- Where catastrophic events result in degraded riparian conditions, allow salvage and fuelwood cutting only where present and future woody debris needs are met. Where cutting would not retard or prevent attainment of other RMOs and where adverse effects can be avoided to inland native fish.
- Apply silvicultural practices for RHCAs to acquire desired vegetation characteristics where needed to attain RMOs. Apply silvicultural practices in a manner that does not retard attainment of RMOs and that avoids adverse effects on inland native fish.

Fremont LMP S&Gs.
Management activities will not cause a measurable increase in water temperature when daily high temperatures exceed the Oregon water quality standard of 58 degrees Fahrenheit (Klamath Basin) or 68 degrees Fahrenheit (all other Fremont National Forest basins) on all perennial streams.

Project activities will be conducted in a manner to ensure that turbidity levels do not exceed ten percent of pre-activity levels on Class I, II and III streams. Short-term violations for required in-stream construction work are acceptable.

Analysis Area
The Toolbox Project Area is comprised of parts of the following watersheds and subsheds:

<u>Silver Creek Watershed (made up of the following subsheds)</u>

- Middle Silver Creek
- West Fork Silver Creek
- Upper Silver Creek
- Thompson Reservoir
- Benny Creek

<u>Silver Lake Watershed (made up of the following subsheds)</u>

- Upper Duncan Creek
- East Duncan Creek
- Lower Duncan Creek

Analysis Methods

The effects analysis for this project is grouped into two general areas, as defined by the purpose and need to develop long-term sustainable forests within the project area, and the key issue of recovery using a limited-intervention approach versus recovery using a full range of active management practices, including commercial salvage:

- *Stand Development* –this topic is directly related to how and when forested communities will be re-established within the project area. It also ties to the degree of long-term sustainability the stands will exhibit once they are established.
- *Forestland Integrity* – this topic addresses the structure, composition, and diversity at the stand and landscape level as compared to the Historic Range of Variability. It is directly related to the question of long-term sustainability of the forests within the project area.

Numerous different sources of data were used to characterize historic and recent (pre- and post-fire) conditions within the project area, and to estimate what conditions would be created by the different alternatives for salvage and recovery activities:

- *The ecoclass layer* in the Geographic Information System (GIS) records was used to map the forested areas and provide an indicator of site productivity.
- *Stand examination data* was used to characterize the forested condition before the 2002 fires. Most of this data is 10-20 years old. It was evaluated to determine that no entries had been made in that time, and was used if no activity (other than the fire) had occurred since the data was collected. The data was used with no growth or mortality assumptions.
- *The Silvicultural Activities Tracking (SAT) layer* in the GIS records was used to categorize and populate rough stand data, based on the past vegetative management activities within stands.
- *The fuels underburning and vegetation management activities layers* in GIS were combined into one layer and used to further evaluate stand conditions.
- *True color aerial photos* were flown in early September 2002 to assess vegetative mortality after the Toolbox and Silver fires. Additional ground verification was done over 10 to 20 percent of the project area.
- *1,121 post-fire plots* were taken in selected areas in October and November of 2002 to further validate vegetative mortality and other post-fire conditions. These plots were done on a 10 by 10 chain grid. They were located in old growth areas, partial-burn areas, areas with white fir, and proposed helicopter yarding areas. These were minimal level plots designed to verify levels of mortality only.
- *Satellite imagery data, known as ISAT data,* was used to determine the degree of canopy closure (an indicator of stand density) present before the 2002 fires in the forested stands within the eight subsheds crossing the project area. This data was compared to the stand density that would have been expected before the advent of regular fire suppression, and used to evaluate whether the present-day forested communities within the project area within or outside the Historic Range of Variability.

The mortality data was classified into one of four mortality levels, as well as areas classified as "null" if no mortality was visible on the photo. All of the data described above was overlaid with other relevant information, such as the location of streams, other waterbodies, and riparian areas; proximity to sensitive cultural resource sites or wildlife areas; the distance from roads; the presence of steep slopes or sensitive soils; and a host of other factors. All these considerations together went into the development of alternatives to the proposed action that have been designed to respond in different ways to the purpose and need for the project, and to the key issues identified during scoping. The detailed silvicultural and other data used to develop the alternatives and to estimate their effects on forested plant communities within the project area is located in the project file.

Condition of Forested Plant Communities Before and After the Fire

Historic Forest Conditions

The forested stands within the Toolbox project area historically have been dominated by ponderosa pine, almost to the exclusion of any other conifer species. These stands were single story large tree stands in an open grown condition with occasional clumps of smaller trees present. Most of the acres that burned were in the ponderosa pine type. Most of these forested stands also contained a shrub component of Basin big sagebrush, bitterbrush, greenleaf manzanita and snowberry. Grasses, when present, were predominantly western needlegrass, Idaho fescue, Ross' sedge, squirreltail, and long-stolen sedge. Even after a century of fire suppression in these watersheds, ponderosa pine has remained as the major overstory and understory species, although minor amounts of white fir, lodgepole pine and juniper were also present. Overall, the vegetative composition of the Forest Service managed lands within the project area is approximately as follows:

- 25 percent of the area would be considered nonforested, classified instead as a grass, meadow, riparian or shrub type. Some of these acres have become occupied with ponderosa pine, lodgepole pine, and/or juniper since the advent of extensive fire suppression.
- 5 percent of the area is occupied by lodgepole pine.

- 55 percent of the area is occupied by "true" ponderosa pine types. This means that even though there may be some inclusions of white fir as a result of fire suppression, if periodic (8 to 20 year intervals) low-intensity fire is re-established as a disturbance agent in these stands, they will return to pure ponderosa pine.
- 15 percent of the project area is a mixed conifer type (primarily ponderosa pine and white fir), which, if left free of disturbance long enough, would become partly or completely dominated by white fir. These sites include the mixed ponderosa pine/white fir stands along Winter Rim, stands at the extreme southern and western edge of the Silver Fire and a few other small, scattered other locations within the project area.

The following maps display the distribution of the forested vegetation types across the Silver Lake and Silver Creek watersheds. The heavy dark line delineates the project area boundary, the blank white areas are nonforested types, and the gray areas are private lands. Ponderosa pine (CP), lodgepole pine (CL), mixed conifer (CW), and hemlock (CM) are the forested types shown on these maps. Hemlock occurs only as a very small patch outside the project area, on the flank of Yamsay Mountain.

Figure 3.1 Forested Vegetation Stand Types Within the Project Area – Silver Portion

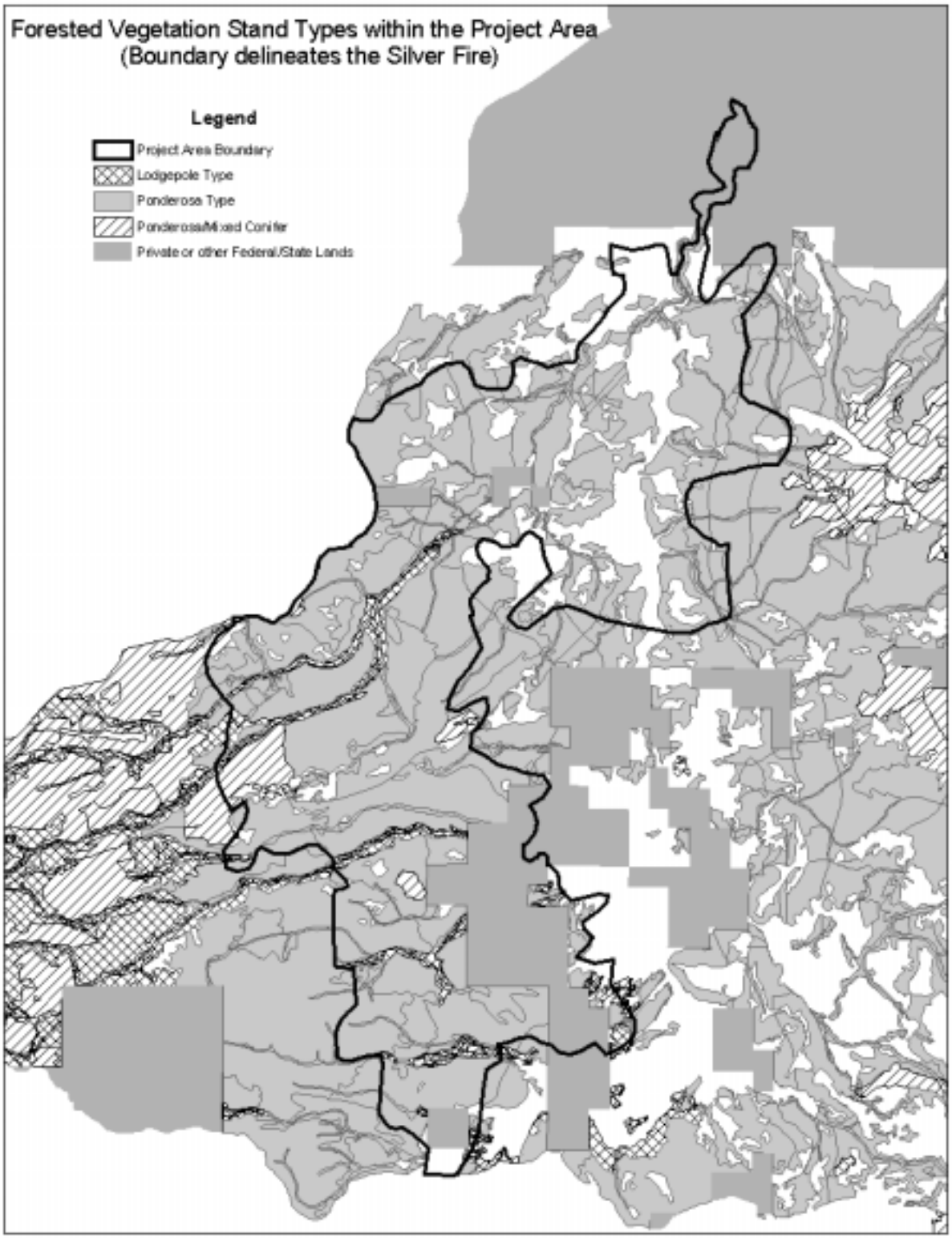
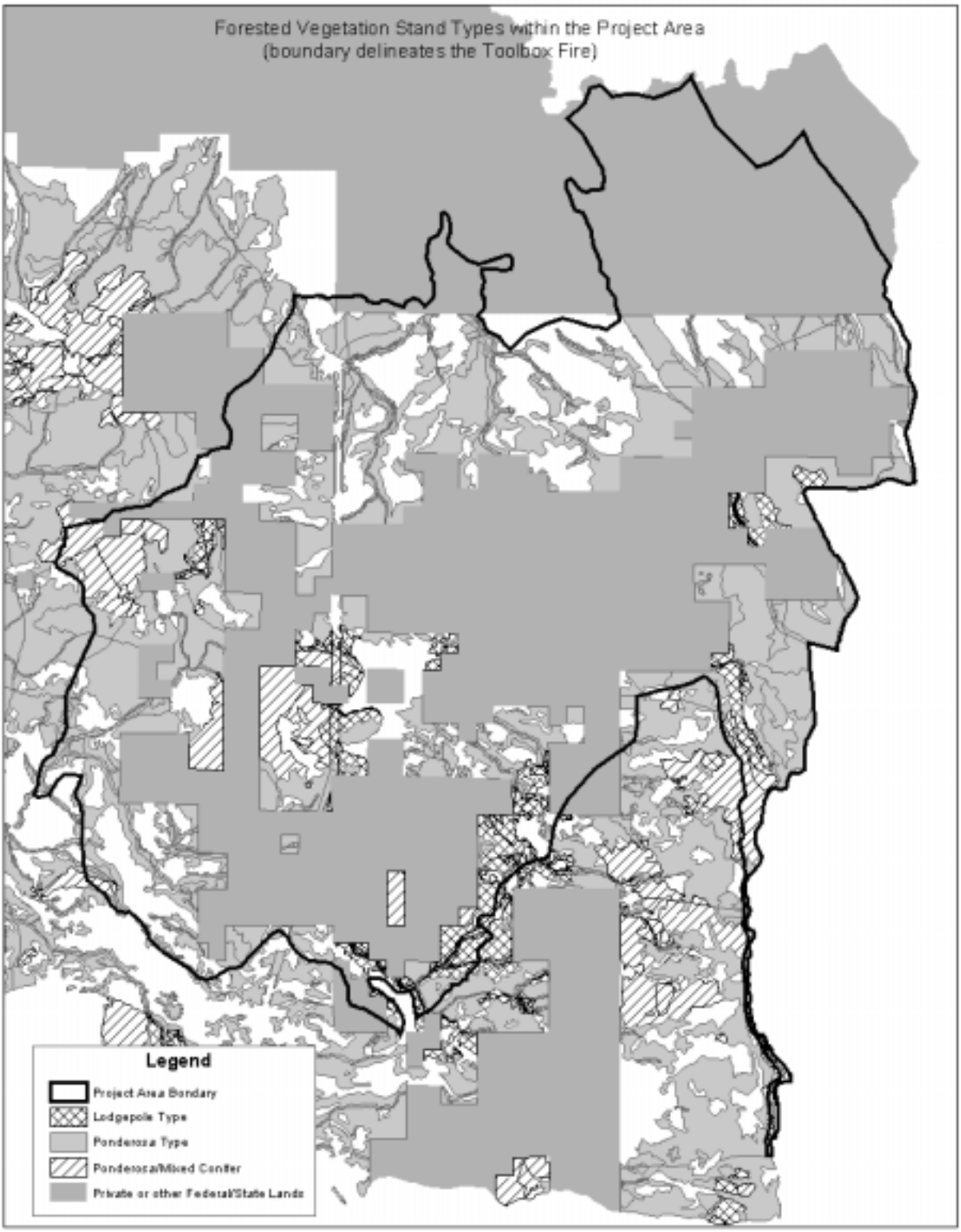


Figure 3.2 Forested Vegetation Stand Types within the Project Area - Toolbox Portion



Site productivity generally increases to the south and east sides of the project area and is directly correlated with the additional rain and snow found at higher elevations. The higher elevation areas also have a greater proportion of forested types, including patches of aspen, especially on Winter Rim. However, regardless of precipitation, all of the project area is classified as low or medium productivity for growing ponderosa pine.

Historically, reforestation by planting has been very successful on the lands within the project area. About 5,000 acres within the project area were in intensive even-age plantations, most of them 15 to 20 years old and densely stocked. Most plantations established on the lands later burned over by the Silver Fire experienced a 90 percent or greater survival rate after initial planting. The plantations established on sites later overrun by the Toolbox Fire averaged closer to an 80 percent survival rate after planting. Where planting failures did occur, they were likely to be found on relatively harsh sites, such as fringe or stringer units between non-forested areas. Planting densities are designed to produce more open fire resistant stands.

All of the forested lands within the project area have had at least one, and most often two or three timber harvest activities in the past, in addition to those intensive treatments discussed in the past activities analysis. However, some of these past timber harvests were very light, removing only a few trees per acre. As a consequence, although extensive *acreage* had been harvested or thinned, most of the forested acres were still very densely stocked (until the 2002 fires). Most forest stands in the project area were also in a multi-storied, multi-aged condition.

Insect and Disease Activity

Endemic levels of Insect and Disease activity are an inherent part of the functionality of the forested types in these areas. Historically bark beetles have been a major factor in controlling stand density in the Ponderosa pine types that dominate the area. In recent years root rot seems to have become a more active cause of mortality.

The first year after wildfire bark beetles easily colonize and brood in the dead trees because; the cambium is still soft enough to be a food source and to develop breeding galleries. But the tree is dead so does not try to kill the beetles by pitching them out. So wildfires have the potential to create large breeding grounds and lead to a significant increase in populations (Ross, 1997). Trees that are heavily burned cannot serve as breeding galleries, but those that are not heavily scorched but are killed do serve well as breeding galleries for the first year. And in partially burned stands, especially the 25-85% mortality range, the beetles will emerge and concentrate their attacks on the remaining live trees. This will increase the chance of mortality for the remaining live trees, especially those that are fire weakened.

Mountain Pine Beetle activity was increasing in the area prior to the fire. The next three maps show the increase in mapped mortality for the last three years. Especially note the increase of activity within the fire area. Bark beetles are capable of flying several miles, under favorable conditions, to attach susceptible trees. The wildfire area will be a significant attraction to local populations.

Mountain Pine beetle is the most destructive bark beetle in the West (Furniss, p.353). It is capable of causing mortality over wide areas. It attacks both Ponderosa pine and lodgepole pine. Past outbreaks have caused many millions of board feet mortality.

Western pine beetle is endemic in the area. Its population may also increase post fire…

The three maps, in the I&DC Map Appendix, show the increase in insect and disease activity, predominately mountain pine beetle, in the past three years.

Insect and Disease Discussion;

There are numerous insects and pathogens present, as a natural condition, in this area. The following discussion only addresses those that, in some way, modify development of silvicultural prescriptions for the area.

The current stand conditions in this area provide excellent habitat for population increases of insect and disease agents. Along with fire these agents are the natural predators, which periodically keep stand populations in check. All are continually present at endemic population/virulence levels. Insects are attracted to trees under stress, from lack of resources (water, nutrients, sun) due to vegetative competition. Most of the stands in the area are either at, or close to, a level of stocking, which has been established as the threshold above which increasing mortality, occurs.

Beetles, bark beetles, while episodic, are the single most significant cause of morality in the pine type of this area. Bark beetles are a primary cause of mortality, and alone are capable of causing widespread mortality. While beetles prefer low-vigor trees, and stands of low vigor facilitate population increases, as population levels increase they can successfully colonize and kill vigorous tree. Both western and mountain pine beetles are present, always at endemic levels and periodically at epidemic levels. The epidemics seem to have a periodicity of 60-80 year intervals and were, along with fire, probably a major contributor to the maintenance of stocking level control in the large tree component. The last major epidemic in ponderosa pine in the area was from 1920-1940. The last epidemic in lodgepole pine was from the 1970s to the 1980s. Outside of epidemic conditions, bark beetles kill individual trees, and a low level of mortality is currently ongoing. While both western and mountain pine beetles have their unique individual characteristics, these differences have become less significant in the multi-sized stands now present, and often both species are working in the same stand and sometimes even the same tree.

BARK BEETLES

Dendroctonus

Western pine beetle, Dendroctonus brevicomis, is periodically destructive to ponderosa pine, especially larger, older pines. While a primary cause of mortality, presence of western pine beetle may also be an indicator of presence of root rot. Western pine beetle can cause mortality of 60-90% of the stand. Western pine beetle has a limitation on attacking smaller trees as it needs to have a wide enough cambium layer to be able to enter and move through. The western pine beetle is larger than the mountain pine beetle so will attack the larger trees, Depending on growth rates western pine beetle cannot successfully attack trees less than 6-10”+ DBH.

Mountain pine beetle, Dendroctonus ponderosae, despite its name is the primary bark beetle colonizing lodgepole pine and smaller ponderosa pine. It can attack trees from 4-8” DBH to the largest ponderosa pine. Populations often build up in lodgepole or smaller pine and then move into all size classes. Mountain pine beetle

has been responsible for significant, landscape level mortality of large pines, but it more often operates in those trees along with western pine beetle. Currently there is mountain pine beetle mortality occurring in both lodgepole pine and ponderosa pine in the planning area. This is a recent increase in the last few years, and appears to be related to a slow, steady expansion of epidemic population levels spreading from the winter rim area. As it is a smaller beetle than brevicomis and can successfully attack trees with smaller cambium than brevicomis, such as smaller trees or slower growing large or small trees.

Pine engraver, Ips pini, is considered second in destructiveness only to Dendroctonus. Ips are especially adapt at overwintering in slash, dead stumps etc, and producing multiple generations in a single season. They can successfully overwinter in most stages of development. Therefore their populations can increase even more rapidly than other bark beetles. Locally Ips have generally only caused small patch killing and were generally not considered a major, primary, cause of mortality. This may be only because other Dendroctonus species followed so quickly. However with the large amount of small diameter trees now present this pattern of mortality could change to more aggressive killing and including more, and larger trees. The emphasis on slash retention will also increase breeding opportunities, until the slash dries out. Greatest risk is from slash created in the spring and early summer.

Fir Engraver, Scolytus ventralis, is a major pest of true firs, It attacks pole sized trees and the tops of mature trees. Trees infected with root rot are especially prone to attack and often the pattern of top killing from Scolytus will identify root rot pockets. Scolytus can kill trees as well as tops. They can breed in slash and windthrow.

ROOT ROT

Two species of root rot predominate in the area. These are:

Annosus Root Rot – Heterobasidion annosum

Armillaria Root Disease – Armillaria ostoyae

While these are two distinct species for the purpose of prescription development they have many similarities.

- They are soil fungi that may be very large underground organisms.
- They do cause mortality either primarily or with other pathogens or insect activity.
- Vigorous stands on suitable sites show little weakening or mortality from root rots.
- There seems to be an increasing virulence in root disease activity in the region, it may have been less active in "natural" stands.
- Spread is either through root to root contact or from airborn spores, produced by ground level fruiting bodies (mushrooms) colonizing cambium exposed through wounding.
- These organisms can generally survive as either a parasite or saprophyte.
- Decreasing the amount of below ground root mass and maintaining open stands with fewer trees per acre is the long term management strategy for root rot management
- Short-term mortality may be increased secondary to mechanical thinning, fuels treatment or fire activities due to a combination of reduction in host population and/or direct wounding of residual stand.

DEFOLIATORS

Modoc Budworm, Choristoneura viridis, has been the most common species of budworm present. While periodically its populations do increase they historically have not resulted in significant mortality.

Western spruce Budworm, Choristoneura occidentalis, is an important defoliator of Douglas-fir and true firs in the Inland Empire. Douglas-fir is not present in this planning area but true firs are present. Repeated years of defoliation, especially for expansion fir populations on poorer sites, can cause mortality. Spruce budworm is a much more aggressive defoliator than Modoc budworm. Unlike Modoc budworm, spruce budworm has not been significant in this area up to this time. However historically true fir populations were low in the area. With the increase of true fir populations as a result of fire exclusion Western spruce Budworm may become significant in this area.

Douglas-fir Tussock Moth (DFTM), Orgyia pseudotsugata, is an important defoliator of Douglas-fir and true firs in the Inland Empire. Douglas-fir is not present in this planning area but true firs are present. DFTM had not been significant in this area up to this time. However historically true fir populations were low in the area. With the increase of true fir populations as a result of fire exclusion DFTM may become significant in this area. Tussock moth traps placed just outside of the Toolbox area, one setting just below Morgan Butte and another just off Government Harvey Rd. in 2001 collected record numbers of Tussock Moths. A similar increase has already occurred in areas of the Klamath Basin. At epidemic levels DFTM will also feed on pines and bitterbrush.

Pandora Moth; Coloradia Pandora, is the major defoliator of mature pines, and associated lodgepole pine and immature pines, in this area. Historically, and by local native oral traditions, pre-historically, it maintained significant population levels in the Klamath-Lake basins. Pandora moth rarely, independently, causes significant mortality but has been demonstrated to predispose conifers to mortality to other agents, especially bark beetles. The last, and most, destructive documented outbreak started in 1911-25. Widespread defoliation and mortality occurred. More significant however was that this outbreak was followed by a very serious bark beetle epidemic. The mortality from this bark beetle epidemic in the Klamath-Lake area was estimated to exceed 100 MM board feet in some years. This bark beetle epidemic lasted for two decades. Currently the Winema is experiencing epidemic levels of Pandora moth, and some minor activity is present in the Toolbox area.

In the pupal stage the larvae bury themselves in large granule loose soils, including pumice, prior to pupation. With fire suppression and lack of surface soil litter layer disturbance it is possible that populations were limited by lack of exposed breeding sites due to heavy litter mats covering the large granule soils. With the increase of large fires and prescribed burning there may be an increase in reproductive potential and subsequent activity. Increased Pandora moth defoliation, the classic "daylighting" of crowns, has been noted in the past years. An outbreak on the Deschutes NF occurred in the early-mid 90s, on areas of second growth that had had surface ground disturbance as a result of mechanical harvest activities. With sustained, multi-year defoliation mortality can result, especially in trees of poor vigor. Although Pandora moth is one of the few pathogens whose activity level is not necessarily associated with poor vigor stands. Recently there has been a small increase in Pandora moth activity in this area and a very significant increase on the Winema NF.

MISTLETOE

Dwarf Mistletoe (Arceuthobium) is a common parasite in the region. Infections are systemic, cortical, perennial shoots.

- It is species specific, and there is a mistletoe species that attacks all conifer, and many woody non-conifer, species in this area. Some transfer between species does occur.
- Dwarf mistletoes reduce growth, up to 90 % when compared to uninfected trees, and may predispose trees to successful attack from insects or pathogens. This reduction is a result of both direct parasitism of the organism and reduction of the trees basic photosynthetic capacity.
- Spread is by spores, the higher the spore producing plants are located in a tree the farther they can spread spores to understory or downslope trees.
- Retention of LOS trees, many of which contain dwarf mistletoe plants, insures continued propagation of dwarf mistletoe. However seed spread generally does not exceed 33 feet horizontal distance. Therefore very wide stand spacing could be effective in reducing spread. Historically consumption of mistletoed trees/clumps by fire may have created a spacing approximating 60+ feet and served to reduce infection levels.
- Mistletoe is very flammable, especially late in the season, and will contribute to crowning of individual trees and to fire spread. Understory infections historically may have assisted in killing smaller trees during otherwise low intensity fires.
- Infected trees produce less seed.
- Brooms may be valuable wildlife habitat, and mistletoe may contribute to creating spike tops providing additional habitat.
- Heavily infected trees will have sparser crowns reducing thermal cover values.

Historic Range of Variability

The Ponderosa pine type Historic Range of Variability is most applicable to most of the project area. This type was characterized by continuous ponderosa pine stands dominated by trees generally greater than 16″ DBH and it a low stocking density compared to today (Lieberg 1899, Munger 1917). Indeed the stands were so widely spaced that some foresters of the time felt that they were understocked and needed additional regeneration to meet their optimum timber production levels. The surface vegetation condition, in the Ponderosa pine type, was most often described as devoid of surface vegetation and down wood. However there was also some mention of grassy glades being scattered throughout the area, especially in higher elevation types. Today the term Late and Old Structure (LOS) is used to generally describe this condition. LOS however is used to addresses structure, and not the stocking levels that are present. The stocking level for the Ponderosa pine type, especially in the lower productivity types found in this planning area, is very critical for stands to function within the Historic Range of Variability.

The historic stand type covered large areas, but within those areas the within stand variation was high. Therefore characterizing the Ponderosa pine HRV must consider both the within stand variation and variation over time. These stands were maintained primarily by low intensity fire and periodic episodes of insect and disease mortality. Most of the forested acres in this project are considered to be an historically functioning Ponderosa Pine dominated type, although some white fir and lodgepole were included in the higher productivity stands. The presence now of larger white fir is representative of both the partial white fir component that was present on some areas and large white fir that are not actually so old as to have been established outside of the low intensity frequent fire regime. White fir is able to grow quickly to a large diameter, and appear rather old, compared to Ponderosa pine.

Before the 2002 fires took place, forested vegetation communities within the Silver Creek and Silver Lake watersheds were outside the Historic Range of Variability (HRV) because they were deficient in stands with late and old structure (LOS). The best landscape-level data available to evaluate the Historic Range of Variability for the subsheds affected by the Toolbox Complex is satellite imagery data (known as ISAT data). This data was collected by Pacific Meridian Resources in 1994 and categorized by degree of canopy closure. The data is pixel-

based, meaning that each individual unit of data represents 9,684 square feet, or just under a quarter of an acre.

For each pixel, the satellite captures a straight-down image of the crowns of whatever vegetation exists on that particular ¼ acre. This is a much finer scale than stand-level data and can tend to skew the data where (as for this project area) there is much small-scale variation within stands. In the ISAT data these fine-scale stand variations can often appear as low-density tree, shrub, or grass types and cause a stand to be classified as low-density, when an on-the-ground stand examination would result in classifying the same area as a forested stand of moderate or even high density. This suggests that actual stand density conditions before the fires were likely to be somewhat higher than that estimated through use of the ISAT data.

ISAT canopy closure data is classified in the following types of categories (not inclusive):

- Grass, rock, or sparse vegetation
- Shrub, 15 to 25 percent canopy closure (CC)
- Shrub, 26 to 40 percent canopy closure
- Tree, 11 to 25 percent canopy closure
- Tree, 25 to 40 percent canopy closure
- Tree, 41 to 55 percent canopy closure
- Tree, 56 to 70 percent canopy closure
- Tree, 70 to 100 percent canopy closure

These canopy closures should not be compared with those obtained with spherical densiometry, which is these types of stands will run up to 50% higher than the satellite, or stand exam, classification. That is because this measurement is based on looking straight down into the crowns. Historical ponderosa and pine associated stand types would most commonly be classed in the Tree CC 11-25% or as a shrub or grass type. See the discussion following. Even in the denser types there are currently many pixels of non-forest inclusions. Stands that have a high amount of the 26-40% and greater ISAT canopy closure range are at high risk for stress related mortality, and in many cases fire related mortality. Stands with density higher than this are generally in the higher elevation fir type, and they are at risk. It is important to remember that the ISAT data is pixel data, and that small percentages of high-density stands are no more significant that percentages of shrub or non-forest. A small clump of trees or a single tree with a very large thick crown centered in a pixel will produce a high Tree CC % for that pixel. (PNW, 1993, p76)

Historic (before fire suppression) LOS ponderosa pine and pine-associated stand types would most commonly be classified in the Tree 11 to 25 percent CC category, or even in a shrub or grass category, because of the low density of trees they contained. Frequent fire-return intervals tended to keep these stands very open. In the Pacific Northwest Region Interim Old Growth Definition for the Ponderosa pine series, Hopkins (1992) identified old-growth ponderosa pine stands typical of this area as containing:

- <u>For areas of low site productivity</u>: per acre, 10 to 30 trees of 21”(or greater) dbh with a Basal Area (BA) range of 24-72+, and two to six trees of 31” (or greater) dbh with a Basal Area of 11-32+, for a total stand basal area of 104+.
- <u>For areas of moderate-high site productivity:</u> per acre, 13 to 45 trees of 21” (or greater) dbh with a Basal Area range of 31-110+, and three to eight trees of 31” (or greater) dbh with a Basal Area of 14-40+, for a total stand basal area of 150+.

The above categories describe the Historic Range of Variability applicable to late and old ponderosa pine stands within the Toolbox project area. Both these categories are found within the project area. Most of the ponderosa pine stands within the project area would be classified as being at the low end of the moderate-high site productivity, with a maximum sustainable BA of 110-130. Stands on the more productive sites, such as those on higher, wetter sites with inclusions of white fir, may be capable of sustaining 150+ BA. This situation is found on only a small number of the project area acres.

The ISAT data, in conjunction with Hopkins' work, can be used to compare the recent condition (both pre and post fire) of forested communities within the project area to the HRV identified for the project area. Consider a stand of the large, old single-story ponderosa pine type common before fire exclusion. On an average low-productivity site, this stand would likely have had 10 to 30 trees of 21" dbh or greater, per acre. At 10 trees to the acre (the low end of the range) the tree crowns (which is what the satellite camera sees) would be expected to be on the large side, because the individual trees would have less competition and would thus tend to grow larger. The following table shows how tree size and numbers of trees for old-growth ponderosa pine stands within HRV correlate to percent of canopy closure. The ISAT data, which is represented in terms of percent of canopy closure, can then be used to compare the recent (pre-fire) condition of stands within the project area to the Historic Range of Variability.

Correlation of Tree Size and Numbers Within HRV to Percent of Canopy Closure

LOS Ponderosa Pine Stands	Diameter at breast height (inches)	# of trees per acre	Basal Area	Average Crown Area (sq.ft./acre)	% Canopy closure
Low Productivity Low range	2	10	23	3,500	8%
	31	2	11	1,550	3.5%
Total		12	34	5,000	11.5%
Low Productivity Highest Range	21	30	69	7,350	16.9%
	31	6	32	4,350	10.6%
Total		36	101	11,700	26.8%
Mod-High Productivity Low Range	21	13	30	4,550	10.4%
	311	3	16	2,325	5.3%
Total		16	46	6,875	15.8%
*Mod-High Productivity High Range**	21	45	103	15,750	36%
	31	8	42.4	6,000	13.7%
Total		53	145	21,750	50%

*very few acres in this category can sustain this stand density over time

In terms of the ISAT data, a stand is represented by an aggregation of the data from numerous 30-meter pixels (the number of pixels varies, depending on the size of the stand). Thus, one "stand" from the ISAT data would likely be represented as a combination of pixel data from the following categories:

- Tree CC 11-25 percent - (probably the classification that would most closely match an average LOS structure of a sustainable stand on an average productivity ponderosa pine type in this project area.)
- Tree CC 26-40 percent - (this classification would occur when a particular tree had a crown large enough to dominate a pixel, or when clumps or areas of heavier stocking were present within the pixel).

- Tree CC 41 percent and greater – (this classification would occur when an especially large clump of trees is centered in a pixel).
- shrub, grass or rock classifications – (would generally occur because of the amount of bare ground between trees).

The following table shows the Historic Range of Variability for stand density in LOS ponderosa pine stand types and LOS lodgepole pine types. These tables also show the percentage of nonforested habitat likely to be found within these stands that would be consistent with HRV. Two scenarios have been developed for LOS ponderosa pine to reflect differing within-stand distributions (Scenario 1 - a relatively clumpy distribution of trees across the stands versus Scenario 2 - a relatively even distribution of trees across the stands) and how those differing distribution scenarios would be interpreted in the ISAT classifications. Both are based on the same canopy closure situation described in this section.

HRV for Stand Density in LOS Ponderosa and Lodgepole Pine Stand Types

Canopy Category	% Canopy Closure		
	Lodgepole Pine Scenario	Ponderosa Pine - Scenario 1	Ponderosa Pine - Scenario 2
Grass	50%	10%	
Rock, Sparse Veg.			
Shrub 15-25%	10%	10%	
Shrub 26-40%			
Tree CC 11-25%	40%	50%	90%
Tree CC 26-40%	0%	30%	10%
Tree CC 41-55%	0%	0%	0%
Tree CC 56-70%	0%	0%	0%

Notes:

- *In the lodgepole pine scenario, no precision between the grass/shrub component is implied.*
- *The two ponderosa pine HRV scenarios are designed to reflect the natural within-stand variation that is characteristic of ponderosa pine stands. Scenario 1 reflects a relatively clumpy distribution of trees, meaning some acres within stands would be classified as nonforested types. Scenario 2 assumes a relatively even distribution of trees within stands, which would mean very few acres would be classified as non-forested types. Both are based on the same total canopy closure values.*

No category is shown for Tree CC 71-100 percent since this degree of canopy closure would almost never be present in the ponderosa pine or lodgepole

ISAT data relationship to Historic Range of Variability.

Since this project is only removing dead and drying trees, except for the plantation thinning, the significance of HRV analysis to this project is focused on developing objectives for development of the next stand condition, rather than a determination of which trees to harvest.

However while the analysis presented here focuses on the functional structure of terrestrial forested development. For this particular project the most significant additional factor affecting the ability to achieve long term objectives is the down fuel the dead trees will become.

While there are varying current requirements for down woody material, and in general current requirements probably exceed the most common average historical down wood condition (Arno, Brown et al. p100, 2000). Current requirements are generally at most a minor barrier to achieving a sustainable stand with similar functionality to pre-fire conditions. Pre-fire stands did have pulses of mortality associated with bark beetle epidemics, and that would result of increased down fuel. However the fuel added by that mortality, while would be a high tonnage, would be less than 10 large trees per acre. Therefore most of the tonnage of fuels would have been in a large bole and large limbs. A very small amount would be in the small fuels, which is the driver for intense fire behavior. These scattered heavy fuels, in the setting of frequent, low intensity fire, would not lead to stand replacement fire mortality. Mortality might occur in small clumps, less than ½ acre. There will be several fuels conditions post fire and post planned treatments, depending on alternative selected. The stands with light mortality are not that significantly changed from their pre-fire condition for this to be an issue. However the stands with heavier mortality have the potential for a fuels condition, which can be a major barrier to future development of LOS and a sustainable stand condition.

The tables included in the HRV map appendix display, by subwatershed:

- 1. The comparison of the ISAT data with several scenarios approximating historic range of variability, and acres excess or deficient to that estimation.
- 2. An estimation of the changes due to the Toolbox/Silver Fires based on estimation of effects of the mortality classifications.
- 3. The effects of the Triad project, which is a signed decision and the most reasonable foreseeable additional project that could change canopy classification within the accuracy of the ISAT data.

The general condition common to all subsheds is that the stands were at a high level of stocking, and at a multi-storied structure but the ISAT data doesn't define structure. Post fire numbers appear to be an improvement due to the increased amount of grass pixels in the conifer areas. However that is misleading because the numbers alone do not recognize distribution. In the historic/sustainable condition these grass pixels would be scattered across all acres, in tiny patches per acre. But the grass pixels created by the fire are a large patch sizes of many acres, and are therefore also outside the range of sustainability.

The Historic Range of Variability (HRV) for Lodgepole Pine is, for this area, the most variable and complicated. The variability is due to the high degree of variability of lodgepole and what historic reports of the type describe, and the high probability that there was much greater within type variability over both time and space than is demonstrated by the lodgepole type. The complication comes from the likely hood that the various plant community types that currently express themselves as "lodgepole" probability had greater between type variations than are displayed now. Indications are that the between type variations ranged from a Ponderosa

pine savannah type to nearly pure grass meadow.
Due to the small amount of lodgepole in this project the HRV comparison only goes as far as displaying likely conifer vs. non-conifer split that might have been more common. The estimates within the conifer and non-conifer types are not meant to be precise, but to display a split between conifer and non-conifer type.

For the lodgepole pine type, the Prefire condition was greatly deficient in non-conifer type and the canopy cover density was excessive in the conifer type. The postifre condition for lodgepole pine is closer to an HRV condition. The planned Triad activity will also move this type closer to an HRV and sustainable type.

Distribution is another consideration. Currently the decrease in conifer type and increase in grass type is located on a few patches on lodgepole type in the burned area. Within those types there should be a mix of conifer and non-conifer, representative of the characteristics of the individual site. So the post fire/Triad condition indicates a greater improvement toward HRV condition than is technically correct.

The Ponderosa pine HRV for the area is displayed using two sets of assumptions of ISAT classifications. Both are based on the same canopy closure situation described in this report. The two classifications simply reflect differing within stand distributions and how the ISAT data would interpret that distribution. The determination of HRV is described elsewhere in this section. While HRV is a RANGE, and it is important to remember that a midrange example is used in these calculations. However for the historic Ponderosa pine type there is a high confidence in the description. This is supported both by consistent descriptions in old information and the growth and reproductive mechanisms of the species. Ponderosa pine seed dispersal is very limited at a distance greater than that equal to the height of the cone.

The pre and postfire condition of the Ponderosa pine type are both outside HRV and both outside the range of adaptability of Ponderosa Pine to maintain a conifer stand type. The prefire condition had a higher proportion of acres in a conifer type, but in a multi-stored overstocked condition that is both outside of HRV and outside of a sustainable condition unless supported with frequent human intervention in the form of mechanical tree cutting, fuels treatment, and careful, slow reintroduction of fire. Distribution is also an important factor that the tables do not display. The "grass” and "shrub" pixels in a historic or sustainable condition would be distributed evenly at no more than one to two per acre, and are the result of the uneven distribution of PP resulting in a pixel with less than 10% canopy closer of tree crowns resulting in a classification of grass or shrub. This is not to imply areas of grass of brush but rather how the individual pixels are classified.

The CW classification in the fire area is one that is a mixture of PP and white fir. The higher amounts of white fir currently present are a function of the past century of fire suppression. While these sites can and do support a component of white fir, in both a sustainable and historic condition they would be dominated by ponderosa pine and function similar to the pine type. The Ponderosa pine HRV for the area is displayed using two sets of assumptions of ISAT classifications. Both are based on the same canopy closure situation described in this report. The two classifications simply reflect differing within stand distributions and how the ISAT data would interpret that distribution. The determination of HRV is described elsewhere in this section. While HRV is a RANGE, and it is important to remember that a midrange example is used in these calculations. However for the historic Ponderosa pine type there is a high confidence in the description. This is supported both by consistent descriptions in old information and the growth and reproductive mechanisms of the species. Ponderosa pine seed dispersal is very limited at a distance greater than that equal to the height of the cone.

The pre and postfire condition of the CW / Ponderosa pine type are both outside HRV and both outside the range of adaptability of Ponderosa Pine to maintain a conifer stand type. The prefire condition had a higher proportion of acres in a conifer type, but in a multi-stored overstocked condition that is both outside of HRV and outside of a sustainable condition unless supported with frequent human intervention in the form of mechanical tree cutting, fuels treatment, and careful, slow reintroduction of fire. Distribution is also an important factor, which the tables do not display. The "grass" and "shrub" pixels in a historic or sustainable condition would be distributed evenly at no more than one to two per acre, and are the result of the uneven distribution of PP resulting in a pixel with less than 10% canopy closer of tree crowns resulting in a classification of grass or shrub. This is not to imply areas of grass of brush but rather how the individual pixels are classified

Recent Conditions (Pre-fire) Compared to Historic Range of Variability

General characteristics of most of the forested acres in the Toolbox project area before the advent of regular fire suppression include the following:

- The stand types were primarily ponderosa pine. They were part of an ecological system that maintained a continuous canopy of mature ponderosa pine, with variations in density, but in a generally open stand condition. During this period of relatively low stand density, individual tree vigor was sufficient to produce adequate seed crops to perpetuate the stand.
- These low density, open park-like stand conditions were maintained by frequent (8 to 20 years) low-intensity fires. These fires occasionally killed a large tree, but, more importantly, killed almost all of the young tree reproduction, burned branches, and fallen snags on the forest floor and burned off the tops of brush and grasses.
- Most of the seed produced by a ponderosa pine does not disperse much farther than the height of the cone on the mother tree. Ponderosa seeds do have wings, but the seed is heavy and does not travel far from the tree. This suggests that stand openings created by fire or insect/disease mortality within ponderosa pine types would have rarely been greater than one acre, since otherwise the almost continuous ponderosa pine canopy documented in historic accounts before the 1900s would not have been present.
- Down wood generally would have been relatively rare. Most ponderosa pine lived 200 to 500 or more years, with stand densities ranging between 5 to 20 or so trees per acre. Pulses of mortality leading to snag creation and subsequent down wood were generally caused by bark beetle events. These events had a periodicity of every 60 to 100 years. Some reported bark beetle events did cause mortality of 50 to 60 percent of the stand, creating, at most, 10 snags per acre. As these fell or were burned through, that much large wood would be on the ground, probably until the next fire occurred in 10 to 15 years. However, then there would be almost no down wood or snags present for another 60 to 100 years in that stand.

After regular fire suppression began (circa 1900) the general condition common to all subsheds is that most forested stands were very dense compared to HRV, and more stands exhibited multi-storied structure than was characteristic for HRV. The following discussions, organized by stand type, compare conditions present in recent time (1900s to 2002) with the Historic Range of Variability defined for each stand type.

Ponderosa Pine Stand Types

Since the advent of regular fire suppression (circa 1900) the condition of the Ponderosa pine stand types began to move away from HRV as stands became denser. Just before the 2002 fires, these stands were considered to be outside of HRV and outside the range of adaptability of ponderosa pine to sustain a conifer stand type. Within the project area, the pre-fire condition included more overall acres of ponderosa pine stands, compared to HRV. However, because these stands exhibited a degree of density and multi-storied structure that was well outside of HRV, without frequent human intervention in the form of tree cutting, fuels treatment, and careful application of prescribed fire they were at high risk for stand replacement fire, insect infestations, or both.

These conditions were in fact a contributing factor to the intense fire behavior in some parts of the Toolbox Complex.

Tree distribution within the ponderosa pine stand types is also an important factor that is not fully captured in the ISAT data. Historic accounts indicate that the non-forested grass and shrub habitats within ponderosa pine stand types were generally distributed fairly evenly at no more than one to two openings per acre, rather than being present in large patch sizes. There is a high confidence in this characterization, as it is supported both by consistent descriptions in old reports (late 1800s/early 1900s) and by the growth and reproductive mechanisms of the species itself. Ponderosa pine seed is relatively heavy and, as a rule, does not disperse very far from the parent tree. Over time, stands would tend to develop relatively uniform spacing, with small openings created as an individual tree or small clump of trees died from insects, windthrow, root rot, or small patches of "torching" from the frequent, low-intensity fires that moved through the stands on an average of every 8 to 20 years.

The following two bar graphs depict the degree to which ponderosa pine stand types within the project area have departed from the Historic Range of Variability. Each of the two distribution scenarios described above is displayed in a bar chart. The vertical axis measures acres of departure from the HRV condition, and the zero point on the vertical axis represents the Historic Range of Variability. The horizontal axis displays the ISAT canopy closure percentages relevant to ponderosa pine stand types. Thus, a bar appearing <u>above</u> the "zero line" on the graph would indicate that in 1994 there were *more* acres of stands in that particular density condition than would have been expected, compared to HRV. A bar that shows <u>below</u> the zero line indicates that in 1994, compared to HRV, there were *fewer* acres of stands in that particular density condition than would have been expected.

ISAT Data Showing the Distribution of Ponderosa Pine LOS, by Percent of Canopy Closure, Within Silver Lake and Silver Creek Watersheds (Scenario 1)

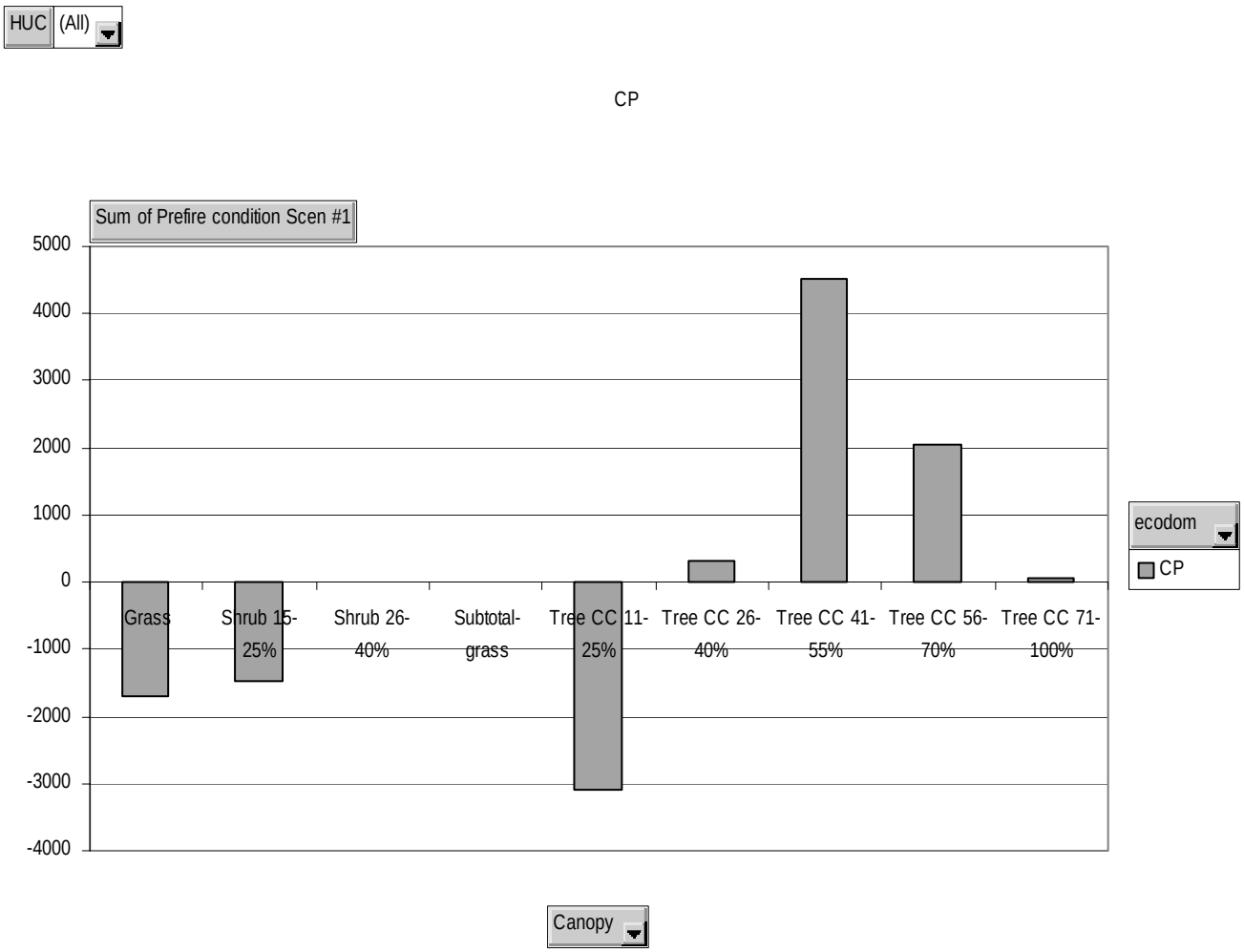
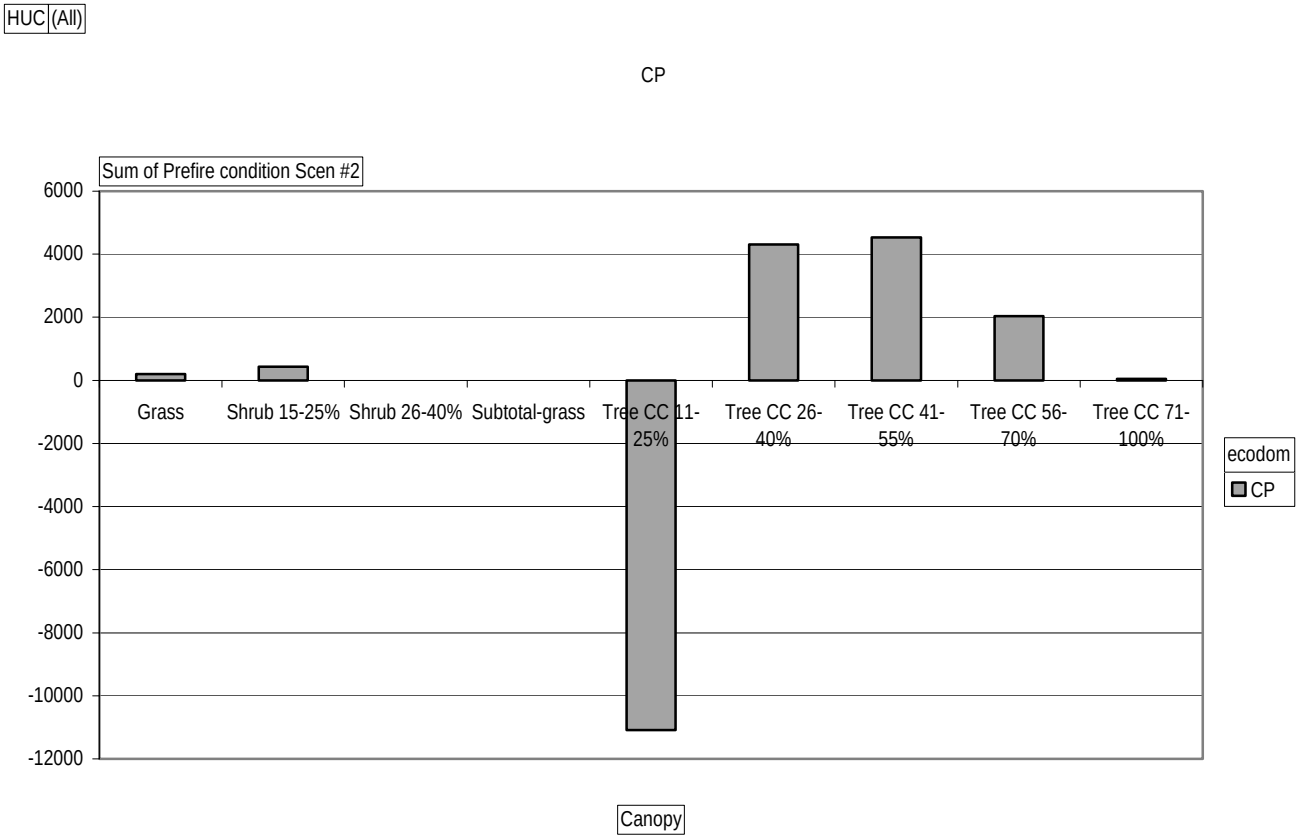


Figure 3.4 ISAT Data Showing the Distribution of Ponderosa Pine LOS, by Percent of Canopy Closure, Within Silver Lake and Silver Creek Watersheds (Scenario 2)



Mixed Conifer (CW) Stand Types

The CW classification in the project area represents a mix of ponderosa pine and white fir. This stand type occurs primarily on the higher, wetter sites within the project area. A century of fire suppression has increased the proportion of white fir in these stands. While historically these sites supported a component of white fir, today's amounts are outside of HRV and act to reduce the long-term sustainability of these stands. The overabundance of white fir contributes to the excessive stand density and multi-storied structure that increases the risk of stand-replacement fire, insect infestations, or both. In a sustainable and historic condition the mixed conifer stand types would have a much lower component of white fir, would be dominated by ponderosa pine, and would exhibit the same general ecological dynamics as the ponderosa pine stand types.

Lodgepole Pine Stand Types

Determining the Historic Range of Variability (HRV) for lodgepole pine in this area is complicated. Several factors contribute to this complication:

- Lodgepole pine itself appears to be a highly variable species.
- Historic accounts and descriptions of this forest type vary widely.
- It is highly probable that there was much greater within-type variability over both time and space than appears in the lodgepole pine type seen today.
- It is also likely that the various plant community types that currently express themselves as "lodgepole" had greater *between*-type variations than are displayed now. Indications are that the between-type variations ranged from a ponderosa pine savannah type to nearly pure grass meadow.

Due to the small amount of lodgepole pine in the Toolbox project area, the HRV comparison only goes as far as displaying the likely conifer vs. non-conifer split that might have been more common. The estimates within the conifer and non-conifer types are not meant to be precise, but to display this split in general terms. The HRV analysis indicates that relatively open stand types (Tree CC 11-25 percent) were more common than today and that non-forested habitats, primarily grass meadows, were a significant component of the lodgepole pine stand types. ISAT data indicates that within recent times (pre-fire) the lodgepole pine stands within the project area were greatly deficient in these non-forested habitat types and that canopy cover in the forested stands generally exceeded HRV.

Down Wood Component

Current estimates and guidelines for retention of down woody material vary, but in general they likely exceed the average amount of down wood present in ponderosa pine stand types during historic conditions (Lieburg and Munger). Before the advent of fire suppression, these stands did have pulses of mortality associated with occasional bark beetle epidemics, and that would have periodically increased the down wood component.

Most of the trees killed by bark beetles would have been fairly large, and generally these episodes killed fewer than 10 trees per acre. While the fuel added by that mortality would represent a high tonnage, most of that tonnage would have been concentrated in a few large boles and large limbs. A very small amount would have consisted of fine fuels such as small branches, twigs, and needles. In a forested community, fine fuels are the driver for intense fire behavior. Such scattered, large down fuels, in the context of the frequent, low-intensity fires experienced by these stands, would not lead to stand replacement fire mortality. Mortality might have occurred in small clumps, generally less than ½ acre.

Current Conditions (Post-fire) Compared to Historic Range of Variability

Overview

Forest Conditions after the 2002 Fire

The 2002 Silver and Toolbox fires created a wide range of vegetative mortality, sometimes at a relatively small scale. The Toolbox Complex did not generally burn as an even fire front. Instead, it spread by spotting and torching and expending from the new flame fronts established by the spotting and torching areas. The situations where a uniform fire front occurred were in areas of upslope runs, in areas where intensive underburning occurred (these were very limited), and in areas of uniformly thick stands. Fortunately almost none of the area burned hot enough to cause serious damage to the basic soil resource (2002 Toolbox Burned Area Emergency Rehabilitation Report). However the vegetative component did not fare as well.

Methods used to determine mortality included a post-fire aerial photo flight, in true color, and collection of data from 600 post-fire inventory plots (concentrated in areas needing additional assessment, such as old growth, partially-burned stands, and white fir-dominated sites). Thus, the vegetative mortality mapping used for this analysis is based on the visible evidence of mortality as of early September 2002. Mortality mapping was done in five-acre or larger units. Later additional ground verification was done.

Vegetative mortality within the fire area was mapped in four classes, based on visible crown mortality as of September 2002.

- *Light mortality of 1 to 25 percent (shown on tables and charts as 1_mt)* - These stands are a mosaic of dead patches, or understory mortality, within a mostly green stand. Torched out patches of dead rarely exceeded 2 to 3 acres. Bark beetle activity is present in these stands. This type also includes areas of white fir expansion into historically ponderosa pine dominated areas. This white fir expansion had increased mortality in the larger ponderosa pine, and the fire activity did cause more mortality in these areas.
- *Moderate mortality of 25 to 50 percent (shown on tables and charts as 2_mt)* - These stands were a mosaic of larger patches of predominately dead trees in a matrix of green trees or understory mortality. Torched out patches are often 3 to 5 acres and mortality extends more into the surrounding, less burned matrix. Bark beetle activity is present in these stands. These stands are in the condition most likely to incur future mortality from beetles and the lingering effects of the 2002 fire. These stands did

receive more heat than the 1 to 25 percent mortality areas. The greatest additional mortality should occur in 2004, but may continue for several more years, although probably at a slower rate.

- *Heavy mortality of 51 to 85 percent (shown on tables and charts as 3_mt)* - These stands were predominantly fire-killed trees that included patches of unburned or lightly burned stands. Bark beetle activity was present, and these stands received a higher degree of heat. Due to this combination of factors, it is expected that increased mortality will occur and some of these acres may move into the 85 percent or greater mortality category.
- *Extensive mortality of 86 percent or greater (shown on tables and charts as 4_mt)* - These stands were predominantly fire killed, with very few live trees, and had received intense heat during the fire. In the near term, more mortality is expected in these stands.

Mortality ratings were not adjusted for bole damage in the white fir. Instead, these areas were manually added to treatment units. Also, the mortality mapping layer was not adjusted for areas of fire-damaged white fir (bole scorch). This damage was validated by formal plot data in several areas, and additional treatment acres to account for this condition were manually added into the activity layers. The mortality coding on the maps reflects only the visible crown damage apparent in the aerial photographs.

The following two maps display vegetative mortality rated within the different categories described above, for both fire portions of the project area. The Toolbox Portion map shows some small inclusions from the Winter Fire, which burned up the face of Winter Rim and a few hundred feet west on top of the Rim.

LOS Stands

Late and old structural stages in all stand types have been further reduced across the landscape as a consequence of the fires. The following table summarizes the acres of LOS lost, either through total or partial loss of larger tree component, in the 2002 fires, by forest type:

LOS Acres Lost

Forest Type	LOS Lost (Acres)
Ponderosa Pine (CP)	8,386
Mixed Conifer (CW)	1,699
Lodgepole Pine (LP)	1,244
Total	11,482

Likely Additional Mortality

Additional mortality from residual effects of the fire is expected to occur in ponderosa pine stand types in the next few years, and in the white fir component of mixed conifer stands within the next five years. Most of the expected white fir mortality will be as a result of cambium or root damage from exposure to resident heat following the actual fire, rather than as a consequence of damage to the crown. The tight canopy closures found in the mixed conifer stands tended to hold in the heat from the fire.

The potential for bark beetle attacks on fire-weakened trees is another factor expected to influence tree mortality in the next several years. Bark beetle numbers and activity had been rising dramatically in the few years before 2002, and many pockets of mortality from beetle hits had been apparent in the project area before the start of the fire. The likelihood of local epidemic populations of bark beetles is difficult to predict. If populations do increase even slightly, trees that have suffered some fire damage may not survive even a light infestation. Stands with relatively high density in the 26 to 50 percent mortality category are likely to see the greatest risk of bark-beetle-related mortality.

Ponderosa Pine Stand Types

When examined from the standpoint of sustainable canopy closure percentages, the post-fire numbers for the ponderosa pine stand types appear to be an improvement because there are now more non-forested openings within stands. However, this is misleading because the numbers alone do not recognize the *distribution* of nonforest habitats characteristic of HRV. In the historic/sustainable condition, these grass or shrub openings would be scattered across all acres, in tiny patches per acre. But the openings created by the fire are in large patch sizes of many acres, and are therefore also outside the range of sustainability. The post-fire condition of the ponderosa pine types is both outside HRV and outside the range of adaptability of ponderosa pine to maintain a conifer stand type.

Current post-fire conditions in the higher mortality areas of this stand type do not favor natural re-establishment of ponderosa pine stands. Natural regeneration of ponderosa pine occurs in infrequent pulses of regeneration, where abundant seed trees are present. These pulses of regeneration that (together with fire suppression) created the overstocked stands of the present era were the result of a combination of factors occurring simultaneously: 1) a fully stocked stand of mature seed-producing trees, 2) open stand conditions which favored unobstructed seed dispersal, 3) periodic light fires that prepared a more favorable seedbed, 4) a good moisture year, and 5) a good seed production year. These factors are not present in the post-fire stand condition. Instead, the following factors will act against natural regeneration of ponderosa pine in the higher mortality areas:

- A high variation of green tree stocking is present, but in understocked areas few seed trees are present and they are not well distributed throughout the area.
- The understocked stands have a large amount of dead standing material that will be a physical barrier to seed dispersal by wind. By the time most of the standing dead trees fall, the mineral soil seedbed prepared by the fire and preferred for ponderosa pine regeneration will have become occupied with competing vegetation and will not be a favorable seedbed.
- Good moisture and seed production years are highly variable.

Mixed conifer (CW) Stand Types

The post-fire condition of these stands remains outside the Historic Range of Variability, both in terms of stand density and multi-storied structure. LOS stands within this stand type have suffered a decrease of almost 1,700 acres. Additional mortality is expected in the white fir component but will not likely become apparent for another two to four years. White fir is very sensitive to resident heat damage to roots or cambium, but this is not photo-identifiable or noticeable at any distance from the tree

Lodgepole Pine Stand Types

Relatively few acres of the lodgepole pine stand type are found within the Toolbox project area, though these acres did sustain mortality from the fire. Approximately 1,240 acres of LOS were lost. Within the project area, these stand types have moved closer to HRV because the trees killed by the fire will create more acres in non-conifer habitat types (see earlier discussion on HRV for this stand type). However, the *distribution* of these newly created non-conifer habitats is more concentrated in a few areas, compared to what would be expected within HRV.

Riparian Plant Communities

Effects of the wildfire have been, and will be, beneficial to the regeneration of riparian vegetation. Conifer competition has been a major negative impact to the health and vigor of riparian hardwood and surface vegetation for some time. In these vegetation types, the absence of fire or other disturbance events allows conifers to dominate the riparian areas at the expense of the native riparian vegetation, notably aspen, willow, black cottonwood and a wide variety of wet-site grasses, forbs, and rushes.

Most of the riparian areas burned quite hot, resulting in extensive conifer mortality. This will stimulate a strong regenerative response from the riparian vegetation. Most riparian species maintain their root crown during average intensity fires and regenerate post-fire quite easily.

The risk to the longevity and structural development of the riparian vegetation is the risk related to the dead trees that will fall to the ground and become fuel. A heavy fuel loading in a narrow canyon can produce a very hot fire. This fire may be outside the range of adaptability for the riparian species, especially in areas of higher fuel concentration. A subsequent reburn is not a question of if, but of when. Over time these down fuels will decay, reducing the potential damage from a reburn. However, if a fire does occur, there could still be damage to the shade-producing riparian vegetation and potentially consumption of the in-channel coarse woody debris. This would lead to a riparian condition deficient in both shade and large wood. The extent of this condition is open to speculation, depending on the reburn situation.

The upland vegetation condition also has some effect on the condition of riparian communities. The mortality from the fires again provided a benefit by reducing the large shrub and conifer component, which will result in more subsurface water moving into the riparian areas.

Relationship of Post-Fire Condition to Historic Range of Variability

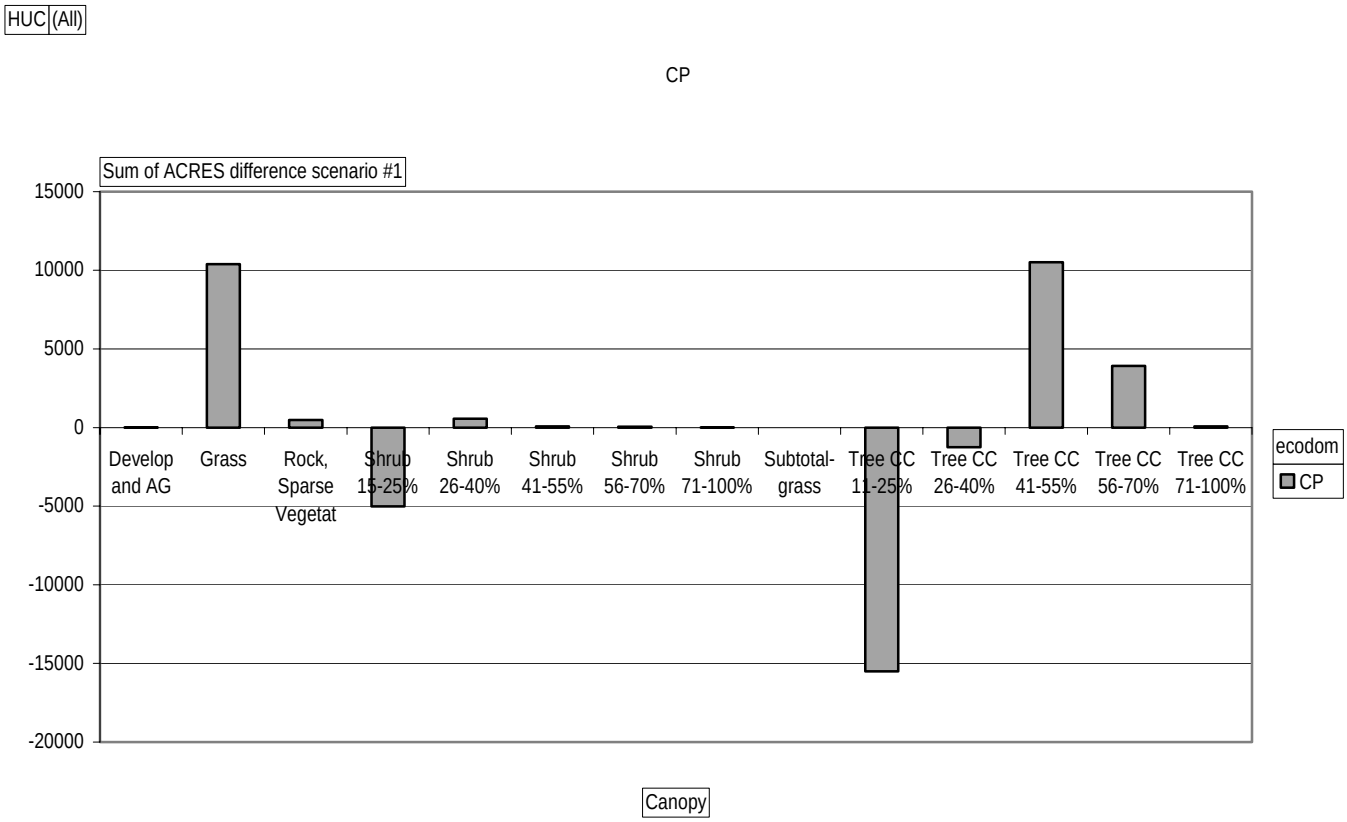
The following bar graphs depict the amounts of mortality within the Toolbox project area, by subshed and by ISAT canopy closure category. Notable on these charts are the large amounts of unburned vegetation in every subshed, and the proportionately higher amounts of mortality in the stands with higher canopy closures.

The last two bar graphs in this group show how stand conditions have shifted with respect to HRV as a result of the 2002 fire. This project proposes to remove only dead and dying trees (except for the noncommercial plantation thinning). Thus, the relevance of HRV analysis to this project is to gain understanding that will be useful in developing objectives and silvicultural prescriptions for the creation of forests that are sustainable over the long term.

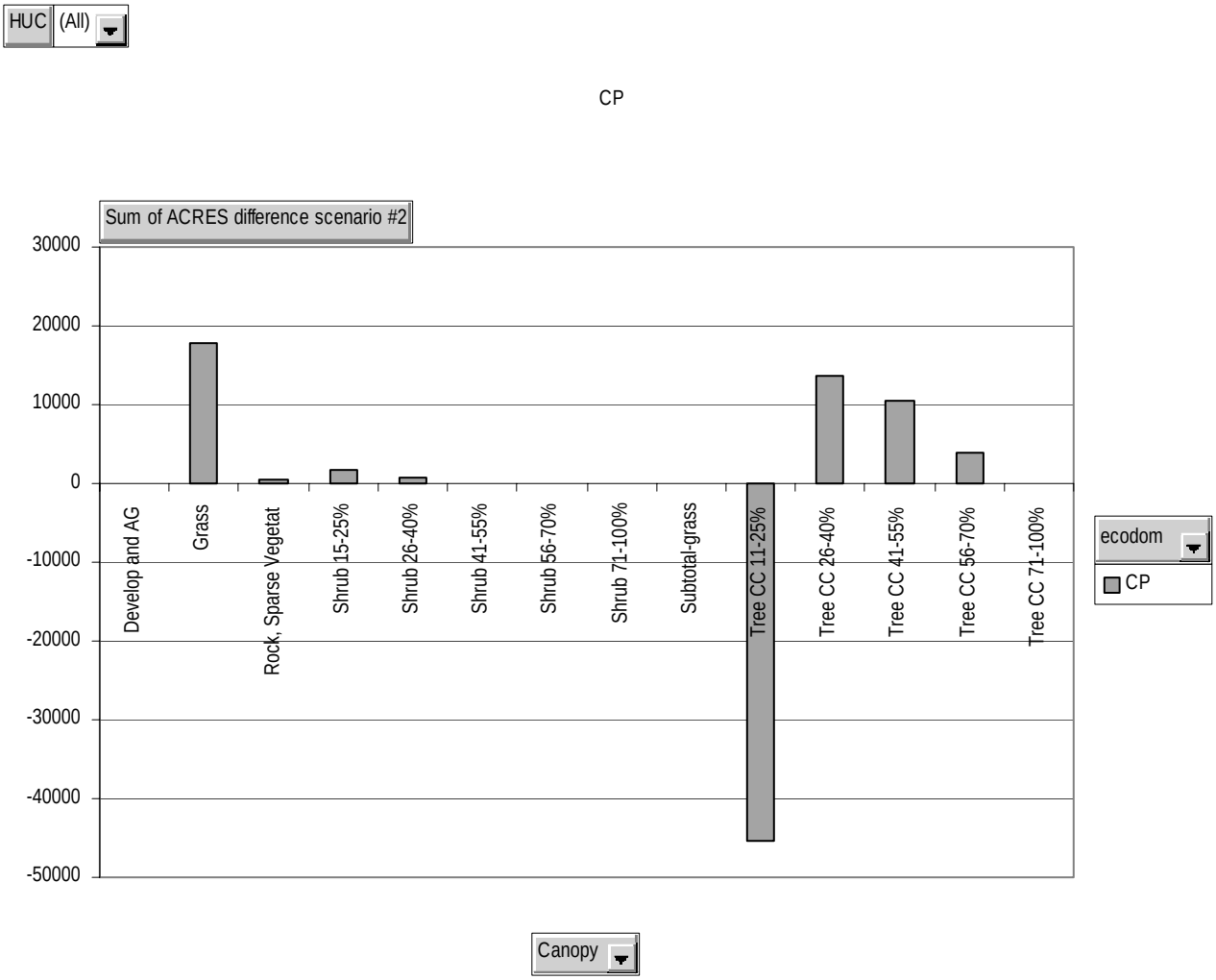
Note: In many cases the denser CC (Canopy Closure) areas received proportionally higher mortality.

The following charts are a summary of the post-fire condition. These charts show the shift in ponderosa pine stand type densities, using ISAT data categories, for the two ponderosa pine scenarios described above.

Summary of the Toolbox Fire Recovery Project Post-fire Condition – Scenario 1



Summary of the Toolbox Fire Recovery Project Post-fire Condition – Scenario 2



Past Management Activities and Their Role in Shaping Landscape Diversity

Geographic Information System (GIS) records for the Ranger District and the Forest were used to complete a detailed analysis of past management activities and their role in shaping the landscape on which the 2002 fires occurred. The analysis data and detailed discussions can be found in the project file. GIS data layers used to conduct the analysis included the Silvicultural Activities Tracking layer, SAT layer, various fuels treatment layers, and the wildfire history layer. These layers record activities dating back to the early 1970s. Prior to this time, vegetation management treatments emphasized individual selection of large, old trees at high risk of dying within 10 years (known as "high-risk" cutting) as well as salvage and planting in stand replacement fires. This high-risk cutting generally removed only a few trees per acre. The major effect of such treatments was to reduce snag levels for the decade or so after the harvest. The only effect that might have persisted to recent times would be some possible reduced levels of down wood that these large "high-risk" trees might otherwise have become. In addition to the intensive treatments discussed above, all of the forested lands within the project area have had at least one, and most often two or three timber harvest activities in the past.

To summarize the analysis, acres of past treatment activities were grouped into categories of harvest activity—intermediate harvest, even-age regeneration harvest, uneven-age regeneration harvest, and salvage harvest, and further divided into treatment categories that included these harvest activities in association with various

combinations of follow-up treatments, including thinning, planting and/or underburning. Acres that received no harvest but did have thinning, planting, and/or underburning were also assessed, as well as acres that received fuels reduction treatments such as mowing or removal of small trees (4 inches dbh and smaller).

Past treatment activities were compiled from the GIS records to show cumulative activities on a given site. Acres of treatment are not truly additive, since many acres in the project area have received multiple treatments, while many other acres have received no treatments. Overall, 100 percent of the forested acres within the project area received one or more treatments.

These acres of past treatment activities were then correlated with the various areas of vegetative mortality resulting from the 2002 fires, to examine whether there might be a tie between past treatment activities and fire behavior and results. Many of the treatments carried out in the 1970s had silvicultural objectives and prescriptions at cross-purposes with the present-day understanding of what conditions are needed to maintain sustainable ponderosa pine stands. These treatments were prescribed during the era of intensive timber management, with the primary purpose of maximizing growth while allowing for numerous re-entries. The result was that many of these stands had the larger trees removed but were still left quite heavily stocked. For many different reasons, the anticipated re-entries often did not occur and this contributed to the overstocked condition present in many stands within the project area at the time of the 2002 fires. Still, for those stands that did receive treatments that reduced density, the analysis shows a correlation between lower density and lowered susceptibility to fire mortality. The maps on the following pages display past harvest, planting, and fuels reduction units across the eight subsheds and within the project area.

Environmental Consequences

Background

This section presents the environmental effects predicted for the different alternatives, including the "No Action" Alternative (A) on the forested plant communities within the project area. The alternatives to the proposed action were developed to evaluate different potential responses to the purpose and need, and to key issues raised during public scoping.

Determination of Dead and Dying Trees

Predicting whether conifers damaged by wildfire will live or die is not an exact science. Yet it is important to establish criteria for when to consider a tree as dead and to anticipate likely mortality conditions so salvage harvest, reforestation, fuels reduction, wildlife leave areas, and riparian area rehabilitation treatments can be designed to accomplish their objectives without unnecessary expense and logistic difficulties. For instance, consider a stand with 60 percent of its trees killed by fire, and another 30 percent so damaged that they are at high risk of dying within two years. If the planned treatment for that stand is to salvage the dead trees, reduce fuels and reforest, it would be expensive, inefficient and potentially damaging to soils to enter the stand twice--once to remove the already-dead trees and a year or two later to remove the now-dead 30 percent component.

The challenge is to predict with a high degree of confidence which trees have sustained enough damage to make mortality very likely within one to three years following the fire. Much attention has been given to this issue by researchers (Agee, 1993; Ryan, 1982; Wagener, 1961). The following discussion considers only the primary effects of fire on tree mortality. Secondary effects, such as mortality from future insect infestations, are discussed elsewhere in this section.

According to Wagener, the minimum requirement for vigorous ponderosa pine living after a fire is moderate (less than 25 percent) cambium injury and 15 to 25 percent or more green foliage. The Toolbox project area is generally poor vigor. This data was for trees not under drought stress mid-season and with 50 percent or greater live crown. Ryan (1982) concludes that few trees survive the loss of more than 80 percent of their crown length after a fire. Agee (1993) has shown that the amount of time in which fire damage kills white fir cambium is about half the time fire damage takes to kill ponderosa pine cambium, due to bark thickness. White fir is basically twice as susceptible to mortality from fire as is ponderosa pine.

For many years the standard of 30 percent or less live crown (for mature trees that have achieved much of their height growth potential) was used as the key indicator of imminent mortality on the Fremont-Winema National Forests. This standard means if a tree retains less than 30 percent bright green crown following a fire, it is regarded as very likely to die within one year. This 30 percent standard was a modified version of *Guidelines for Estimating the Survival of Fire-damaged Trees in California* (Wagener, 1961). Wagener also identifies 50 percent live crown as the minimum criterion for survival of ponderosa pine in a mid- or late-season fire.

Within the last decade, managers have used varying standards of live crown retention as an indicator of survival or mortality when trying to decide which trees are likely to die and should be salvaged. In the seven years prior to 2002, the Fremont-Winema National Forests experienced three fairly large fires: the Thomas fire, the Lone Pine fire, and the Robinson Springs fire. For these fire areas, the guideline used for predicting which trees were very likely to die varied between the 20 percent live crown minimum or the 30 percent live crown minimum. The experience gained in relation to these fires indicated that it is far more likely that a tree with 20 to 30 percent live crown will die, than that a tree with less than 20 percent crown will recover. This is consistent with findings by Wagner (1961), Ryan (1982), and Agee (1993).

Using researchers' findings in combination with this local experience, silviculturists for the Fremont-Winema National Forests have determined that for the purposes of the Toolbox project, a tree with less than 20 percent bright green crown will be considered dead.

White fir is highly susceptible to cambium death from heat damage. This occurs generally at the root collar or within the first few feet above the ground. Random sampling of "green" trees has been conducted during spring and early summer of 2003 (Pierce, 2003). This sampling consistently has confirmed that "green" white fir less than 21 inches dbh that show even light char on a portion of the bole have dead cambium the entire circumference of the bole. In "green" trees greater than 21 inches dbh, the cambium death has been more variable.

For the purposes of the Toolbox Fire Recovery Project salvage, any white fir with less than 20 percent bright green crown will be removed. In addition, any white fir less than 21 inches dbh, regardless of crown condition, will be removed as fire-damaged if bole char is visible for 30 percent or greater circumference of the bole or root collar.

Direct and Indirect Effects

Alternative A (No Action)

The effects of Alternative A on forested plant communities are described first, as this alternative provides a baseline against which readers can evaluate the advantages and drawbacks of the action alternatives. Alternative A assumes no human intervention to change environmental conditions within the Toolbox project area. No commercial salvage harvest, thinning, or tree cutting would take place other than hazard trees that must be cut for public safety. No lands would be reforested, and the road system would remain as it is today. No prescribed burning or other fuels reduction treatments would take place; dead trees would be left to follow their expected path of decay and eventual collapse to the forest floor. Stream channels and riparian areas would be left to recover without intervention.

The following narratives describe predicted forested community development in a no-action scenario over the next 30 to 60 years. For the purposes of this section, short-term is considered to be 30 years or less. This assessment is done for each mortality mapping category (1-25 percent, 26-50 percent, 51-85 percent, 86-100 percent), as predicted conditions vary somewhat within these different categories. (Mortality mapping was completed as of early September 2002. Significant increases from fire damage are expected to develop by summer 2003. Additional mortality from bark beetles is anticipated, especially in the 26-85 percent mortality range.) In the average conifer stand, no harvest, fuels treatment, planting, later harvest or thinning, or cultural treatments would take place.

First 30 Years:

1 to 25 Percent Vegetative Mortality

The conifer component still overstocked for sustainable condition. Essentially all dead has fallen, resulting in increased fuel loading. By the end of the period 1 to 3 inch fuels are deteriorating. Stress related mortality is slowly killing larger trees. Dense young regeneration has developed adjacent to live trees, interspersed with heavy fuels. There is significant damage to young regeneration but little mortality from falling dead. The small mortality pockets from the fire have mostly seeded in with conifers, but also have an abundant grass/shrub component. Additionally, multiple wildfires would have occurred in this time period, which would have caused additional pockets of mortality and, potentially, soil damage in pockets of heavier down fuel.

26 to 50 Percent Vegetative Mortality

Patches of conifer component are still overstocked for sustainable condition. Bark beetle mortality has continued for many years. Many of these stands now have greater than 50 percent mortality from a combination of fire and insects. Essentially all dead has fallen, resulting in increased fuel loading. By the end of the period 1 to 3 inch fuels are deteriorating. Dense young regeneration has developed adjacent to live trees, interspersed with heavy fuels. There is significant damage to young regeneration but little mortality from falling dead. The mortality pockets from the fire have an abundant grass/shrub component. Some conifer establishment has occurred at the edge of the burned area where seed trees were present. Depending on the virulence of the bark beetle activity, many additional larger trees have been killed and more of these acres have moved into the 50 percent mortality category. Aspen regeneration in areas of high mortality that are subwatered is present, but less abundant than in the 50 percent or greater mortality areas. Additionally, multiple wildfires would have occurred in this time period, which would have caused additional pockets of mortality and soil damage (Hall, 2003) in pockets of heavier down fuel.

51 to 85 Percent Vegetative Mortality

Only small patches of residual live mature conifers remain. Many larger conifers succumbed to fire damage, and the remaining ones received concentrated bark beetle attacks from broods that developed in the recently dead trees. Most of the area has little conifer stocking, but does have an abundant, vigorous shrub component growing in a heavy fuel bed from the down trees. Aspen regeneration in subwatered areas is abundant. Surviving mature conifers are receiving competition stress from the immediately adjacent natural regeneration. Essentially all dead has fallen, resulting in increased fuel loading. By the end of the period 1 to 3 inch fuels are deteriorating. Prescribed fire cannot safely be reintroduced into the stand to kill the excess regeneration due to the high fuel loading. At the end of the 30-year period the remaining LOS trees are slowing dying due to the stress provided by the regeneration from that mother tree. Fuel loadings range from 60 to 120 tons (Hall, 2003). Due to the expense, only a few small areas have been precommercially thinned and had fuels treatment. Additionally, multiple wildfires would have occurred in this time period, which would have caused additional pockets of mortality and soil damage (Hall, 2003) in pockets of heavier down fuel.

86 to 100 Percent Vegetative Mortality

Almost no residual live mature conifers remain, and natural regeneration of pines has only occurred within 100 or so feet of these residual trees. Many larger conifers succumbed to fire damage, and the remaining ones received concentrated bark beetle attacks from broods that developed in the recently dead trees. The area does have an abundant, vigorous shrub component growing in a heavy fuel bed from the down trees. Aspen regeneration in subwatered areas is abundant. The few surviving mature conifers are receiving competition stress from the immediately adjacent natural regeneration. Essentially all dead has fallen resulting in increased fuel loading. By the end of the period 1 to3 inch fuels are deteriorating. Prescribed fire cannot safely be reintroduced into the stand to kill the excess regeneration due to the high fuel loading. At the end of the 30-year period the remaining LOS trees are slowly dying due to the stress provided by the regeneration from the mother tree. Fuel loadings range from 60 to 120 tons (Hall, 2003). Due to the high cost of fuels treatment, only a few small areas have been precommercially thinned and had fuels treatment. Additionally, multiple wildfires would have occurred in this time period, which would have caused additional pockets of mortality and soil damage (Hall, 2003) in pockets of heavier down fuel.

30 – 60 Years Post-fire:

1-25% Vegetative Mortality

The conifer component is highly stocked with trees less than 8 inches dbh. Few larger trees are present. By the end of this period much of the 3 to 8 inch fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. Very high small tree conifer stocking is present across essentially all of the area. The fire-killed pockets have been regenerated and the continuing stress-related mortality has only killed the larger trees, leaving the reproduction. The ponderosa is mostly in a stagnated state. Aspen is nearly absent. Shrub and herbaceous vegetation is nearly absent. Most of the existing reproduction is too highly stocked to produce cones with significant viable seed. Only the occasional tree growing under less competition is developing large tree structure and is capable of reseeding the immediate area if necessary. Conditions that would contribute to stand high intensity and stand-replacement wildfire have persisted. If fires occur, the result would be the creation of patches of various sizes that are mostly shrubs, some aspen, and herbaceous vegetation.

26-50% Vegetative Mortality

The conifer component is highly stocked with trees less than 8 inches dbh. Few larger trees are present. By the end of this period much of the 3 to 8 inch fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. Very high small tree conifer stocking is present across essentially all of the area. The fire-killed pockets have been regenerated and the continuing stress-related mortality has only killed the larger trees, leaving the reproduction. The ponderosa is mostly in a stagnated state. Aspen is nearly absent. Shrub and herbaceous vegetation is nearly absent. Most of the existing reproduction is too highly stocked to produce cones with significant viable seed. Only the occasional tree growing under less competition is developing large tree structure and is capable of reseeding the immediate area if necessary. Conditions that would contribute to stand high intensity and stand-replacement wildfire have persisted. If fires occur, the result would be the creation of patches of various sizes that are mostly shrubs, some aspen, and herbaceous vegetation.

51-85% Vegetative Mortality

The majority of the area is shrubs, aspen, and herbaceous vegetation. There are small patches of highly stocked conifers, generally with trees less than 8 inches dbh. Few larger trees are present. By the end of this period much of the 3to 8 inch fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. The fire killed pockets have regenerated to shrubs, aspen, and herbaceous vegetation. Conditions that would contribute to stand high intensity and stand-replacement wildfire have persisted. If fires occur, the result would be the creation of patches of various sizes that are mostly shrubs, some aspen, and herbaceous vegetation.

86-100% Vegetative Mortality

The majority of the area is shrubs, aspen, and herbaceous vegetation. There are small patches of highly stocked conifers, generally with trees less than 8 inches dbh. Few larger trees are present. By the end of this period, much of the 3 to 8 inch fuels have deteriorated, but the larger fuels from both the fire kill and subsequent mortality are still present. The fire killed pockets have regenerated to shrubs, aspen, and herbaceous vegetation. Conditions that would contribute to stand high intensity and stand-replacement wildfire have persisted. If fires occur, the result would be the creation of patches of various sizes that are mostly shrubs, some aspen, and herbaceous vegetation.

Vegetative Management Activities Common to All Action Alternatives

All action alternatives share the common long-term silvicultural objective of restoring Late and Old Structure (LOS) forested communities, in accordance with Regional Forester's Eastside Forest Plans Amendments #1 and #2, across the project area, on the sites where they would normally occur. The Historic Range of Variability (HRV) would be used as a reference point to ensure that silvicultural prescriptions promote the development of forest conditions that are sustainable over the long term.

The fire behavior that resulted in the sites of higher vegetative mortality over much of the Toolbox Complex was outside the range of historical fire behavior for ponderosa pine and mixed conifer (ponderosa pine-dominated) stand types in this area. It is also likely that re-occupancy of these extensive burned areas with mature ponderosa pine through natural seeding would take hundreds of years. Regeneration of ponderosa pine

by natural seeding occurs in relatively infrequent pulses, depending on favorable conditions for seed production, and the presence of numerous seed trees. Consumption of the seed by small mammals, and the fact that ponderosa pine seed is heavy and generally does not disperse very far from the parent tree (Barrett, 1966) also slows the re-establishment of ponderosa pine across large areas.

All action alternatives would propose the same set of silvicultural prescriptions to achieve the re-establishment of LOS forested communities within the project area. What would vary among alternatives is how many acres would be treated and where the treatment units would be located. All action alternatives propose some amount of planting, as most areas no longer have enough seed trees to assure natural regeneration.

Proposed Stand Prescriptions:

Note on mapping accuracy:
Reasons For Units Boundary Modification Between Planning and Implementation:

Horizontal Mapping Standards Accuracy:
Forest Service Primary Base series maps shall comply with National Map Accuracy Standards (sec 05). For example:
For maps at 1:24,000 scale, not more than 10% of points should be at greater than 66 feet of error. These limits of accuracy shall apply in all cases to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as property boundaries, intersections of roads, corners of large buildings etc. Similarly; features not identifiable upon the ground within close limits are not to be considered test points within the limits quoted, even though their positions may be scaled closely upon the map. In this case could come timber line, soil boundaries etc.

Therefore, with a combination of multiple layers, a control point could vary up to 132 feet 90% of the time, and greater than that 10% of the time, and be within the mapping standards. Also, based on horizontal mapping standards accuracy, unit boundaries and other non-control points, may vary 200-300 feet.

Mapping Error, specific causes:

- Road locations; during the unitization process, unit locations which had been planned and surveyed, were moved to the road locations on the Forest GIS transportation layer. The road locations on this layer are approximate, and may exceed the national mapping standards due to low frequency of identifiable intersections or other control points. The on-the-ground layout brings the unit to the intended road boundary.

If area does not appear to be a map standards or mapping error, shift unit boundaries by no more than 150-200 feet. Additions outside of mapped unit boundaries must not enter sensitive resource areas such as:

- Cultural Resources
- Connectivity Corridors to a degree that either the corridor width is reduced to less than 400′ (unless a short deviation is needed to reach a road) and the total acres of connectivity corridor is not significantly impacted.
- Allocated Old Growth
- Riparian Habitat Conservation Areas

Individual total unit acres should not increase more than 1-2 acres.

The following section summarizes the proposed stand prescriptions common to all action alternatives. Because additional mortality is expected in the next one to three years, the prescription would be applied according to the stand condition at the time of treatment, not at the time of the vegetative mortality mapping (September 2002). The conifer species to be planted would include ponderosa pine and lodgepole pine, if the natural regeneration expected for this species did not occur.

Salvage Harvest

- For stands to be treated, all merchantable trees (generally 14 inches dbh and above, although this would depend on the degree of deterioration at the time of harvest) that were outside of designated wildlife leave areas would be removed if they exhibited less than 20 percent bright green crown, or in the case of white fir, showed bole scorch to 30 percent or more circumference of the bole, regardless of crown condition. The extent to which salvage harvest would be applied to a given stand depends on how hot the stand burned, what the burning pattern was, and the extent of resulting mortality (immediate or likely within the next two years). For:
    - Lighter-mortality areas with previous entries—most commonly, these were stands that had been treated before the 2002 fire with one or more harvest entries, followed by thinning and one or more underburning treatments. Often very little mortality occurred, and that was primarily in small clumps or individual trees. Generally, these dead trees would not be salvaged, but would be retained to provide snag habitat and future organic matter to aid soil development. Small clumps or individual trees that pose a hazard to public safety because of their proximity to roads or recreation use areas would be salvaged and planted, if no adequate seed source were present for natural regeneration. If these salvage areas were smaller than 10 acres, wildlife leave clumps would not be designated (see Wildlife section for further discussion on how wildlife habitat needs are addressed).
    - Lighter-mortality areas with fewer or no previous entries—often, in stands with few or no previous entries, enough ladder fuels were present that the fire created a series of repetitive, small "torching" burns instead of a true crown fire. These torching burns resulted in heavy mortality, ranging from small clumps of trees to patches of several acres or more. Small clumps of mortality of a few acres or less that are surrounded by a live stand would be left for habitat and soils purposes, as with the category above. The same approach described above would be used for hazard trees and wildlife leave clumps.
    - Heavier-mortality areas—most commonly, these were thickly-stocked stands with trees of many size classes, old woody brush component (most often bitterbrush), or both. Although these stands may have had past entries, those entries did not remove enough to reduce the high fuel load and ladder fuels. Fire in these stands progressed by spotting, torching, or as a wind-driven flaming front, and generally resulted in complete or nearly complete mortality. The patches that remained unburned also remain very densely stocked. Wildlife leave areas and clumps would be provided in these heavier mortality areas. The remaining merchantable trees that have less than 20 percent bright green crown (or in the case of white fir, have 30 percent or greater circumference or more of the bole scorched, regardless of crown condition) would be removed.

Natural Regeneration

- Reforestation by natural regeneration would be favored in areas with an adequate seed source (except for white fir), or where enough natural regeneration has already developed from soil seed bank. The regeneration objective established by the Forest Plan is 100 seedlings per acre. On a relatively small, lightly burned site, a few mature trees with high seed production would be enough to naturally regenerate the area over time. In situations where the stand has been salvage harvested, is below minimum stocking of residual live trees, and has not naturally regenerated at four years post-harvest, planting would occur in year five to meet the five-year regeneration requirement.

Planting (Factors applicable to all areas of conifer planting)

- Would not require planters to plant seedlings within 150 feet of an aspen plant greater than 5 feet tall.
- Would require planters to pull or clip any seedlings planted within 50 feet of an aspen plant greater than 5 feet tall.
- Would not plant within 50 feet of a riparian area.
- Would not plant within 35 feet of an acceptable, live pine tree with at least 40 percent live crown.
- Would not plant in meadow encroachment areas (shown on the following map). These areas are along edges of units and total 337 acres.
- Planting prescriptions would be site specific and time specific. The objective would be 100 well-distributed (over at least 80 percent of the stand) seedlings per acre that are expected to survive to maturity. Planting density would be adjusted to site conditions and designed for that objective. Plantation survival on these sites historically had often been 80 to 90 percent or better, although those seedlings were often planted the spring following the harvest activity. For the Toolbox project, seedlings are not available and have to be grown in the nursery, which means there will be a time lag of two years or more between when sites are salvaged and when they are planted. The planting window (moisture and temperature conditions that favor good survival) is often short in this area, averaging six weeks for a given site; however, yearly fluctuations are very wide. It is estimated that initial planting for the project as a whole would not be complete until spring of 2008.
- Each year post-fire would allow for increasing establishment of competing surface vegetation to occur. Conifer seedlings compete very poorly against well-established grass and brush, and higher seedling mortality would occur as competing vegetation increased. Hand scalping, up to 3 feet by 3 feet, would occur as part of the planting operation to remove plants immediately adjacent to the seedling, to help reduce such competition. However, this treatment would not greatly reduce competition for moisture from nearby well-established, deep-rooted vegetation. Past local experience has demonstrated success with this treatment.
- Planting densities would range between 130 to 400 seedlings per acre, depending on the amount of competing vegetation. The higher numbers would occur only on sites with thick, well-established competing vegetation. This condition would only be expected to occur in the last years of planting. The need for higher planting densities would be based on local, site-specific experience with seedling mortality rates.

Site Preparation

- In order to implement reforestation, site preparation to remove trees that would be hazardous to planting contractors (under Occupational Safety and Health Administration (OSHA) guidelines) would sometimes be necessary. Fire-killed trees can become a hazardous working environment as time passes and they begin to decay. Consultation with Oregon OSHA will be used as a guide to how much site preparation would be needed to remove standing dead trees for the purposes of hazard abatement. In areas where it was determined that site preparation for hazard abatement was needed, all dead standing trees outside of wildlife areas would be felled, lopped and scattered. Where concentrations of down material prevented access to planting spots additional treatment (either low-ground pressure mechanical treatments or burning) would occur. Mechanical treatments could include bunching,

mastication (with a slashbuster or similar equipment), roller-chopper, grapple piling, or yarding if a market developed.

Treatment Proposed in Alternatives C, D, G, and H

Noncommercial Thinning of Plantations Burned in the 2002 fires

There were approximately 5,000 acres of plantations, generally in 20 to 40 acre units, scattered throughout the fire area. The effect of the fire on these plantations varied widely. A key aspect to the pattern of mortality in the plantations is that where there was mortality, it was generally complete (close to 100 percent). Mortality within individual plantations is highly variable as far as how much of that plantation burned. Many plantations have complete mortality for ¼ to ½ of the plantation exposed to the hot side of the fire, and have no mortality in the rest of the plantation.

These plantations had most often been planted at densities of 500 to 800 trees per acre. Most plantations had survival rates greater than 90 percent and were 15 to 20 years old in 2002. This resulted in tight, thick young stands, with individual tree growth rates that had slowed due to competition. Some self-pruning of the lower branches had begun but most of the young trees still have enough lower branches to provide deer hiding cover.

The prescription proposed for the live portions of the plantations is to thin them to a density that will maintain, for a much longer period of time, the mule deer hiding cover qualities of the stand. Therefore, a first stage thinning, leaving between 125 to 170 trees per acre, would be conducted as part of this project. This density would only slightly increase individual growth rates and would not alone be sufficient to move stands to an LOS condition. However, it would maintain existing growth rates and cover qualities much longer. At the next precommercial entry, the stand would be larger and more economical to treat (because it would be less dense and fewer additional trees would need to be removed) than if this first entry thinning had not occurred.

Growth Projection for Thinned Plantations

Stand Growth Basal Area (GBA)	126			
Year	Trees/ac	DBH	BA/a	SDI
2005	600	3	29.5	87
2015	120	6.5	27.9	61
2025	120	9.3	56.6	107
2035	120	11	82	144
2045	120	12.64	105	175
2055	120	13.8	124	201
2065	50	14.2	55.3	88
2075	50	16.2	71.9	109
2085	50	17.9	87	127
2095	50	19.3	101	143
2105	50	20.5	114	158
2115	50	21.5	126	171

Future Foreseeable Treatments

Future treatments such as non-commercial and commercial thinning would be needed to maintain the relatively open stand conditions that most favor the development and sustainability of LOS ponderosa pine stand types in this area. Initial plantings would be designed to develop a low density tree stocking. However, one effect of planting fewer seedlings per acre is that as those seedlings mature, they can begin to produce viable seed at a relatively young age, in some cases as young as 10 years. Vigorous, low density ponderosa pine would be expected to be producing natural regeneration by the time it is 20 years old. This would create the need for noncommercial thinning in the near future and commercial thinnings farther down the road.

Direct and Indirect Effects Common to All Action Alternatives

Effects of Excluding Treatments within Riparian Habitat Conservation Areas

No fuels treatments or conifer planting is planned within Class 1 RHCAs except for 22 acres in Alternative C. Most of the riparian areas experienced a high degree of mortality in the conifer component and moderate mortality in the riparian vegetation. The riparian corridors generally had a high stocking level. In the higher mortality areas this will produce a high fuel loading in 10 to 20 years as the dead trees fall. The riparian vegetation would be expected to respond vigorously in this same time period, since competition with conifers for light, nutrients, and moisture has generally been eliminated.

If, in the future, the heavy down fuels were to ignite, the likely high-intensity fire could jeopardize the long term success of reestablishment of riparian vegetation. Any wildfire with a fuel loading that heavy would severely damage riparian vegetation and soils (Hall, 2003). In the absence of fire, the down wood component would provide exceptional stream shading and protection. In areas that burn, it would be expected that most of the down wood would be consumed. Some of the large down logs would contain very high moisture content from being in contact with water. These would be expected to persist after a wildfire, even one of high-intensity. The expected down fuel loading is likely to result in very hot fires at some time in the future for some of these areas. The timing and extent is difficult to predict, but the fire spread observed in the Toolbox Complex, especially in the Silver Fire area, was up the riparian corridors. These corridors experienced some of the most intense fire activity within the Toolbox Complex.

Some natural regeneration of conifers could occur in areas with seed producing ponderosa pine at the edge of riparian canyons. Because of the significant slope and height differences, reseeding could easily occur as far as 200 feet from the parent tree. Most of the riparian buffers are not greater than 600 feet in total width. Light natural regeneration could lead to development of future large wood that could provide for the future in-stream wood component.

Long Term Site Productivity

Long term site productivity would be maintained, and potentially enhanced by all action alternatives. The greatest risk to long-term site productivity is the future effect of a hot surface fire burning in concentrations of down wood. The concentrations of down wood, or even single large down boles, result in long term resident heat which can cause long term soil damage. Soil surface temperatures may range from 120 degrees F to more than 2730 degrees F during a fire and the downward heat pulse depends more on duration than intensity of burn (Northernrockiesfire.org). Large amounts of organic soil consumption can lead to significant changes in plant community (Hungerford et. al). The potential for site degradation is increased by a more severe burn (Lindeburgh 1990). This could have a negative effect on soil productivity. The more material that is removed through harvest, fuels treatment including cooler prescribed burns, and site preparation treatments that accelerate breakdown of fuels to forms less likely to contribute to hot combustion, to less risk to long term site productivity. Fires occurring in Ponderosa pine stands with heavy fuel loads are more likely to cause serious damage to the soil environment. Soil temperatures between 120 and 250 degrees Centigrade can create significant losses of soil microorganisms, soil nitrogen, and soil organic matter (Shea & Kauffman 1993). This effect could result from increases in fuel loading, especially large down logs, as the trees killed by the 2002 fires began to fall. All action alternatives would remove some of these dead trees. All of the proposed alternatives would retain some portion of the existing and future down wood. As the years go by, tree mortality would be

expected to continue, although at a much lesser rate. As these trees fall, they would contribute to future soil organic matter.

Ground-based skidding would be restricted to sites with slope and soil types that would not be likely to develop detrimental compaction (based on experience with similar past similar activities and Forest Plan standards and guidelines). Other sites would either be helicopter yarded or would not be harvested. Planned fuels treatment activities would help to start the nutrient cycling process with which these sites evolved. On those sites where fuels treatment includes mastication, this breakdown of tree boles and limbs into small pieces would accelerate development of future soil organic matter.

Direct and Indirect Effects That Vary By Alternative

Stand Development

The following tables compare, for one acre in a hypothetical stand that experienced 100 percent mortality and was replanted with 130 ponderosa pine seedlings, how the stand on that acre would be expected to develop, with and without stocking control by means of thinning or underburning

The following table displays growth projections of planted stands with stocking level control maintained by fire or precommercial thinning in a 100 percent mortality area using Growth Basal Area (Hall, 1987).

Growth Projections of Planted Stand – Stocking Level Control Maintained

Stand GBA\		126			
Year	Trees/ac	DBH	BA/a	SDI	
2005	130	0.1	0.0	0	
2015	130	4.6	15.0	37	
2025	100	7.8	33.0	67	
2035	100	10	59	107	
2045	100	12.3	83	139	
2055	100	13.7	103	166	
2065	100	14.3	111.5	177	Commercial thinning, remove 50 Trees /ac
2075	50	15.8	68.5	105	
2085	50	17.5	84	123	
2095	50	19.0	98	140	
2105	50	20.2	112	155	
2115	50	21.3	124	169	Selection Harvest, remove 30 TA
Stand GBA\			126		

The following table displays growth projections of planted stand (with stocking level control not maintained) in a 100 percent mortality area using Growth Basal Area (Hall, 1987). Introduction of estimated natural reproduction into the formula was random. Pulses of reproduction are estimated at 400 seedlings per event, based on the condition of existing stands in the area. The subsequent reduction of trees per acre to 100 estimates the likely mortality that would result from intertree competition, insects and/or disease.)

Growth Projections of Planted Stand - Stocking Level Control Not Maintained

Year	Trees/ac	DBH	BA/a	SDI
2005	130	0.1	0.0	0
2015	130	4.6	15.0	37
2025	100	7.8	33.0	67
	400	0.1	0.0	0
2035	100	10	58	106
	400	3	16	48
2045	100	11.85	77	131
	400	4.173	38	98
2055	100	12.9	90	150
	400	5.2	58	139
2065	100	13.2	94.9	156
Commercial thin 50 ta	400	5.5	66.3	154
2075	50	14.0	53.7	86
	400	6.4	88.0	193
2085	50	14.8	60	94
	400	7.1	111	232
2095	50	15.4	65	100
	400	7.7	130	264
2105	50	15.9	69	105
	400	8.0	138	278
2115	50	16.3	72	109
	400	8.4	153	301

The following narratives provide a summary description of the estimated effects on stand development over time in the different mortality categories, with sample scenarios applying the different sets of treatments proposed in the alternatives. These are compared with a sample scenario of "no treatments" (the No Action alternative) for that mortality category. The extent to which these predicted effects would occur across the project area landscape varies among alternatives, depending on how many acres in the particular alternative would receive the different treatment combinations. These narrative summaries are followed by tables that display, for each alternative, how many acres would be treated and with what treatment combination (as well as how many acres would receive no treatment).

Projections of potential stand development and growth were estimated using Growth Basal Area (Hall, 1987) growth formulas. The introduction of reproduction into the formula was random, and slight differences between scenarios are not meant to be significant. Pulses of reproduction are estimated at 300 or 400 seedlings per event, and, again, there is no significance of one choice over another. The numbers are based on the condition of existing stands in the area. Mortality would start to occur after the stand exceeded the stand GBA, i.e. the basal area for the type where growth drops below the threshold for susceptibility to bark beetle related mortality.

1-25 Percent Mortality Category (These stands are a matrix of lightly burned areas with patches of high to complete mortality, less than 5 acres in size. The majority of the area is densely stocked with multi-storied stands).

Sample Scenario 1: Treatments occurring: Salvage; Fuels Treatment; Planting or Natural Regeneration; Future Precommercial Thinning and Underburning. Future commercial thinning.

Condition at year 2015: multi-storied stand. Stand includes, a few larger trees, some trees of this size class have already died from fire/beetle mortality, Most of the larger dead was removed by salvage harvest. Fuels were treated. Snag and future down wood is being recruited from light continuing bark beetle mortality in the stand. Larger patches of high mortality were planted or have naturally regenerated.

Condition at year 2025: some large trees are still persisting, excessive understory has been precommercially thinned, and fuels are treated. The stand is at low risk of stand replacement fire. Next understory removal can be done by fire. Individual tree vigor is moderate to low, due to heavy pockets of residual pre-fire stocking. Future harvest is a viable option for stocking control in that material.

Condition at year 2075; stand has been commercially thinned. Stand is very close to a single story structure although not yet an older mature stand. Most trees are greater than 14" dbh. Individual tree vigor is improving and grasses, forbs, shrubs and occasional aspen are responding well.

Condition at year 2115: Stand has developed into a large single story stand. Average stand diameter is 21" with a few 30" dbh trees. Stand is now overstocked and either natural mortality or a commercial harvest to remove approximately 50 percent of the stand. Periodic underburning has maintained stocking level control.

Sample Scenario 2: Treatments occurring: Salvage; *No* Fuels Treatment; Planting or Natural Regeneration; Future Precommercial and Commercial Thinning, and Underburning.

Condition at year 2015: Two pre-fire stand structures
Multi-storied Stand: Stand includes, a few larger trees, some trees of this size class have already died from fire/beetle mortality; Most of the larger dead was removed by salvage harvest. Small accumulations of fuels are present. Snag and future down wood is being recruited from light continuing bark beetle mortality in the stand. Larger patches of high mortality were planted or have naturally regenerated.

Single Storied Stands: Stand is still dominated by a larger tree component. Natural regeneration has been abundant in areas where a mineral seedbed was created. Underburning will be necessary to maintain the single story condition and stocking level control.

Condition at year 2025: The two pre-fire stand conditions are becoming more similar in structure, although the pre-fire multi-storied is still a much younger, smaller stand. The understory has been precommercially thinned, and fuels are treated. This fuels treatment was higher cost due to lack of post salvage fuels treatment, but these fuels were relatively light. The stand is at low risk of stand replacement fire. Next understory removal can be done by fire. Individual tree vigor is moderate to low, due to heavy pockets of residual pre-fire stocking. Future harvest is a viable option for stocking control in that material.

Condition at year 2075: stand has been commercially thinned. Stand is very close to a single story structure although not yet an older mature stand. Most trees are greater than 14″ dbh. Individual tree vigor is improving and grasses, forbs, shrubs and occasional aspen are responding well.

Condition at year 2115: Stand has developed into a large single story stand. Average stand diameter is 21″ with a few 30″ dbh trees. Stand is now overstocked and either natural mortality or a commercial harvest to remove approximately 50 percent of the stand. Periodic underburning has maintained stocking level control.

Sample Scenario 3: No Harvest, No Fuels Treatment, No Foreseeable actions.

Condition at 2015: Pockets of dead trees and increasing fuel loading in these pockets. Rest of stand highly stocked, and some additional natural regeneration is occurring where the fire created a mineral soil seedbed. This is very favorable to Ponderosa regeneration establishment. The stand structure is not much changed from the pre-fire condition. Most of these stands

Condition at 2075: Most of the larger trees have died due to stress related mortality. Heavily stocked understory.

Condition at 2115: Another perturbation event has occurred, either fire or insect or disease activity. Stocking has been reduced considerably. Two scenarios occur. Much of the area is nearly complete mortality from a stand replacement event. However some of the could have a light enough stocking remaining to have potential to develop a sustainable stand if natural role of fire is allowed to maintain stocking level control.

25-50 percent mortality category (These stands are a matrix of moderately burned stands with patches of high to complete mortality greater than 5 acres in size. An increase in bark beetle mortality would be expected in these stands).

Sample Scenario 1: Treatments occurring: Salvage; Fuels Treatment; Planting or Natural Regeneration; Future Precommercial Thinning/Whipfelling and Underburning. Future commercial thinning.

Condition at 2015: Increased mortality due to fire and bark beetles reduced live tree component for several years after the fire. The salvage harvest removed much of the mortality but not all of it, and did treat most of the fuels. Young trees either from post-fire natural regeneration or planting are growing vigorously, and are starting to produce seed and progeny of their own. There is a vigorous grass/forb, shrub and some aspen component.

Condition at 2025: Stocking level control in the progeny of the regenerated stand will be controlled by thinning/whipfelling activities. Some large trees have survived and now they are doing very well. Future understory stocking level control can be maintained by fire.

Condition at 2075: Commercial thinning has removed approximately 50 14″dbh, after that treatment the residual stand is a sustainable, with frequent low intensity underburns, single story stand of trees 14″ to 30″ dbh. There is a vigorous grass/forb, shrub and some aspen component.

Condition at 2115: Stand has developed into a large single story stand. Average stand diameter is 21″ with a few 30″ dbh trees. Stand is now overstocked and either natural mortality or a commercial harvest to remove approximately 50 percent of the stand. Periodic underburning has maintained stocking level control.

Sample Scenario 2: Treatments occurring: Salvage; *No* Fuels Treatment; Planting or Natural Regeneration; Future Precommercial Thinning/Whipfelling and Underburning. Future commercial thinning.

Condition at 2015: Increased mortality due to fire and bark beetles reduced live tree component for several years after the fire. The salvage harvest removed much of the mortality but not all of it, but a heavy fuel load remains. Young trees either from post-fire natural regeneration or planting are growing vigorously, and are starting to produce seed and progeny of their own. There is a vigorous grass/forb, shrub and some aspen component.

Condition at 2025: Two conditions; 1. If funds are available to treat the heavy residual fuel loading: Stocking level control in the progeny of the regenerated stand will be controlled by thinning/whipfelling activities. Some large trees have survived and now they are doing very well. Future understory stocking level control can be maintained by fire. Or 2. if funds are not available to treat the heavy residual fuel loading: Increased regeneration from seed from the planted and residual trees are establishing a pulse of regeneration that is the beginning of a multi-story stand condition. This understory will have the effect of greatly slowing growth and vigor of the entire stand. Slowly more of the larger residual trees are dying until very few are left. The stand is mostly a stagnated small tree stand in a heavy fuel bed. Most of the trees are not large enough for bark beetle mortality unless Ips becomes active. These areas would be in a condition that, in the event of fire, it would be a stand replacement event.

Condition at 2075: In stands that received stocking level control: Commercial thinning has removed approximately 50 14″dbh, after that treatment the residual stand is a sustainable, with frequent low intensity underburns, single story stand of trees 14″ to 30″ dbh. In stands that did not receive stocking level control: Many acres have burned. These acres are developing a vigorous grass/forb, shrub, and aspen component in some of the areas. There are also areas of soil damage where only a few of the most vigorous pioneer plants are starting to colonize.

Condition at 2115: In stands that received stocking level control and fuels treatment. Stand has developed into a large single story stand. Average stand diameter is 21″ with a few 30″ dbh trees. Stand is now overstocked and either natural mortality or a commercial harvest to remove approximately 50 percent of the stand. Periodic underburning has maintained stocking level control. Stands that did not receive stocking level control are in similar situation as in 2075.

Sample Scenario 3: No Harvest or fuels treatment; no foreseeable actions.

Condition at 2015: Bark beetle activities have been very active in this stand condition. Many of the mid to larger size trees that survived the fire have died from bark beetle attacks, However the few that have survived were gaining in individual tree vigor, however now the natural regeneration that has established immediately adjacent to the residual live trees is beginning to reduce the vigor of the parent trees. More than half of the area is almost devoid of conifers, but does have vigorous grass/forb, shrub and aspen vegetation.

50-100 percent mortality category (These areas range from heavily burned stands that are expected to show significant increases in mortality in summer 2003 to stands that are almost completely dead. There are small patches of lightly burned trees in a matrix of fire-killed trees. An increase in bark beetle activity would be expected in these stands).

Sample Scenario 1: Treatments occurring: Salvage; Fuels Treatment; Planting or Natural Regeneration; Future Precommercial Thinning/Whipfelling and Underburning. Future commercial thinning.

Condition at 2015: Bark beetle mortality has continued in these stands. Salvage has removed many of the dead trees, but not all. None were removed from the wildlife clumps. And these clumps were not planted, but eventually will reforest from seed from the adjacent residual or planted trees. Natural regeneration or planting has reforested the high mortality areas, small patches of less burned trees are scattered throughout these areas, but they are very scarce. The regenerated trees are starting to produce viable seed and progeny of their own. A vigorous grass/forb, shrub, and aspen component has developed.

Condition at 2025: Precommercial thinning/whipfelling and fuel treatment has occurred to remove young regeneration, and also accomplished ladder fuel reduction. Stand structure has developed such that future understory stocking level control can be maintained by fire. The residual large trees are increasing in vigor and provide a scattering of LOS trees, but certainly not a stand condition.

Condition at 2075: Commercial thinning has occurred, removing 50 or so 14" dbh trees per acre. The stand size is 14"-30"+, most of the trees are 14-16", but have good individual tree vigor. Stand stocking is about 50 trees per acre.

Condition at 2115: Stand is a LOS stand with most trees 20" dbh or larger, understory stocking has been removed by periodic underburning. Individual trees growth has slowed to a point where either significant bark beetle mortality or harvest will occur. Either should remove about half of the stand.

Sample Scenario 2: Treatments occurring: Salvage; No Fuels Treatment; Planting or Natural Regeneration; Future Precommercial Thinning/Whipfelling and Underburning. Future commercial thinning.

Condition at 2015: Increased mortality due to fire and bark beetles reduced live tree component for several years after the fire. The salvage harvest removed much of the mortality but not all of it, but a heavy fuel load remains. Young trees either from post-fire natural regeneration or planting are growing vigorously, and are starting to produce seed and progeny of their own. There is a vigorous grass/forb, shrub and some aspen component.

Condition at 2025: Two conditions; 1. If funds are available to treat the heavy residual fuel loading: Stocking level control in the progeny of the regenerated stand will be controlled by thinning/whipfelling activities. Some large trees have survived and now they are doing very well. Future understory stocking level control can be maintained by fire. Or 2. If funds are not available to treat the heavy residual fuel loading: Increased regeneration from seed from the planted and residual trees are establishing a pulse of regeneration that is the beginning of a multi-story stand condition. This understory will have the effect of greatly slowing growth and vigor of the entire stand. Slowly more of the larger residual trees are dying until very few are left. The stand is mostly a stagnated small tree stand in a heavy fuel bed. Most of the trees are not large enough for bark beetle mortality unless Ips become active. These areas would be in a condition that, in the event of fire, it would be a stand replacement event.

Condition at 2075: In stands that received stocking level control: Commercial thinning has removed approximately 50 14"dbh, after that treatment the residual stand is a sustainable, with frequent low intensity underburns, single story stand of trees 14" to 30" dbh. In stands that did not receive stocking level control: Many acres have burned. These acres are developing a vigorous grass/forb, shrub, aspen component in some of the areas. There are also areas of soil damage where only a few of the most vigorous pioneer plants are starting to colonize.

Condition at 2115: In stands that received stocking level control and fuels treatment. Stand has developed into a large single story stand. Average stand diameter is 21" with a few 30" dbh trees. Stand is now overstocked and either natural mortality or a commercial harvest to remove approximately 50 percent of the stand. Periodic underburning has maintained stocking level control. Stands that did not received stocking level control are in similar situation as in 2075

Sample Scenario 3: No Harvest or fuels treatment; no foreseeable actions.

Condition at 2015: Bark beetles have been somewhat active in the remaining live component of this stand condition. Many of the mid-size to larger-size trees that survived the fire have died from bark beetle attacks. The few that have survived are gaining in individual tree vigor. More than half and in some cases, most of the area is virtually devoid of conifers, but does have vigorous grass/forb, shrub and aspen vegetation.

The following table summarizes, by action alternative, the number of acres in each mortality category that would receive the treatment combinations described in scenarios 1, 2, and 3 (no action) above.

Summary of Scenarios 1, 2, and 3 Treatment Combinations

Mortality Class	Acres	Scenario 1 Harvest/Fuels Treatment					Scenario 2 Harvest/ No Fuels Treatment					Scenario 3 (No Action) Acres with No Harvest or Fuels Treatment				
		Alternative					Alternative					Alternative				
		C (acres) (% of total)	D (acres) (% of total)	E (acres) (% of total)	G (incl. buffer acres)	H (acres) (% of total)	C (acres) (% of total)	D (acres) (% of total)	E (acres) (% of total)	G (acres) (% of total)	H (acres) (% of total)	C (acres) (% of total)	D (acres) (% of total)	E (acres) (% of total)	G (minus buffer acres)	H (acres) (% of total)
1-25% Veg. Mortality	6727	270 4%	214 3%	253 4%	269+ 272 = 541 8%	259 4%	975 14%	107 2%	639 9%	975 14%	968 14%	5,482 81%	6,407 95%	5,835 87%	5,211-(1,065) =4146 62%	5,500 82%
26-50% Veg. Mortality	9408	1,784 19%	1,155 12%	1,317 14%	1,778+ 339 = 2,117 23%	1,585 17%	1585 17%	83 1%	867 9%	1,584 17%	1,446 15%	6,039 64%	8,171 87%	7,223 77%	5,707-(1,370) =4337 46%	6,377 68%
51-85% Veg. Mortality	5360	1,831 34%	1,213 22%	1,590 30%	1,823+ 97 = 1,920 36%	1,568 29%	664 12%	67 1%	435 8%	663 12%	642 12%	2,866 53%	4,080 76%	3,335 62%	2,777-(602)=2 ,175 41%	3,150 59%
86%-100% Veg. Mortality	12339	5,669 46%	3,148 25%	5,149 42%	5,658+ 132 = 5790 47%	5,159 42%	536 4%	52 0%	384 3%	536 4%	506 4%	6,134 50%	9,139 74%	6,806 55%	3,013-(1,599) =4414 36%	6,674 54%

Alternative G, which focuses on fuels reduction to promote long-term sustainability, includes proposals for fuels treatment on additional acres, compared to some of the other action alternatives. While the other alternatives limit fuels treatment to acres that would be expected to develop 20 tons or more of fuel loading per acre as the dead trees fall, Alternative G proposes fuels treatment on all harvest units within ¼ mile of the boundary between any private lands and National Forest System lands, whether or not the predicted fuel loading would exceed 20 tons per acre. Additionally, Alternative G would treat fuels on some lands within the project area that are outside of salvage units altogether (see the fire and fuels section for more detail). The additional acres to be treated in Alternative G are broken out in the table above as "buffer" acres

Effects of Proposed Treatments on Forest Stand Types Within the Project Area

Ponderosa Pine Stand Types

Salvage Harvest

Salvage harvesting would reduce the potential for large, down fuels within the project area. Successful development and maintenance of sustainable ponderosa pine LOS stands depends on reducing unnaturally high fuel loads to the point that fire can be reintroduced into the stand without significant damage to the future LOS trees. In about 20 years, the seedlings planted after the fire would have progeny of their own, and the stand would need to be treated to keep density conditions favorable for the development of LOS. At about the same time, without earlier removal by salvage, most of the large dead trees would have fallen.

Removing the dead, merchantable-sized trees would significantly reduce the potential fuel loading from the fire-killed trees. This in turn would make it easier and less costly to achieve LOS stand conditions, by allowing the use of prescribed fire for stand development and maintenance. Abundant large down wood can become a barrier to future fuels reduction, from both cost and logistical standpoints. While many treatment options are available to reduce smaller size slash, boles from large down trees are difficult to burn, require large machinery to move, can cause damage to young reproduction if moved, and would be very expensive to cut, pile, and burn on site. In the dry climate of this area, such larger fuels could persist for up to a century.

Salvage harvests, along with proposed fuels and site preparation treatments, would also reduce the potential for future intense, "hot" fires that have stand replacement potential. If a fires starts in areas where the large, fire or beetle-killed trees have fallen; the high fuel loading would create a very hot fire. "Should fire occur in this heavy fuel, all live trees would be killed and the soil surface sterilized to a degree inhibiting regeneration." (Hall, 2003). At the least, a subsequent wildfire could result in loss of the stands that were planted or naturally regenerated after the Toolbox Complex. This loss would further retard the development of LOS stands within the project area.

Sexton (1998) showed a two-year benefit in species richness and density for shrubs and herbaceous vegetation in unsalvaged versus salvaged plots. This benefit may be attributable to an improved microclimate for the first year of establishment of germinants. Local experience has repeatedly shown that in first year burned areas, salvaged or not, there is early spring-summer germination of many species, including pines that do not survive the summer. Under all action alternatives, all first-year germinants would have the benefit of site modification from dead cover, as no salvage would be proposed during that season (spring/summer of 2003).

Salvage harvesting would also facilitate reforestation within the project area. Stands that were partially burned (1 to 50 percent mortality) are perhaps in worse condition to achieve LOS than before the fire. Because they have a seed source, are overstocked, and now have a receptive seed bed for increased conifer reproduction, many new seedlings would be expected to establish naturally, increasing the need for stocking control to maintain appropriate densities. The effect of salvage harvests in these partially burned stands would be to remove the larger fuels and facilitate future thinning and reintroduction of fire.

In the more heavily burned stands (51 to 100 percent mortality), the many standing dead trees would be likely to pose hazards for planting crews by about 2007, when they would begin to fall in large numbers. The stands that were heavily stocked before the 2002 fires would now be developing a deep fuelbed that would restrict access to desirable planting spots. These larger dead trees would need to be removed before planting could proceed, in areas where salvage harvest had not occurred. Since by 2007 the large material would have no merchantable value, federal funds would be needed to accomplish the removal. Additionally, the large, dead material would be quite expensive to remove. If funds were not available in a timely manner, progress toward re-establishment of LOS stands in these areas could be significantly delayed.

In stands that could be planted before the dead trees become a hazard; the large, dead trees would eventually pose the same fuel loading problems described earlier. In addition, the planted trees would be damaged as the

larger trees fall. While a few would be killed outright, the larger problem to LOS development would be enough permanent deformity in the developing trees that they would never develop into LOS.

Mechanical Fuels Treatments and Prescribed Burning

Mechanical fuels treatments (as distinguished from salvage harvesting) are designed to reduce fuels from smaller dead trees, in the 1 to 9 inch dbh range. These size classes represent the highest number of trees in most ponderosa pine stand types. The effect of the fuels treatments would be to reduce fire hazard from unplanned ignitions and, by accelerating the decay of these smaller fuels, to allow earlier reintroduction of prescribed fire into the stand. This earlier reintroduction of fire would reduce the cost of both future fuels treatments and future stocking level control treatments needed to maintain appropriate stand densities. Without fuels treatment and reintroduction of fire, stand conditions similar to those that supported the spread of the Toolbox Complex would develop. Such stand conditions are well outside the Historic Range of Variability.

Site Preparation – Hazard Tree Falling

This activity would fall standing dead trees in planting areas that pose a hazard to planting crews. Most of this activity would occur several seasons after the 2002 fires. One thousand or less acres of site preparation would likely occur during the first growing season and could negatively affect some of the first year germinants. The degree of that effect would also be dependent on that year's weather, if mild or extreme. Site preparation would have effects similar to those for fuel treatments, but to a lesser degree. Trees would be felled, lopped, and scattered. It is expected that most trees would shatter on falling, and this would accelerate the decay process somewhat. Some additional mechanical or fire treatments could be applied to units where the down material posed a barrier to accessing planting spots.

Reforestation by Planting

The effect of reforestation by planting would be to re-establish light density ponderosa pine stands in areas with an inadequate seed source and to speed the re-establishment of Late and Old Structure (LOS) ponderosa pine stands within the project area. Mortality at the scale represented by the project area is outside of the range of adaptability of ponderosa pine to naturally reforest, in any time frame less than several hundred years. Ponderosa pine stand types in this area are characterized by:

- Stand structure dominated by low numbers of trees, most being mature trees in the larger size classes, with few smaller trees present.
- Small, generally less than 1 acre, areas of mortality, resulting from fire or bark beetles killing individuals or small clumps of trees.
- Infrequent pulses of regeneration. Ponderosa pine seed, in an occupied stand, disperses only about 100 feet from the tree, or about a distance equal to the cone height. Ponderosa seed establishes best on a mineral soil seedbed, such that as prepared by fire. Rodents eat large amounts of the seed and very little is actually able to germinate.

Without planting, very little ponderosa pine establishment would occur, within the next few decades, in areas that lack adequate seed trees. Therefore, without planting, development of a sustainable stand of LOS could take up to several hundred years. The actual time would depend on the distance to seed producing trees, how far their progeny were able to spread, how quickly those trees produced seed, and how far they spread it. As no grass seeding occurred, native vegetation response and rapid replanting of ponderosa pine will maintain a mycorrhizal fungi component (Amaranthus, et al.). Past replanting, even in areas of some soil compaction, have been quite successful.

Mixed Conifer Stand Types (White Fir Expansion into Pre-fire Suppression Ponderosa Pine Types)

Salvage Harvest

The effects of salvage harvest on this forest type are virtually identical to the effects that would be expected in the pure ponderosa pine stand types. There are a few differences with respect to expected vegetative regeneration. Salvaging the dead overstory could reduce the short-term benefit that the dead overstory would

provide in terms of a better microclimate for regenerating species. However, the vegetative species that the dead cover would favor would not be the pioneer species best suited to restoration of a sustainable ponderosa pine type. More shade-tolerant species, such as white fir, could be favored, at the expense of the associated early seral species desired for the more sustainable pine-dominated type. Salvage harvests would open up the stands and possibly limit the success of white fir natural regeneration. This in turn could favor re-establishment of the more open ponderosa pine stands that are closer to the Historic Range of Variability.

Fuels Treatments

The effects of this activity on the areas of white fir expansion would be essentially the same as for the ponderosa pine stand types. Please see the ponderosa pine discussion above.

Site Preparation – Hazard Tree Falling

The effects of this treatment would be the same as that described for the ponderosa pine stand types above.

Reforestation by Planting

The effect of reforestation by planting would be to re-establish ponderosa pine in areas with an inadequate ponderosa seed source. Ponderosa pine seed source has been deficient in these areas, even pre-fire, for several reasons:

- These types are at higher elevations. Ponderosa pines at these elevations produce a good seed crop at an interval of 10 to 25 years rather than the 3 to 5 years common at lower elevations.
- Due to the extent of white fir expansion into these stands, most ponderosa pine is of poor vigor and not capable of significant seed production. They also are generally older, and also produce fewer seed.
- Many ponderosa pines had died, either before or during the fire.

Large white fir, however, is often not immediately killed by fire. The fire-damaged white fir may produce several seed crops prior to dying and is an abundant seed producing species.

Planting ponderosa pine would lead to development of more sustainable LOS stands. The effect of not planting on these types in high mortality areas (greater than 50 percent mortality) would be development of a heavy shrub component with some white fir regeneration. The effect of not planting in partially burned areas would be to develop a stand of even denser, smaller white fir than the pre-fire stand.

Lodgepole Pine Stand Types

There are relatively few acres of the lodgepole pine stand types within the Toolbox project area. For the purposes of this discussion, those acres are further divided into moist lodgepole pine/meadow, wet riparian lodgepole, and dry lodgepole types. The effects are different for each type.

Salvage Harvest

The effect of salvage logging on the dry type would be to remove some of the future dead fuel. In the dry type the average diameter is generally on the larger side, so salvage harvest, or firewood cutting could be used to remove some of this fuel. If not removed, the dead trees would pose a future hazard to soils once they fell, in terms of the heat damage that could result from an ignition in the down material. This forest type did not co-evolve with frequent low-intensity fire and is fairly susceptible to fire damage, even from a relatively "cool" fire. Thus, prescribed fire would not commonly be used as a management tool for developing old stands of lodgepole pine. Fuels removal through salvage harvest would be primarily to modify the fuel loadings such that they do not contribute to future high intensity, large-scale fires.

The effect of salvage logging on the moist LP/meadow type would be to remove fuels and begin the process of meadow restoration in these stands, many of which lack the non-forested meadow component, compared to HRV.

The effect of salvage harvest on the wet riparian stand types would be to remove some fuel. Most of the acres in this stand type would not have any salvage harvest planned. Most of the trees in this stand type are smaller diameter and highly stocked. The dead trees in these stands would not create much of a fuels hazard.

Fuels Treatment

Mechanical fuels treatments in lodgepole pine types would be used to reduce wildfire hazard and thus protect the stands and soil from damage by fire.

Reforestation by Planting

The effects of reforestation by planting would vary dramatically by type. Lodgepole pine is not serotinous in this area (serotinous cones are those that require heat from a fire to open and release the seed). Regeneration is by direct seeding, or by seed already existing in the soil seedbank.

Locally the dry lodgepole pine stand type has an erratic history of natural regeneration. Some acres within this type have not naturally regenerated from many years after they have experienced a fire. Other acres have regenerated very densely; however, it took many years for that regeneration to occur. In the latter case, it is likely that the stand regenerated from seed already in the soil, as no seed trees remained in most areas after the fire. This suggests that lodgepole pine moved into these areas after the advent of fire suppression and that, before fire suppression, the stand was probably a ponderosa pine/grass type, very sparsely stocked with ponderosa pine. The effects of replanting to lodgepole pine would be to ensure conifer regeneration on these sites. Future planting of ponderosa pine could start a long-term conversion process back to a ponderosa pine savannah. If lodgepole pine naturally regenerated at a low enough density to grow to maturity that would also be a sustainable condition.

The moist and riparian lodgepole stands would be expected to regenerate heavily to lodgepole pine without any need for planting. The meadow component would not be planted.

Effects of the Alternatives on Development of Sustainable Forested Vegetated Communities

The alternatives differ in how they would influence the development of sustainable Late and Old Structure (LOS) stands across the Toolbox project area.

Acres of Proposed Treatment Combinations by Alternative (Includes acres for which no treatment would be proposed), and Relationship to Development of LOS Within the Toolbox Project Area.

Alternative	Salvage Harvest	Fuels Trtmt	Site Prep	Planted (1)	Mature Dead Stands Retained	Areas most likely to develop into sustainable LOS stands in the future: acres with fuels trtmts and 50% site preparation	Areas planted in which future high fuel loading would reduce sustainability of "new" forests": acres of planting w/o fuels treatments or site prep	Future forest that would retain high-density clumps and mod. fuel loads (2)	Future "forest-type" in non-forested condition (3)
	Acres								
A	0	0	0	0	29,000	0		14,000	20,000
C	14,441	10,244	5,301	20,750	14,559	12,894	7,856	14,000	1,000
D	6,367	5,680	4,830	20,750	22,633	8,095	12,655	14,000	1,000
E	11,490	6,723	5,330	20,750	17,510	9,388	11,362	14,000	1,000
G	14,419	11,354	3,580	20,750	14,581	13,144	7,606	8,404	1,000
H	13,031	9,070	4,695	20,750	15,969	11,417	9,333	14,000	1,000

(1) This acreage would increase if additional fire or beetle-related mortality developed within the stands in the next 1-3 years, or if replanting was needed due to high seedling mortality. Detailed data on planting schedules and expected survival rates is available in the project file.

(2) Consideration of fuel loading based on Sept. 2002 mortality levels. Sustainability of these stands would be reduced.

(3) These are acres that historically would have been in a forested condition.

Effects of Alternative A on the Development of Sustainable Forests

- An estimated 20,000 acres that would normally (if consistent with HRV) support forested vegetative communities would develop vigorous shrub-grass vegetation instead, because of a lack of seed trees. Generally, reestablishment of conifer seedlings, except in very small localized pockets, would take 30 to 75 or more years. Development of LOS structure (in the absence of stand-replacing wildfire) could take up to 300 years across most acres, due to the lag time in reestablishing conifers and the solid establishment of competing vegetation. About 20 to 30 percent of the area could develop LOS structure in 150 to 200 years. This LOS structure would be multi-storied and not a stable, sustainable stand.

- Because no fuels reduction would occur, higher mortality forested stand types would have very heavy fuel loadings. The larger fuels could persist for 50 to 100 years. This fuel loading would eliminate the use of prescribed fire without very expensive mechanical pretreatments. It would also create a fuelbed, which would support the spread of severe, stand-replacement wildfires. This in turn would increase the potential for soil damage occurring from burning of large, down fuels and the potential for establishment of non-native vegetation and noxious weeds (see Noxious Weeds section).

- In areas of white fir expansion, white fir reproduction will be more successful than ponderosa pine. In this alternative, white fir would re-establish relatively quickly in areas historically dominated by

ponderosa pine. Stand densities would increase. White fir is a relatively short-lived species and susceptible to mortality from a number of insect and disease agents. Over time, as white fir died in these stands, fuel loads would increase and the potential for the spread of severe wildfire would also increase. Acres in this condition would move farther away from a long-term sustainable condition.

- The roughly 14,000 acres that burned with less than 50 percent vegetative mortality would develop as a mosaic of:
  - Residual overstocked patches,
  - Regenerated overstocked patches.
  - Moderate to heavy fuel loading,
  - Forested stand type that regenerated to shrub/grass vegetation with very few trees. These conditions would not be sustainable over the long term, though they could provide some habitat diversity.

Effects of Alternative C on the Development of Sustainable Forests

- An estimated 1,000 acres that would normally (if consistent with HRV) support forested vegetative communities would develop vigorous shrub-grass vegetation instead, because of a lack of seed trees. Generally, reestablishment of conifer seedlings, except in very small localized pockets, would take 30 to 75 or more years. Development of LOS structure (in the absence of stand-replacing wildfire) could take up to 300 years across most acres, due to the lag time in reestablishing conifers and the solid establishment of competing vegetation. About 20 to 30 percent of the area could develop LOS structure in 150 to 200 years. This LOS structure would be multi-storied and not a stable, sustainable stand.
- No fuels reduction or effective site preparation would occur on approximately 7,856 acres of planted forested type. The acres of higher mortality forested types that did not receive such treatment would exhibit very heavy fuel loadings. Development of single story, low-density sustainable stands would be difficult and expensive on these acres. The larger fuels could persist for 50 to 100 years. This fuel loading would eliminate the use of prescribed fire without very expensive mechanical pretreatments. It would also create a fuelbed that would support the spread of severe, stand-replacement wildfires. This in turn would increase the potential for soil damage occurring from burning of large, down fuels and the potential for establishment of non-native vegetation and noxious weeds (see Noxious Weeds section). As dead trees fell on these acres, they would damage some of the conifer regeneration. Such damage would limit its ability to develop LOS structure and provide infection opportunities for insect and disease agents.
- Approximately 12, 894 acres would be planted or naturally regenerated, and would receive enough fuels treatment so that, if maintained by underburning, sustainable LOS stands would be expected to develop.
- The roughly 14,000 acres that burned with less than 50 percent vegetative mortality would develop as a mosaic of:
  - Residual overstocked patches,
  - Regenerated overstocked patches.
  - Moderate to heavy fuel loading,
  - Forested stand type that regenerated to shrub/grass vegetation with very few trees. These conditions would not be sustainable over the long term, though they could provide some habitat diversity.

- Noncommercial thinning of plantations burned in the 2002 fires would occur on approximately 2,214 acres. This thinning would reduce fuel hazards and accelerate development of LOS.
- Prescribed burning would occur on 3,572 acres, reducing fire hazard by reduction of ladder fuel and surface fuel component. This would also reduce costs for future stocking level control treatments.
- Aspen enhancement would occur on 690 acres of riparian aspen, and 7 acres of riparian areas would have deciduous species planting. These treatments would increase habitat diversity within the project area.

Effects of Alternative D on the Development of Sustainable Forests

- An estimated 1,000 forested type non-stocked acres, lacking adequate seed trees, would develop vigorous shrub-grass vegetation. Generally, reestablishment of conifer seedlings, except in very small localized pockets, would take 30 to 75or more years. Development of LOS structure (in the absence of stand-replacing wildfire) could take up to 300 years across most acres, due to the lag time in reestablishing conifers and the solid establishment of competing vegetation. About 20 to 30 percent of the area could develop LOS structure in 150 to 200 years. This LOS structure would be multi-storied and not a stable, sustainable stand.
- No fuels reduction or effective site preparation would occur on approximately 12,655 acres of planted forested type. The acres of higher mortality forested types that did not receive such treatment would exhibit very heavy fuel loadings. Development of single story, low-density sustainable stands would be difficult and expensive on these acres. The larger fuels could persist for 50 to 100 years. This fuel loading would eliminate the use of prescribed fire without very expensive mechanical pretreatments. It would also create a fuelbed that would support the spread of severe, stand-replacement wildfires. This in turn would increase the potential for soil damage occurring from burning of large, down fuels and the potential for establishment of non-native vegetation and noxious weeds (see Noxious Weeds section). As dead trees fell on these acres, they would damage some of the conifer regeneration. Such damage would limit its ability to develop LOS structure and provide infection opportunities for insect and disease agents.
- Approximately 8,095 acres will be planted or naturally regenerated, and receive enough fuels treatment so that, if maintained by underburning, sustainable LOS stands would be expected to develop.
- The roughly 14,000 acres that burned with less than 50 percent vegetative mortality would develop as a mosaic of:
    - Residual overstocked patches,
    - Regenerated overstocked patches.
    - Moderate to heavy fuel loading,
    - Forested stand type that regenerated to shrub/grass vegetation with very few trees. ,These conditions would not be sustainable over the long term, though they could provide some habitat diversity.
- Plantation noncommercial thinning would occur on approximately 2,214 acres. This would reduce fuel hazard and accelerate development of LOS.
- Prescribed burning would occur on 2,450 acres, reducing fire hazard by reduction of ladder fuel and surface fuel component. This would also reduce costs for future stocking level control treatments.
- Aspen enhancement will occur on 690 acres of riparian aspen and 7 acres of riparian would have deciduous species planting. These treatments would increase habitat diversity within the project area.

Effects of Alternative E on the Development of Sustainable Forests

- An estimated 1,000 forested type non-stocked acres, lacking adequate seed trees, would develop vigorous shrub-grass vegetation. Generally, reestablishment of conifer seedlings, except in very small localized pockets, would take 30 to 75 or more years. Development of LOS structure (in the absence of stand-replacing wildfire) could take up to 300 years across most acres, due to the lag time in reestablishing conifers and the solid establishment of competing vegetation. About 20 to 30 percent of the area could develop LOS structure in 150 to 200 years. This LOS structure would be multi-storied and not a stable, sustainable stand.
- No fuels reduction or effective site preparation would occur on approximately 11,362 acres of planted forested type. The acres of higher mortality forested types that did not receive such treatment would exhibit very heavy fuel loadings. Development of single story, low-density sustainable stands would be difficult and expensive on these acres. The larger fuels could persist for 50 to 100 years. This fuel loading would eliminate the use of prescribed fire without very expensive mechanical pretreatments. It would also create a fuelbed that would support the spread of severe, stand-replacement wildfires. This in turn would increase the potential for soil damage occurring from burning of large, down fuels and the potential for establishment of non-native vegetation and noxious weeds (see Noxious Weeds section). As dead trees fell on these acres, they would damage some of the conifer regeneration. Such damage would limit its ability to develop LOS structure, and provide infection opportunities for insect and disease agents.
- Approximately 9,388 acres would be planted or naturally regenerated, and would receive enough fuels treatment so that if maintained by underburning sustainable LOS stands would be expected to develop.
- The roughly 14,000 acres that burned with less than 50 percent vegetative mortality would develop as a mosaic of:
    - Residual overstocked patches,
    - Regenerated overstocked patches.
    - Moderate to heavy fuel loading,
    - Forested stand type that regenerated to shrub/grass vegetation with very few trees. These conditions would not be sustainable over the long term, though they could provide some habitat diversity.

Effects of Alternative G on the Development of Sustainable Forests

- An estimated 1,000 forested type non-stocked acres, lacking adequate seed trees, would develop vigorous shrub-grass vegetation. Generally, reestablishment of conifer seedlings, except in very small localized pockets, would take 30 to 75 or more years. Development of LOS structure (in the absence of stand-replacing wildfire) could take up to 300 years across most acres, due to the lag time in reestablishing conifers and the solid establishment of competing vegetation. About 20 to 30 percent of the area could develop LOS structure in 150 to 200 years. This LOS structure would be multi-storied and not a stable, sustainable stand.
- No fuels reduction or effective site preparation would occur on approximately 7,606 acres of planted forested type. The acres of higher mortality forested types that did not receive such treatment would exhibit very heavy fuel loadings. Development of single story, low-density sustainable stands would be difficult and expensive on these acres. The larger fuels could persist for 50 to 100 years. This fuel loading would eliminate the use of prescribed fire without very expensive mechanical pretreatments. It would also create a fuelbed that would support the spread of severe, stand-replacement wildfires. This in turn would increase the potential for soil damage occurring from burning of large, down fuels and the potential for establishment of non-native vegetation and noxious weeds (see Noxious Weeds section). As dead trees fell on these acres, they would damage some of the conifer regeneration. Such damage

would limit its ability to develop LOS structure, and provide infection opportunities for insect and disease agents.

- Approximately 13,144 acres would be planted or naturally regenerated, and would receive enough fuels treatment so that if maintained by underburning sustainable LOS stands would be expected to develop.
- The roughly 14,000 acres that burned with less than 50 percent vegetative mortality would develop as a mosaic of:
    - Residual overstocked patches,
    - Regenerated overstocked patches.
    - Moderate to heavy fuel loading,
    - Forested stand type that regenerated to shrub/grass vegetation with very few trees. These conditions would not be sustainable over the long term, though they could provide some habitat diversity.
- About 5,596 acres of National Forest System land next to private land boundaries would have various fuels treatment activities. These treatments would reduce fire hazard, facilitate application of prescribed fire on federal lands, and reduce costs for future stocking level control treatments.
- Plantation noncommercial thinning would occur on approximately 2,214 acres. This would reduce fuel hazard and accelerate development of LOS.
- Prescribed burning would occur on 3,572 acres, reducing fire hazard by reduction of ladder fuel and surface fuel component. This would also reduce costs for future stocking level control treatments.
- Aspen enhancement will occur on 690 acres of riparian aspen and 7 acres of riparian would have deciduous species planting. These treatments would increase habitat diversity within the project area.

Effects of Alternative H on the Development of Sustainable Forests

- An estimated 1,000 forested type non-stocked acres, lacking adequate seed trees, would develop vigorous shrub-grass vegetation. Generally, reestablishment of conifer seedlings, except in very small localized pockets, would take 30 to 75 or more years. Development of LOS structure (in the absence of stand-replacing wildfire) could take up to 300 years across most acres, due to the lag time in reestablishing conifers and the solid establishment of competing vegetation. About 20 to 30 percent of the area could develop LOS structure in 150 to 200 years. This LOS structure would be multi-storied and not a stable, sustainable stand.
- No fuels reduction or effective site preparation would occur on approximately 9,333 acres of planted forested type. The acres of higher mortality forested types that did not receive such treatment would exhibit very heavy fuel loadings. Development of single story, low-density sustainable stands would be difficult and expensive on these acres. The larger fuels could persist for 50 to 100 years. This fuel loading would eliminate the use of prescribed fire without very expensive mechanical pretreatments. It would also create a fuelbed that would support the spread of severe, stand-replacement wildfires. This in turn would increase the potential for soil damage occurring from burning of large, down fuels and the potential for establishment of non-native vegetation and noxious weeds (see Noxious Weeds section). As dead trees fell on these acres, they would damage some of the conifer regeneration. Such damage would limit its ability to develop LOS structure, and provide infection opportunities for insect and disease agents.
- Approximately 11,417 acres will be planted or naturally regenerated, and receive enough fuels treatment so that if maintained by underburning sustainable LOS stands would be expected to develop.
- The roughly 14,000 acres that burned with less than 50 percent vegetative mortality would develop as a mosaic of:

  - Residual overstocked patches,
  - Regenerated overstocked patches.
  - Moderate to heavy fuel loading,
  - Forested stand type that regenerated to shrub/grass vegetation with very few trees. These conditions would not be sustainable over the long term, though they could provide some habitat diversity.
- Plantation noncommercial thinning would occur on approximately 2,214 acres. This would reduce fuel hazard and accelerate development of LOS.
- Prescribed burning would occur on 2,450 acres, reducing fire hazard by reduction of ladder fuel and surface fuel component. This would also reduce costs for future stocking level control treatments.
- Aspen enhancement will occur on 690 acres of riparian aspen and 7 acres of riparian would have deciduous species planting. These treatments would increase habitat diversity within the project area.

Cumulative Effects of the Alternatives

Earlier parts in this section have described past activities that contributed to the creation of current conditions on National Forest System lands. Management on adjacent privately-owned forestlands has also contributed to the creation of current conditions within the Silver Creek and Silver Lake watersheds. Much of the project area is intermingled with these lands.

Timber companies own most of the acres of private land within and surrounding the project area. In recent history (before the 2002 fires), these lands had been intensively managed for timber production. The Toolbox Complex burned over much of these intermingled private lands. Following the fires, any merchantable size trees in areas that burned on these private lands were salvaged in the winter of 2002-2003. Planting has now started on the private land. Planting that has occurred so far on private land is much less dense that that done previously. It appears that at least some of the planting density is 200 trees per acre or less, so the future stands should be much less dense than in the past.

These private land activities are not expected to have an effect on efforts to restore forest vegetation on the adjacent National Forest System lands. Many of the private stands have been harvested to a degree that dead fuel is not the issue that it is on the National Forest System lands. A few private parcels belonging to non-industrial owners had much denser stands that were burned in 2002, and fuel hazard on those acres would be higher. But acres in that condition are in the minority. Alternative G would provide for a fuels treatment "buffer" around private lands that could address the issue of these adjacent fuels in the long term.

There is little concern that insect populations would build up on private land to a degree that would threaten vegetative communities on National Forest System lands. Most acres on private land do not have enough remaining large trees (that have not been salvaged) for this to be a significant issue.

There are three reasonably foreseeable vegetation management projects that are being planned on National Forest System lands close to the project area. These three projects—the Windmill restoration project, the Triad restoration project, and the West Fork Silver Creek restoration project—all involve a combination of understory thinnings, mechanical fuels treatments, and prescribed burning intended to promote the development of LOS stands by reducing stand densities and reducing the risk of stand-replacement fires. In addition, approximately 1,400 acres of prescribed burning under existing NEPA decisions (Retool North and South) is expected to occur in the Fall of 2003, if weather and other conditions are appropriate to conduct the burn. The predicted cumulative effect of these projects on vegetative conditions, when combined with the alternatives, would be to increase the development of LOS and sustainable forests across the landscape that encompasses the Toolbox project area. Appendix A, page 24, provides specific details by subshed regarding how much treatment is planned within each subshed.

Consistency with the Forest Plan and Other Regulatory Direction

All proposed activities analyzed in this Forested Vegetation section would be consistent with the Fremont National Forest Land and Resource Management Plan, as amended, and other direction listed in the Regulatory Framework for Forested Vegetation.

Specific Alternative Prescriptions

Proposed Stand Prescriptions:

The toolbox wildfire area vegetative mortality condition was mapped using a combination of aerial photo interpretation, post fire inventory plots, and ground verification of the aerial photo condition as of early September, 2002. The post fire aerial photo flight was flown in early September. Mapping was done in fire acre or larger units. For planning purposes the vegetation mortality condition was frozen at that point, even though additional mortality was noted later in the fall. Additional mortality is expected to occur in the next few years from a combination of fire cause and bark beetles. Bark Beetle, most mountain pine beetle, activity was present and increasing in the area prior to the fire. The post fire condition is expected to result in increased mortality in the partial burned areas. The prescription to be applied will be based on the stand condition at the time of treatment, not at the time of mapping.

The prescription treatment for these stands and designed to be applied to morality patches contained within the matrix of a live stand condition.

Toolbox fire spread primarily by spotting and then burned by ground fire with frequent torching, with some areas of underburning.

Factors applicable to all areas of conifer planting:

- Will not require planters to plant seedlings within 150 of an aspen plant greater than 5′ tall,
- Will require planters to pull or clip and seedlings planted within 50 feet of an aspen plant greater than 5′ tall.
- Will not plant within 50 feet of a riparian area
- Will not plant within 35 feet of an acceptable, live pine tree with at least 40% live crown
- Will not plant in the identified meadow encroachment areas. These areas are along edges of units and total 337 acres.

Restoration prescriptions in stands with less than 50% mortality:

There were several conditions where this occurred:

- Juxtaposition of ground vegetation conditions which protected the stand from more intensive spotting or direct fire activity. Stands located in a matrix of non-forested areas such as meadows, scabrock or grass/brush types were sometimes shielded from hotter fire activity or intensive spotting. Lighter spotting, especially towards the end of the daily burning period, sometimes resulted in less intensive burning and less stand mortality.

- Stands with a more mature, single story structure were less susceptible to mortality, and were generally underburned. Some patches of mortality did occur in this stand structure, often where the stands were

in tighter clumps, or had adjacent understory or larger brush. Stands on steeper slopes often suffered higher mortality.

- Toolbox/Silver Fires burned over many days with varying burning conditions. Some stands escaped heavier mortality because the fire passed through them at periods of less active burning, and more intensive reburn did not occur.

The underburning areas were:

- In stands which had previously had one or more past harvest entries followed by precommercial thinning and one to three times underburned, often very little conifer mortality occurred and most of the mortality is present in the grass/brush vegetation. Small clumps or individual trees were killed, but they will be retained for snag and future soil organic matter. Small clumps of mortality if only a few acres in size, and surrounded by a live stand, generally will not be salvaged and not planted. However small clumps along roads or in use areas may be salvaged and then planted if adequate seed source (other than white fir) for natural regeneration. Salvage will consist of removing trees with less than 20% bright green crown or 1/3 or greater bole scorch. The size of the trees to be removed will be dependent on the degree of deterioration present at time of logging. In these small, less than 10 acre openings, wildlife leave clumps will not be designated.

- Post treatment many of these areas have low susceptibility to stand replacement wildfire, especially where a good underburn occurred. However the large tree density of these stands most commonly is still high enough that individual trees are not vigorous enough to survive increased bark beetle attacks. If and where bark beetle activity increases increased mortality is expected in these trees. However due to the lower number of trees per acre in these stands, stand replacement mortality from bark beetles should not be likely.

The torching areas were:

- In stands which either had not had past harvest, precommercial thinning and fuels treatment or underburning. These stands had an intact fuels ladder and most burning was not truly a crown fire but a series of repetitive small torching burns which resulted in heavy mortality ranging from individual clumps to several acres or more. Small clumps of mortality if only a few acres in size, and surrounded by a live stand, generally will not be salvaged and not planted. However small clumps along roads or in use areas may be salvaged and then planted if adequate seed source (other than white fir) for natural regeneration. Salvage will consist of removing trees with less than 20% bright green crown or 1/3 or greater bole scorch. The size of the trees to be removed will be dependent on the degree of deterioration present at time of logging. In these small, less than 10 acre openings, wildlife leave clumps will not be designated. At the mapped morality condition it is estimated that 15% of these areas may be planted. Additional mortality may increase that estimate depending on the pattern of mortality.

Post treatment condition:

Overall the post fire and post treatment condition of these stands will be one of two conditions:

- These stands will have all merchantable trees removed that are outside of wildlife leave areas (see wildlife area for specifications) and have less than 20% bright green crown, or white fir with 1/3 or greater bole scorch.

- Reforestation by natural regeneration will occur in areas with adequate seed source, not including white fir, or where adequate natural regeneration from the soil seed bank has already developed. Ponderosa pine does not seed well at a distance greater than the tree height. Average tree height of mature ponderosa pine is 100′. The regeneration objective, from the Forest Plan, is 100 seedlings per acre. One a few mature, good seed producing, trees per acre would be adequate to naturally regenerate the area over time. Natural regeneration will occur post fire. However it will mostly occur immediately adjacent to live green trees, and create an excessive stocking condition, rather than make a significant contribution to restocking larger areas of mortality. If the stand has been harvested, is below minimum stocking of residual live trees, and not naturally regenerated at four years post harvest planting will occur in year five to meet the five year regeneration requirement.

- Planting prescriptions will be site specific and time specific. The objective will be 100 well distributed (over at least 80% of the stand) seedlings per acre that are expected to survive to maturity. Planting density will be adjusted to site conditions and designed for that objective. Plantation survival on these sites historically had often been 8-90% or better. But those seedlings were often planted the next spring after the previous activity. For the Toolbox project, seedlings are not available and have to be grown in the nursery. Also analysis and other activities need to occur prior to planting. The planting window, conditions that favor good survival is often short in this area, averaging six weeks for a given site. However yearly fluctuations are very wide. I estimate that initial planting will not be complete until spring of 2008. Each year post fire will allow for increasing establishment of competing surface vegetation to occur. Conifer seedlings compete very poorly against well-established grass and brush, and higher seedlings mortality will occur with an increase in competing vegetation. Hand scalping, up to 3′ by 3′ will occur as part of the planting operation, and remove immediately adjacent plants. However it will not greatly affect soil moisture loss from deeper established roots. Planting densities are expected to range between 50-200 seedlings per acre depending on these varying conditions. The higher numbers would occur only on sites with thick, well-established competing vegetation. That condition is only expected to occur in the last years of planting. The need for such a high planting density will be based on locally experienced mortality.

- In order to implement reforestation, site preparation to remove hazard trees may be necessary. Fire killed trees after a period of decay are a hazardous working environment. Consultation with Oregon OHSA will be used as a guide to how much site preparation to remove hazard trees will occur. In areas of site preparation, all dead standing trees outside of wildlife areas will be felled, lopped and scattered. Where concentrations of down material constitute a barrier to access planting spots additional treatment, either low ground pressure mechanical or burning activities will occur. This activities may include bunching, mastication (slashbuster or similar), roller-chopper, grapple piling, or yarding if a market develops.

- The residual stand not removed in the salvage efforts may have a profound effect on the future stand development in several ways depending on which scenario:

- If this material is completely felled and fuels treatment occurs sufficient to start accelerated deterioration of the woody material then the ability to use economical stocking level control methods and economical reintroduction of fire that can restore the sustainable process and function to this stand type.
- If site preparation activities occur only at a level to gain access to planting sites some acceleration of decay will begin, but in many cases additional mechanical fuels treatment activity will be necessary prior to reintroduction of fire, and while costs will be greater this treatment should be feasible without major damage to the planted stand.
- In areas where salvage only occurs, depending on the stand condition and size of material salvaged. A significant portion of the larger material may be removed. This affects the cost of future treatments, and longer term the source of longer-term resident heat, which leads to, increased mortality with future fire. Depending on the stand condition, if fuels are predicted to be less than 20-30 tons per acre, development of a future LOS stand may generally be possible. There will probably be patches of failure where heavier fuels exist.
- If no salvage, no fuels treatment and no site preparation occur, the stand condition developed will have poor chance of success of developing into a LOS stand. This is because of the difficulty of effective and economical stocking level control. Over time both the residual live stand and planted seedlings will produce a large amount of natural regeneration, and without the limiting factor of a natural fire return interval, will develop a stand condition similar to the area pre Toolbox/silver fires, with the addition of a significant fuel loading. Development of LOS trees will be very slow and difficult due to the understory competition. The risk of future mortality from future wildfires will be great.

- Future foreseeable treatments to develop a LOS stand condition will be necessary to maintain the desired open stand condition which is more sustainable and able to develop LOS stands in a relatively short period of time. Reforestation activities for this treatment will be designed to develop a low density tree stocking to meet the desired condition objectives. However one effect of a low density of seedlings is that those trees can start producing viable seed at a young age. Vigorous Ponderosa pine can produce viable seed as young as 10 years of age. Vigorous, low density ponderosa pine is expected to be producing natural regeneration by 20 years of age. Current existing plantations do not have this condition as the seedlings are under too much intertree competition to allocate energy to reproduction. This natural reproduction from young seedlings is expected to not expand much farther that the height of the mother tree, perhaps 15-30 feet. Also natural regeneration will predominantly occur immediately adjacent to remnant surviving trees.

Restoration Prescriptions greater than 50% mortality stands:

This condition most often occurred in stands which where thickly stocked with trees of many size classes, including many small sizes, although often old, trees or an old woody brush component, most often bitterbrush. These stands may have had several harvest entries in the past. But those harvest, and occasionally precommercial thinning activities, was not aggressive enough to reverse the effects of lack of fire in the stands for the last century.

The fire in these stands progressed either by spotting and torching or as a wind driven flaming front. The result is that very few areas are a partial burn or a mosaic at a small scale. Most of the burned areas have complete or nearly complete mortality as of fall 02. The areas without mortality are still in a highly stocked condition.

- These stands will have all merchantable trees removed that are outside of wildlife leave areas (see wildlife area for specifications) and have less than 20% bright green crown, or white fir with 1/3 or greater bole scorch.
- Reforestation by natural regeneration will occur in areas with adequate seed source, not including white fir, or where adequate natural regeneration from the soil seed bank has already developed. Ponderosa pine does not seed well at a distance greater than the tree height. Average tree height of mature ponderosa pine is 100′. The regeneration objective, from the Forest Plan, is 100 seedlings per acre. One a few mature, good seed producing, trees per acre would be adequate to naturally regenerate the area over time. Natural regeneration will occur post fire. However it will mostly occur immediately adjacent to live green trees, and create an excessive stocking condition, rather than make a significant contribution to restocking larger areas of mortality. If the stand has been harvested, is below minimum stocking of residual live trees, and not naturally regenerated at four years post harvest planting will occur in year five to meet the five year regeneration requirement.

- Planting prescriptions will be site specific and time specific. The objective will be 100 well distributed (over at least 80% of the stand) seedlings per acre which are expected to survive to maturity. Planting density will be adjusted to site conditions and designed for that objective. Plantation survival on these sites historically had often been 90% or better. But those seedlings were often planted the next spring after the previous activity. For the Toolbox project, seedlings are not available and have to be grown in the nursery. Also analysis and other activities need to occur prior to planting. The planting window, conditions that favor good survival is often short in this area, averaging six weeks for a given site. However yearly fluctuations are very wide. I estimate that initial planting will not be complete until spring of 2008. Each year post fire increasing establishment of competing surface vegetation will occur. Conifer seedlings compete very poorly against well established grass and brush, and higher seedlings mortality will occur with an increase in competing vegetation. Hand scalping, up to 3′ by 3′ will occur as part of the planting operation, and remove immediately adjacent plants. However it will not greatly affect soil moisture loss from deeper established roots. Planting densities are expected to range between 130-400 seedlings per acre depending on these varying conditions. The higher numbers would occur only on sites with thick, well established competing vegetation. That condition is only expected to occur in the last years of planting. The need for such a high planting density will be based on locally experienced mortality.

- In order to implement reforestation, site preparation to remove hazard trees may be necessary. Fire killed trees after a period of decay are a hazardous working environment. Consultation with Oregon OHSA will be used as a guide to how much site preparation to remove hazard trees will occur. In areas of site preparation, all dead standing trees outside of wildlife areas will be felled, lopped and scattered. Where concentrations of down material constitute a barrier to access planting spots additional treatment, either low ground pressure mechanical or burning activities will occur. These activities may include bunching, mastication (slashbuster or similar), roller-chopper, grapple piling, or yarding if a market develops.

- The residual stand not removed in the salvage efforts may have a profound effect on the future stand development in several ways depending on which scenario occurs:

    - If this material is completely felled and fuels treatment occurs sufficient to start accelerated deterioration of the woody material then the ability to use economical stocking level control

methods and economical reintroduction of fire that can restore the sustainable process and function to this stand type.

- If site preparation activities occur only at a level to gain access to planting sites some acceleration of decay will begin, but in many cases additional mechanical fuels treatment activity will be necessary prior to reintroduction of fire, and while costs will be greater this treatment should be feasible without major damage to the planted stand.

- In areas where salvage only occurs, depending on the stand condition and size of material salvaged. A significant portion of the larger material may be removed. This affects the cost of future treatments, and longer term the source of longer-term resident heat, which leads to, increased mortality with future fire. Depending on the stand condition, if fuels are predicted to be less than 20-30 tons per acre, development of a future LOS stand may generally be possible. There will probably be patches of failure where heavier fuels exist.

- If no salvage, no fuels treatment and no site preparation occur, the stand condition developed will have poor chance of success of developing into a LOS stand. This is because of the difficulty of effective and economical stocking level control. Over time both the residual live stand and planted seedlings will produce a large amount of natural regeneration, and without the limiting factor of a natural fire return interval, will develop a stand condition similar to the area pre Toolbox/silver fires, with the addition of a significant fuel loading. Development of LOS trees will be very slow and difficult due to the understory competition. The risk of future mortality from future wildfires will be great.

- Future foreseeable treatments to develop a LOS stand condition will be necessary to maintain the desired open stand condition which is more sustainable and able to develop LOS stands in a relatively short period of time. Reforestation activities for this treatment will be designed to develop a low density tree stocking to meet the desired condition objectives. However one effect of a low density of seedlings is that those trees can start producing viable seed at a young age. Vigorous Ponderosa pine can produce viable seed as young as 10 years of age. Vigorous, low-density ponderosa pine is expected to be producing natural regeneration by 20 years of age. Current existing plantations do not have this condition as the seedlings are under too much intertree competition to allocate energy to reproduction. This natural reproduction from young seedlings is expected to not expand much farther that the height of the mother tree, perhaps 15-30 feet. Also natural regeneration will predominantly occur immediately adjacent to remnant surviving trees.

Growth Projections of planted stand, with stocking level control maintained by fire or precommercial thinning, in a 100% mortality area using Growth Basal Area (Hall, 1987), example

Stand GBA\ 126

year	Trees/ac	DBH	BA/a	SDI	
2005	130	0.1	0.0	0	
2015	130	4.6	15.0	37	
2025	100	7.8	33.0	67	
2035	100	10	59	107	
2045	100	12.3	83	139	
2055	100	13.7	103	166	
2065	100	14.3	111.5	177	Commercial thinning, remove 50 Trees /ac
2075	50	15.8	68.5	105	
2085	50	17.5	84	123	
2095	50	19.0	98	140	
2105	50	20.2	112	155	
2115	50	21.3	124	169	Selection Harvest, remove 30 TA

Stand GBA\ 126

Growth Projections of planted stand, with stocking level control not maintained in a 100% mortality area using Growth Basal Area (Hall, 1987), example stand.

year	Trees/ac	DBH	BA/a	SDI
2005	130	0.1	0.0	0
2015	130	4.6	15.0	37
2025	100	7.8	33.0	67
	400	0.1	0.0	0
2035	100	10	58	106
	400	3	16	48
2045	100	11.85	77	131
	400	4.173	38	98
2055	100	12.9	90	150
	400	5.2	58	139
2065	100	13.2	94.9	156
Commercial thin 50 ta	400	5.5	66.3	154
2075	50	14.0	53.7	86
	400	6.4	88.0	193
2085	50	14.8	60	94
	400	7.1	111	232
2095	50	15.4	65	100
	400	7.7	130	264
2105	50	15.9	69	105
	400	8.0	138	278
2115	50	16.3	72	109
	400	8.4	153	301

Precommercial thinning of existing plantations:

Current condition:
There were approximately 5000 acres of plantations, generally in 20-40 acre units, scattered throughout the fire area. The effect of the fire on these plantations varied widely. The significant difference in the pattern of mortality in the plantations is that mortality areas were generally complete. Mortality within individual plantations is highly variable. Many plantations have complete mortality for ¼ to ½ of the plantation exposed to the hot side of the fire, and have no mortality in the rest of the plantation.

The existing plantations were most often planted at densities of 500-800 trees per acre. Most plantations had survival rates greater than 90% and were 15-20 years old. This resulted in tight thick young stands and individual tree growth rate had slowed due to competition. Some self-pruning of the lower branches had begun but most seedlings still have adequate lower branches to provide deer hiding cover.

The prescription for the live portions of the plantations is to precommercially thin using a density that will maintain, for a much longer period of time, the mule deer hiding cover qualities of the stand. Therefore a first stage thinning, leaving between 125-170 trees per acre, will be implemented with this project. This density will only slightly increase individual growth rates and will not alone be sufficient to move stands to an LOS condition. However this treatment will maintain existing growth rates and cover qualities much longer and at next precommercial entry the stand will be larger and more economical to treat than if this first entry thinning had not occurred.

Growth projection for thinned plantation

Stand GBA\ 126

year	Trees/ac	DBH	BA/a	SDI
2005	600	3	29.5	87
total	600	3.00	29.45	86.88
2015	120	6.5	27.9	61
2025	120	9.3	56.6	107
2035	120	11	82	144
2045	120	12.64	105	175
2055	120	13.8	124	201
2065	50	14.2	55.3	88
2075	50	16.2	71.9	109
2085	50	17.9	87	127
2095	50	19.3	101	143
2105	50	20.5	114	158
2115	50	21.5	126	171

Alternative A. no planting, all reforestation will be by natural regeneration. This will be highly successful in small areas where adequate seed trees are available and the standing dead trees do not provide too great a barrier to seed dispersal.

Alt	Harvest Ac	Fuels AC	Sitepre p AC	Est Planting ac, change w/need	Mature mort. without harvest	Future LOS sustainable acres, fuels + 50% SP	Planted Acres with high fuel loading, forested but not sustainable at that point.	Future forested, mod fuel loads, clumps of high stocking, est. based on 9/2002 mort levels	Future forested acres in non-forested condition.
A	0	0	0	0	29000	0		14,000	20,000

Reforestation Success will be limited.

Development of LOS stands will not be initiated by this alternative. Development of LOS or a sustainable forested condition will only occur from decisions and actions taken subsequent to this decision. Natural recovery to a sustainable forested condition would eventually occur, but could take several hundred years for some acres. For a sustainable stand to develop naturally another fire event will need to occur after much of the standing dead has fallen. Until the large amount of fuel is removed from the site, the restoration process will not begin. Naturally the only way this would occur is by fire or a very long decay process. The small material may decay within 20 years. The larger material may take up to 100 years. After 100 years Ponderosa pine regeneration should have started on most of the area, through a slow process of a new tree establishing within a few hundred feet (after the dead stand is down) producing seed and growing tall enough to disperse

the seed another few hundred feet and so on. Then either a natural or prescribed fire process returns the role of fire to the stand. Fire and bark beetle attacks regain their role in stocking level control, and a sustainable forest condition is restored.

Alternative C. Natural regeneration will be used where conditions are favorable and evidence of successful natural regeneration is occurring. Fill in planting will be used if needed.

Alt	Harvest Ac	Fuels AC	Sitepre p AC	Est Planting ac, change w/need	Mature mort. without harvest	Future LOS sustainable acres, fuels + 50% SP	Planted Acres with high fuel loading, forested but not sustainable at that point.	Future forested, mod fuel loads, clumps of high stocking, est. based on 9/2002 mort levels	Future forested acres in non-forested condition.
C	14441	10244	5301	20750	14559	12894	7856	14,000	1000

Planting is planned for understocked areas where natural regeneration is not occurring or adequate seed trees are not present. Implementation of the planned planting should be successful if funds are available in a timely manner.

		Net H-Ref with Fuels Treat	Net H-Ref w/o Fuels Treat	Non-H, Non-PL net ref est no siteprep	Non-H, Non-PL net ref est with siteprep optional	PL net ref est no siteprep	PL net ref est with siteprep optional	replant est.		
		8462	2045	4648	4301	332	938	4000	total	20726
2004	Siteprep				1000				Siteprep	1000
	Fuels								Fuels	0
	Plant								Plant	0
2005	Siteprep				3301				Siteprep	3301
	Fuels	3000							Fuels	3000
	Plant		2045	1458	1500				Plant	5003
2006	Siteprep								Siteprep	0
	Fuels	3974							Fuels	3974
	Plant	540		3190		332	938		Plant	5000
2007	Siteprep	0							Siteprep	0
	Fuels	1668							Fuels	1668
	Plant	5000							Plant	5000
2008	Siteprep							1000	Siteprep	1000
	Fuels								Fuels	0
	Plant	3102			2000				Plant	5102
2009	Siteprep								Siteprep	0
	Fuels								Fuels	0
	Plant				801			4000	Plant	4801
totals	Siteprep	0	0	0	4301	0	0	1000		5301
	Fuels	8642	0	0	0	0	0	0		8642
0	Plant	8642	2045	4648	4301	332	938	4000	Plant	24906

Success of Implementation of planting; High chance of success

In review of the alternative C schedule of activities, As long as the funding is available in the appropriate years, it is reasonable to assume that this proposal can be implemented successfully. The limitations on cutting hazard trees apply to approximately 6600 acres, (and the harvest acre component of that, 2045 can be site prepped 3-4 years after harvest if necessary). Accomplishment of 6600 acres of planting prior to development of hazard tree limitations has a high probability of success. There is some risk of obtaining the fuels treatment dollars needed to meet this schedule, but this schedule has more flexibility to shift from one type of planting area to another, to keep the program going.

Success of development of sustainable LOS from the planted stands; High chance of success.
The large amount of fuels treatment and site prep in this alternative facilitates a high probability of success. 6600 acres of future high cost fuels treatment needs, while dependent on budgets, could be achievable over a 10-year implementation period. At least a high proportion of it may be achieved. The risk of failure is highest in the case of a reburn on those acres. In which case the planting would be lost.

Alternative D

Alt	Harvest Ac	Fuels AC	Siteprep AC	Est Planting ac, change w/need	Mature mort. without harvest	Future LOS sustainable acres, fuels + 50% SP	Planted Acres with high fuel loading, forested but not sustainable at that point.	Future forested, mod fuel loads, clumps of high stocking, est. based on 9/2002 mort levels	Future forested acres in non-forested condition.
D	6367	5680	4830	20750	22633	8095	12655	"	"

		Net H-Ref with Fuels Treat	Net H-Ref w/o Fuels Treat	Non-H, Non-PL net ref est no siteprep	Non-H, Non-PL net ref est with siteprep	PL net ref est no siteprep	PL net ref est with siteprep	replant est.		
		4776	363	10004	4330	332	938	4000	total	24742.93
2004	Siteprep				1000		938		Siteprep	1938
	Fuels								Fuels	0
	Plant								Plant	0
2005	Siteprep	0		0	2000				Siteprep	2000
	Fuels	2776				0			Fuels	2776
	Plant		363	5000		0			Plant	5363
2006	Siteprep	0		0	1330				Siteprep	1330
	Fuels	2000							Fuels	2000
	Plant	1000		5004	0	0	0		Plant	6004
2007	Siteprep				0				Siteprep	0
	Fuels								Fuels	0
	Plant	3776			0	332	938		Plant	5046
2008	Siteprep							500	Siteprep	500
	Fuels								Fuels	0
	Plant				4330				Plant	4330
2009	Siteprep				0				Siteprep	0
	Fuels								Fuels	0
	Plant				0			4000	Plant	4000
										0
totals	Siteprep	0	0	0	4330	0	938	500	Siteprep	5768
	Fuels	4776	0	0	0	0	0	0	Fuels	4776
	Plant	4776	363	10004	4330	332	938	4000	Plant	24743

Success of Implementation of planting; this alterative offers the least chance of success.

In review of the alternative D schedule of activities, there is a high probability of failure of achieving the 5000 acres of planting in non-site prep areas in 2006. The sources of risk are a combination of funding needs (10,000 acres of planting in the first two year plus the site preparation costs for those years) and that a hazard tree situation may develop on some of those acres by 2006. This schedule provides very little flexibility in the planting program to keep the program going to achieve reforestation on a timely bases.

Success of development of sustainable LOS from the planted stands.. This alternative offers the least chance of success.
The large amount of acres without harvest, fuels treatment and site prep in this alternative decreases the probability of success in achieving sustainable LOS on a portion of the acres. The risk of failure is both due to the potential of initial failure to complete planting and the long-term high fuel loading on those acres. This alternative does create the largest backlog fuels treatment needs of any of the action alternatives. And because so many of the acres are not harvested they would be the most expensive acres, which could be a barrier to success. At least a high proportion of fuels treatment may not be achieved. The risk of failure is highest in the case of a reburn on those acres. In which case the planting would be lost.

Alternative E

Alt	Harvest Ac	Fuels AC	Site prep AC	Est Planting ac, change w/need	Mature mort. without harvest	Future LOS sustainable acres, fuels + 50% SP	Planted Acres with high fuel loading, forested but not sustainable at that point.	Future forested, mod fuel loads, clumps of high stocking, est. based on 9/2002 mort levels	Future forested acres in non-forested condition.
E	11490	6723	5330	20750	17510	9388	11362	"	"

		Net H-Ref with Fuels Treat	Net H-Ref w/o Fuels Treat	Non-H, Non-PL net ref est no siteprep	Non-H, Non-PL net ref est with siteprep	PL net ref est no siteprep	PL net ref est with siteprep	replant est.		
		5759	3042	6344	4330	335	943	4000	total	24752
2004	Siteprep				1000				Siteprep	1000
	Fuels								Fuels	0
	Plant								Plant	0
2005	Siteprep	3000			1530				Siteprep	4530
	Fuels								Fuels	0
	Plant		2500	2500					Plant	5000
2006	Siteprep	2759			1800				Siteprep	4559
	Fuels								Fuels	0
	Plant	500	542	3844		335	0		Plant	5221
2007	Siteprep								Siteprep	0
	Fuels								Fuels	0
	Plant	5000			0				Plant	5000
2008	Siteprep							1000	Siteprep	1000
	Fuels								Fuels	0
	Plant	259			4030		943		Plant	5232
2009	Siteprep								Siteprep	0
	Fuels								Fuels	0
	Plant				300			4000	Plant	4300
										0
totals	Siteprep	5759	0	0	4330	0	0	1000	Siteprep	11089
	Fuels	0	0	0	0	0	0	0	Fuels	0
	Plant	5759	3042	6344	4330	335	943	4000	Plant	24753

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Success of Implementation of planting Moderate to Low

In review of the alternative E schedule of activities, As long as the funding is available in the appropriate years, it is reasonable to assume that this proposal can be implemented successfully. The limitations on cutting hazard trees apply to approximately 9386 acres, (and the harvest acre component of that, 3042 can be site prepped 3-4 years after harvest if necessary). Accomplishment of 9386 acres of planting prior to development of hazard tree limitations has a moderate probability of success. There is some risk of obtaining the fuels treatment dollars needed to meet this schedule, but this schedule has more flexibility to shift from one type of planting area to another, to keep the program going.

Success of development of sustainable LOS from the planted stands. Moderate to LOW
The large amount of untreated in this alternative facilitates a low-moderate probability of success. 9386 acres of future high cost fuels treatment needs, while dependent on budgets, may not be achievable over a 10-year implementation period. At least a high proportion of it may be achieved. The risk of failure is highest in the case of a reburn on those acres. In which case the planting would be lost.

Alternative G

Alt	Harvest Ac	Fuels AC	Siteprep AC	Est Planting ac, change w/need	Mature mort. without harvest	Future LOS sustainable acres, fuels + 50% SP	Planted Acres with high fuel loading, forested but not sustainable at that point.	Future forested, mod fuel loads, clumps of high stocking, est. based on 9/2002 mort levels	Future forested acres in non-forested condition.
G	14419	11354	3580	20750	14581	13144	7606	8,404	"

		Net H-Ref with Fuels Treat	Net H-Ref w/o Fuels Treat	NON-H, NON_PL with buffer fuels	Non-H, Non-PL net ref est no siteprep	Non-H, Non-PL net ref est with siteprep	PL net ref est no siteprep	PL net ref est with siteprep	replant est.		
		8851	1638	2499	3290	3180	332	938	4000	total	24729.22
2004	Siteprep					1000				Siteprep	1000
	Fuels									Fuels	0
	Plant									Plant	0
2005	Siteprep	0				2180				Siteprep	2180
	Fuels	4500								Fuels	4500
	Plant		1638		3290					Plant	4928
2006	Siteprep	0								Siteprep	0
	Fuels	4351								Fuels	4351
	Plant	1500				2180	332	938		Plant	4950
2007	Siteprep			0						Siteprep	0
	Fuels			1499						Fuels	1499
	Plant	5000				0				Plant	5000
2008	Siteprep			0						Siteprep	0
	Fuels			1000						Fuels	1000
	Plant	2351		1499		1000				Plant	4850
2009	Siteprep								400	Siteprep	400
	Fuels									Fuels	0
	Plant			1000		0			4000	Plant	5000
											0
totals	Siteprep	0	0	0	0	3180	0	0	400		3580
	Fuels	8851	0	2499	0	0	0	0	0		11350
	Plant	8851	1638	2499	3290	3180	332	938	4000		24728

Success of Implementation of planting; Best chance of success

In review of the alternative C schedule of activities, As long as the funding is available in the appropriate years, it is reasonable to assume that this proposal can be implemented successfully. The limitations on cutting hazard trees apply to approximately 4928 acres, (and the harvest acre

component of that, 1638 can be site prepped 3-4 years after harvest if necessary). Accomplishment of 4928 acres of planting prior to development of hazard tree limitations has a high probability of success. There is some risk of obtaining the fuels treatment dollars needed to meet this schedule, but this schedule has more flexibility to shift from one type of planting area to another, to keep the program going.

Success of development of sustainable LOS from the planted stands; Best chance of success.
The large amount of fuels treatment and site prep in this alternative facilitates a high probability of success. 4928 acres of future high cost fuels treatment needs, while dependent on budgets, could be achievable over a 10-year implementation period. At least a high proportion of it may be achieved. The risk of failure is highest in the case of a reburn on those acres. In which case the planting would be lost.

Alternative H

Alt	Harvest Ac	Fuels AC	Sitepre p AC	Est Planting ac, change w/need	Mature mort. without harvest	Future LOS sustainable acres, fuels + 50% SP	Planted Acres with high fuel loading, forested but not sustainable at that point.	Future forested, mod fuel loads, clumps of high stocking, est. based on 9/2002 mort levels	Future forested acres in non-forested condition.
H	13031	9070	4695	20750	15969	11417	9333	14,000	"

		Net H-Ref with Fuels Treat	Net H-Ref w/o Fuels Treat	Non-H, Non-PL net ref est no siteprep	Non-H, Non-PL net ref est with siteprep	PL net ref est no siteprep	PL net ref est with siteprep	replant est.		
		7535	1950	5671	4295	332	938	4000	total	24719
2004	Siteprep				1000				Siteprep	1000
	Fuels								Fuels	0
	Plant								Plant	0
2005	Siteprep	0			2295				Siteprep	2295
	Fuels	4000							Fuels	4000
	Plant		1950	3000					Plant	4950
2006	Siteprep	0			1000				Siteprep	1000
	Fuels	3535							Fuels	3535
	Plant	0	0	2671		332	400		Plant	3403
2007	Siteprep	1500							Siteprep	1500
	Fuels								Fuels	0
	Plant	5000			0				Plant	5000
2008	Siteprep							400	Siteprep	400
	Fuels								Fuels	0
	Plant	1035			3595		538		Plant	5168
2009	Siteprep								Siteprep	0
	Fuels								Fuels	0
	Plant				700			4000	Plant	4700
										0
totals	Siteprep	1500	0	0	4295	0	0	400	Siteprep	6195
	Fuels	7535	0	0	0	0	0	0	Fuels	7535
	Plant	6035	1950	5671	4295	332	938	4000	Plant	23221

Success of Implementation of planting; Moderate to High chance of success

In review of the alternative H schedule of activities, As long as the funding is available in the appropriate years, it is reasonable to assume that this proposal can be implemented successfully. The limitations on cutting hazard trees apply to approximately 7621 acres, (and the harvest acre

component of that, 1950 can be site prepped 3-4 years after harvest if necessary). Accomplishment of 7621 acres of planting prior to development of hazard tree limitations has a moderately high probability of success. There is some risk of obtaining the fuels treatment dollars needed to meet this schedule, but this schedule has more flexibility to shift from one type of planting area to another, to keep the program going.

Success of development of sustainable LOS from the planted stands; Moderate to High chance of success.
The large amount of fuels treatment and site prep in this alternative facilitates a high probability of success. 7621 acres of future high cost fuels treatment needs, while dependent on budgets, could be achievable over a 10-year implementation period. At least a high proportion of it may be achieved. The risk of failure is highest in the case of a reburn on those acres. In which case the planting would be lost.

Bibliography

Amaranthus, Michael P. 2003. Soil Moisture, Native Revegetation, and Pinus Lambertiana Survival, Growth, and Mycorrhiza Formation Following Wildfire and Grass Seeding.

Arno, Stephen F. in Brown, JamesK.;Smith,Jane Kapler, eds. 2000. Chapter 5: Fire in Western Forest Ecosystems. In Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257p.

Barrett, James w., A record of ponderosa pine seed flight. Res. Note PNW-38 Portland, OR USDA Forest Service, Pacific Northwest Forest and Range Experiment station 1966 , 5p. In: Hobbs, Stephen D. Tesch, Steven D. Owston, Payton W, Stewart, Ronald E. Tappeiner II, John C., Wells, Gail E. 1992. Reforestation Practices in Southwestern Oregon and Northern California. Forest Research Laboratory. Oregon State University, Corvallis, Oregon.

Barrett, James W., 1983, Martin, Robert E. Wood, Donald C., Northwestern Ponderosa Pine and Associated Species., In: Burns, Russell M. tech comp. Silvicultural Systems for The Major Forest Types of the United States. Ag. Handbook No. 445. Washington DC: USDA Forest Service.

Burns, Russell M., tech comp. Silvicultural Systems for The Major Forest Types of the United States, , Ag. Handbook No. 445. Washington DC: USDA Forest Service 1983. 191 p.

Chiloquin Ranger District type 2 Review, Quick and Buckhorn fires. August 10, 1995,

Cleary, Brian D, Greves, Robert D, Hermann, Richard K. Regenerating Oregon's Forests, A guide for the Regeneration Forester, Oregon State University, School of Forestry, 1978, 287 pps.

Furniss, R.L. and V.M. Carolan. 1992. Western Forest Insects. USDA Forest Service.

Hall Fredrick C. Growth Basal Area Handbook, USDA Forest Service, Pacific Northwest Region, R6 Ecol 181b-1985.

Hall, Fredrick C. Expected Vegetation Responses of the Toolbox and Silver Fires, Silver Lake District, Fremont National Forest, January, 2003. 42 pps.

Hobbs, Stephen D. Tesch, Steven D. Owston, Payton W, Stewart, Ronald E. Tappeiner II, John C., Wells, Gail E. 1992. Reforestation Practices in Southwestern Oregon and Northern California. Forest Research Laboratory. Oregon State University, Corvallis, Oregon.

Hopkins, William E. 1979. Plant Associations of the Fremont National Forest. USDA Forest Service.

Hopkins, Bill, S.Simon, M.Schafer, and T.Lillybridge. 1992. Region 6 Interim Old Growth Definition for Ponderosa Pine Series. USDA Forest Service.

Hungerford, Roger D., William M. Frandsen, and Kevin C. Ryan. 1992. Heat Transfer Into the Duff and Organic Soil. USDA Forest Service. Intermountain Research Station. Intermountain Fire Sciences Lab. Missoula, MT.

Leiberg, J.B. 1899. Cascade Range and Ashland Forest Reserve and Adjacent Regions. Twenty-first Annual Report. Part II. Washington, DC. USDI – Geological Survey.

Lindeburgh, S.B. 1990. Effects of Prescribed Fire on Site productivity: A Literature Review. B.C. Ministry of Forests. Victoria, B.C.

McDonald, Philip M. and Gary O. Fiddler. 1989. Competing Vegetation in Ponderosa Pine Plantations: Ecology and Control.

Munger, T.T. 1917. Western Yellow Pine in Oregon. USDA Bulletin No. 418.

Pacific Northwest Region. 1993. A first Approximation of Ecosystem Health.

Pierce, Glenn. 2003. Random Samples – White Fir. USDA Forest Service.

Ryan, Kevin C. 1982. Techniques for Assessing Fire Damage to Trees. USDA Forest Service.

Sackett, Stephen S. 1984. Observations on natural regeneration in ponderosa pine following a prescribed fire in Arizona. *Res. Note RM-435*. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 8 p.

Shea, Ronald W. and J. Boone Kauffman. 1993. Effects of Prescribed Fire and Thinning Activities on Fuel Mass and Nitrogen Redistribution in Pinus Ponderosa Ecosystems of Central Oregon. Oregon State University, Dept. of Rangeland Resources. Corvallis, OR.

Scott, Donald W., Craig L. Schmitt, Lia H. Spiegel, *Factors Affecting Survival of Fire Injured Trees: A Rating System for Determining Relative Probability of Survival of Conifers in the Blue and Wallowa Mountains*., Blue Mountains Pest Management service center. BMPMSC-03-01, November 25, 2002, 66 pps.

Wagener, Willis W. *Guidelines for Estimating the Survival of Fire-Damaged trees in California*, Pacific Southwest Forest and range Experiment station, Berkeley, California. Misc. Paper No. 60, September, 1961.