

2007 Restoration Thinning Project Plan and Results

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Purpose of the Document

The 2007 Restoration Thinning Project Plan and Results document is intended to address multiple purposes. First, this document includes a brief overview about the restoration thinning program relative to the City's Cedar River Watershed (CRW) Habitat Conservation Plan (HCP). Second, it provides a brief overview of the restoration thinning candidate selection process. And finally, it provides a detailed summary of the restoration thinning work completed in 2007. This project plan is intended to function as an inclusive reference about the restoration thinning activities completed in the Cedar River Watershed in 2007.

1.0 Background – Restoration Philosophy

The focus of restoration should be towards restoring ecological functions and processes, which are dynamic in time, rather than seeking to restore a particular suite of ecological attributes that may be present at a specific point in time. In restoring a disturbed ecosystem, we seek creation of ecosystems that support and enhance natural ecological functions and processes, even though these are not always well understood. We need to be thoughtful and explicit about what ecological functions and processes we are attempting to restore (Chapin et al. 2004).

It is often difficult to measure the key processes and functions in the natural environment. Therefore, in our restoration efforts we try to provide, enhance or emphasize the components or attributes that we assume to be necessary to support particular processes or functions. In more specific terms, we can alter the current tree growing conditions through our restoration thinning efforts and expect that the 'restored' habitat will be utilized now and into the future. We anticipate that by manipulating attributes (e.g. prescribing different tree densities and tree spacing patterns) across the previously altered landscape we are facilitating opportunities for key processes and their associated functions (such as complex forest habitat) to occur (see the Upland Forest Habitat Restoration Strategic Plan, 2008, for a more detailed discussion).

1.1 HCP Commitment

The writers of the HCP intended the restoration thinning program to address those areas within the CRW that had been harvested in the recent past (1970-present; approximately 30 year old and younger trees). The 50-year HCP committed fifteen years of funding to implement the restoration thinning program, within which time at least 10,480 acres of restoration thinning will have been treated.

1.2 Restoration Thinning Goals and Objectives

Upland restoration thinning is the thinning of dense second-growth forest areas generally less than 30 years of age that have relatively low biological diversity and are in or approaching the competitive exclusion successional stage of forest succession. The overarching goal of restoration thinning is to accelerate the development of complex habitat in the near-term and late-successional and old-growth forest conditions in the long-term. More specific objectives of restoration thinning include:

- reduce competition among trees;
- increase light penetration;
- stimulate tree growth;
- increase tree and understory plant species diversity;
- reduce long-term fire hazard;
- minimize the chance of catastrophic windthrow, insect, or disease outbreak;
- accelerate forest development past the competitive exclusion state to a more biologically diverse stage, and/or;
- extend the stand initiation period such that more diverse species and stand structures become established.

2.0 The Restoration Thinning Candidate Pool

In order to identify remaining restoration thinning candidates, a new system was developed in 2006 that incorporated remote sensing image data and a landscape-scale prioritization scheme. Approximately 6000 acres had already been treated with restoration thinning to date, and there was a need to better identify and

prioritize the remaining acres. This section describes how the restoration thinning candidate pool was created.

2.1 Identifying the Candidates

In 2006, the restoration thinning units were identified utilizing LiDAR data, which provides both ground surface imagery and vegetation surface imagery. The LiDAR ground surface model provides excellent topographic information, and when combined with the vegetation surface images it can provide information on average canopy height. Based on safety considerations, it was determined that the restoration thinning candidate pool would include stands of trees whose average canopy height was less than or equal to thirty feet (and greater than 3 feet tall to eliminate noise associated with the LiDAR data and shrubby areas). The LiDAR analysis identified that there was just over 12,000 acres in this pool, which is more than can be realistically treated by 2015.

2.2 Prioritizing the Candidates

Ecologists who work in the CRW have struggled with how to prioritize restoration activities. In other words, where should restoration activities occur first and why during the implementation of the 50-year HCP. A landscape-scale prioritization effort (the Landscape Synthesis Plan) was initiated by watershed staff in 2005 that facilitated the identification of high priority areas for restoration (Erckmann et al. 2008). The resulting GIS layer, called the Synergy Layer, identifies the highest synergy areas where there are overlaps among water bodies and their associated riparian areas, old-growth forests and high functioning second-growth forests, and special habitats such as wetlands, rock outcrops, and talus slopes.

The Synergy Layer was overlaid with the LiDAR derived restoration thinning candidate pool map (stands with 3-30 foot average canopy height), in order to rank the candidates and provide a means to prioritize among the previously identified 12,000 acres. Simply put, the restoration thinning unit ranked one has the greatest potential to provide important habitat improvement with appropriate restoration activities. However, the identified and prioritized candidate pool did not incorporate current conditions, so stand exams have been conducted in the lowest numbered candidates in order to provide real stand data. Practically speaking, all of the candidates under number 100 may be considered for restoration thinning, and a large portion of those will actually be thinned depending on their current conditions (e.g., tree density, tree sizes, species composition, patchiness).

2.3 Sequencing Restoration Thinning with Road Decommissioning

The HCP road decommissioning program focuses on removing roads in the CRW that are determined to be unnecessary for current or future operations as well as removing roads that cause sediment contributions to water bodies. Coordinating restoration thinning activities with the road decommissioning program is necessary to implementing restoration thinning cost-effectively, efficiently, and safely. Prioritizing restoration thinning units in an area identified for road decommissioning makes better sense than decommissioning the road and sometime in the future requiring the contractor to walk the decommissioned road to access the restoration thinning unit. Some of 2007 restoration thinning units were selected to compliment road decommissioning planned for 2008.

3.0 Objectives for 2007 Restoration Thinning

As in years past, the ecological objectives for restoration thinning include: accelerating the forest development pathway through the stem exclusion stage, maintaining or increasing the growth rate of trees, facilitating future recruitment of large diameter snags and coarse woody debris, increasing plant species diversity, protecting special habitats, and protecting water quality. The prescriptions for 2007 restoration thinning treatments continue to focus on these ecological objectives and include these additional objectives:

- Designing and implementing restoration thinning treatments to provide for varying forest stand structures and development pathways;
- Minimizing continuous slash loading adjacent to older RT units;
- Installing a second restoration thinning trial experiment which investigates individual tree and understory response to spacing variations (the first restoration thinning trial experiment was installed in 2005);
- Treating slash in different ways to address City and stakeholder concerns;

- Providing connectivity/proximity to old growth and special habitats;
- Minimizing habitat fragmentation;
- Minimizing sediment production through road decommissioning and restoration.

3.1 Phases of 2007 Restoration Thinning Work

2007 Restoration thinning was designed as three phases for contract advertisement and work completion and consisted of twenty-six units totaling 662 acres. Phase One included of five units totaling 130 acres, all units occurring in lower elevations or on south slopes that were accessible first and required no additional field layout or field review by specialists. Phase Two consisted of seventeen units totaling 494 acres, while Phase Three consisted of four units totaling 38 acres. Phase Two and Phase Three included those units that required more specific field review, layout and/or had snow that delayed access. Additionally, Phase Three had seasonal timing restrictions and was advertised and implemented last. The units varied in size from 2 acres to 61 acres. The majority of the 2007 restoration thinning work occurred in the upper watershed with only one unit occurring in the lower watershed. Table 1 provides 2007 restoration thinning information regarding unit numbers, phases of work and sub-basin location.

Table 1. 2007 Restoration Thinning Phases with Unit Locations

Unit #	Acres Planned	Acres Completed	Sub-basin location	Phase
1.1A, 1.1B, 1.2 (Imagine)	40	10	Main stem Cedar River	1
14.1	15		Roaring Creek	1
25	31		Upper Cedar River	1
37	21		Roaring Creek	1
66.2	23		Rack Creek	1
4.1	38		Lost Creek	2
4.21	21		Lost Creek	2
4.22	4		Lost Creek	2
4.23	3		Lost Creek	2
4.3	3		Lost Creek	2
5.1	31		McClellan Creek	2
5.21	9		McClellan Creek	2
5.22	28		McClellan Creek	2
11.11	36		Goat Creek	2
11.12	50		Goat Creek	2
21.1	27		Roaring Creek	2
21.2	61		Roaring Creek	2
28.1	39		Roaring Creek	2
66.1	53		Rack Creek	2
87	21		Seattle Creek	2
91.3	15		Lost Creek	2
20.3	2		Rex River	3
20.4	6		Rex River	3
30.1	25		South Fork Cedar	3
36	5	5	North Fork Cedar	3

3.2 Work Planning

A project team included Forest Ecology staff (Stan Pasin project lead, Amy LaBarge, Rolf Gersonde) and Fish and Wildlife staff (Bill Richards), who analyzed stand exam data from proposed restoration thinning units and developed management objectives and prescriptions. Expertise and input was sought from the Forest Hydrology group (Dave Beedle, Todd Bohle) and Fish and Wildlife group (Heidy Barnett, Sally Nicholson) to guide prescription development. Once the work packages for each phase were complete, they were reviewed by key staff, and the project team worked to incorporate those comments. The reviewed and adjusted work packages were then advertised and awarded to restoration thinning contractors in the established vendor pool.

4.0 Unit Summary

This section provides the following information specific to each unit:

- Unit history and context;
- Site specific objectives;
- Prescriptions, which include information on species preferences, thinning treatments, skips, gaps, planting and slash treatment;
- Post-treatment results.

Note that for the most part the prescriptions are written in future tense, as they were to be implemented, while post-treatment results are written in past tense.

Unit maps are included for each 2007 restoration thinning unit in Appendix A. An example of a 2007 restoration thinning contract is included in Appendix B. 4.1 includes site recommendations for wetland habitats.

4.1 Phase One

Bids were awarded on June 12, 2007 for Phase One units.

Unit 1.1A, 1.1B, and 1.2 (Imagine) (40 acres)

location: lower watershed

Unit History and Context

The area was initially harvested in approximately 1920 and it is assumed trees were allowed to regenerate naturally. A commercial thinning occurred in 1986, when the stand was roughly 66-years-old. The commercial thinning objective was to remove the suppressed and poor quality trees as well as spacing out the remaining trees with the intention of a future harvest (the basal area target is unknown). The area underwent a variable retention regeneration harvest (called the “Imagine” unit) in 1994, when the stand was 74-years-old. This harvest prescription required part of the stand to be left in thinned wedges. However, the thinned wedges suffered significant blow-down after the harvest, and salvage of the blown down trees occurred where the trees were accessible from existing roads. The area was planted with Douglas-fir and western redcedar in 1995. Western hemlock naturally regenerated. In 2006, staff collected data on trees per acre, diameters and species composition the Imagine area, as shown in Table 2.

Table 2. Imagine Unit 2006 pre-treatment information*

Type	Trees per acre
Total number of trees	10,077
Western hemlock, 6” dbh or smaller	9,747
Douglas-fir, 5” dbh or smaller	187
Western redcedar, 3” dbh or smaller	127
Red alder, 2” dbh or smaller	16

*sample information: Twelve plots were measured. Three of the twelve had 1 or 2 western redcedar, 9 of the 12 had 1 to 3 Douglas-fir, 2 of the 12 had 1 red alder, and all plots had 8-15 western hemlock.

Site Specific Objectives:

1. Reduce competition among conifer tree species to maintain/increase growth rates.
2. Increase residual tree species diversity.
3. Reduce the dominance of western hemlock and retain a mix of Douglas-fir, western redcedar, deciduous tree species, and hemlock in the understory.
4. Maintain and increase the growth rate of all deciduous tree species to increase overall biodiversity on the project site, as well as to provide the potential for future development of gaps in otherwise continuous coniferous forest overstory.
5. Promote tree species diversity (both conifer and deciduous), structural diversity (in the form of different stand densities with retained skips, and different thinning intensities), habitat diversity, and wildlife species diversity on at least the short term, and potentially, long-term scales.
6. Improve soil productivity by leaving all nitrogen-fixing alder and calcium accumulating big-leaf maple.

Prescription

Species Preferences - To address the objectives above, all hemlock are to be cut unless needed to meet spacing requirements if no other species are available to retain as leave trees. All cedar are to be left except if found in clumps, then the clumps are to be thinned to one dominant cedar to give that individual room to grow. All alder will be left to enhance soil productivity and to provide future gaps in the stand when the alder matures and dies. All other deciduous tree species will be left to enhance wildlife diversity and improve soil productivity. Deciduous tree species will be ignored for spacing purposes. All western white pine, if found, will be left for species diversity and to retain blister rust resistant individuals and will be ignored for spacing purposes.

Thinning - The Douglas-fir will be retained when found and spaced from other trees with a thinning prescription. The tree spacing will vary based on the following: north (sub-unit 1.1B) and southwest (sub-unit 1.1A) corners of the unit to 18' x 18' spacing (134 tpa) and the interior (sub-unit 1.2) to 15' x 15' spacing (194 tpa). The residual overstory trees left in aggregated wedges as part of the 1994 harvest treatment will be left and spacing will be measured from these overstory trees where they are present.

Slash Treatment –Slash lopping of a 100' area along the most heavily traveled road (70 road) is required (5 acres). This lopping, it is hoped, will accelerate decomposition and minimize the fire hazard.

Skips - A 50' uncut strip will be retained adjacent to the spur roads, where most alder currently are found. These uncut strips will provide higher tree density patches with a relatively high density of red alder, especially near the road side. This area will eventually leave a gap in the stand when the alder mature and die (60-100 years). Alternatively, if species other than alder (e.g., hemlock) are growing, the area will have longer lasting skips. Two 100 foot diameter skips will be left in conifer dominated areas of subunit 1.2 to provide for conifer skips. These skips are intended to promote different stand structures than roadside skips dominated by deciduous trees.

Planting/Gaps/Road Decommissioning - The spur roads that extend into the unit will eventually be decommissioned, allowing these areas to develop into hardwood patches. The rock that was hauled in for the road base may be removed as a part of decommissioning. Once this decommissioning is done, these areas will be planted with big leaf maple. No additional gaps will be provided within the unit (**NOTE:** Since this unit was not completed in 2007, and comments had been received from the Muckleshoot Indian Tribe, the prescription was amended to include gaps and corridors between gaps with lopped slash. That work was planned and implemented in 2008).

Post-Treatment

This unit was not completed in 2007. It was to be the last unit completed in 2007 due to its low elevation and presumed year-round access. However, Ramirez Reforestation was unable to complete this unit in December of 2007 due to persistent low elevation snow. An estimated 30+ acres of this 40 acre unit were completed in 2008.

Unit 14.1 (15 acres)

Unit History and Context

Unit 14.1 was clear-cut logged by a USFS contractor around 1982 and apparently planted with Douglas-fir about 1983 (planting information unavailable). It is surrounded by older forest on the north, east, and west sides, and is on a south facing exposure. Elevations range from 3200 to 3700 feet above sea level. Pre-treatment information for this unit is presented in Table 3. In addition to Douglas-fir, western hemlock, and Pacific silver fir, western white pine and western red cedar were observed in this unit. Scattered vine maple is found throughout the unit.

Table 3. Unit 14.1 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	688
Western hemlock, 1-3" dbh or smaller	125

Douglas fir, 0-4" dbh	500
Silver fir, 0"	63

*sample information: four plots were measured.

Site Specific Objectives:

1. Provide additional space for the shade intolerant Douglas-fir to grow on this hot, dry, south facing slope.
2. Retain less common conifer and deciduous species.
3. Retain and develop structural complexity.

Prescription

Species preferences - No deciduous tree species and no western white pine will be cut; these species will be ignored for spacing purposes. The deciduous trees will provide gaps when they mature and die and will improve soil productivity in the meantime. The hardwoods will also provide a diverse environment for wildlife. Although not many are present, all western red cedar (wrc) will be retained when found, except if found in clumps. The wrc clumps will be thinned to one dominant cedar to give that individual room to grow. Other species which are less than 6" dbh, are within the spacing distance and are less than twice the height of the wrc will be cut. If these rules do not apply, the wrc will be ignored for spacing purposes (it will be retained, but not given additional room to grow) and the other larger species will be thinned according to the regular spacing.

Thinning - The tree spacing will be 15' x 15' (194 trees per acre) to provide the space needed for Douglas-fir to grow well.

Skips – A 10,000 square foot skip will be installed in the unit near the eastern unit boundary but a minimum of 50' away from the boundary. It will be 200 ft. north-south by 50 ft. east-west. A single large skip will be installed as opposed to numerous small skips because of the following: (1) the adjacent unit to the south was thinned to 13' x 13' in 1996 (258 trees per acre = relatively dense); (2) At 15 total acres, this unit is quite small; and (3) the unit is bounded by older forest on three sides. The approximate location of this skip is shown on the unit map in Appendix A.

Gaps – This stand has many small gaps, no additional gaps are needed.

Planting - All landings should be planted with mountain ash for wildlife and ground cover.

Post-Treatment

Six 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre. Compliance measured at each plot was at 100%. Some of the plots fell within natural gaps in this stand, bringing the actual trees per acre down to 158. The 200ft by 50ft skip was installed about 100 feet west of its prescribed location. This skip still performs its intended function as it was installed in a location with high tree density. The site specific objectives have been met with this treatment. Table 3.1 shows the resulting species distribution.

Table 3.1 Unit 14.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	158
Western hemlock, 0" dbh	8
Douglas fir, 0-6" dbh	75
Silver fir, 1-6"	67
Noble fir, 0" dbh	8

*sample information: six plots were measured.

Unit 25 (31 acres)

Unit History and Context

Unit 25 was clear-cut logged by a USFS contractor around 1984 and apparently planted with Douglas-fir in 1985 (planting information unavailable). This stand is fairly uniformly stocked. The dominant trees are well spaced Douglas fir that were probably planted. Western white pine was also observed in the area. Pre-treatment data for this unit is shown in Table 4. Unit 25 has older forest on the east and west boundary, second growth bordering to the north and a talus slope bordering on the south.

Table 4. Unit 25 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	1,938
Douglas fir, 0-5" dbh	563
Western hemlock 0-1" dbh	813
silver fir, 0-5" dbh	562

*sample information: four plots were measured.

Site Specific Objectives

1. Provide additional space for the shade intolerant Douglas-fir to grow on this hot, dry, south facing slope.
2. Retain less common conifer and deciduous species.
3. Retain and develop structural complexity.

Prescriptions

Species preferences - No deciduous tree species and no western white pine will be cut; these species will be ignored for spacing purposes. The deciduous tree species will provide a diverse environment for wildlife. Although not many are present, all western redcedar will be retained when found, except if found in clumps; the clumps will be thinned to one dominant cedar to give that individual room to grow. Other species which are less than 6" dbh, are within the spacing distance and which are less than twice the height of the western redcedar will be cut. If these rules do not apply, the western redcedar will be ignored for spacing purposes (it will be retained, but not given additional room to grow) and the other larger species will be thinned according to the regular spacing.

Thinning – The tree spacing will be 15' x 15' (194 trees per acre) to provide the space needed for Douglas-fir to grow well.

Skips - Three 100' diameter skips will be retained within the unit to provide within stand structural complexity. The approximate locations of the skips are shown on the unit map included in Appendix A.

Gaps - Because there are many natural gaps present in the area due to a talus area on the south side, the spur roads which will eventually be decommissioned and planted with hardwoods, landings that will be planted with Mountain ash, and small talus pockets and vine maple patches within the unit, the project team decided that no additional gaps are needed.

Planting - All landings should be planted with mountain ash and other deciduous species for wildlife and ground cover.

Post-Treatment

Eleven 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A. This stand was thinned to meet the target of 194 trees per acre. Compliance measured in this stand was 92% based on the quality calculation included in Appendix B. The plot calculation results below show 42 trees per acre higher than the target, which is due to the number of excess trees found on a few plots. The three 100ft diameter skips were installed in their prescribed locations. The site specific objectives mentioned above have been met with this treatment. Table 4.1 shows the post-treatment trees per acre by species.

Table 4.1 Unit 25 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	236
Douglas fir, 0-7" dbh	145
Western hemlock 0-4" dbh	64
silver fir, 3-8" dbh	27

*sample information: eleven plots were measured.

Unit 37 (21 acres)

Unit History and Context

This area was clear cut logged by a USFS contractor around 1984 and apparently planted with Douglas-fir in 1985. There are numerous natural gaps existing in this unit. Unit 37 has an 80 year old second growth stand south of the unit and older forest bordering on the remaining 3 sides. The unit is dominated by Douglas-fir, as shown in Table 5. Noble fir, western redcedar, and Pacific silver fir were also observed in the unit.

Table 5. Unit 37 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	1,750
Douglas fir, 0-6" dbh	1,438
Western hemlock 0-1" dbh or smaller	312

*sample information: four plots were measured.

Site Specific Objectives

1. Provide additional space for the shade intolerant Douglas-fir to grow on this hot, dry, south west facing slope.

Prescriptions

Species preferences - No deciduous tree species and no western white pine will be cut; these species will be ignored for spacing purposes. Although not many are present, all western redcedar will be retained when found, except if found in clumps; the clumps would be thinned to one dominant cedar to give that individual room to grow. Other species which are less than 6" dbh, are within the spacing distance and are less than twice the height of the western redcedar will be cut. If these rules do not apply, the western redcedar will be ignored for spacing purposes (it will be retained, but not given additional room to grow) and the other larger species will be thinned according to the regular spacing.

Thinning - The tree spacing prescription is 15' x 15' (194 trees per acre) to provide space for Douglas-fir to grow on this hot dry south west facing slope. Leave tree requirements are the same as for units 14.1 and 25 as conditions are very similar.

Skips - We left two 100 foot diameter skips (see unit map for the approximate location in Appendix A) to provide variable stand density.

Gaps - Natural gaps already exist with talus and other unit features. The project team determined that no additional gaps are needed.

Planting - All landings should be planted with Mountain ash and other appropriate species for wildlife and ground cover.

Post-Treatment

Seven 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A. This stand was thinned to meet the target of 194 trees per acre. Compliance measured in this stand was 96% based on the quality calculation included in Appendix B. The calculated trees per acre are

very close to the target. The two 100ft diameter skips were installed in their prescribed locations. The site specific objectives mentioned above have been met with this treatment. Table 5.1 shows the post-treatment trees per acre by species.

Table 5.1 Unit 37 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	199
Douglas fir, 1-9" dbh	150
Silver fir, 1-4" dbh	35
Noble fir, 0-6" dbh	7
Western hemlock 0-1" dbh or smaller	7

*sample information: seven plots were measured.

Unit 66 – General and sub-units 66.2 (23 acres thinning) and 66.3 (20 acres planting)

Unit History and Context

The unit was split into three sub-units, 66.1, 66.2, and 66.3. Unit 66.1 is implemented under Phase Two and totals 53 acres. Unit 66.3 was thinned under Phase One and totals 23 acres. Unit 66.3 may be planted at a future date and totals 20 acres. The portion of Unit 66 that is located below the 811 road in section 23 and about half way up the slope above the 811 road was apparently logged in 1989 and never planted. The portion in section 14 was apparently logged in about 1985 and planted with Douglas-fir below the 811 road and with Noble fir above the 811 road. Table 6 provides pre-treatment information for the entire unit.

Table 6. Unit 66 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	2,333
Douglas fir	211
Western hemlock	2,044
Western red cedar	67
Noble fir	11

*sample information: nine plots were measured.

Site Specific Objectives:

1. Conduct upland restoration thinning work before road decommissioning.
2. Plant poorly stocked areas to increase species diversity and stocking.

Prescriptions

For units 66.1 and 66.2

Invasive Species Management - Decommission work on the 811 road should address the Scots broom as well as potentially improving the road bed soil with a thick layer of mulch. The overall restoration of this road system should happen concurrently with the decommissioning work and will be better addressed with the restoration planting team.

Thinning Units - The restoration thinning prescription team divided the thinnable area into two units, divided by the 811 road. Due to the difference in elevations and resulting snow depths, area 66.2 will be contracted in phase I while 66.1 will be contracted in phase II after the snow melts.

Prescriptions for Unit 66.2 (23 acres)

Species Preferences - We will have a leave tree species preference of Douglas-fir, then noble fir, then other conifers. No deciduous tree species and no western white pine will be cut; these species will be ignored for spacing purposes. Although not many are present, all western redcedar will be retained when found, except if found in clumps; the clumps would be thinned to one dominant cedar to give that individual room to grow. Other species which are less than 6" dbh, are within the spacing distance and are less than twice the height of the western redcedar will be cut. If these rules do not apply, the western redcedar will be ignored for spacing purposes (it will be retained, but not given additional room to grow) and the other larger species

will be thinned according to the regular spacing. This preference will provide species diversity for the predominantly hemlock stand.

Thinning - Unit 66.2 will have a variable spacing prescription. Where Douglas-fir or noble fir are the leave trees the spacing will be 18 x 18 (134 tpa) to provide additional space for these shade intolerant species and all other species will be thinned to 15 x 15 foot spacing (194 tpa).

Skips – Because of the unthinned clumps left in the adjacent unit 66.3 and the clumpy nature of the stand, we decided that no additional skips were needed to provide stocking diversity.

Gaps - Gaps were considered; however this area is naturally patchy and does not appear to be in need of additional gaps in the main part of the stand.

Planting – Landings will be checked for the opportunity to plant some hardwood species, such as mountain ash, to provide wildlife benefits.

Post-Treatment

Eight 1/50th acre compliance plots were installed in unit 66.2 as shown on the unit map included in Appendix A. This stand was thinned with a variable spacing prescription described above. Compliance measured in this stand was 90% based on the quality calculation included in Appendix B. Compliance of the variable spacing by species was achieved by determining the number of trees to be left at each plot based on the required distance between the tree species on the plot. The calculated trees per acre are higher than the target due to the clumpy nature of the stand and excess trees left by the contractor. The site specific objectives mentioned above have been met with this treatment. Table 6.1 shows the post treatment trees per acre by species.

Table 6.1 Unit 66.2 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	225
Douglas fir, 1-6” dbh	69
Silver fir, 1-6” dbh	88
Western hemlock, 0-6” dbh	44
Western red cedar, 0” dbh	6
Noble fir, 1-2” dbh	6
Red alder, 0-2” dbh	12

*sample information: eight plots were measured.

Planting Prescriptions for Unit 66.3 (20 acres)

The sparsely stocked area below the 811 road (66.3 on the map in Appendix A) will be considered for restoration planting at a later date. This does not necessarily mean it will be planted; landscape and habitat variability will be considerations. If this area is planted, planting mixes to consider are a mix of hardwoods (alder in particular) and conifers such as rust resistant western white pine. Some of this area is talus and vine maple patches and is unplantable. Some of the area is covered with small dense clumps of conifers and some has sparsely stocked areas of conifers not needing thinning.

Slash Lopping in 2004 Restoration Thinning Unit (22 acres)

Unit History and Context

This area was restoration thinned in 2004 with no slash treatment. It consisted of a variety of age classes, species mixes, and sizes of trees. Following thinning it became apparent that slash treatment should be done on part of the area as the cut trees were larger and denser than anticipated.

Site Specific Objectives:

1. Reduce the fire hazard along core roads.
2. Reduce the chance of fire spreading into adjacent older forest.

3. Facilitate wildlife travel along streams.
4. Facilitate travel by wildlife between adjacent older forest and roads 521 and 500.4 and thinned areas.

Prescription

Lopping of thinning slash so that it is in contact with the ground will be required in the following areas:

1. Within 100 feet of the clearing edges of road 500.
2. Within 50 feet of road 521.
3. Between road 500.4 and the old growth south of the road.
4. Between road 500 and the old growth west of the road near the junction with road 500.4.
5. Within 50 feet of all other old growth.
6. Within 50 feet of all streams.

Phase Two (continue reviewing here)

Bids were awarded on August 28 and September 12 for Phase Two.

3.5.1 Unit 4 General (151 acres)

Unit History and Context

This area is located in the headwaters of Fish and Lost Creeks. It is bounded on the west side by two areas (13 and 44 acres) thinned in 2000 to 13' x 13' (258 tpa) with a 5.5" maximum cut diameter. There are older forests on the south and parts of the east side. There is a stand of second growth forest on the north side. A fringe of older forest on the south east corner separates this unit from a 44 acre unit that was thinned in 2006 to 12'x12' (303 tpa) and 17' x 17' (151 tpa). Unit 4 is a high ranking restoration thinning synergy area and is the highest ranked area remaining unthinned. It was apparently logged in 1984 and planted in 1985. Smaller Douglas-fir trees found in openings in area 4.1 appear to be planted trees. They average about 6 feet in height but don't look very healthy. It appears that this is too high in elevation for Douglas-fir to do well. This area contains a significant wetland complex in area 4.2 for which a detailed plan was developed.

The isolated smaller units (4.4 - 7 acres and 4.5 - 8 acres) identified by LIDAR to the east of the larger units will not be thinned and they will be identified as reserve units on GIS. The 4-acre unit identified as 4.6 on the map will also be left as an unthinned reserve because of the large diameter of most of the trees. Because of these smaller unit locations, and the restoration treatment activity around them, they will essentially be skips on the landscape and will help to provide diversity over the landscape.

Unit 4 2006 pre-treatment table provides information regarding trees present (table 7). Some Df and wrc were also observed in the stand but did not fall in the plots.

Table 7. Unit 4 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	1,286
Silver fir	1,100
Western hemlock	172
Noble fir	14

*sample information: nine plots were measured.

Site Specific Objectives:

1. Maintain/increase tree growth. Adjust thinning densities relative to aspect and moisture, with specific thinning densities for shade intolerant/tolerant species
2. Increase tree species diversity by retaining less common species, and cutting more of the common species

3. Increase understory plant diversity. Allow growing space for establishment and growth of understory plants and focus on higher potential for understory plant growth in moist spots and existing gaps
4. Protect & enhance special habitats (streams & wetlands). Maintain shade and relative humidity along these habitats and increase snow retention to improve hydrologic regime.

Prescriptions

The larger treatment area is divided into two areas for prescription purposes: 4.1 (east of the 860.1 road) and 4.2 (west of the 860.1 road.) The unit map is located in Appendix A.

3.5.2 Prescriptions for Unit 4.1 (38 acres)

Species Preferences - Because western red cedar and Douglas-fir were not observed in any of the pre-treatment samples for both units (which consisted of nine 1/100th acre fixed radius plots) and because noble fir was observed at a frequency of only 14 trees per acre, the leave tree preference will be noble fir, then Douglas-fir, then western hemlock and other conifer species. No hardwood tree species and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife. Although not many are present, all wrc will also be retained when found.

Thinning - Spacing will vary in the larger units east and west of the 860.1 road.

Unit 4.1 will have a variable spacing prescription of 14' x 14' (222 tpa) and 17' x 17' (151 tpa). The standard spacing will be 14'x14' but where a suitable Douglas-fir or noble fir is found, spacing will be 17' from the more shade intolerant Douglas-fir and noble fir.

Yarding corridor considerations (primarily in 4.1) included observations that the trees are larger on the edges of the sparsely treed corridors. "Erasing" these linear yarding features on the landscape over time is a goal. The prescription requires the thinner to fall surplus trees along the corridors perpendicular to the sparsely treed portion of the corridor. The prescription also requires the thinner to lop any of these trees that fall across the sparsely treed portion of the corridor so that the tree boles are in contact with the ground, following the standard lopping contract clause (note: contract in appendix B) . This lopping prescription is intended to create micro-environments within the sparsely treed yarding corridors which, over time, will improve soil conditions and growing conditions for the maturing forest. Because the yarding corridors are not natural, the prescription will not attempt to preserve the feature as a tree less, or sparsely treed gap.

Skips – One 60 diameter skip/acre will be left.

Gaps – One 60' diameter gap/ acre will be left in the 16 acre dense area east of the dashed line shown on the map.

Planting - Planting will not occur in the yarding corridors due to the vegetation already occurring (small trees and shrubs), current soil conditions, and evidence of mountain beavers. The thought is that over time, as the existing trees get larger, these unnatural linear features will disappear as their crowns grow over the corridors. Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment – None will be required because the material being cut along the roads is relatively small.

Other - The small wetland along the south east boundary of unit 4.1 (east of the 860.1 road near the southeast corner of 4.1) will over time have larger trees on the south edges because of the thinning prescription that encourages tree growth. The north side of this wetland is bordered by older forest. No additional planting in this area is suggested at this time.

Post-Treatment

Ten 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned with a variable spacing prescription described above. Compliance measured in this stand was 90.5% based on the quality calculation included in Appendix B. Compliance of the variable spacing by species was achieved by determining the number of trees to be left at each plot based on the required distance between the tree species on the plot. There were a few excess trees left on some plots and other plots that landed in sparse corridors. These plot count differences balanced each other out with an average number of trees per acre for the unit very close to the target. Compliance of the lopping within corridors was achieved by checking each corridor as they were crossed during plot grid travel between plots. There were initially several corridors noted without lopping complete. The contractor re-entered this unit to lop all slash within corridors as prescribed. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 7.1 Unit 4.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	235
Western hemlock, 0" dbh	5
Douglas fir, 0-1" dbh or smaller	10
Silver fir, 0-11" dbh	205
Noble fir, 0" dbh	5
Red alder 0" dbh	10

*sample information: ten plots were measured.

3.5.3 Prescriptions for Unit 4.2 (89 acres)

This unit is divided into three types of areas identified on the map as THIN (with gaps), GAPS (no thinning - only gaps), and RESERVE (No thinning or gaps). The THIN areas total 27 acres, the GAPS areas total 35 acres, and the RESERVE areas total 27 acres. The THIN area consists of 21 acres of thinning plus 6 acres of gaps within the THIN area. The GAPS area consists of 28 acres of unthinned areas plus 7 acres of gaps which are within the unthinned areas. Map in Appendix A.

Species Preferences – To increase the relative abundance of minor species, leave trees will be selected by species preference. Noble fir, Douglas-fir, and hemlock are the preferred species. Rare species, western white pine, all hardwood species and western red cedar will be left. Other species will be cut to retain minor species.

Thinning – We will thin all trees in “THIN” areas to 12’ x 12’ spacing, leaving approximately 302 trees per acre. This overall average spacing will end up below 302 trees per acre when the gaps are subtracted and should average about 223 trees per acre in a clumpy distribution. Fourteen gaps per acre (five 20’, five 30’, four 40’ diameter) will be created in the “THIN” area as flagged, (blue/pink glo flagging marks 20’ gap diameters, pink glo marks 30’ gap diameters, yellow/pink glo marks 40’ gap diameters) which will total an average of about 0.26 acre of gap area per acre.

Skips. No thinning will be permitted within 30 feet from major streams and wetlands or where flagged with blue/white flagging boundaries in the 27 acre RESERVE areas. Some of the reserve areas were designated based on the likelihood that they provide natural migration corridors for wildlife such as amphibians to move between wet meadow systems.

Gaps - Meadow features, rock areas, brush patches and decommissioned roads offer many gap features in and around the area west of the 860.1 road. In addition, variable size gaps, whose size has been randomly selected from three possible sizes, are installed in THIN areas as described above under thinning. Gaps will be created in “GAPS” areas at the rate of 3 gaps per acre, 30’ x 100’ in size in an E-W direction. This amounts to about 0.21 acres of gaps/acre within the GAPS areas for a total of about 7 acres of gaps. No thinning will be done outside these flagged gaps in the GAP areas. In gaps, **all** conifers will be cut or pulled out of the ground, regardless of species or size, except that hardwood species will be left in the gaps created in the GAPS areas as they do not intercept snow. The east-west oriented gaps in GAPS areas are

designed to increase the snow pack and late season snowmelt which will help provide water to maintain the wet meadow system. The gaps in THIN areas are designed to create a clumpy stand structure.

Gap centerlines are marked in advance by SPU with pink glo flagging in the two eastern GAPS areas, while the two western GAP areas are unmarked and gaps will be located there by the contractor. Location of gaps should take advantage of existing gaps.

Planting – Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment – All the slash in gaps will be lopped. Trees will be felled away from wet meadow openings to retain growing conditions favored by meadow forbs.

Post-Treatment

GAP Area

Three gaps per acre were installed in units 4.22 and 4.23 as prescribed. They are generally oriented in an East-west direction except in a few cases where they fit topography or spacing otherwise. Most of these gaps can be viewed by walking the decommissioned spur 860.1A toward the wetland meadow.

THIN Area

Nine 1/50th acre compliance plots were installed in the “THIN area” of this unit as shown on the unit map included in Appendix A. This area was thinned to 12 x 12 spacing leaving approximately 302 trees per acre. Also 14 gaps per acre were installed with the size distribution prescribed above. These gap centers were flagged in the field by SPU but many had to be moved so as not to overlap with adjacent gaps. Compliance measured in this stand was 95.7% based on the quality calculation included in Appendix B. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species. The resulting average of 256 trees per acre shown below is lower than the target due to occasional natural open areas within the stand. Table 7.2 Unit 4.2 “THIN areas” 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	256
Western hemlock, 0-6” dbh	50
Silver fir, 1-9” dbh	137
Noble fir, 2-9” dbh	69

*sample information: eight plots were used for these calculations. A ninth plot fell in a gap and was excluded from these averages.

Both Unit 4.1 and 4.2:

The following requirements will also help to provide species diversity in the stand that remains following thinning:

The streams, small wetlands and associated meadows (those not already delineated in Reserve areas) in both units have a standard prescription requiring leaving trees whose drip lines are over any part of the feature. Buffer widths and spacing or no spacing within buffers were discussed in depth at various times for the program as a whole with Dave Beedle, Todd Bohle, Heidi Barnett, Dwayne Paige, Sally Nickelson, and project team members. There is a sizable body of scientific work on these issues which was considered in the interdisciplinary discussion. Consensus was reached by these professionals and resulted in the buffer specifications used.

3.5.4 Unit 4.3. (3 acres)

Species Preference - A small unit (3 acres) which is identified as unit 4.3 is located within the decommissioned 860 road switchback. The priority for leave trees will be noble fir first, then Douglas-fir, then any other conifers. No hardwood tree species, wrc, and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife. This will help to provide species diversity in the stand that remains following thinning.

Thinning – This unit will have a prescription of 15 x 15 foot spacing (194 tpa) with a 6” maximum cut diameter limit.

Skips - One 60’ diameter skip per acre will be left.

Gaps – One 60’ gap per acre will be created.

Planting – Landings will be checked for the opportunity to plant some hardwood species, such as mountain ash, to provide wildlife benefits.

Slash Treatment – No slash treatment is needed for this isolated unit.

Post-Treatment

Three 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre. Compliance measured in this stand was 94.4% based on the quality calculation included in Appendix B. The calculated trees per acre are higher than the target due to the large number of trees larger than the thinning diameter limit. The 60ft diameter skips were installed as prescribed. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 7.3 Unit 4.3 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	350
Western hemlock, 7” dbh	25
Silver fir, 7-8” dbh	50
Noble fir, 7-13” dbh	275

*sample information: three plots were measured, one was a gap and therefore not included in the average.

3.5.5 Unit 5.1 (33 acres)

Unit History and Context

This unit was logged in 1985 and planted with nf in 1986. This unit is bordered on the west, north and east sides by older forest. The area south of this unit was thinned to 302 trees per acre (12’ x 12’ spacing) in 2005.

Unit 5.1 2006 pre-treatment table provides information regarding trees present (table 8). A few western hemlock (wh) and mountain hemlock (mh) were also observed in the stand but did not fall in the plots. This unit has very rocky soil with exposed rocks showing in many places. The stocking is very clumpy with most trees found in stringers between mostly non-stocked cable skid trails.

Table 8. Unit 5.1 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	1,250
Silver fir, 0-5” dbh	1,000
Noble fir, 3-6” dbh	250

*sample information: four plots were measured.

Site Specific Objectives.

1. Reduce competition.
2. Increase species diversity.
3. Provide some within stand stocking diversity.

Prescription

Species Preference - Noble fir will be the preferred species of choice for leave trees. Western and Mountain hemlocks, when found, will also be preferred over the predominant silver fir to increase species diversity. No hardwood tree species, and no wrc will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - Thin to 194 tpa (15' x 15') with a 6" maximum cut dbh. Anything larger than 6" dbh will be ignored for spacing purposes.

Skips - Three 100' diameter skips will be left for stocking diversity. Their approximate locations are shown on the unit map in Appendix A. An additional 60' diameter skip/acre will be left.

Gaps - One 60' diameter gap/acre will be created.

Planting - Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Disposal – No slash treatment will be required because the material being cut along the roads is relatively small.

Post-Treatment

Eleven 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre. Compliance was first measured in this stand to be 87.8% based on the quality calculation included in Appendix B. The contractor chose to re-work the deficient areas of this stand resulting in a new compliance quality of 95.1%. The calculated trees per acre are very close to the target. The 60ft diameter skips and gaps were installed as prescribed. The three 100' diameter skips were installed in the approximate locations shown on the unit map included in Appendix A. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 8.1 Unit 5.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	205
Silver fir, 0-7" dbh	195
Noble fir, 5-6" dbh	5
Western hemlock, 5-6" dbh	5

*sample information: eleven plots were measured

3.5.6 Unit 5.21, 5.22, 5.3 – General (50 acres)

Unit history and Context

The origin date of the upper part of this unit is approximately 1984, as a result of clear cut logging done in 1983 and the origin date of the lower part is approximately 1970, as a result of clear cut logging done in 1969. Because of differences in the areas above and below the 127.1 road, the area was subdivided into two sub units for prescription purposes. The area bordering on the west and north of 5.21 is older forest. The area on the east side is talus with older forest further east. The area south of 5.21 is subdivision 5.22. Unit 5.22 is bordered on the west by older forest, on the east by talus, large second growth and further east by older forest. The area to the south is an area thinned in 2005 to 302 tpa (12' x 12' spacing) and on the south of the most south easterly tip by a 12 acre reserve of larger second growth.

Unit 5.2 2006 pre-treatment table provides information regarding trees present (table 9).

Table 9. Unit 5.2 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	6,167
Silver fir 0-3" dbh	5,833
Mountain hemlock 0" dbh	334

*sample information: three plots were measured.

Site specific objectives

1. Create gaps in the forest around wet meadow habitat to retain deep pockets of snow which will feed the wet meadow system in the spring.
2. Reduce the stocking of the larger size lower part of the stand that is adjacent to the comparable stand thinned in 2005.
3. Protect and enhance wildlife habitat around the wet meadow by creating a matrix of thinned/unthinned forest immediately around the meadow.

3.5.7 Unit 5.21 (10 acres)

Prescription

Species preference - Noble fir will be the preferred leave tree species. Mountain hemlock and western hemlock, then Douglas-fir, will be next in preference over the predominant silver fir to increase species diversity. No hardwood tree species and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife. Although not many are present, all wrc will be retained when found and ignored for spacing purposes.

Thinning – The project team discussed whether or not to leave unthinned the area above the 127.1 road for now because it has a number of large rock areas spaced throughout it. We decided to go ahead and thin it to a spacing of 18 x 18 feet (134 trees per acre) to encourage huckleberry production. Rock areas are subtracted from the gross acreage to arrive at the thinnable pay acres. A six inch maximum dbh cut limit will be used.

Skips – We will leave one 60' diameter skip/acre to provide spatial diversity.

Gaps - We will create one 60' diameter gap/acre to create clumpiness.

Planting - Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment – No slash treatment will be required because the material being cut along the road is relatively small.

Post-Treatment

Six 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 134 trees per acre. Compliance was measured in this stand to be 90.5% based on the quality calculation included in Appendix B. The calculated trees per acre are only slightly higher than the target due to a couple excess trees on compliance plots. The 60ft diameter skips and gaps were installed as prescribed. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 9.1 Unit 5.21 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	190
Silver fir 0-6" dbh	190

*sample information: five plots were measured, a sixth plot was taken in a gap and not included in this average.

3.5.8 Unit 5.22 (28 acres)

Prescription

This area contains a wet meadow, which was reviewed by the CRW aquatic ecologist (Heidy Barnett). A site specific wetland prescription was developed complimenting the site plan developed by Heidy. The site plan is included in Appendix D. The plan for the area around the wetland requires a combination of thinned and unthinned areas surrounding the perimeter of the wet meadow. In addition, six gaps approximately 30' x 100' were laid out by SPU at Heidy's direction and will be cut by the contractor on the slope to the southeast of the meadow. These gaps were designed to increase the snow pack and pro-long the late season snow melt which will help provide water to maintain the wet meadow system. The final on the ground layout for this area is reflected on the contract area map (see Appendix A).

Encroaching trees within the wet meadow, mostly mountain hemlock, will be cut by SPU employees following a careful assessment.

Species preference - Noble fir will be the preferred leave tree species. Mountain hemlock and western hemlock will be next in preference followed by Df over the predominant silver fir to increase species diversity. No hardwood tree species, wrc, and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - The lower part of this area contains some larger diameter trees that are similar to the adjacent area below the 127 road that was thinned to 12x12 feet in 2005. To vary the tree density in this area a prescription of 17x17 feet spacing (151 trees per acre) was applied with a maximum diameter cut size of 6". We discussed not having a maximum cut diameter but decided that this would result in too much large slash. Leaving some of these oversize trees will result in denser spacing but will provide some variability with the rest of the unit where the trees are smaller.

Skips - We are leaving area 5.3 as an unthinned reserve and there are additional unthinned areas adjacent to this unit and adjacent to the wetland. In addition, one 60' skip/acre will be left unthinned.

Gaps -The contractor was required to mark and cut one 60' diameter gap/acre in the 5 acre area north of the dashed line shown on the map (see Appendix A). These gaps must be spaced apart by at least 50' and must be at least 50' from the unit boundaries and wetland. **All** trees, regardless of size or species, will be cut or pulled out of the ground in these gaps.

Southeast of the wet meadow, six 30' x 100' gaps were marked within which **all conifers** will be cut or pulled out of the ground, regardless of species or size. Hardwood species will be left in the gaps created in these areas as they do not intercept snow. The six 30' x 100' gaps are designed to increase the snow pack and pro-long late season snowmelt which will help provide water to maintain the wet meadow system. The 60' diameter gaps in the thinned area are designed to create a clumpy stand structure. These gaps will amount to about 1.1 acres total gap area in the subunit.

Planting - Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment - To reduce the fire hazard the slash will be lopped within 50' of the 127 road above the road, from where the 127 road enters the unit to the big switch back near the junction of the 127.1 and the 127.1A roads. In addition, all gaps will have the slash lopped. The total acres of lopping for the roadside strip, and all gaps in the unit and around the wet meadow, is 4 acres. All trees will be felled away from the wet meadow to protect growing conditions for meadow forbs.

Post-Treatment

Eleven 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre. Compliance was first measured in this stand to be 88.2% based on the quality calculation included in Appendix B. The contractor chose to re-work the deficient areas of this stand resulting in a new compliance quality of 96.8%. The calculated trees per acre are very close to the target. The 60ft diameter skips and gaps were installed as prescribed. The six 30' x 100' gaps were installed differently than the preliminary design. GPS locations and orientation of the six gaps were recorded and are shown on the unit map included in Appendix A. The site specific objectives mentioned above have been met with this treatment. The trees per acre measured in this stand is much higher than the prescribed spacing because there are so many trees larger than the maximum diameter limit set for the thinning. The following table shows the post treatment trees per acre by species.

Table 9.2 Unit 5.22 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	351
Silver fir, 3-14" dbh	328
Noble fir, 5-7" dbh	12
Douglas fir, 6-7" dbh	11

*sample information: nine plots were measured.

3.5.9 Unit 5.3 (12 acres) Reserve

This area of second growth is being left unthinned and will be entered in the GIS as a reserve. It borders some older forest on the south, some older second growth on the west, an area thinned in 2004 and some patchy brush areas on the north, some talus on the north east and some small older forest on the north east.

3.5.10 Unit 11 (141 acres) Sutton Lake Area- General

Unit History and Context

The portion of this stand located in section 15 was clear cut logged while in private ownership and has an origin date of approximately 1975 or earlier (trees were 32 years in 2007). The portion located in section 25 was also clear cut logged while in private ownership and has an origin date of approximately 1981 (trees were 26 years old in 2007). The part of this stand located in section 16 was clear cut logged while in National Forest ownership and has an origin date of 1984 (trees were 23 years old in 2007). The stand is surrounded by remnant older forest on much of the south and west sides and by a 2003 restoration thinned stand on the north side. Elevations range from about 3200 to 3800 feet.

There is considerable variation in size and density of the trees in different areas which is not explained entirely by the known logging history, but possibly by site class. Unit 11.1 2006 pre-treatment table provides information regarding trees present (table 10).

Table 10. Unit 11.1 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	5,800
Silver fir, 0-3" dbh	4,900
western hemlock, 0-3" dbh	700
Douglas fir, 4-5" dbh	200

*sample information: five plots were measured.

This unit has a very high synergy ranking, likely due to its proximity to Sutton Lake and adjacent old growth. This unit was divided into three parts with different prescriptions being applied to the parts (Appendix A).

Site Specific Objectives:

1. Provide connectivity/proximity to adjacent older forest, the thinned stand to the north, and special habitats such as the pockets of talus surrounded by brush.

2. Retain less common conifer species and deciduous tree species.
3. Retain/develop some structural complexity.

3.5.11 Unit 11.11 (39 acres)

Prescription

Species Preference - Preference will be given to leaving noble fir, Douglas-fir, and western hemlock, silver fir will have the lowest preference because of its dominance in the existing stand. No hardwood tree species, wrc, and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - This area will be thinned to 15 x 15 feet (194 tpa). A 6" dbh maximum cut limit will be used for both 11.11 and 11.12.

Skips - This stand is variable in stocking because of its logging history and different site productivity. Those areas having trees over the maximum dbh cut size will provide structural differences from those areas that are small enough to be thinned to the specified spacing. Because of the differences in tree sizes and density within the unit, much structural diversity will be naturally provided. Some areas have significant numbers of trees over the 6" maximum cut size so stocking will be denser than 194 tpa in these areas. In addition, one 60' diameter skip/acre will be left unthinned.

Gaps - One 60' diameter gap/acre will be created. All trees will be cut or pulled in these gaps, regardless of size or species.

Planting - Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment - Slash will be lopped in all of the gaps.

Post-Treatment

Ten 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre with a maximum cut limit of 6". Compliance was measured in this stand to be 92% based on the quality calculation included in Appendix B. The calculated trees per acre are higher than the target due to the number of trees that are larger than the maximum cut limit. The 60ft diameter skips and gaps were installed throughout the unit. The skips and gaps in the west end of the unit were placed slightly closer than prescribed due to the contractor not correcting for slope. This error was discovered and corrected before the east half of the unit was completed. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 10.1 Unit 11.11 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	260
Silver fir, 0-9" dbh	240
Douglas fir, 4-8" dbh	10
western hemlock, 0" dbh	5
Western red cedar, 1-2"	5

*sample information: ten plots were measured

3.5.12 Unit 11.12 (67 acres)

Prescription

Species Preference - Preference will be given to leaving Douglas-fir and noble fir and other conifer trees. Silver fir will have the lowest preference because of its dominance in the existing stand. No hardwood tree

species, wrc, and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning – This stand will be spaced at 13’x 13’ (258 tpa) with fourteen 30’ diameter gaps per acre spaced throughout the stand to create a clumpy distribution. A 6” dbh maximum cut limit will be used.

Skips - This stand is already very variable in stocking because of its logging history and different site productivity. Those areas having trees over the maximum dbh cut size will provide structural differences from those areas that are small enough to be thinned to the specified spacing. Because of the differences in tree sizes and density within the unit, much structural diversity will be naturally provided. Some areas have significant numbers of trees over the 6” maximum cut size so stocking will be denser than 194 tpa in these areas while 10’ x 10’ spacing along the stream in the Northwest corner of the unit will provide 436 tpa in this area. In addition, a 150’ x 450’ skip will be placed between the end of the 621.1B spur road and the ridge near the old growth corner in section 22 on about a SE bearing from the spur road. This skip is about 1.55 acres in size. This skip is intended to provide connectivity from one older forest patch to a broad ridge.

Gaps – Because of the large number of talus areas, brush patches, roads, decommissioned roads, and other non-stocked areas in the unit, a lot of natural gaps are present. Fourteen additional 30’ diameter gaps per acre will be laid out and cut by the contractor in unit 11.12 as described under thinning above. Gaps total 15.2 acres.

Planting - Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment – Fifteen acres of slash in the gaps will be lopped.

Post Treatment

Eighteen 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 258 trees per acre with a maximum cut limit of 6”. Compliance was first measured in this stand to be 87.4% based on the quality calculation included in Appendix B. The contractor chose to re-work the deficient areas of this stand resulting in a new compliance quality of 93.7%. The calculated trees per acre are higher than the target due to the number of trees that are larger than the maximum cut limit. The 30ft diameter gaps were installed throughout the unit at an intensity of 14 per acre. The skips were installed as prescribed. The location of the nine 100’ diameter skips and the 150’ x 450’ skip are shown on the unit map included in Appendix A. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 10.2 Unit 11.12 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	389
Silver fir, 0-8” dbh	210
Douglas fir, 2-6” dbh	43
western hemlock, 0-4” dbh	57
Western red cedar, 0-2” dbh	61
Noble fir, 2-7” dbh	18

*sample information: fourteen plots were measured, four additional plots in skips or gaps were not included in this summary

3.5.13 Unit 11.2 (35 acres) Reserve

The 35 acre area in section 21 (south west of the stand to be thinned) has generally smaller size trees and includes Sutton Lake and surrounding wetlands, an inner gorge area, and talus. No treatment is planned in

this area and it will be shown as a reserve in the GIS. Unit 11.2 2006 pre-treatment table provides information regarding trees present (table 11).

Table 11. Unit 11.2 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	15,750
Silver fir, 0-3" dbh	13,250
western hemlock, 0-1" dbh	2,500

*sample information: two plots were measured.

3.5.14 Unit 21 (193 acres) General

Unit 21 is subdivided into 4 sub areas for prescription and treatment purposes.

3.5.15 Unit 21.1 (36 acres)

Unit History and Context

This unit consists of two narrow fingers that run up and down the slope. The western lobe averaged 500 tpa and the eastern lobe averaged 2,125 tpa. Unit 21.1 2006 pre-treatment table provides information regarding trees present (table 12). That portion of 21.1 located in section 30 has an origin date of approximately 1985 (22 year old trees at time of restoration thinning) following clear cut logging under USFS contract. The portion in section 19 is assumed to have been logged about 1 year later, with an origin date of approximately 1986 (21 year old trees at time of restoration thinning), while under private ownership. This area has older forest flanking three sides. Units 21.2 and 21.3 border the north side. A 46 acre area that was thinned in 1996 to 300 tpa is located about 600 feet west from the west side of this unit.

Table 12. Unit 21.1 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	1,313
Douglas fir, 0-5" dbh	687
western hemlock, 0-4" dbh	500
Noble fir, 1" dbh	63
Western white pine, 2" dbh	63

*sample information: four plots were measured.

Site Specific Objectives.

1. Reduce competition
2. Increase species diversity by retaining less common conifer and deciduous species
3. Provide additional space for the shade intolerant Douglas-fir to grow on this hot, dry, south facing slope.

Prescription

Species Preference - Preference will be given to leaving Douglas-fir and noble fir. No hardwood tree species, wrc, and no wwp will be cut outside of gaps; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - Unit 21.1 will have a clumpy spacing prescription. The spacing will be 15' x 15' (194 tpa) with gaps as described below.

Skips - Ten 100' diameter skips will be left unthinned. The approximate location of these skips is shown on the map (Appendix A). The skip area equals about 1.8 acres.

Gaps - Fourteen 30 foot diameter gaps/acre will be installed and cut by the contractor. The gaps area equals about 0.23 acres.

Planting - Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment - Slash will be lopped in all of the gaps.

Post Treatment

Ten 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre. Compliance was measured in this stand to be 93.1% based on the quality calculation included in Appendix B. The calculated trees per acre are very close to the target. The 30ft diameter gaps were installed throughout the unit at an intensity of 14 per acre. The skips were installed as prescribed. The location of the ten 100' diameter skips are shown on the unit map included in Appendix A. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 12.1 Unit 21.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	175
Douglas fir, 0-6" dbh	131
Silver fir, 2-7" dbh	38
Western red cedar, 0" dbh	6

*sample information: ten plots were measured, plots in gaps were not included in this summary

3.5.16 Unit 21.2 (65 acres)

Unit history and context.

The western third of the unit has an origin date of 1986 (21 year old trees at time of restoration thinning) following clear cut logging while privately owned. The eastern 2/3 of the unit has an origin date of 1976 (31 year old trees at time of restoration thinning) following clear cut logging while privately owned. This unit is near the northern boundary of the watershed. Unit 21.2 2006 pre-treatment table provides information regarding trees present (table 13).

Table 13. Unit 21.2 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	1,428
silver fir, 0-4" dbh	1,357
western hemlock, 0" dbh	71

*sample information: seven plots were measured.

Site Specific Objectives.

1. Reduce competition.
2. Increase species diversity by retaining less common conifer and deciduous species
3. Provide connectivity along the stream between the old growth patch on the south and talus and old growth near the ridge.

Prescription

Species Preference - Preference will be given to leaving Douglas-fir and noble fir and other conifer trees with silver fir having the lowest preference because of it's dominance in the existing stand. No hardwood tree species, wrc, and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - This stand will have a variable spacing prescription. Where Douglas-fir or noble fir are the leave trees the spacing will be 18 x 18 (134 tpa) to provide additional space for these shade intolerant species and all other species will be thinned to 15 x 15 foot spacing (194 tpa) with a 6' dbh maximum cut diameter limit.

Skips - This stand is already very variable in stocking which will help to reduce the need for additional skips. Streamside buffers of 25' either side of the stream that runs through the unit will be left unthinned and 25' wide unthinned buffers will be left around talus/and associated brush areas which will serve as skips. In addition, one 60' diameter skip/acre will be left unthinned.

Gaps – One 60' diameter gap/acre, totaling about 4 acres, will be created in which all trees, regardless of size or species, will be cut or pulled from the ground.

Planting - Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment - All slash in gaps will be lopped.

Post-Treatment

Eighteen 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned with a variable spacing prescription described above with a maximum cut limit of 6". Compliance was measured in this stand to be 96.6% based on the quality calculation included in Appendix B. Compliance of the variable spacing by species was achieved by determining the number of trees to be left at each plot based on the required distance between the tree species on the plot. Since there were very few shade intolerant species, the calculated trees per acre best match the target of 194 trees per acre that was set for all other species. The 60ft diameter skips and gaps were installed throughout the unit according to the prescription. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 13.1 Unit 21.2 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	203
silver fir, 0-8" dbh	166
Douglas fir, 2-4" dbh	9
western hemlock, 0-7" dbh	23
Western red cedar, 0" dbh	3

*sample information: eighteen plots were measured, 4 of these plots in gaps or buffers were not included in this summary

3.5.17 Unit 21.3 (31 acres) - Reserve

Unit History and Context.

Unit 21.3 was clear cut logged while privately owned in 1985, the unit was allowed to regenerate naturally (no planting) and has an origin date of approximately 1986 (21 year old trees at time of restoration thinning). Stocking occurs primarily in clumps between the cable yarding corridors. The trees looked very lush and healthy when measured in August 2006. Because of the low density of stocking, **thinning is not being done at this time**. This unit is adjacent to the northern boundary of the watershed. Unit 21.3 2006 pre-treatment table provides information regarding trees present (table 14).

Table 14. Unit 21.3 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	500
silver fir 0-2" dbh	450
Noble fir 1" dbh	25
western hemlock 1" dbh	25

*sample information: four plots were measured.

3.5.18 Unit 21.4 (61 acres) – Future Thinning

This is a dense stand composed primarily of silver fir and mountain hemlock. Because it's northern and eastern boundaries are adjacent to The City's property boundary, thinning is being deferred until this

property line can be surveyed and marked. Unit 21.4 2006 pre-treatment table provides information regarding trees present (table 15).

Table 15. Unit 21.4 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	6,083
silver fir 0-3" dbh	3,500
western hemlock 0" dbh	167
Mountain hemlock 0-3" dbh	1,666
Western red cedar 0-2" dbh	750

*sample information: six plots were measured.

3.5.19 Unit 28.1 (42 acres)

Unit history and context.

Unit 28.1 is adjacent to unit 21.2 and is similar in tree size and density. The LiDAR boundary between 28.1 and 21.2 was adjusted to include that part of 28.1 north of the east/west ridge that connects the 155.5 road to the landing in the north east corner of the section to unit 21.2. White pine and Douglas-fir were observed in the unit, but did not occur on the four plots measured. Unit 28 2006 pre-treatment table provides information regarding trees present (table 16).

This unit is near the northern boundary of the Cedar River Watershed.

The portion of this unit in section 30 was clear cut logged while in National Forest ownership in 1984. The new stand origin date is approximately 1985 (trees were 22 years old at time of restoration thinning). The portion of this stand located in section 29 was clear cut logged while in private ownership in 1975. The new stand origin date is approximately 1976 (trees were 31 years old at time of restoration thinning).

Unit 28.1 is bordered on the north by unit 21.2, and is bordered by the 155.5 road on the south. The 155.5 separates this unit from older forest, on the southwest and a previously restoration thinned stand (treatment 1996) on the southeast. Unit 28.2 is east and adjacent to unit 28.1. Unit 28 is a high ranked synergy area, apparently because of it's proximity to older forest, some talus openings, and a small pond just west of the deconstructed road 155.5A which is outside the planned treatment areas.

Table 16. Unit 28 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	2,625
silver fir 0-5" dbh	2,500
Noble fir 1" dbh	63
Mountain hemlock 2" dbh	62

*sample information: four plots were measured.

Site Specific Objectives.

1. Reduce competition.
2. Increase species diversity by retaining less common conifer and deciduous species.
3. Increase spatial heterogeneity.

Prescription

Species Preference - Preference will be given to leaving noble fir then Douglas-fir. Silver fir will have the lowest preference because of it's dominance in the existing stand. No hardwood tree species, wrc, and no wwp will be cut; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - This stand will be thinned to 15 x 15 feet (194 tpa) with a 6" dbh maximum cut limit which will provide some variation from the adjacent unit 21.2.

Skips - One 60' skip/acre will be left unthinned.

Gaps – Because of the large number of talus areas, brush patches, roads, and other non-stocked areas in the unit, a lot of variability is naturally provided. In addition we will create one 60' diameter gap/acre.

Planting - Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment - All slash in gaps will be lopped.

Post-Treatment

Twelve 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to a target of 194 trees per acre with a maximum cut limit of 6". Compliance was measured in this stand to be 93% based on the quality calculation included in Appendix B. The 60ft diameter skips and gaps were installed throughout the unit according to the prescription. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 16.1 Unit 28.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	191
silver fir, 2-7" dbh	186
Noble fir, 3" dbh	5

*sample information: twelve plots were measured, 2 of these plots in gaps were not included in this summary

Unit 28.2 (41 acres) - Future treatment

This stand is a dense silver fir stand with mountain hemlock, western hemlock, noble fir and Douglas-fir also found. It was not inventoried in 2006. Because it's northern and eastern boundaries are adjacent to the City's property boundary, **thinning is being deferred until this property line can be surveyed and marked.** National Forest property signs were observed along the talus area in the NW corner of section 29 and at the corner of sections 19, 20, 29, and 30 so the USFS may have surveyed the line from this section corner to the North ¼ corner of section 29 to establish the south property boundary of the area logged from the end of the 155.5A road.

Unit 66.1 (53 acres) - North of the 811 road

Unit 66 history and context is located in the section of this report that covers Phase One - Unit 66. Unit 66.1 2006 pre-treatment table provides information regarding trees present (table 17).

Table 17. Unit 66.1 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	2,333
silver fir, 0-5" dbh	844
Western hemlock, 0-5" dbh	1,144
Douglas fir, 0-5" dbh	211
Noble fir, 1" dbh	11
Western red cedar, 0-1" dbh	67
Red alder, 1-6" dbh	62

*sample information: nine plots were measured.

Prescription

Species preferences. - No Western white pine, hardwood tree species, or western red cedar will be cut. Noble fir, then western hemlock, then Douglas-fir, then will be given preference for a leave tree over the abundant silver fir.

Thinning – The unit will be thinned to a of 15 x 15 foot spacing (194 tpa) with a 6” dbh maximum cut limit.

Skips – Three ½ acre skips will be installed by the contractor in the approximate location shown on the contract map. In addition, one 60’ diameter skip/acre will be left unthinned.

Gaps - Much of this area is naturally patchy, however, in addition, one 60’ diameter gap/acre totaling about 3 acres, will be created.

Planting - Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash treatment – Slash in gaps will be lopped.

Post-Treatment

Eighteen 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to a target of 194 trees per acre with a maximum cut limit of 6”. Compliance was first measured in this stand to be 79.7% based on the quality calculation included in Appendix B. This is unacceptable quality and the contractor was required to re-work the deficient areas of this stand resulting in a new compliance quality of 90.6% The 60ft diameter skips and gaps were installed throughout the unit according to the prescription. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 17.1 Unit 66.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	204
silver fir, 1-7” dbh	139
Western hemlock, 1-5” dbh	19
Douglas fir, 3-5” dbh	23
Noble fir, 1-8” dbh	23

*sample information: fifteen plots were measured, an additional three plots in skips and gaps were not included in this summary.

3.5.22 Unit 87 (21 acres)

Unit History and Context

This area was clear cut logged while in private ownership. Origin dates for this unit range between 1964 and 1974 (43-33 years old at time of restoration thinning). The unit is bordered by a gravel pit on the se corner adjacent to a small patch of older forest. The remaining unit boundary is adjacent to a 2002 restoration thinning area. Nearby on the south side is an “unthinned reserve” area of about 20 acres that was left for wildlife at our wildlife biologist’s request. The portion of the unit that borders the 6 acre unit on its south side and is bordered by the 610.1A1 and 610.1A2 roads is a very clumpy stand and is included in the reserve areas. All of the area to be thinned drains into Seattle Creek but a small portion of the reserve area on the east side drains into Goat Creek. Elevations range from about 3600 to 4200 feet above sea level.

This area was not inventoried in 2006 because of its low synergy rating. It had been passed over for thinning in 2001 because the trees were generally smaller than in the 2001 thinning areas but growth has now brought it to a good size for thinning. We were notified that many of the roads in the area are scheduled for decommissioning in 2008 therefore, from an operational stand point it makes sense to thin

this area in 2007. We were later notified that the Muckleshoot Indian Tribe is interested in keeping road 610.1A2 open to the landing on the knob.

Site Specific Objectives.

1. Reduce competition.
2. Increase species diversity.
3. Accomplish thinning before the access roads are decommissioned.
4. Leave some unthinned areas to provide diversity from the predominately thinned areas in the drainages.

Prescription

Species Preference - Preference will be given to leaving noble fir, then Douglas-fir, then western hemlock. Silver fir will have the lowest preference because of it's abundance in the existing stand. No hardwood tree species, wrc, and no wwp will be cut, if found; these species will be ignored for spacing purposes. The hardwoods will provide gaps when they mature and die and will improve soil productivity in the meantime. They will also provide a diverse environment for wildlife.

Thinning - This stand will be thinned to 16' x 16' (170 tpa) to create a difference from the surrounding thinned stands that were thinned to 15' x 15' (194 tpa) in 2001. This area will also have a 6" dbh maximum cut limit. This unit will consist of 3 wedges approximately 400 feet wide at the bottom and 80 feet wide at the top of the knoll near the end of the 610.1A2 road with unthinned areas in between the wedges and on both sides. The unthinned areas are being recorded as "reserves" in the GIS. The LiDAR system identified a small area near the north side of the 8 acre wedge, south of the 610.1A, road, which is taller than 30 feet in height. Some of this area will fall in the 8 acre wedge. Normally, these size trees would not be included in our planned thinning. Since we have a 6" dbh maximum cut tree size, this area will end up being denser than the 170 tpa specified elsewhere and will provide some structural diversity in this small area.

Skips - The area being left as a reserve (55 acres) around the thinned wedges will serve as a skip. No additional skips are being provided within the thinned wedges.

Gaps – Because of the large number of talus areas, brush patches, roads, rock pit, and other non-stocked areas in the immediate vicinity, the project team determined that no additional gaps are needed within the thinned areas.

Planting - Planting of mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment - None will be required because the material being cut along the roads is relatively small, the area is fairly isolated and doesn't receive a lot of traffic, and the road access will soon be eliminated when the roads are deconstructed.

Post-Treatment

Eight 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to a target of 170 trees per acre with a maximum cut limit of 6". Compliance was measured in this stand to be 96.1% based on the quality calculation included in Appendix B. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 18. Unit 87 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	187
silver fir, 2-11 dbh	181

Western hemlock, 6" dbh

6

*sample information: eight plots were included in this summary.

3.5.23 Unit 91 General

Unit History and Context

The portion of this unit that was logged in 1986 and has an origin date of approximately 1986 (trees were 21 years old at time of restoration thinning). Part of the south east facing slope is non-stocked, mainly because of talus or other non-plantable areas, part is sparsely stocked and needs no thinning, some has small clumps of overstocked trees that will be left as skips, and some is overstocked and will be restoration thinned. The large area that is not being restoration thinned is designated 91.1 (Appendix A). It provides a lot of variability and diversity on the landscape. Another similar area is shown as 91.5. The north east lobe of area 91.3 is adjacent to older forest on much of its north west and north sides. It also has a significant brush patch on the side north of the landing at the end of the 860.1 road and is adjacent to the sparsely stocked area 91.5 on the north east side. Unit 91.2 and 91.3 2006 pre-treatment table provides information regarding trees present (table 18 & table 19).

Table 19. Unit 91.2 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	2,100
silver fir, 0-6" dbh	800
Western hemlock, 0-2" dbh	700
Noble fir, 1-5" dbh	500
Western red cedar, 1" dbh	100

*sample information: five plots were measured.

Table 19.1 Unit 91.3 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	4,375
silver fir, 0-5" dbh	875
Western hemlock, 0-4" dbh	3,375
Douglas fir, 0" dbh	125

*sample information: four plots were measured.

Site Specific Objectives.

1. Conduct upland restoration thinning before road decommissioning.
2. Consider planting poorly stocked areas to improve species diversity and increase stocking.
3. Increase growing space differentially between shade intolerant and tolerant conifer species.
4. Complement stand structural diversity within the basin.

3.5.24 Unit 91.1 – (54 acres) - Planting

Prescription

Planting - The largest area within the LIDAR identified unit 91 is sparsely stocked (primarily the south east facing slope) and is designated as 91.1 on the map (Appendix A). This area is located on poor soils and was considered for restoration planting at a later date but is not a very good candidate for planting because of poor site quality, ground cover, and expected planting failures on this hot, dry, site. It contains some non-stocked areas with rocky soils, some small clumps of densely stocked conifers, and some sparsely stocked areas. If the non-stocked area and/or the sparsely stocked area are planted, planting mixes to consider are a mix of hardwoods (alder in particular) and conifers such as western white pine. Cherry, vine maple and other hardwoods are found in this area. We feel that this area is best left as is to provide some variation in stocking on the landscape.

3.5.25 Unit 91.2 (25 acres) Reserve

Although this area has some thinnable areas, it was decided to leave it unthinned for a reserve. It has no road access and is difficult to access. It will provide some variation on the landscape.

3.5.26 Unit 91.3 (15 acres)

Specific Sampling Information

This unit is bordered by older forest growth on the northwest corner and the southwest portion. Unit 91.1 borders it on the south east and east sides and unit 91.5 and 91.7 border it on the northeast portions. Harvest records indicate that this entire unit has an origin date of 1986 (trees are 21 years old at time of restoration thinning). Unit 91.3 2006 pre-treatment table provides information regarding trees present (table 19).

Prescription

Species Preferences

Douglas-fir and noble fir will be selected as leave trees where available. All western white pine, hardwood tree species, and cedar, when found, will be left and ignored for spacing purposes. This stand should end up being a mixture of many species following thinning.

Thinning –The project team decided to thin the Douglas-fir and noble firs to 18 x 18 foot spacing (134 tpa). This spacing is intended to benefit Douglas-fir and noble fir’s wider (longer) branching habits and intolerance to shade. All other species will be thinned to 13’ x 13’ (258 tpa). This prescription should complement structural and species diversity. The maximum dbh cut size will be 6”.

Skips – Because of the clumps of unthinned trees being left adjacent to this unit, it was decided that no additional skips were necessary.

Gaps – The project team determined that gaps were not warranted given the sparse spacing in adjacent areas identified for planting and also within the unit.

Planting - Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment – This is an isolated patch of fairly small size trees between a deconstructed road (811.2) and the end of the 860.1 and 860.1C spur so no slash treatment is considered necessary.

Post-Treatment

Six 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned with a variable spacing prescription described above with a maximum cut limit of 6”. Compliance was measured in this stand to be 90.9% based on the quality calculation included in Appendix B. Compliance of the variable spacing by species was achieved by determining the number of trees to be left at each plot based on the required distance between the tree species on the plot. Since there were very few shade intolerant species, the calculated trees per acre best matches the target of 258 trees per acre that was set for all other species. The presence of trees larger than the maximum cut limit, contribute to the calculated average trees per acre being higher than the target. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 19.2 Unit 91.3 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	283
silver fir, 1-7” dbh	183
Western hemlock, 0-8” dbh	33
noble fir, 3-6” dbh	25
Red alder, 1-2”	42

*sample information: six plots were measured.

3.5.27 Unit 91.4 (3 acres) - Reserve

This is a poorly stocked stand of small trees not needing restoration thinning at this time. It is seeding in from adjacent mature trees. It will be maintained as a reserve gap and recorded as such in the GIS.

3.5.28 Unit 91.5 (16 acres) - Reserve

This is a variable stand that has large patches of devils club, brush, sparsely stocked areas, and small clumps of dense conifers within it. This area is being left untreated and will be shown as a reserve area in the GIS.

3.5.29 Unit 91.6 (19 acres) Reserve

This area consists of talus, brush patches, cliffs, and older forest. This area is being left untreated and will be shown as a reserve area in the GIS.

3.5.30 Unit 91.7 (17 acres) - Reserve

This area was originally considered for thinning but after field review it was decided to leave it as a reserve. It has some patches of brush intermingled with the trees. Stocking of the trees varies from very dense to sparsely stocked. The area is inaccessible by road and is difficult to access.

3.5.31 300 Road Restoration Thinning Trial – (59 Acres)

Unit History and Context

The unit is located on a broad ridge separating the Cedar and Rex Rivers at 3200 feet elevation. Due to the size of the trees (> 30 feet tall) this area was not identified by LiDAR, and is not part of the restoration thinning candidate pool. Further inspection determined that the area appears ideal, however, to locate the second block of the restoration thinning adaptive management installation due to its relatively consistent stem density, composed primarily of western hemlock and Pacific silver fir and it's being located on gentle ground suitable for getting around easily for repeat measurements. The first installment of this experimental design was in 2005 with an installation on the Taylor Plateau. Three installations of this experimental design are planned, with the 300 Road Restoration thinning trial being the second installation. The trial will investigate the effect of uniform and clumped tree distribution on understory development as well as overstory growth response.

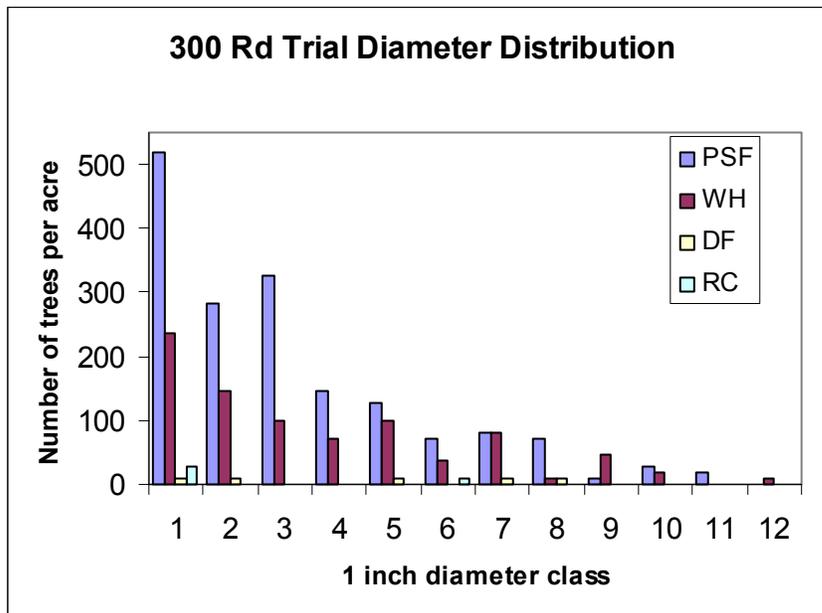


Figure: Diameter distribution of young stand in RT Trial area along the 300 Road prior to thinning. The 12 inch diameter class includes all trees 12 inch and larger.

Site Specific Objectives.

Treatments are assigned in a 2 X 2 factorial design with replication within the blocks. Density and spatial patterns were treatment factors, including untreated controls. Treatments were replicated and randomly distributed within the blocks. Treatment area was based on the size of the trees (edge effect) and spatial heterogeneity of the treatment. Given the current and expected tree size development as well as spacing and clumped distribution, treatment plots were assigned a minimum size of 0.4 hectare (1.0 acre), allowing for a 0.2 hectare sample plot (0.5 acre) and 10 meter buffer to the treatment edge. Each treatment was replicated at least three times in each block. The proposed treatment range included currently implemented spacing prescriptions (high and low density and untreated control) and spatial patterns of residual trees as uniform and clumped. This design addressed the assumption that clumped patterns with larger gaps between trees improve understory development, while uniform tree distribution maximizes tree growth on the residual trees.

Treatment Matrix

High density/uniform (H/U)	Low density/uniform (L/U)	Untreated control
High density/clumped (H/C)	Low density/clumped (L/C)	

Random block layout (example)

H/U	L/C	H/C	L/C	L/U
Control	L/C	H/U	L/U	Control
H/C	Control	L/U	H/U	H/C

Prescription.

Species Preferences - No preference will be given to any species. The largest tree will be selected for a leave tree, regardless of species. No diameter limit will be applied.

Thinning – A total of 53 acres will be thinned in 12 one acre study blocks and in areas surrounding the 18 blocks. Plot boundaries are flagged in the field with glo pink flagging and treatments were randomly assigned to the square plots. The thinning prescriptions are marked with white paper signs facing into the blocks with the identifying letter indicated on the signs. Thinning will be performed by the contract crew. Uniform thinning will be achieved by following a spacing prescription as follows:

- Thin the 3 one acre “A” sub-units to 12’ x 12’ spacing. (302 tpa).
- Thin the 3 one acre “B” sub-units to 16’ x 16’ spacing. (170 tpa).
- Thin the 3 one acre “C” sub-units to 13’ x 13’ spacing. (258 tpa).
- Thin the 3 one acre “D” sub-units to 10’ x 10’ spacing. (436 tpa).
- Leave the 3 one acre “E” sub-units unthinned.
- Leave the 3 one acre “F” sub-units unthinned.
- Thin the 41 acre area surrounding the 1 acre sub-units to 14’ x 14’ spacing. (222 tpa).

Stocking of high density plots (10x100) is 1,077 trees per hectare (436 TPA); stocking of low density plots(16X16) is 420 trees per hectare (170 TPA). The area outside the marked experimental units will be thinned to an average density of 222 trees per acre.

Skips –Three of the 1 acre blocks will be left unthinned to act as controls. Three additional 1 acre blocks will be left unthinned to provide a safety backup in case of errors in cutting and/or to serve as additional controls. The area is surrounded by unthinned second growth.

Gaps – Clumped distribution of residual trees is achieved by thinning the trees to the same plot density as under uniform spacing in 75% of the area and installing a number of small canopy gaps at irregular distances, covering 25% of the clumped treatment areas.

Slash Treatment - Thinning slash in all experimental thinned blocks and gap areas will be lopped to a maximum of 18 inches above the ground as provided in contract specification B1.7R. This will total 12 acres of slash lopping.

3.6 Phase III

Bids were awarded on October 10, 2007 for phase III.

Unit 9 (31 acres)

Note: unit 9 was not completed in 2007. Intentions are to complete thinning in unit 9 during the fall of 2008. Prescriptions will remain the same

Unit History and Context

Units 9 and 30 are located near each other and were clear cut harvest by Forest Service contractors in 1985. Planting records indicate these two areas were planted with Douglas-fir in 1986. Unit 9 2006 pre-treatment table provides information regarding trees present (table 20). Western red cedar, while not occurring on any sample plot, was also observed in this unit. This unit follows along the North fork of the Cedar River and the Cedar River proper at the junction of the two forks. An inner gorge is located along the rivers at the bottom of the unit in places. The stand adjacent to unit 9 on the northeast side was restoration thinned in 2004. A Marbled Murrelet nest site was identified in the older forest along the Cedar River on the south side of Unit 9 and a Northern Goshawk nest site has been active in older forest a little over a ½ mile east of Unit 9.

Table 20. Unit 9 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	667
silver fir, 3-6" dbh	67
Western hemlock, 0-5" dbh	250
Douglas fir, 0-8" dbh	350

*sample information: six plots were measured.

Additional Site Specific Objectives.

1. Consider the development of a streamside plan with recommendations from David Chapin, Aquatic Riparian Ecologist, and Dave Beedle, Hydrologist, for the areas along the north fork of the Cedar River and/or along the Cedar River. David Chapin and Rolf Gersonde field reviewed the area along the north fork of the Cedar River and decided that a specific streamside plan was not necessary since the area immediately adjacent to the Cedar River is being left unthinned.
2. Avoid disturbing marbled murrelets and northern goshawks in nearby older forest by limiting operations to non nesting periods. The operating season provided in the Habitat Management Plan is September 1 to April 1.
3. Develop treatments to discourage the proliferation of rodents that would attract predatory birds that might prey on the murrelets.

This unit was subdivided into three units: 9.1, 9.2, and 9.3. A map is provided in Appendix A. Unit 9.2 (10 acres) is a sparsely stocked portion that is being left unthinned, as a reserve, intending to provide spatial diversity on the landscape and undisturbed connectivity between the north fork of the Cedar River and an older forest above the 521 road. Unit 9.1 (16 acres) and 9.3 (5 acres) located on either side of 9.2, are being thinned.

Prescription (For units 9.1 and 9.3)

Species Preferences

Preference will be given to leaving noble fir, Douglas-fir, western hemlock, and silver fir, in that priority order, as leave trees.

Thinning

Thin to a spacing of 15x15 feet (194 trees per acre) leaving all alder, other deciduous tree species, wwp (if found), and wrc to create species diversity and to create future gaps when the hardwoods mature and die. Ignore these species for spacing purposes.

Skips – Leave one 60’ diameter unthinned skip/acre. The inner gorge area will be left unthinned and a 25’ buffer above the break will be thinned to 10’ x 10’. No trees will be cut if their drip line extends over the inner gorge.

Gaps – To discourage the proliferation of rodents that might attract predatory birds that might prey on the murrelets, no gaps are being installed.

Planting - Planting of Mountain ash or other suitable species will be considered for landings and deconstructed roads for wildlife purposes.

Slash Treatment – None provided.

Other – Operations will be limited to September 1-April 1 to limit disturbance to marbled murrelets and northern goshawks.

3.6.2 Unit 20 – (20 acres) General

Unit History and Context

This area was logged by USFS contractors in 1984 and apparently spot planted with noble fir in 1985. Unit 20 2006 pre-treatment table provides information regarding trees present (table 21). Most noble fir trees were observed in the portion of the unit designated as 20.1.

Table 21. Unit 20 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	2,063
silver fir, 0-5” dbh	2,063

*sample information: four plots were measured.

Site Specific Objectives

1. Conduct upland restoration thinning before road deconstruction takes place.
2. Protect the wetland in the middle of the unit.
3. Plant the very large non-stocked landing area with species that will benefit wildlife. Mountain ash is one species to be considered.
4. Avoid disturbing marbled murrelets in nearby older forest through seasonal operational restrictions.

The area was subdivided into four units. Unit 20.1 is a 10 acre area that is being left unthinned due to its sparse stocking in the center of the unit, because the north and exterior portions of the unit contains trees that are too larger in diameter, and because a 50’ unthinned buffer was suggested to be left around the wetland (area 20.2) following by Heidy Barnett, aquatic ecologist. The unthinned buffer around the wetland is intending to provide a connection between the wetland with the adjacent old growth/large second growth on either side. Unit 20.2 is the 2 acre wetland that is being left untreated. Unit 20.3 is a 2 acre area west of a small stream that flows from the wetland and unit 20.4 is a 6 acre area east of the small stream that flows from the wetland.

Prescription

Species Preferences - The standard preference for leaving wwp, hardwood tree species, and wrc will apply. Noble fir, then Douglas-fir, then western hemlock, and then silver fir will be left in that priority for leave trees.

Thinning – Following the recommendations of Heidy Barnett, aquatic ecologist, unit 20 is divided into four separate units with four varying prescriptions. Unit 20.1, the area above and around the wetland will be

unthinned because it is very open and clumpy near the landing with larger trees on the north side. Unit 20.1 includes leaving a 50 foot unthinned buffer below the wetland to provide opportunities for amphibian movement between the wetland and older forest on the east and west sides. The wetland is unit 20.2, and will receive no treatment. Unit 20.3 is below the wetland buffer that is west of the stream flowing out of the wetland has a spacing prescription of 14' x 14' (222 tpa). Unit 20.4 is below the wetland buffer and east of this stream has a spacing prescription of 18' x 18' (134 tpa). Unit 20.3 and 20.4 have different spacing prescriptions for variability.

Special Habitat Considerations – Protecting the wetland and related meadow and stream, as well as amphibian transportation are being addressed. Heidy’s recommendations for the wetland are being followed. (See above) Encroaching trees within the wetland may be cut by SPU employees after careful analysis, per Heidy’s recommendation.

Skips and Gaps – The area around the wet meadow (about a 50’ buffer on the lower (south) side) and all of the north side of the wet meadow is being left as a skip to provide unthinned connectivity to the older forest and larger second growth stands on both sides. Large gaps are present within the stand in the form of cable logging corridors, the landing and wet meadow in this unit.

Planting - The large landing may be a good candidate for planting with mountain ash because of its value to wildlife.

Slash Treatment – No slash treatment is planned for this small isolated area.

Post-Treatment Unit 20.3

Three 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to a target of 222 trees per acre. Compliance was measured in this stand to be 100% based on the quality calculation included in Appendix B. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 21.1 Unit 20.3 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	217
silver fir, 1-12” dbh	200
Western hemlock, 16” dbh	17

*sample information: three plots were measured.

Post-Treatment Unit 20.4

Four 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to a target of 134 trees per acre. Compliance was measured in this stand to be 100% based on the quality calculation included in Appendix B. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 21.2 Unit 20.4 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	163
silver fir, 4-16” dbh	113
Noble fir, 3-10” dbh	50

*sample information: four plots were measured.

3.6.3 Unit 30.1 (33 Acres)
Unit History and Context

Both units 9 and 30 were clear cut harvested by Forest Service contractors in 1985. They were planted with Douglas-fir in 1986. Unit 30 2006 pre-treatment table provides information regarding trees present (table 22). Western red cedar was also observed in this unit while traveling between plots. A marbled murrelet nest site was identified in the older forest along the Cedar River on the west side of the unit and a northern goshawk nest site has been located in older forest a little over a ½ mile east of unit 30.

Table 22. Unit 30 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	3,438
silver fir 1-3" dbh	188
Western hemlock 0-4" dbh	1,500
Douglas fir 0-6" dbh	1,688
Noble fir 1" dbh	62

*sample information: four plots were measured.

Additional Site Specific Objectives.

1. Develop a streamside plan with recommendations from David Chapin, Aquatic Riparian Ecologist, and Dave Beedle, Hydrologist, for the areas along the Cedar River. David Chapin and Rolf Gersonde field reviewed the area along the north fork of the Cedar River and decided that a specific streamside plan was not necessary since the area immediately adjacent to the Cedar River is being left unthinned.
2. Avoid disturbing marbled murrelets and northern goshawks in nearby older forest by limiting operations to non nesting periods. The operating season provided in the Habitat Management Plan is September 1 to April 1.
3. Develop treatments to discourage the proliferation of rodents that would attract predatory birds that might prey on the marbled murrelet.

Unit 30 was subdivided into two units: 30.1 and 30.2. Unit 30.1 (25 acres) will be treated, Unit 30.2 (8 acres) will be and unthinned reserve. A map of this unit is located in Appendix A.

Prescription for 30.1.

Species Preferences

Preference will be given to leaving Noble fir, then Douglas-fir, then western hemlock, then silver fir, in that order, for leave trees, in order to maximize species diversity.

Thinning - Thin to a spacing of 15x15 feet (194 trees per acre) leaving alder, other deciduous tree species, wwp (if found), and wrc to create species diversity and to create future gaps when the hardwoods mature and die. Ignore these species for spacing purposes.

Skips - The south portion of the unit, below road 521, will not be thinned. This unthinned area includes the talus and 8 acre patch of overstocked conifers that divides the talus thus leaving a skip and some gaps. The treated unit lies north of the end of the 521 road and east of the road using the interface with the talus slope as the boundary for the south end of the unit. In addition, four ¼ acre skips will be left in approximate locations shown on the map (Appendix A).

Gaps – No gaps will be provided since there are already significant areas of gaps in the talus areas and because we want to avoid creating conditions that would favor the proliferation of rodents that might attract predatory birds that might prey on marbled murrelets.

Planting - The large landing may be a good candidate for planting with Mountain ash because of its value to wildlife.

Slash Treatment – None prescribed

Other – Operations will be limited to September 1-April 1 to limit disturbance to marbled murrelets and northern goshawks.

Post-Treatment

Eight 1/50th acre compliance plots were installed in this unit as shown on the unit map included in Appendix A.

This stand was thinned to meet the target of 194 trees per acre. Compliance was measured in this stand to be 97.6% based on the quality calculation included in Appendix B. The calculated trees per acre are higher than the target due to the number of small cedar trees that are not to be cut. The four ¼ acre skips were installed in the approximate locations shown on the unit map included in Appendix A. The site specific objectives mentioned above have been met with this treatment. The following table shows the post treatment trees per acre by species.

Table 22. 1 Unit 30.1 2007 post-treatment information

Type	Average number of trees per acre
Total number of trees	325
silver fir, 0-6” dbh	38
Western hemlock, 0-6” dbh	69
Douglas fir, 0-7” dbh	118
Western red cedar, 0-2” dbh	100

*sample information: eight plots were measured.

Unit 36 (55 acres)

Note: Six acres of this 55 acre unit was completed in 2007. This six acres is the North-east polygon of this unit named 36.1 in the data. The remaining 49 acres was not completed in 2007. Intentions are to complete thinning in unit 36 during the fall of 2008. Prescriptions will remain the same

Unit History and Context

Harvest and planting history are unknown. Origin dates for this area vary between 1952 and 1979 (55-28 years at time of restoration thinning). Based on plot data collected in 2006, the trees in the unit are closer to 28 years (tree core sub-sample). Unit 30 2006 pre-treatment table provides information regarding trees present (table 22). The talus slopes vertically bisect the unit in three places. Unit 36 is bordered to the east and south by older forest.

Table 23. Unit 36 2006 pre-treatment information

Type	Average number of trees per acre
Total number of trees	6,500
silver fir 1-4” dbh	1,167
Western hemlock 0-5” dbh	4,500
Douglas fir 0-3” dbh	833

*sample information: three plots were measured.

Site Specific Objectives.

1. Protect the nearby northern goshawk nest site from disturbance during the nesting season.
2. Provide habitat protection for amphibians which may be found in the area.

Prescription

Species preferences. – Priority will be given to leaving Douglas-fir, then noble fir, then silver fir, then western hemlock, in this order of priority, for leave trees.

Thinning – Leave trees will be spaced to 13 x 13 foot (285 trees per acre) spacing.

Skips – Varying configurations of skips will be left. These skips consist of two 50’ wide skips that follow draws vertically and connect near the top of the unit, one 1 acre skip around a patch of hardwoods, four ¼

acre skips distributed throughout the unit, and two unthinned 25 foot wide buffers on the west side of two of the blocks separating talus from the thinning area. In addition, the east boundary is located on the inner gorge break and spacing is 10 x 10 feet within 25 feet of this boundary. These skips are intended to provide protection and relatively static climate and moisture conditions for travel and breeding of amphibians. These skipped areas also provide linear links to the North Fork of the Cedar River.

Gaps – One 60 foot diameter gap per acre will be placed by the contractor.

Planting - Planting of Mountain ash or other suitable species will be considered on landings for wildlife purposes.

Slash treatment – Slash in all gaps will be lopped.

Wildlife protection – An established northern goshawk nest site is within ½ mile of the most westerly part of the unit. A seasonal operational restriction limiting thinning work to after September 1 is required to minimize disturbance. .

Special habitats - The Larch Mountain salamander is a federal species of concern whose habitat is shady, moss covered talus slopes at low to mid elevations. Because of aspect, topography and hydrology, this area may be ideal for them. The thinning prescription will encourage development of larger trees adjacent to the buffers of the talus slopes. This prescription is intending to continue to provide a shady stable environment for the talus slope inhabitants.

Lessons Learned

Lessons learned refers to knowledge and experience gained relative to the 2007 Restoration Thinning work. There are two parts to lessons learned: 1. Internal ecosystems team lessons learned; and 2.) External hired contractor lessons learned.

Internal Ecosystem Team Lessons Learned

- Communication appears to be the key for creating a successful project. The project team model works effectively for the restoration thinning program; however, it is not the only communication mechanism that should be utilized. What was attempted in 2007 was to identify potential units, primarily based on road decommissioning intentions for 2008 within the Forest Ecology Group. After these units were identified, a larger meeting with folks from the Fish and Wildlife Group and Hydrology Group was held for the purpose of revealing where restoration thinning may occur in 2007, and to solicit the larger groups input from a basin and habitat sensitivity perspective. This larger meeting was followed by smaller project team meetings. At these project team meetings a more intensive look at the individual units was completed, and prescriptions were crafted. Where the project team determined that additional specialty information was needed, due to habitat features primarily, input was sought from CRW's resident experts. This expert input was incorporated into the prescriptions. The contract and prescriptions were then prepared for bid.
- Reviewing the decisions of the project team by the greater Ecosystems Group is an important step to success. In both 2006 and 2007, the review process created several problems. In 2006, because information was provided that only pertained to the prescriptions, and not what was considered leading up to the prescriptions, it was assumed by some on the larger Ecosystem Team that the project team had not done a thorough job, which resulted in a number of last minute prescription changes. In 2007, attempts to document all that was considered in formulating the prescriptions was initiated; however, due to mis-communication within the Forest Ecology group there were problems with what was sent to the Ecosystem Team for review. These problems resulted in contracting delays.
- Timing is everything. Thorough review takes time, and it is important to allow ample time, as appropriate, for this review to occur. Due to weather related access constraints the actual thinning and data gathering, in preparation for prescription crafting, has a relatively small operational window (May/June through October/November). As we gain more knowledge

about the complex forest ecosystem in which we operate, complexity is added to the restoration thinning prescriptions. The prescriptions are intending to respect that complexity (rather than simplify it).

- As we incorporate more complexity into the prescriptions, it can be difficult communicating what we intend the contractor to do in the contract language. It can be equally difficult to communicate what is expected on the ground. And there are difficulties in performing compliance sampling of atypical thinning prescriptions with typical compliance methods.

External Hired Compliance Contractor Lessons Learned

- Communicating the unit history and current objectives along with the thinning prescriptions to the compliance contractor will support better compliance decisions and help the contractor become more involved in assuring the desired outcome in each unit. With more background information at hand, the compliance contractor can make better recommendations for improvement to the compliance procedures based on the desired outcome of the project team.
- Plot data collection procedures were set up at the beginning of the 2007 compliance to conform to both proper inventory procedures and thorough thinning compliance. This concern was brought to attention by the contractor as some plots were landing in skips and gaps where spacing compliance did not apply. It was decided that for the purpose of the inventory, those plots would be retained and the plot grid not altered. For the purpose of tree spacing and quality compliance, an additional plot was added generally at a distance of one chain ahead on the plot line. After the compliance plot was recorded (#left, # of excess, etc.) then the contractor would proceed to the original plot grid. All of the plots on the original plot grid should be used in the inventory data since they represent an unbiased sample of the stand after treatment.
- Electronic data collection can be designed around the inventory system that will hold the data. Data collection can be done on the same machine used in the field to collect GPS points at each plot. This and other procedures can be set up for 2008 to streamline data transfer and improve efficiency.
- A separate compliance method to capture the quality of the skip and gap installations was suggested by the contractor and will be put in place for the 2008 compliance. The new method should include some measure of frequency, location, spacing, and lopping compliance.
- Flagging is often not used where a unit boundary is represented on the ground by a good physical boundary. There were a few cases where physical boundaries such as brushy areas or gentle slope breaks were used without flagging. In these few cases it could be seen on a map but very difficult for the thinning contractor to determine on the ground. If a boundary could be difficult to determine on the ground, it should be flagged. Also it should be confirmed by GPS or other means that the flagged boundary is in the same location as the mapped boundary.
- In units where skips and gaps are to be installed by the thinning contractor at a given spacing, that spacing should be included in the contract to avoid confusion. The spacing should be given in both per acre and lineal distance. For example, if a unit requires 14 gaps per acre of 30 foot diameter, it should also be stated as an example of distance between centers of 55.78 feet on a square grid. This would give the contractors a visual idea of how to install the gaps with about 26 feet between the edge of one gap to the next.
- It should also be noted that some thinning contractors are unaware of the need to correct for slope distance when laying out a grid of skips and gaps. In one of the 2007 units, skips and gaps in the west end of the unit were placed slightly closer than prescribed due to the contractor not correcting for slope. This error was discovered by the compliance contractor and corrected before the east half of the unit was completed. It should be mentioned in the prescriptions within the contract that the spacing is assumed in horizontal distance just as the area of a unit is.
- In units where the thinning contractor marks the location of skips and gaps, it is assumed that they will use the natural characteristics of the unit when deciding where to install a skip vs. a gap. This worked well in all units except one where there was a concentration of gaps installed in a low stocked portion of the unit. This action does not achieve the desired diversity built

into the prescription. We want to see gaps distributed throughout the unit, not concentrated where there is already natural gaps present. If there are areas similar to this (the Southern lobe of unit 4.1) they should be treated differently than the rest of the unit, or limit the number of gaps adjacent to other gaps. This same principal should be applied to skips.

Citations

Chapin, David; Antieau, Clay; Beedle; Dave; Boeckstiegel; Joselyn, Mark. 2004. Ecosystem Restoration and Management Philosophy for the Cedar River Watershed Habitat Conservation Plan. Science Information Catalog

Location of plot level data:

J:\SSW\ws541\secure\forest ecology unit\restoration thinning\2007 thinning\2007 rt data\2007 restoration thin compliance