A Management Plan For Two Stands of Timber Owned by the Wolf Family

by

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A MANAGEMENT PLAN FOR TWO STANDS OF TIMBER OWNED BY THE WOLF FAMILY

SYNOPSIS

The prescription presented covers two stands of timber, designated Stands A and B, owned by the Wolf family. The owners seek a management plan which will coordinate activities between the stands to yield a continuous flow of wood products and income.

Stand A

Homogenous 40-50 year old stand of Douglas-fir, intermixed with some grand fir, growing on approximately 10 acres of Site II land. The stand will be commercially thinned at 50 years of age (present age); thereafter at approximately 10 year intervals until Stand B is established and approaching commercial size. In approximately 30 years Stand A will be clear-cut. All thinnings and final harvest activities in Stand A will be done using the same logging methods. Directional falling of trees towards winching corridors will be used, with the trees being winched by crawler tractor to a skid road, to minimize damage to the soil. The falling will be done sometime before late summer, with the yarding activities to take place during the dry months of late summer. This will further reduce any possible damage to the

soil as well as minimize any erosion that might occur. Firewood material that can be economically removed will also be yarded at this time. The trees will then be skidded down to the main road (Bear Creek) for decking and hauling to the mill.

After the final harvest of Stand A, trees will be hand planted the following winter (≈ 350 trees per acre (TPA)), before the brush has a chance to reestablish itself. The only site preparation prior to this activity will be that which occurs during logging activities, such as knocking down of the brush and partial scarification of areas by dragging the logs across the ground during winching to the skid road. The second winter a replant will be carried out if the stocking level has fallen below 300 TPA. At three to ten years, if a high percentage of the planted trees are being overtopped, brush control will be carried out. A pre-commercial thinning will be done, at 10-15 years of age, when the trees are 10-15 feet tall, if natural regeneration has significantly increased the stocking level (≈ 425 TPA).

Once a new stand is established and fully stocked, the owners' objectives and desires will be reevaluated and future management decisions made at that point in time.

Stand B

Two storied stand of white oak consisting of scattered, large trees 200-300 years old of open-grown form and a majority of smaller trees, of narrow form, 75-100 years of

age. Underneath and growing up through these trees is an understory of Douglas-fir and grand fir seedlings, saplings and poles ranging in age from 1-30 years, with the majority 8-12 years old. Many brush species, grasses and other hardwoods are also present (see Plant Communities). Interspersed within this mixture are older (100-120 years) Douglas-fir and grand fir residuals and snags left from previous logging, which occurred about 30 years ago. The stand is growing on Site IV land and is approximately 25 acres in size.

Management activities will be carried out to improve the growing conditions for conifers while creating a more evenly spaced stand than presently exists. The stand will be pre-commercially thinned to approximately 350 conifers per acre while hand clearing of brush around established conifer crop trees will be done simultaneously during one pass through the stand. Those few portions of the stand which are primarily small scrub white oaks will be left as is, along with the few old, larger oaks, to maintain some diversity within the stand and enhance the wildlife habitat. The older conifer residuals and snags will be left for wildlife, because their merchantable value is small and it is currently uneconomical to remove them. The primary objective of these management activities will be to establish a vigorous stand of conifers.

Once these activities are completed, periodic surveys of the stand will be conducted to monitor the growth of crop

trees and determine when the stand has reached a commercial size.

When Stand B has reached a commercial size (≈7.5" diameter), a commercial thinning will be carried out (30-45 years from the present). Future commercial thinnings will be carried out as the leave trees reach a merchantable size. All thinnings will be from above with naturals or hand planted trees restocking the understory as the stand opens up. All commercial thinnings will be conducted using directional falling, winching of trees to predetermined skid trails (using old skid trails present in stand) and logging during the dry months to minimize damage to the soil. In this manner the stand will yield wood products and some revenue after the harvest of Stand A, meet the aesthetic desires of the owners and enhance the wildlife habitat, while maintaining a stand of conifers growing at all times.

INTRODUCTION

The Wolf family of Eugene owns 120 acres of timberland in the foothills southeast of Creswell, Oregon. A management plan, with emphasis being placed on long range goals rather than short term profits, is to be administered over several decades. The family seeks a continuous yield of forest products and a steady cash flow in perpetuity. The owners also desire any management of the land to maintain a high level of aesthetic and visual qualities. With these goals in mind, two stands of particular interest are examined and prescriptions for each are presented.

The two stands being examined, in this report, have been designated Stands A and B. Stand A (10 acres) is well stocked with Douglas-fir, intermixed with a few grand fir, 50-55 years old. Stand B (25 acres) was logged in the past and is now a mixture of brush, hardwoods, old grand fir and Douglas-fir residuals and snags, with a new stand of Douglas-fir intermixed with some grand fir coming up underneath, ranging from small seedlings to small poles approaching commercial size. The stocking level and age classes vary throughout the stand, with the majority of crop trees present in the 8-12 year old class.

The owners seek to coordinate the management of the two stands in order to meet their objectives. The final harvest of Stand A will not take place until Stand B is approaching

commercial size. Thus the owners' objectives of a continuous yield of wood products and financial return into the future should be met.

Owners' Motivation for Seeking a Management Plan

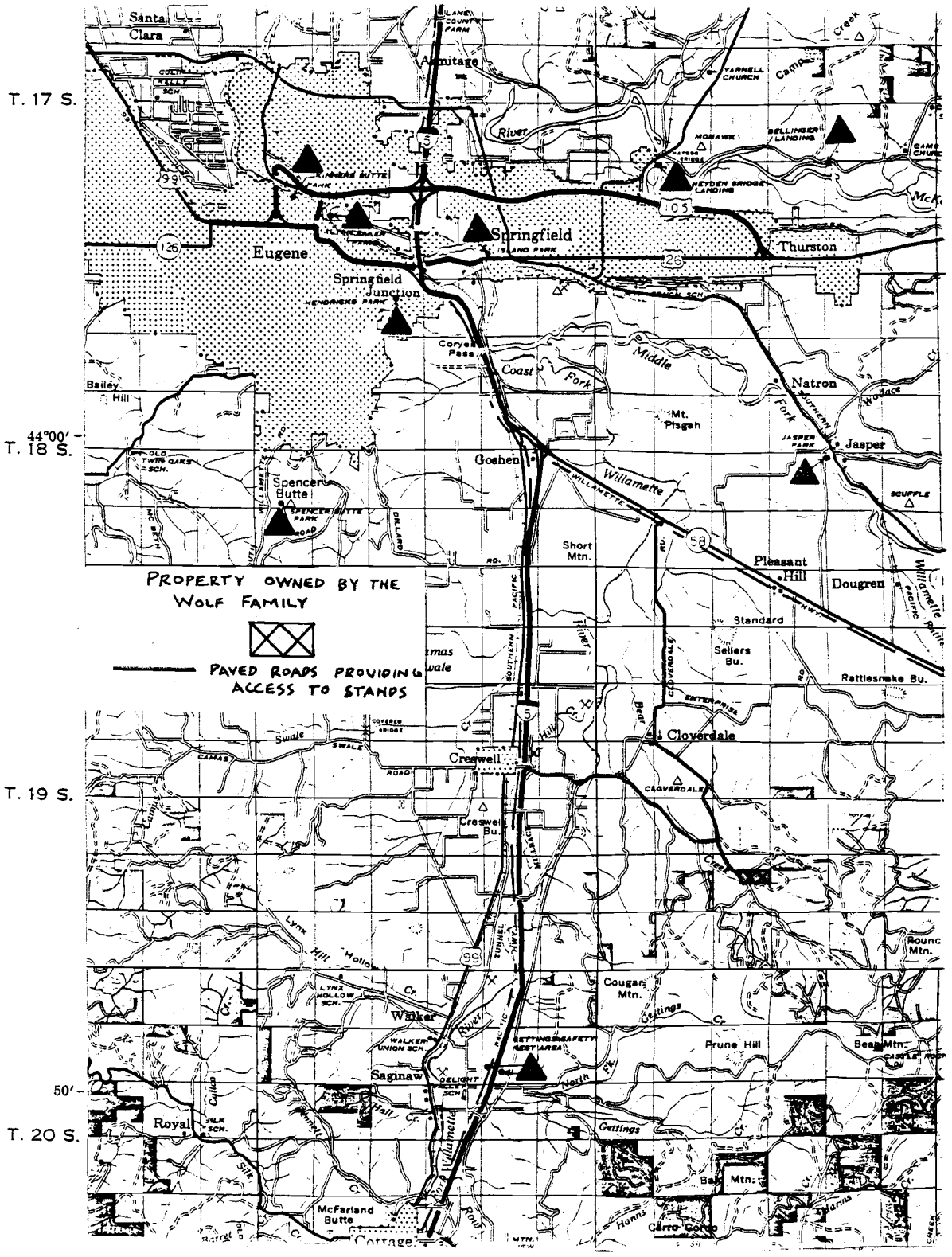
The owners' primary motivation is financial return; they seek income on a regular basis, not necessarily annually, but from each 5-10 year period of management. However, the monetary returns will not be maximized at the expense of secondary goals. The owners wish to maintain the production of Stand A and possibly increase the production of Stand B. Any activities carried out will be designed to prevent any reduction in site productivity or irreversible environmental damage from occurring, such as removal of topsoil. They also seek to preserve a forest environment (although not necessarily in an undisturbed state) and enhance the wildlife in the area.

The owners seek a strategy to meet all these desires and objectives through a management plan for these two stands.

Abiotic

Location

The stands to be managed are located in T19S R2W Sec. 28, approximately four miles southeast of Creswell, Oregon (see page 3 and 4).


T. 17 S.
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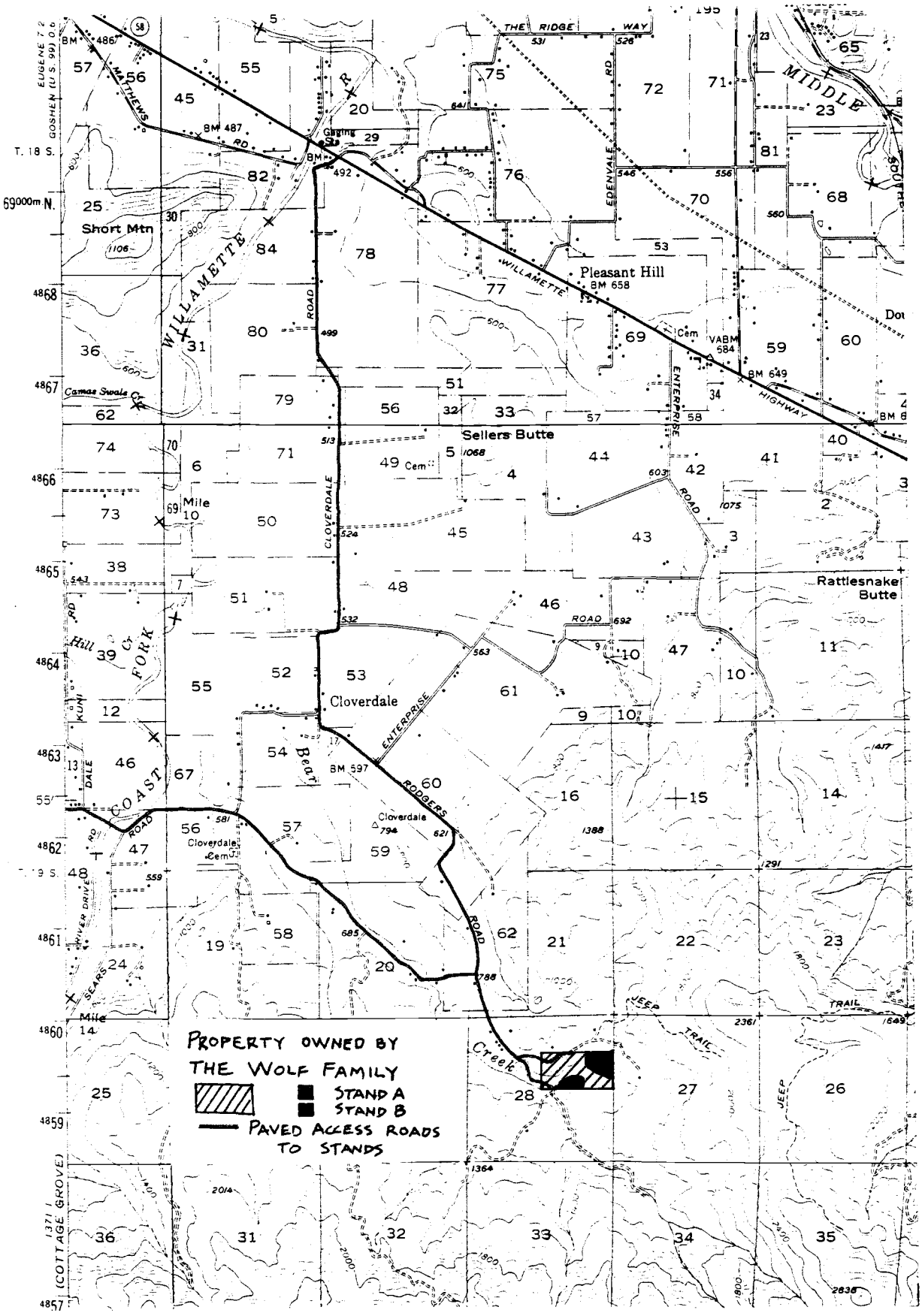
Santa Clara
Armitage
Eugene
Springfield
Thurston
Springfield Junction
Coryell Pass
Coast Fork
Middle Fork
Natron
Jasper
Mt. Pisgah
Goshen
Willamette
Spencer Butte
Bailey Hill
Short Mtn.
Pleasant Hill
Dougren
Standard
Sellers Bu.
Rattlesnake Bu.
Cloverdale
Creswell
Creswell Bu.
Lynx Hill
Walker
Cougar Mtn.
Prune Hill
Saginaw
Royal
McFarland Butte
Cottage
Cerro Gordo
PROPERTY OWNED BY THE WOLF FAMILY
PAVED ROADS PROVIDING ACCESS TO STANDS


PROPERTY OWNED BY
THE WOLF FAMILY
STAND A
STAND B
PAVED ACCESS ROADS
TO STANDS
Short Mtn
Pleasant Hill
Sellers Butte
Rattlesnake Butte
Cloverdale
Cloverdale Cem
Mile 10
Mile 14
WILLAMETTE
HIGHWAY
THE RIDGE WAY
MIDDLE
EDENVALE RD
ENTERPRISE ROAD
CLOVERDALE ROAD
RODGERS ROAD
COAST ROAD
MATTHEWS RD
JEEP TRAIL
Beaver Creek
Camas Swale Cr
Hill Cr
FORK
T. 18 S.
T. 19 S.
69000m N.
EUGENE 7.2
GOSHEN (U.S. 99) 0.6
(COTTAGE GROVE)

Access

Bear Creek Road, which is paved, passes through the southwest corner of the Wolf's property and borders the western boundary of Stand A, providing excellent access to the stand.

Wills Road passes through the northwest corner of the Wolf's property, within a short distance of Stand B, but does not provide good access to the stand. An old spur road off of Wills Road goes into the stand and another old spur road off the Bear Creek Road also goes into the stand; either one of these roads would need to be reconstructed in order to provide access into the stand.

Topography

Stand A: Gentle slopes (10-25%) facing to the north and northwest. Elevation ranges from 920-1040 feet (U.S. Geological Survey, 1955).

Stand B: Gentle slopes (10-25%) facing to the southwest. Elevation ranges from 1000-1160 feet (U.S. Geological Survey, 1955).

Climate

Average annual precipitation: 40 inches. Only 2 inches falls during summer months of June-August.

Average annual snowfall: ≈ one inch. 2.54 cm Average annual temperature: 52` F. 11` C.

Average during winter months: 40` F. 4` C. Average minimum in January 32` F. 0` C.

Average during summer months: 65` F. 18` C. Average maximum in July 82` F. 28` C. (U.S. Weather Bureau, 1965)

Watershed

One small creek, which dries up in droughty summers, runs along the south edge of Stand B and the north edge of Stand A. This creek flows into Bear Creek, a year round creek of good size and flow.

Biotic

Wildlife

Many deer and small rodents inhabit the stands. The signs of deer are particularly prevalent in Stand B. Many birds reside in the area, particularly in Stand B, where snags and residuals, left from previous logging activities, are still standing. No endangered species are known to inhabit either stand.

STAND A

Field Data

Stand at Present Time

Very homogenous stand of 40-50 year old Douglas-fir intermixed with some grand fir.

Volume and Basal Area

Trees per acre = 200, evenly spaced throughout stand.

Average DBH = 12.15 inches

Diameter growth = .23 inches/year

Basal area = 161 ft2/acre.

Basal area growth/acre = 5.9 ft2/acre/year.

Volume/acre = 6879 ft3/acre.

Volume growth/acre = 234 ft3/acre (current annual increment).

Grade of timber: 2 and 3 sawmill with some special mill and poles.

Site Index: 128 (Kings) Low Site II.

Note: Data obtained from 11 variable plots taken with 30 BAF prism.

Biotic

Plant Communities

The tree and shrub species present in Stand A are indicative of the *Acer circinatum/Gaultheria shallon*, (*Corylus cornuta californica-Holodiscus* subtype), association common in the Willamette Valley, particularly on north facing slopes (Franklin & Dryness, 1973).

Dominant tree: *Pseudotsuga menziesii* (Douglas-fir)

Occasional trees: *Abies grandis* (grand fir)
Acer macrophyllum (bigleaf maple)

Understory shrubs: *Acer circinatum* (vine maple)
Cornus nuttallii (Pacific dogwood)
Corylus cornuta var. *californica* (California hazel)
Holodiscus discolor (ocean spray)
Rosa gymnocarpa (little wood rose)

Herb and forb species: *Gaultheria shallon* (salal)
Berberis nervosa (Oregon grape)
Adenocaulon bicolor (trail plant)
Polystichum munitum (swordfern)
Anemone deltoidea (threeleaf anemone)
Galium triflorum (sweetscented bedstraw)

Festuca occidentalis (western fescue)

Insects and Disease

Stand A is free, at this point in time, of any insect or disease problems.

Soil

The soil is classified as a Dixonville silty clay loam (SCS, 1980). The surface layer is a very dark brown silty clay and clay, with the layer beneath a mixture of dark brown silty clay and clay. From soil pits dug on the site, the division between the two layers appears to be at 14-16" below the surface. It is a moderately deep soil, well drained, with a rooting depth of 20-36", but subject to slippage and instability on steep slopes. Permeability of the soil is slow, with a water holding capacity of 4-7". Erosion hazards are moderate on gentle slopes, high on steeper slopes. There is presently little evidence of any erosion in the stand and no areas of slippage are present, despite the fact that the site was logged in the past.

This soil type is suited to the production of commercial timber. The depth of the soil, the growth rates and size of the trees present, indicate that the site is productive and capable of growing merchantable timber. Although the soil type indicates a low III to high IV timber growing site, the trees present indicate a low II growing

site. This could be due to the topsoil being deeper in the stand than in the SCS specifications for this soil type.

Fuels and Fire Potential

The fire potential of Stand A is medium low. Due to a northern exposure the stand stays moist until the late months of summer, when hot weather and extended periods of dry weather can create possible fire hazards. But with a creek bordering the north edge and roads on the west and south edges, accessibility to the area is good and water readily available for fighting any possible fires. The fuels present on the ground now are small and low in total volume and do not present a serious threat to spread a fire. There are no houses close to the stand and the only homes within a half mile of the stand are on the other side of Bear Creek Road (paved) and the creek bordering the north side of the stand.

Following any logging activities within the stand, the large slash and residue will be yarded to the landing to be utilized as firewood or piled and burned. The smaller material will be hand piled and burned in the late fall when the fire danger is at a minimum.

Management Objectives

The objectives of managing Stand A are to provide a sustained yield of wood products while maintaining a healthy stand of trees throughout the rotation age. The owners are

more interested in maintaining a continuing flow of income from the stand, rather than maximizing immediate profit. Certain aesthetic and visual values of the land must also be maintained. Future objectives, following the final harvest, include regeneration of the stand and maintenance (pre-commercial thinning, brush control, etc.) of a healthy stand until any future activity within the stand is decided upon. Any maintenance or logging activities within the stand will be planned with these objectives in mind.

Silvicultural Objectives

The silvicultural objective desired for Stand A is to maintain site productivity and a healthy, disease-free stand of Douglas-fir without allowing brush and hardwoods to encroach.

Management and Silvicultural Constraints

Soil

The primary factor affecting activities within Stand A is the type of soil present. Heavy equipment must be used carefully as the soil is easily compacted when wet and the erosion hazard is moderate to high (depending on slope) when the soil is disturbed (SCS, 1980). Slippage is also a problem with this soil type, although the problem is minimal on the gentle slope within the stand. When locating skid roads and yarding corridors these factors must be considered. The existing conditions restrain any logging

activities, other than falling and bucking, to the dry period in the summer months. Care must also be taken during any activities close to the creek in order to avoid silting or clogging up the creek with mud and slash.

Commercial Thinning

Any commercial thinning done in the stand should be done with care. Felling and skidding operations must be carried out cautiously to avoid damaging standing trees, particularly any grand fir, as it is very susceptible to rot when injured (Bergstrom, 1980).

Site Preparation

Scarification of the site using heavy equipment could cause soil compaction, erosion and loss of topsoil. These factors, combined with the expense of such activity, make this alternative unattractive to the owners. No burning will be done due to the proximity of private timberland bordering the southern edge of the stand, other timber on the owners' land which will be left, and houses on adjacent properties. The owners feel that the risk of slopover from a slash burn, as well as the expense involved does not warrant the use of burning for site preparation. Due to expense and safety considerations, herbicides will only be used if the brush left after logging activities is too dense for planting activities to be conducted.

Planting (After final harvest)

After final harvest of the stand, immediate hand planting will be necessary because brush competition is a problem on the site. Due to the above constraints (see Site Preparation), there will be no site preparation other than disturbance during yarding and skidding operations and removing as much brush and slash as is practically and economically feasible during logging activities. Therefore, planting should be completed during the first winter following harvest activities, in order to get a headstart over the reestablishment and growth of brush species. The planting should be done, if at all possible, during any relatively dry periods of the winter months. Due to the clayey nature of the soil, planting tools are difficult to use when soil is wet. Although wet soil will not make planting impossible, it will slow production down considerably. Once planted, using large seedlings with good root systems, the crop trees should be able to outdistance and overtop the brush before it becomes a problem (Howard and Newton, 1984). This should allow the crop trees to establish themselves without further activities being carried out. However, an annual inspection will be conducted to monitor height growth of the brush in relation to crop tree height. If, after a period of 3-5 years, the brush is deemed a problem, hand clearing or herbicides to release the seedlings will be considered.

Cash Flow

A constraint on the harvest age has also been set by the owners. The stand could be clearcut today, but the owners seek two other objectives also. They would rather spread out the income received from harvest activities over several years rather than get a lump sum now. Second, is a desire to follow the progress of management activities within Stand B and allow the full establishment and development of a vigorous conifer stand, before a final harvest of Stand A occurs. The owners want to see the results of managing Stand B before Stand A is harvested. In this fashion, Stand B will then be yielding revenue while a new Stand A is being established and growing to commercial size.

Markets

A final constraint on the implementation of any activities within Stand A is the condition of the lumber market. If the market for logs and poles is poor the owners wish to delay any logging activities until the market conditions warrant. This could possibly delay any activities, but due to the age of the stand, the owners would like to thin as soon as the price of timber is high enough to assure a profit (> 5%) after the cost of logging activities are considered.

Silvicultural Alternatives Considered

Alternative I:

Commercial thin 45% of basal area now (50 years).

Commercial thin 40% of basal area at 60 years.

Commercial thin 35% of basal area at 70 years.

Clearcut at 80 years. Regenerate.

Alternative II:

Commercial thin 45% of basal area now (50 years).

Commercial thin 40% of basal area at 65 years.

Commercial thin 35% of basal area at 80 years.

Clearcut at 95 years. Regenerate.

There are many possible alternatives for Stand A; therefore, the alternatives presented should not be considered the only prescriptions possible for this stand, but two possible approaches to accomplishing the objectives sought by the owners while staying within the constraints imposed upon any activities conducted within the stand. Alternative I calls for final harvest at 80 years; this age was chosen because this is the upper end of rotation ages commonly used in the Pacific Northwest (Barrett, 1980). Alternative II calls for final harvest at 95 years in order to show the Owners what would happen to the stand if it was allowed to grow for longer periods of time between thinnings. This time period will also present an alternative to an earlier final harvest, in the event Stand B does not grow according to projected expectations. Given

the present improving market conditions, combined with the owners' desire for revenue within the next year or so, the first commercial thinning will probably be carried out as depicted by the above management plans. Following this initial entry, the owners may wish to alter their harvest activities in the future, as market conditions or personal desires change; they may even wish to change from one alternative to another at sometime in the future. They may decide to do something different, such as thinning when the stand is 58 or 59 years of age, instead of 60 years as shown in Alternative 1. If this is the case, the figures presented would still be useful as estimates of the costs and revenues at that time because due to the fluctuations in market conditions, logging costs and growth rates of the stand, the data presented are not absolute facts but only predictions using formulas developed from collected data. Thus the figures presented would still be valid points of reference for the owners to use in making a decision. The alternatives presented are meant to be used as guidelines, not as inflexible management policy for the stand.

The two alternatives are presented and variations within each are also shown (see Table 1). Clearcutting the stand at the present time was not considered due to the owners' objectives and constraints. The alternatives are first compared from a financial standpoint. Also shown are projected volumes obtained from the different management regimes presented. For these computations I have used cubic

volume for all projections, for two reasons; cubic volume is a more accurate measurement for small logs and more consistent (Snellgrove & Fahey, 1982). Board foot volume is dependent on log lengths and taper; cubic volume remains virtually the same regardless of log lengths.
surveys) into a computer program using DFSIM, as developed by Curtis et al. (1980). The computer model was calibrated to the stand as it is now, using the site index computed for the stand at the present time and projecting the growth from the basal area, trees per acre and mean quadratic diameter obtained from field surveys. Another computer program, called VARP (s variable plot cruise program using the tariff concept)(Brackett, 1973), was also used in order to substantiate, through duplication, the projections used. While using these projections assumes that the growth will follow a specified path as predicted from the present data, it is the only means of comparing future returns. For the projections shown, DFSIM was used (see Table 1). This computer program is the most up-to-date model available at the present time and should be relatively accurate in its predictions. given the infinite number of fluctuations in site conditions and growth possible on a real site it should not be accepted as absolute fact but as a basis of comparison.

The cost and revenue figures presented were derived from the Logging Cost-Economics computer Program as developed by LeDoux (1983). The program considers falling and bucking, skidding and yarding, and hauling costs, as

related to the size trees existing on the stand at the present time. All costs and revenues are computed using figures accurate through December 1981. These figures may have changed slightly since then, but for reasons of comparison they are still valid. The present net worth have changed slightly since then, but for reasons of comparison they are still valid. The present net worth (PNW) of the profits are all projected to the present time (age of stand, 50 years) to enable the owners to see a figure which is meaningful to them at this time. The owners did not own the land 50 years ago, thus a projection back to year zero would not be as meaningful to them. All PNW figures are calculated using a five percent real interest rate as this figure is deemed most appropriate for today's cost analysis (Berck, 1979).

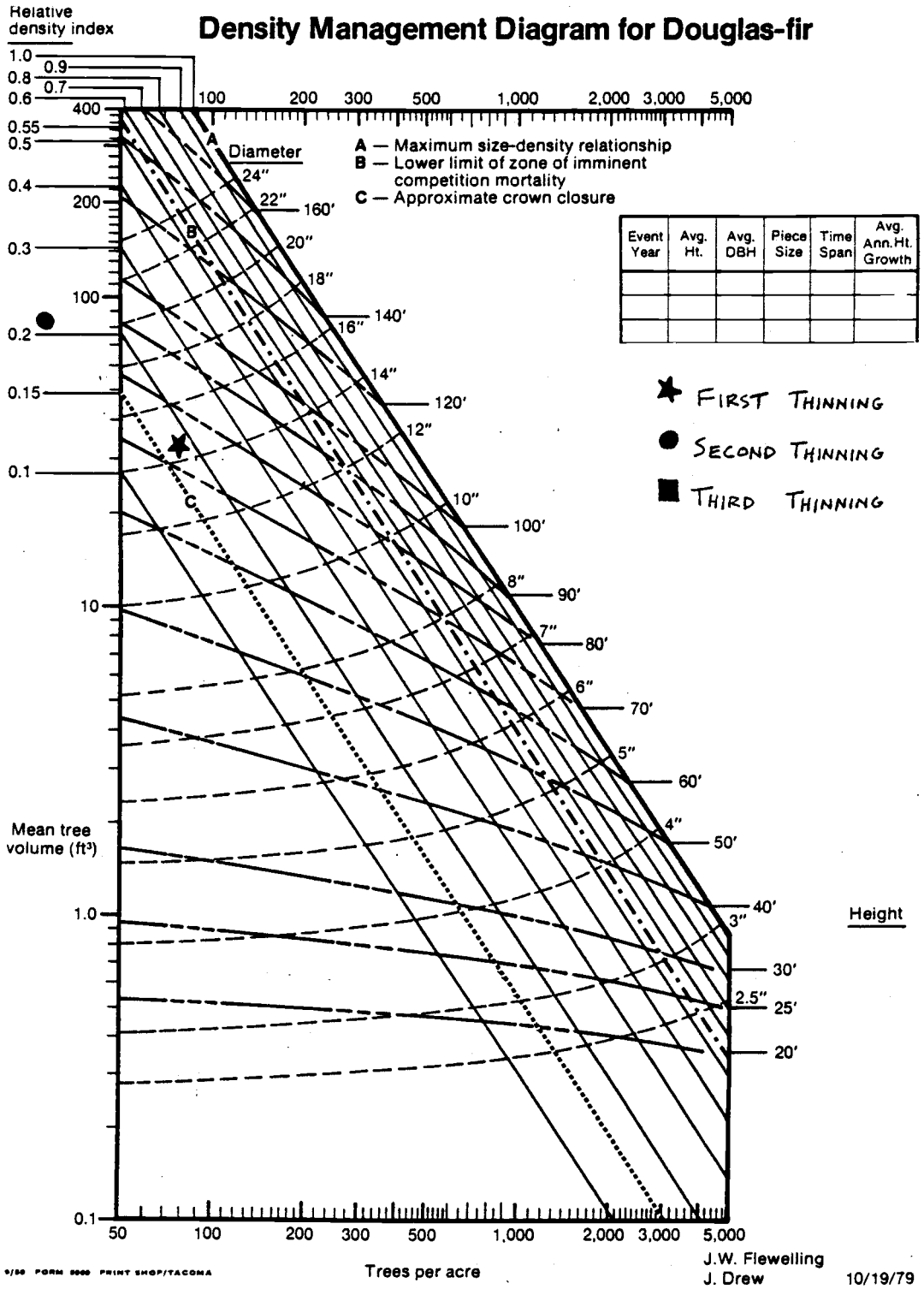
The figure of 45 percent of the basal area as a criteria for thinning the stand at the present time was picked for several reasons. The owners seek a cash flow from the stand, not necessarily the maximum possible, but one which ensures a profit above the costs incurred. For a stand of this size (≈12" DBH) approximately 3,000 ft.3/ac. must be removed to cover the costs of harvest and ensure a profit (LeDoux, 1983). Thinning 45 percent of the basal area removes 3,161 ft3/ac. (≈46% of the volume). This ensures the owners a profit at this time while still leaving a stand of trees capable of responding after the thinning and producing volume in the future. The first thinning will

leave a stand of conifers with spacing in between the point of crown closure and the lower limit of the zone of imminent competition mortality (see Figure 1) (Drew & Flewelling, 1979). Future thinnings will leave a stand with spacing wider than the point of crown closure. This will result in spacing which is wider than that which is optimal for maximum utilization of the site, but will result in a good monetary return. In short, a compromise in order to meet the objectives of the owners.

For future thinnings the percentage of basal area to be removed can be more variable and lower because the trees will be larger, thus cheaper to log on a per-unit basis and easier to sell due to increased commercial value. I have used the figures of 40 percent and 35 percent for future thinnings simply because these figures provide a good cash return while still leaving a stand capable of further growth producing more volume for revenue farther in the future. These percentages can be changed in the future if the owners seek more or less revenue at this point in time. However, for comparison purposes I will use these figures. For all alternatives I have used basal area as a thinning criteria because it is more easily applied than volume or stems per acre, particularly when marking the stand.

For each alternative the costs and revenues from clear-cutting at a particular point in time, as opposed to thinning, are also shown. This will enable the owners to see the results of altering a particular management plan at that

Density Management Diagram for Douglas-fir



Event Year	Avg. Ht.	Avg. DBH	Piece Size	Time Span	Avg. Ann. Ht. Growth

J.W. Flewelling
J. Drew

10/19/79

point in time. Example: Owners thinned at 50 and 60 years, then decided to clearcut at 70 years.

Discussion of Alternatives

Both alternatives meet the objectives of the owners while staying within the constraints imposed on management of the stand. Both would meet the visual and aesthetic values sought during the time period from the present time until Stand B is close to commercial size, at which time Stand A will be clearcut. Both provide for continuous revenue up through the final harvest, after which revenue will be obtained from Stand B, which should be established at some future date within the time span of both alternatives. The exact year or period of years during which Stand B will reach a desirable commercial size cannot be predicted with accuracy, hence the two alternatives give the owners leeway in deciding when to carry out the final harvest of Stand A. From a financial point of view it appears that final harvest at age 70 under Alternative I would yield the highest PNW and may be the most attractive to the owners. However, Stand B may not be close to commercial size at that point in time, in which case the owners could commercial thin again, as set forth under the alternative and final harvest at 80 years. On the other hand if the owners decided that Stand B was close to commercial size when Stand A was 60 years of age they could forego commercial thinning and clearcut Stand A when it reaches 65 years old. These scenarios show that

Table 1. Stand A (10 Acres)

Entry Age (Years)	Percent Basal Area Removed	Aver. No. Trees Per Acre Removed	Aver. DBH of Trees Removed	Volume Cut Per Acre (ft^3)[1]	Trees Left Per Acre	Aver. DBH of Trees Left	Residual Volume Per Acre (ft^3)	Logging Cost ($)	Pond Value (Present Worth)	PNW at 50 years (today)	Total PNW at 50 Years (today) after final harvest
ALTERNATIVE I: Figures show per acre averages Multiply by 10 for whole stand figures All thinnings are from below (low)											
50 (CT)	45	123	10.43	3,161	77	14.47	3,718	1,165	2,521	1,356	-----
60 (CT)	40	47	13.96	2,480	30	21.20	3,382	756	2,664	1,171	-----
60 (CC)	100	77	17.18	5,862	--	---	---	1,446	7,777	3,887	5,255
70 (CT)	35	15	21.65	1,947	15	28.62	3,225	323	3,265	1,109	-----
70 (CC)	100	30	25.47	5,171	--	---	---	500	10,221	3,664	6,136
80 (CC)	100	15	34.75	4,806	--	---	---	245	10,452	2,362	5,998
ALTERNATIVE II: Figures show per acre average Multiply by 10 for whole stand figures All thinnings are from below (low)											
50 (CT)	45	123	10.43	3,161	77	14,47	3,718	1,165	2,521	1,356	-----
65 (CT)	40	47	14.91	2,968	30	22.61	4,000	854	3,410	1,229	-----
65 (CC)	100	77	18.33	6,968	--	---	---	1,574	9,873	3,992	5,348
80 (CT)	35	15	24.27	2,599	15	32.13	4,198	308	4,893	1,060	-----
80 (CC)	100	30	28.55	6,798	--	---	---	365	14,785	3,337	5,921
95 (CC)	100	15	40.86	6,733	--	---	---	343	14,636	1,591	5,237

CT: Commercial Thinning
CC: Clearcut
[1] Projected Using DFSIM

the owners do not have to make a definite decision at this point in time, but can decide at any point in the future. It must also be remembered that these projections are based on an assumed rate of stand growth, with logging costs and timber prices predicted into the future. Thus any of these figures could change and the values could show a different harvest plan to be more profitable. But a decision needs to be based on something the owners can see today and the figures presented can be used as parameters to be compared and used to make a decision as to which management option is the most desirable.

Comparison of the two alternatives also shows that income from the harvest activities is almost equal up to the age of 80 years ($59,977 to $59,214), at which time the decreasing growth rate of the stand results in a declining PNW for future harvest. This shows the owners that regardless of the timing of thinning entries, the PNW comes out almost the same. Knowing this, the owners can time the thinning entries according to when they wish to receive income from the stand. Also, the owners would probably not want to wait much longer (after 80 years) for the final harvest, but if Stand B was still not of commercial size at this point in time, the option to harvest later is still there.

Both alternatives would meet the aesthetic and wildlife objectives of the owners, within the time frame given. The owners want at least one stand (either A or B) to be in a

semi-natural looking state at any one time. By waiting until Stand B is established before clearcutting Stand A this will be accomplished. The objectives of maintaining soil productivity and minimizing erosion and loss of topsoil will be met under both objectives, provided the guidelines presented in the constraints are followed. Any problems with brush and regeneration will be the same under both alternatives, thus will not be a major factor in the owners' decision. Any expense incurred due to brush control or regeneration will come out of the returns from logging the stand.

In brief, the alternatives are not significantly different, but by presenting them as separate options, with variations within, they give the owners a choice of ways to meet their objectives.

Recommended Silvicultural Alternative

Alternative I is recommended because it offers the owners a cash flow at shorter intervals than Alternative II and a higher PNW.

It is also recommended that Alternative I be carried through to a final harvest at 80 years rather than an earlier date. This will spread the income received, from logging activities, out over a longer period of time; which will decrease the total tax on the revenue and increase the total PNW over the long run. However, if it appears that Stand B will not reach the stocking level and size sought by

the owners, within the time span of Alternative I, Alternative II can be used to meet the objectives of the owners while Stand B continues to develop.

Implementation of Desired Alternative

1. Negotiate a written contract (purchase order) with a mill to buy the timber before any logging activity is begun.
2. Mark trees to be cut with blue paint. First commercial thinning will remove approximately 45 percent of the conifer basal area. Cruiser will check work with prism to ensure proper basal area is left. The approximate spacing between trees left will be 24 feet. Thinning will be from below.

   Rules for marking: (a) remove suppressed, dying and overtopped trees; (b) remove intermediates except where necessary to maintain desired basal area or proper spacing; (c) remove dominants and codominants. To meet the final desired spacing and basal area, the trees to be marked will come from category "a" first, followed by category "b", then "c." Example: If removing the suppressed, dying and overtopped trees from one particular area of the stand does not leave the desired basal area, then intermediates will be removed. If this still does not leave the desired basal area then dominants and codominants will be removed.
3. Directional fall trees towards skid road. Cut down

non-crop trees (except snags which would classify as wildlife trees) and hardwood trees for firewood (very few exist in present stand).

4. (To be done during dry season, preferably late summer) yard trees using winch on the back of owners' Cat 20 to skid road, then skid turn of logs down to decking area next to main road. When practical yard and skid firewood to road to be sold. Firewood trees will be skidded when needed to complete a full load for a turn or can be easily hooked without undue extra effort.
5. This same process will be repeated through all successive thinnings.
6. Final harvest. All trees will be directional felled towards skid road, winched to skid road and skidded to decking area by main road.
7. Logs will be loaded and hauled to mill from decking area on Bear Creek Road.

Suggested steps to follow after harvest activities, can be changed if so desired by owners.

1. Trees (Douglas-fir seedlings) will be hand planted the winter following harvest (=350 TPA)[1].
2. Given the number of trees left after the third and final thinning (15 TPA), the brush will most likely be

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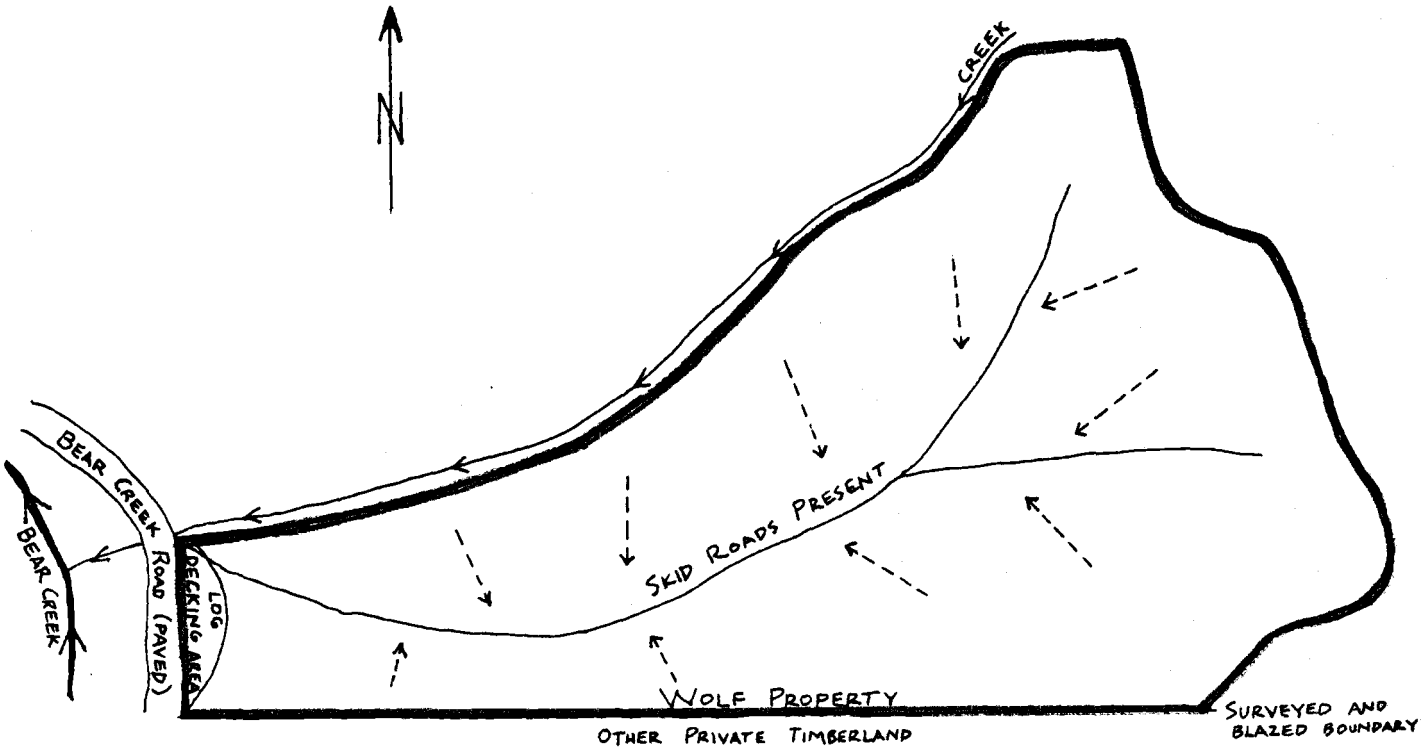
[1]350 TPA is desired level of stocking because this will give the trees space to reach 10 inches in diameter (a desired merchantable size) before reaching the lower limit of zone of imminent competition mortality (Drew & Flewelling, 1979).

a problem on the site. Therefore, brush control by herbicides or manual clearing will be carried out for release of the seedlings during early (3-10 years) development.

3. At 15 years of age the stand will be pre-commercially thinned if necessary (if naturals have come in and upped the stocking level).

4. At age 30 an inventory will be conducted. Future management decisions concerning activities such as commercial thinnings will be made at this time. Objectives sought by the owners may have changed by then and any future management should take these changes into account.



Boundary of Stand A

←--------- Direction trees will be felled and yarded to skid road. Logs will then be skidded down to log decking area. Longest yarding distance is 125'. Longest skidding distance approximately 1,100'.

Figure 1. Schematic Diagram of Stand A

STAND B

Field Data

Stand at Present Time

Two-storied stand of white oak consisting of scattered, large trees 200-300 years old of open-grown form (≈3-5/ac) and a majority of smaller trees(≈50-75/ ac), of narrow form, 75-100 years of age. Underneath and growing up through these trees is an understory of Douglas-fir and grand fir seedlings, saplings and poles ranging in age from 1-30 years with the majority 8-12 years old. Big leaf maple is present in both canopy levels and a wide range of shrubs, herbs and grasses also exist in the stand (see Plant Communities, page 28), and at this time present a problem for conifer growth.

Within the stand is one small grassy meadow which will be left for a possible future homesite. No management activities will be carried out in this area.

Volume and Basal Area

Only Douglas-fir and grand fir are included in these calculations because white oak (growing in this area) is of little commercial value for anything other than firewood. However, with the oak averaging 30-60 ft^2/ac. there is approximately 6 cords/acre which could also provide a

monetary return to the owners.

Data estimate for trees approaching commercial size (≈ 7") (trees smaller than this have no merchantable volume).

Trees per acre ≈ 140/acre.

Average DBH ≈ 8.4 inches.

Basal area/acre = 17 ft2/acre.

Volume/acre = 300 ft3/acre.

Data estimate for all trees large enough to calculate a volume.

Trees per acre ≈ 260/acre (≈ 320 TPA with ≥ 1" DBH)

Basal area/acre = 36 ft2/acre.

Volume/acre = 500 ft3/acre.

SITE INDEX = 80 (Kings) Site IV

Note: Estimates obtained from 25 hundredth acre plots, however, site index is approximate because it is hard to obtain accurate site calculations from 20-30 year old trees (Tappeiner, Bell, & Brodie, 1982).

Total trees per acre (seedlings, saplings, poles) 1500.

Seedlings range from 500 to 3000/acre.

Note: All trees per acre figures are averages, with sapling and pole sized trees tending to grow in clusters with seedlings growing in between these clusters. However, there are no totally unstocked acres within the stand.

Biotic

Plant Communities

Most of the stand is a *Quercus garryana* community, except for one small meadow present within the stand. The stand has been in a transition state from hardwoods to conifers for many years. This transition was slowed by logging activities in the past, when almost all of the merchantable timber was removed, but is continuing to take place at the present time. Species present in the stand now indicate most of the plant community to be in the *Corylus cornuta*/*Polystichum munitum* association (Franklin & Dryness, 1973).

Primary tree species: *Quercus garryana* (white oak)
Pseudotsuga menziesii (Douglas-fir)
Abies grandis (grand fir)

Occasional tree species: *Acer macrophyllum* (bigleaf maple)
Tsuga heteropylla (western hemlock)
Thuja plicata (western red cedar)

Tall shrubs: *Corylus cornuta* (hazel)
Prunus avium (mazzard cherry)
Amelanchier alnifolia (Saskatoon service-berry)

Holodiscus discolor (oceanspray)

Osmaronia cerasiformis (Indian plum)

Crataegus douglassii (black hawthorn)

Low shrubs: Polystichum munitum (swordfern)

Symphoricarpos albus (common snowberry)

Rubus parviflorus (thimbleberry)

Rhus diversiloba (poison oak)

Pteridium aquilinum (bracken fern)

Rubus ursinus (trailing blackberry)

Rosa eglanteria (sweetbriar rose)

Rosa gymnocarpa (baldhip rose)

Herbs: Tellima grandiflora (Alaska fringecup)

Galium spp. (bedstraw spp.)

Numerous other herbs and grasses have invaded the site from nearby pastures.

Insects and Disease

No severe insect or disease problems exist in Stand B. However, there are pockets of Phellinus (Poria) weirii root rot scattered throughout the stand which should be monitored. The white oak in the stand is heavily infested with Phoradendron villosum (hairy mistletoe) and Micro-sphaera alni (oak mildew), Armillaria mellea (shoestring root rot) and Polyporus dryophilus (trunk rot) is also present in the oaks within the stand. There is some evidence of cynipids (gall wasps) and Lambelina fiscellaria somniara (western oak looper) as well, however, they do not present a serious

problem at this time. Most of these problems should be ameliorated through shading out and eventual removal of the oaks. However, Armellaria could spread to Douglas-fir trees after the oaks are gone; this should be monitored to see if this does occur. If it becomes a problem, infected trees should be removed and resistant species, such as ponderosa pine and red alder, planted in those areas.

Soil

The soil in Stand B consists of components of the Dixonville-Philomath-Hazelair complex (SCS, 1980). The occurrence of these patterns is complex and soil pits dug on the site bear this out. While the soil is similar to the silty clay loam in Stand A (due to the Dixonville soil present), it has a distinct grayish color and is cobbly as well. These facets are a result of the Philomath soil in the mixture. At about 11 inches a distinct light olive brown mottled clay is present; the color change from the surface soil is distinct. This is due to the Hazelair soil present in the complex.

The permeability of these soils is low and the water holding capacity is low (≈2-7"), hence the runoff is moderate to high, with the hazard of erosion high. The silty clay loam and cobbly silty clay texture of the surface layer means the soil can be easily compacted when wet. Visual inspection of the site bears this out; wherever heavy equipment has moved through the stand, the soil is severely

compacted and in the summer it is similar to concrete. Where heavy equipment has gone up slopes within the stand, erosion is evident, with small rills and gullies forming. In areas where erosion has occurred, the cobbles present in the surface layers of soil are visible everywhere. Care must be taken during any future activities to avoid more erosion from taking place. This can be accomplished by keeping heavy equipment from moving directly up any slope and using a minimum number of predetermined skid trails.

This soil type is poorly suited to the production of commercial timber (SCS, 1980) but is capable of producing merchantable timber if the owner is willing to lengthen the rotation age. The SCS does not categorize the soil into a timber growing site class, but the trees present now would indicate that although the site is capable of growing conifers, their growth is slow. The conifer seedlings and small poles, present on the site now, show growth to be slow when the trees are very young (1-8 years) and then dramatically pick up once they are established (4-1/2 feet tall, 10-15 years). This could be due to the low available water capacity and droughty conditions of the site; once the trees are established their roots are deep enough to obtain the needed water and nutrients for better growth.

Fuels and Fire Potential

Stand B presents a different situation from Stand A, with the fire potential rating medium high. The southern

exposure creates drier conditions, especially during the summer months and the grasses present also increase the likelihood of a fire spreading. Other woody fuels are low in total volume.

Access to the stand is poor; the old skid roads would need reconstructing to be of any use. It would take some sort of tractor to gain access into the stand by any kind of machinery. However, the southern edge is bordered by a creek which would provide a water source, except in very dry years.

Following any logging activities within the stand, the same procedure used in Stand A will be followed in order to minimize any possible fire danger.

Management and Silvicultural Objectives

The principal objective of managing Stand B is to convert the present mixture of brush, white oak and other hardwoods to a stand of primarily Douglas-fir intermixed with some grand fir. The objectives of the management plan are to release conifer seedlings overtopped by brush and pre-commercially thin overstocked areas with the end result leaving 350-400 evenly spaced crop trees per acre. Some of the hardwoods will be left to keep some diversity within the stand, in order to enhance the wildlife habitat as well. Other objectives include the possible utilization of what is growing at the present time, primarily the oak (as firewood, approximately 6 cords/acre), and residual Douglas-fir and

grand fir (as wildlife trees).

Once a commercial sized stand of conifers (≈7.5" DBH) is established on the site, the silvicultural objective will be maintenance of the stand without allowing the brush and hardwoods to reestablish themselves as the dominant vegetation.

Stand B will also be managed on a long-term basis similar to Stand A, with emphasis on a continual flow of wood products and monetary return, rather than maximizing short-term profits. However, due to the poor site conditions, slow growing trees within the stand and the possibility of building a home on the site in the future, the visual, aesthetic and wildlife values will be given a higher priority in this stand than in Stand A. The stand will still be maintained and logged for wood products but these objectives will be tempered somewhat in order to meet the visual, aesthetic and wildlife objectives.

Management and Silvicultural Constraints

Site

Stand B presents several problems for management. The thin, rocky soil is easily compacted and subject to rill and gully erosion when wet (SCS, 1980). The shallow soil and low available water capacity makes regeneration of conifer trees difficult, particularly on south or southwest facing slopes (SCS, 1980). The shallow soil also means trees are

subject to windthrow, particularly when the soil is excessively wet and winds are strong. Windthrow which occurred within the stand, in the winter of 1981-82 confirms the problem. The erosion hazard of this soil is moderate to high and skid roads or other logging activities must be carefully planned to avoid excessive erosion from occurring.

Brush

The brush presents problems for establishment and growth of conifers. Constraints on the removal of the brush also exist. The use of fire or mechanical clearing of the brush using heavy equipment is restricted due to regeneration (400+ crop trees per acre) presently coming up under and through the brush and groups of older (15-30 years) conifers growing throughout the stand. The use of fire or heavy machinery to prepare the site, while opening up areas for planting, would destroy much regeneration and young growth already present. Fire would destroy most everything while heavy machinery would be good for clearing large areas but would not be utilized efficiently if only small areas scattered throughout the stand were to be cleared. Overall the damage to trees presently growing in the stand would negate any positive results.

Any use of herbicides must be carefully carried out due to the owners' concern with the safety and cost of such substances. If herbicides are used, the owners wish it to be by basal and spot spraying using a backpack sprayer.

These methods allow more complete control over the application of herbicides as opposed to aerial spraying. By localizing the application to where it is needed, rather than over the whole area, the cost factor can also be better controlled. Two constraints apply to the use of herbicides, one is a formality; a written application to the State of Oregon must be submitted 15 days before any spraying is done, detailing where and when spraying is to take place. The other constraint must be followed when spraying takes place; a minimum 50 foot buffer strip between Class I creeks must be left untreated.

One more alternative is hand clearing of the brush. The only constraints on this activity would be cost and effectiveness; could it be justified financially based on future returns.

Residual Stand

The removal of older conifer residuals, left from previous logging activities, could be considered as a source of income. However, two constraints on this possibility have to be considered. One, the expense of rebuilding the spur into the stand, to gain access to the trees, could run as high as $10,000. The value of the residual volume, due to small total volume and high percentage of cull in what is there, would not justify building the road. Second, the owners' desire to enhance the wildlife habitat within the stand would be helped by leaving these old residuals, many

of which have broken tops sought by birds for nesting (Thomas, et al., 1975).

Clearcutting (Future management constraint)

Three constraints preclude clearcutting Stand B in the future. First, the low site and poor growing conditions make establishment of a new stand difficult. Trees on the site are growing slowly and any future regeneration will be slow to establish itself. The second constraint is aesthetic; the owners have ideas for a possible future homesite in a small meadow within the stand on a southwest facing slope with a good view. A clearcut around this area of the stand will not enhance this. The third constraint is the problem of brush and hardwoods reinvading the site. From residual trees, stumps, skid roads and slash residue left on the site it is evident that a stand of conifers existed at one time. Since clearcutting, the hardwoods and brush species have dominated the site. Taking these constraints into consideration would mean that the stand should be thinned from above when the trees reach commercial size rather than clearcut. This would work well in this stand; by thinning from above a growing stand would be left at all times. Commercial thinnings would be carried out as trees left at previous thinnings reached commercial size. If after several commercial thinnings natural regeneration has failed to maintain a desired stocking level, hand planting will be carried out to restock the stand.

Silvicultural Alternatives Considered

Alternative I:

Do nothing at the present time. Allow stand to grow to commercial size with no management activities taking place. Commercially thin from above when trees reach merchantable size.

Alternative II:

Conduct timber stand improvement activities now. Pre-commercially thin and hand release overtopped seedlings, simultaneously during one pass through the stand. Commercially thin from above when trees reach merchantable size.

Alternative III:

Same as II except also spray for vegetation control.

Optional for Alternative II and III:

Remove thinned oak for firewood for personal use or sell to reduce the cost of these activities ($\approx$6 cords/acre).

In all alternatives the older residual trees will be left as wildlife trees.

These alternatives take different approaches to accomplishing the same objective: growing a commercial size stand of conifers. While one entails no cost at the present time, it could result in postponed revenue in the future. The other alternatives, while costing money today, would shorten the time period until revenue is produced from the

stand, as well as increasing the return due to the sale of larger diameter trees. For discussion of the alternatives and making a final decision on which alternative to recommend, cost and growth estimates were considered. Growth and future revenue predictions are presented first and cost estimates of treatments looked at second.

Growth Projections at 60 Years for Site IV Land
(80 Kings, 100 McArdle)

	Ft3/ac	Avg. Dia.	
	5000	8.7"	McArdle et al., 1961
	5400	10.7"	DNR, Washington State, 1980
	6100	8.5"	DFSIM, Curtis et al., 1980
	6300	N/A	SCS, 1980 (N/A=Not Available)
Avg.	5700	9.3"	

These projections are averages from natural (untreated), fully stocked stands growing on Site IV land. Sixty years was chosen because that is approximately when a stand of timber on Site IV land, grown with no management activities taking place, will reach a minimum merchantable size ($\approx$ 7.5" DBH). For larger sized trees, with a higher value, the rotation age of this stand would have to be lengthened to 70, 80 or 90 years.

Financial Analysis and Discussion of Management Options

The PNW of the projected future stand is presented using the average of the figures shown (5700 ft3/ac. and

9.3" dia.). While this assumes the entire stand will grow evenly, and produce the same volume of timber per acre, it will be used because a commercial stand does not exist now, therefore, a projection must be made. The question could also be raised: will these projections fit the existing stand? Projections shown assume a time frame of 50 years from the present time, since the majority of the trees present are in the 8-12 year old category. While the stocking level of this group of trees (saplings) does not quite meet the optimal level desired, the addition of poles and seedlings growing within the stand provide more than adequate stocking throughout the stand. Even though the age of most trees within the stand range over a 20 year span, this would still be considered an even-aged stand. A stand may be considered even-aged for purposes of management if the difference in age between the oldest and youngest trees does not exceed 20 percent of the length of the rotation (Smith, 1962). While even-aged management is not being proposed for this stand, for the purpose of growth projections the stand can be considered even-aged. As with all projections the possibility of error exists, therefore, these figures should be used only for comparisons.

Revenue and cost projections shown were generated using formulas developed by Chris LeDoux (1983). Revenue projections are sensitive to the average diameter of trees removed and logging cost functions are sensitive to average diameter and amount of volume removed.

Inserting the average figures into the formula shows a revenue return of $4041/acre minus logging and hauling costs of $2217/acre, for a value of $1824/acre. The PNW projected back from 60 years to today (10 years, the average age of established crop trees on the site now) shows a value of $159/acre. Multiply this figure by the 25 acres in this stand shows a PNW of $3975 at harvest, if the stand were allowed to grow in a natural state until 60 years and then clearcut. If the stand was commercially thinned at that age the return would be proportionately less.

For a stand of larger sized trees with a higher market value the. rotation age would have to be lengthened to 70, 80 or 90 years. This would lower the PNW to the owners. Therefore, if timber stand improvement activities could produce larger diameter trees throughout a shorter rotation, with the cost of the activity not exceeding the increased PNW, the owners would benefit.

The two timber stand improvement activities being looked at are pre-commercial thinning and brush/hardwood control; both activities have a direct affect on conifer growth.

Pre-commercial thinning (PCT) concentrates growth on the crop trees to be left, substantially increasing diameter growth (Tappeiner, Bell, & Brodie, 1982; Reukema & Bruce, 1977) and possibly increasing height growth on poor sites (Reukema & Bruce, 1977). Proper spacing is most critical on poor quality sites if trees are to reach merchantable size

and the additional gain in growth from PCT is greatest on Site IV land (such as this site). Reukema & Bruce estimate the increased diameter growth to be 10 to 15 percent on this type of site. The gains from this increased growth is greater in terms of board foot volume than in cubic foot volume, which means a greater gain in merchantability and value of the trees.

Vegetation control is necessary in order to allow conifers to become established and to prevent suppression of their growth once they do become established. Trees overtopped by brush and hardwoods will grow slower and will, under adverse conditions, be shaded out and die (Howard & Newton, 1984). The two approaches to vegetation control being considered here are hand clearing around seedlings for release and spraying of herbicides to kill and prevent further growth of the brush, hardwoods and grasses.

The cost figures used for these activities are $85/acre for PCT and hand clearing of brush, $65/acre for basal spraying of Garlon on hardwoods and brush, and $45/acre for spot spraying of Atrazine and Dapalon on grass. The figures for spraying assume the use of a backpack sprayer by a person on foot. Figures were obtained from Robert Brown at the Western Lane County office of the State of Oregon Forestry Department. The costs were arrived at by averaging the costs incurred by landowners on projects which were submitted to the State of Oregon, under the cost-share program. It is felt, from studies of data collected, that these costs

are accurate and representative for this area and are used throughout Lane County for cost analyses of reforestation, site prep and timber stand improvement activities. The costs vary depending on the site, ranging from low to high, and are determined by terrain, slope, access to the site, stock to be planted, etc. This particular site is of medium-difficulty by their rating system. Therefore, the costs used are representative of a medium-difficult site.

PCT, with manual release of crop trees, is looked at first. Using the revenues presented in the previous section some comparisons are presented. Projections of the future stand are presented with the cost of PCT and manual release subtracted from the net revenue to obtain the present net worth (PNW). The first comparisons assume the same volume production per acre, but also take into consideration different average diameters (at 60 years) which could result from PCT and manual release activities (see Table 2). It is also possible that the stand will not produce 5700 ft^3/ac. at 60 years; therefore, revenue projections of the stand using lower per-acre volumes are also presented. This shows the owners a range of possibilities which could occur on this site.

The argument could be raised that a natural stand would have more trees hence more harvestable volume would exist. However, much of this extra volume would be lost to mortality occurring as the stand grew, and if the stand were precommercially thinned early enough, the total volume

produced would likely almost equal that of an unthinned stand (Reukema & Bruce, 1977; Tappeiner, Bell, & Brodie, 1982). However, to account for the possibility that a stand which was precommercially thinned would produce less volume, PNW projections have also been made using smaller volume figures. An infinite number of projections could be made; I have picked some viable possibilities as a sample (see Table 2). All figures presented in Table 2 are on a per-acre basis for trees clearcut at 60 years of age, with the total PNW (for all 25 acres) also shown.

All these figures will change if commercial thinning of the stand is carried out at an earlier age or at 60 years. Also, the growth rates of this particular stand might not meet these projections or they could exceed it. They are presented as a point of reference in order to make a management decision on timber stand improvement activities at this point in time.

From these projections it can be seen that an increase of just .3 inches in the average stand diameter will result in an increased PNW, if the volume produced from a stand which has been precommercially thinned equals the volume of a natural stand at 60 years. Other break-even points can be seen at different diameters and volume predictions. At an average stand diameter of 10.2 inches (a 10% increase in diameter from a natural stand) only 4800 ft3/acre is needed to exceed the PNW of a natural stand. At an average stand diameter of 9.8 inches (a 5% increase in diameter from a

Table 2. Stand B (25 acres)

		Average ft^3/acre (at 60 yr)	Average Diameter	Pond Value	Logging Costs	Net Revenue	PNW* Per Acre	Total PNW (25 acres)
ALT. I	Natural (untreated) Stand	5,700	9.3	$4,041	$2,217	$1,824	$159	$3,975
ALT. II	Different Projections of Stands which have been PCT/Manually released	5,700	9.5	4,130	2,197	1,933	157	3,925
		5,700	9.6	4,175	2,186	1,989	162	4,050
		5,700	9.8	4,264	2,185	2,079	169	4,225
		5,700	10.2	4,443	2,125	2,318	202	5,050
		5,700	10.7	4,666	2,073	2,593	213	5,325
	Projections of Stands which have been PCT/Manually released	4,500	10.2	3,508	1,677	1,831	152	3,800
		4,800	10.2	3,742	1,789	1,953	162	4,050
		5,130	10.2	3,999	1,912	2,087	174	4,350
	but produced less volume	4,800	9.8	3,591	1,824	1,767	146	3,650
		5,200	9.8	3,890	1,976	1,914	159	3,975

*All PNW figures are projected back from 60 years to the present age of the existing stand (=10 years). All PNW figures for the projections of stands which have been PCT have the cost of PCT subtracted from the figures presented. All PNW figures are calculated using a 5% real interest figure as this figure is deemed most appropriate for today's cost analysis (Berck, 1979).

natural stand) only 5300 ft3/acre is needed to exceed the PNW of a natural stand.

These figures show that a small increase in stand diameter will result in a higher PNW than that of a natural stand grown to 60 years. If the average stand diameter increased as much as 15 percent the PNW would be significantly higher. Two factors come into play in this situation. Increased tree diameter results in increased merchantability and value of the trees harvested and as the average tree diameter increases the logging costs per unit of volume decrease. Therefore, the increase in PNW will be progressively more as the diameter of the stand increases.

Projections of growth differences, as a result of vegetation control using herbicides, are more difficult to make. Controlling the vegetation does not really result in an increase in growth of the stand as much as it prevents a decrease in growth rates of the stand. Therefore, PNW projections with vegetation control costs deducted will show the stand reaching its site potential rather than any dramatic increase in volume and revenue figures.

Deducting the cost of spraying for hardwoods and brush ($65/acre) and grasses ($45/acre) shows a PNW (for a natural (untreated) stand at 60 years, projected back to the present) of $153/acre if hardwoods and brush are sprayed and $149/acre if grasses are also sprayed. If the growth of the stand to the projected volume and diameter is slowed down by two years, the PNW would decrease to $144/acre. From a

strictly financial viewpoint, vegetation control would pay for itself if the growth of the stand to a commercial size was slowed down just two years.

Recommended Silvicultural Alternative

Alternative II is recommended because the saplings growing are approaching the optimal age (10-15 years) and size (10-15') for pre-commercial thinning (PCT) to have the most desirable effects (see Discussion of Management Options). The pole sized trees growing are slightly beyond the optimal age and size but would still benefit from PCT. The simultaneous hand clearing of brush and hardwoods around crop trees would also release (temporarily) those seedlings still overtopped by vegetation. This will leave an equal distribution of 350-400 trees per acre, ranging from seedlings to poles with the majority being of sapling size. The stand should then reach a commercial size in 40 to 50 years; at which point the owners will be able to receive revenue from thinning. Spraying of herbicides (Alternative III) is not recommended for this stand for several reasons. One is the owners' reluctance to use herbicides unless absolutely necessary. Another reason is the age and height of the seedlings present now. At an earlier age when the seedlings were smaller the spraying of herbicides would have been more effective. However, the crop trees (8-12 years) now growing are above the level of the grasses present and it is questionable whether the additional expense of Atrazine and

Dapalon would be cost effective. Also, since the majority of crop trees growing now are overtopping the brush or close to it, with new leader growth averaging 1-1.2'/yr, the option of spraying for brush and hardwood control would be of questionable benefit, especially since the crop trees can be released through hand clearing around them while PCT is being carried out. Hand clearing of brush and hardwoods simultaneously during pre-commercial thinning would not cost much more than just thinning and would release the crop trees temporarily. Given the height of most crop trees already present, the temporary release of these trees for just 2-3 years would give them a chance to grow up above the brush. Another reason for not spraying the hardwoods is that the owners' would like to leave some for diversity within the stand, future firewood use and as a benefit to the wildlife.

Alternative I is not recommended because while not costing anything now it would result in postponed revenues from the stand due to the increased time period required for the trees to reach a merchantable size. The expense of PCT and hand clearing brush around seedlings is more than returned by increasing revenue from larger crop trees in a shorter period of time.

A final factor to consider, when spending money up front for timber stand improvement activities, is the state cost-share program which will pay up to 65 percent of the cost of these activities. If the owners present a plan to

the State prior to carrying out any management activities, have it approved by the local State Forester, they will then be eligible to receive up to 65 percent of their costs refunded. This would further increase the PNW of a future stand by reducing the cost of carrying out management activities.

Note: By following through with Alternative II, Stand B will eventually approach uneven aged management. While this is not the specific goal of managing this stand, it is also not undesirable. The thinning regimes proposed are a mixture of group selection and thinning from above. This will result in an irregular uneven-aged stand rather than a pure uneven-aged stand which follows a J curve through the different diameter classes. If, in the future, the owners decide they do not want an uneven-aged stand, management of the site can be changed at that time.

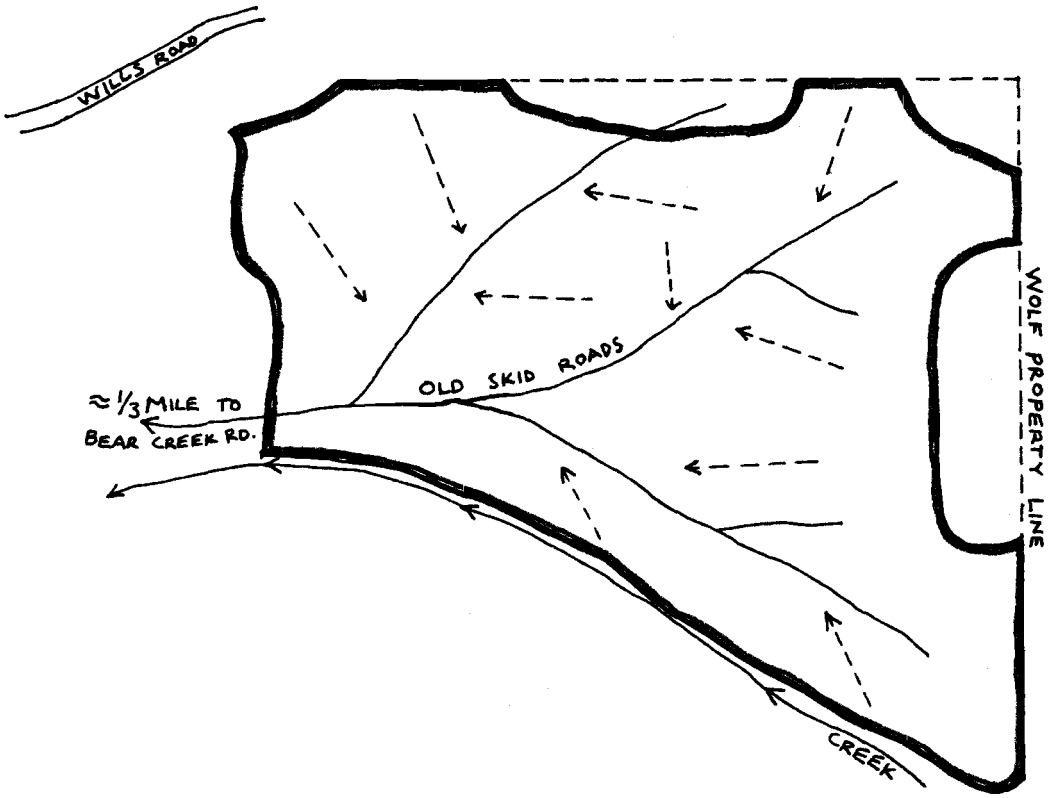
Implementation of Desired Alternative

1. Submit plan for timber stand improvement activities to the State of Oregon to enable owners to participate in cost-share program.
2. Precommercially thin and clear brush from around over-topped seedlings picked for crop trees (those seedlings which have established dominance over those around them). Brush to be cleared 4' out from lateral branches. These activities will be done simultaneously during one pass through the stand using brushcutters.

Thinning and hand clearing will leave desirable crop trees at an average spacing of 11 x 11 feet. This will leave approximately 360 trees per acre.

3. Conduct periodic surveys every five to ten years to monitor growth and size of trees growing on site. This will show the owners when the stand is approaching commercial size. This should occur when stand is between 40-55 years of age (30-40 years from present time).
4. When trees reach a desirable commercial size, reconstruct old logging road into stand, then thin stand from above leaving smaller trees to fill back in. Conduct future commercial thinnings as trees left reach a merchantable size and market conditions (higher prices for wood) dictate.

Trees will be directionally felled towards predetermined skid trails (in this case using some of the old skid trails left from previous logging activities), and winching logs to these trails, then to a decking area for hauling. All logging activities to be conducted during dry months in order to minimize damage to the soil. If natural regeneration does not come in underneath, consider hand planting, if stand has produced enough revenue to warrant spending money on this activity. By following this procedure it is hoped that the stand will not have to be clearcut. If this proves unfeasible, consideration will be given to a group selection method, with small areas being clearcut and new trees established before the adjoining areas are clearcut.



Boundary of Stand B

←--------- Direction trees will be felled and yarded to skid road. Logs will then be skidded down to log decking area. Longest yarding distance is 150'. Longest skidding distance approximately 1,000'.

Figure 2. Schematic Diagram of Stand B

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