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DOUGLAS -- FIR THINNING HANDBOOK

FIELD EDITION

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BUREAU OF LAND MANAGEMENT
OREGON STATE OFFICETHINNING HANDBOOK
DOUGLAS-FIR
October 1963Field Edition
May 1964SD
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DEFINITIONS

For purposes of definition we will refer to a thinning made in an immature stand which does not produce saleable products as being a precommercial thinning; to a thinning made in an immature stand which does produce saleable products and in which the residual trees are capable of response to release as being a commercial release thinning. To a thinning made in a young stand, no longer capable of significant response to release, for the salvage of dead trees and anticipated mortality as being a sanitation thinning.

Crown classification

Dominant The tallest trees in the stand. They receive full light from above and part from the side. The well-developed crown may be somewhat crowded on the sides.

Codominant These trees are in the upper level of the canopy, but below the dominants. They receive full light from above and a little from the side. The medium-sized crown is frequently crowded on the sides.

Intermediate Trees shorter than dominant or codominant, but with tip of crown extending into upper canopy and receiving some direct light from above but none from the sides. Crowns are small and are crowded on the sides.

Suppressed Crowns of these trees are below the upper canopy level and they receive no direct light from above nor from the side. Crowns are small and poorly developed.

PRUNING

All dead and dying limbs should be removed. Pruning of live limbs should progress gradually up the tree trunk as height is increased. It should never exceed more than $\frac{1}{3}$ of the crown length nor over 50% of total tree height. It should ultimately be carried to a height of 18 feet in order to produce a clear 16 foot log. Such pruning begun early enough will restrict the knotty core to a diameter of 4 or 5 inches.

The costs of the pruning operation require that it be confined to eventual crop trees. The number of trees required per acre for the site at harvest age will indicate the number of trees to be pruned initially. This number should be increased by 20% to provide a safety factor for error and loss during the development of the stand.

TABLE 2.—Yield tables for Douglas fir on fully stocked acre, total stand

TOTAL NUMBER OF TREES

Age (years)	Site Class V		Site Class IV				Site Class III				Site Class II				Site Class I			
	Site index		Site index		Site index		Site index		Site index		Site index		Site index		Site index		Site index	
	80	90	100	110	120	130	140	150	160	170	180	190	200	210	Number	Number	Number	Number
20	6,920	5,500	4,150	3,069	2,324	1,815	1,460	1,210	1,012	880	756	654	571	490	654	571	490	490
30	2,700	2,200	1,800	1,472	1,219	1,030	865	735	640	555	483	408	350	300	408	350	300	300
40	1,530	1,275	1,090	927	798	680	585	510	445	385	335	282	240	203	282	240	203	203
50	1,050	890	764	659	572	496	430	377	331	290	248	208	176	150	208	176	150	150
60	780	670	580	500	439	380	337	296	261	228	195	164	138	116	164	138	116	116
70	625	537	468	405	352	310	274	242	214	186	160	135	113	95	135	113	95	95
80	525	455	394	345	303	266	232	207	182	159	136	115	97	81	115	97	81	81
90	451	398	347	304	266	235	205	180	158	138	118	100	84	71	100	84	71	71
100	403	352	311	271	239	209	184	161	142	123	106	89	75	64	89	75	64	64
110	362	319	281	247	217	188	166	146	128	111	95	81	69	58	81	69	58	58
120	331	292	259	224	197	173	152	134	116	101	87	74	63	53	74	63	53	53
130	305	271	240	209	184	161	141	124	108	94	80	69	59	49	69	59	49	49
140	284	252	224	195	171	149	131	115	101	88	75	64	55	45	64	55	45	45
150	266	238	211	184	160	141	123	108	95	82	71	60	51	42	60	51	42	42
160	250	225	200	175	152	133	117	102	90	78	67	57	48	40	57	48	40	40

DIAMETER OF AVERAGE TREE AT BREASTHEIGHT

Age (years)	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
20	1.3	1.5	1.8	2.2	2.6	3.0	3.4	3.8	4.2	4.5	4.9	5.3	5.7	6.2	5.3	5.7	6.2	6.2
30	2.6	3.0	3.4	3.9	4.4	4.9	5.5	6.0	6.5	7.0	7.6	8.3	9.0	9.8	8.3	9.0	9.8	9.8
40	3.8	4.4	4.9	5.5	6.1	6.8	7.4	8.0	8.7	9.4	10.2	11.2	12.2	13.3	10.2	11.2	12.2	13.3
50	4.9	5.6	6.3	7.0	7.7	8.5	9.3	10.1	10.9	11.8	12.8	14.0	15.3	16.7	12.8	14.0	15.3	16.7
60	6.0	6.8	7.6	8.3	9.3	10.2	11.1	12.0	12.9	14.0	15.2	16.6	18.2	19.9	14.0	15.2	16.6	18.2
70	7.0	7.9	8.8	9.8	10.8	11.8	12.8	13.8	14.8	16.0	17.5	19.1	20.9	22.8	16.6	17.5	19.1	20.9
80	7.9	8.9	9.9	10.9	12.0	13.1	14.3	15.4	16.6	17.9	19.6	21.3	23.3	25.5	17.9	19.6	21.3	23.3
90	8.7	9.7	10.8	11.9	13.1	14.3	15.6	16.9	18.2	19.6	21.4	23.3	25.6	28.0	19.6	21.4	23.3	25.6
100	9.4	10.5	11.6	12.8	14.2	15.5	16.9	18.2	19.7	21.2	23.1	25.1	27.6	30.1	21.2	23.1	25.1	27.6
110	10.1	11.3	12.4	13.7	15.2	16.6	18.0	19.5	21.0	22.6	24.6	26.9	29.4	32.2	23.1	24.6	26.9	29.4
120	10.7	11.9	13.2	14.6	16.1	17.6	19.1	20.7	22.3	24.0	26.1	28.5	31.1	34.2	24.0	26.1	28.5	31.1
130	11.3	12.5	13.9	15.3	16.9	18.5	20.1	21.7	23.5	25.3	27.5	30.0	32.7	36.0	26.1	27.5	30.0	32.7
140	11.9	13.1	14.5	16.0	17.7	19.4	21.1	22.8	24.5	26.5	28.8	31.4	34.3	37.8	27.5	28.8	31.4	34.3
150	12.4	13.7	15.1	16.7	18.4	20.2	22.0	23.8	25.6	27.7	30.0	32.8	35.8	39.4	28.8	30.0	32.8	35.8
160	12.9	14.2	15.7	17.4	19.1	21.0	22.8	24.7	26.6	28.9	31.2	34.1	37.2	41.0	30.0	31.2	34.1	37.2

THE YIELD OF DOUGLAS FIR

Age (years)	Site Class V		Site Class IV			Site Class III			Site Class II			Site Class I		
	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index	Site index
	80	90	100	110	120	130	140	150	160	170	180	190	200	210

TOTAL BASAL AREA

20	Sq. ft. 64	Sq. ft. 70	Sq. ft. 76	Sq. ft. 81	Sq. ft. 86	Sq. ft. 89	Sq. ft. 92	Sq. ft. 95	Sq. ft. 97	Sq. ft. 98	Sq. ft. 99	Sq. ft. 100	Sq. ft. 101	Sq. ft. 102
30	96	105	114	122	129	135	140	144	147	150	152	153	154	155
40	121	132	143	153	162	170	177	182	186	189	191	193	195	196
50	140	153	165	177	187	196	204	210	214	217	220	222	224	226
60	154	169	182	195	207	217	226	232	237	241	244	246	248	250
70	166	183	197	211	224	235	244	251	256	260	264	266	268	270
80	177	194	210	224	238	249	259	266	271	276	280	283	285	287
90	185	204	220	235	249	262	272	279	285	290	294	297	299	301
100	193	212	229	245	260	273	283	291	297	302	306	309	312	314
110	200	220	238	254	269	282	292	301	307	313	317	320	323	325
120	206	226	245	261	277	290	301	310	316	322	326	329	332	335
130	213	233	251	268	284	298	309	318	325	331	335	338	341	344
140	218	238	257	275	291	305	317	326	333	338	343	347	350	353
150	223	243	263	281	298	312	324	333	340	346	351	354	357	360
160	227	248	268	287	304	318	331	340	347	353	357	361	364	367

TOTAL YIELD IN CUBIC FEET

20	Cu. ft. 520	Cu. ft. 620	Cu. ft. 730	Cu. ft. 870	Cu. ft. 990	Cu. ft. 1,120	Cu. ft. 1,250	Cu. ft. 1,380	Cu. ft. 1,490	Cu. ft. 1,550	Cu. ft. 1,650	Cu. ft. 1,730	Cu. ft. 1,830	Cu. ft. 1,920
30	1,330	1,610	1,930	2,270	2,630	2,980	3,300	3,610	3,880	4,110	4,330	4,530	4,750	4,990
40	2,110	2,520	3,020	3,560	4,150	4,690	5,250	5,750	6,160	6,550	6,900	7,220	7,500	7,830
50	2,840	3,410	4,080	4,780	5,540	6,300	7,050	7,730	8,300	8,840	9,320	9,770	10,150	10,560
60	3,500	4,200	5,010	5,880	6,800	7,760	8,700	9,490	10,200	10,860	11,450	12,000	12,500	12,960
70	4,090	4,920	5,820	6,830	7,880	8,900	9,700	11,060	11,900	12,660	13,300	13,950	14,500	15,080
80	4,580	5,510	6,530	7,690	8,900	10,240	11,350	12,400	13,360	14,220	14,990	15,700	16,350	16,970
90	5,000	6,010	7,120	8,400	9,810	11,160	12,390	13,500	14,600	15,540	16,400	17,190	17,880	18,500
100	5,350	6,420	7,620	9,000	10,510	11,940	13,270	14,460	15,600	16,610	17,550	18,370	19,140	19,820
110	5,640	6,780	8,050	9,500	11,080	12,610	14,000	15,290	16,500	17,560	18,510	19,390	20,200	20,940
120	5,900	7,080	8,410	9,920	11,580	13,180	14,600	15,990	17,240	18,340	19,320	20,220	21,090	21,870
130	6,130	7,340	8,730	10,290	12,000	13,650	15,140	16,560	17,870	19,000	20,000	20,980	21,840	22,660
140	6,340	7,600	9,020	10,620	12,370	14,080	15,610	17,090	18,410	19,590	20,640	21,610	22,520	23,360
150	6,520	7,810	9,280	10,920	12,710	14,490	16,080	17,560	18,910	20,130	21,270	22,250	23,170	24,030
160	6,670	8,000	9,500	11,200	13,040	14,850	16,490	18,010	19,380	20,650	21,820	22,830	23,780	24,660

TABLE 1.—Average total height of dominant and codominant trees, by site classes

Age (years)	Site Class V		Site Class IV			Site Class III			Site Class II			Site Class I		
	Site index 80	Site index 90	Site index 100	Site index 110	Site index 120	Site index 130	Site index 140	Site index 150	Site index 160	Site index 170	Site index 180	Site index 190	Site index 200	Site index 210
	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Feet</i>
20.....	21	24	26	29	31	34	37	39	42	44	47	49	52	54
30.....	37	41	46	50	55	60	64	69	74	78	83	88	92	96
40.....	48	54	60	66	72	78	84	90	96	102	108	114	120	126
50.....	56	63	70	77	84	91	98	105	112	119	125	132	139	146
60.....	63	70	78	86	93	101	109	117	124	132	140	148	156	163
70.....	68	77	85	94	102	110	119	127	135	144	152	161	170	178
80.....	73	82	91	100	109	118	127	136	145	154	163	172	181	190
90.....	77	86	96	105	115	125	134	144	153	163	172	182	192	201
100.....	80	90	100	110	120	130	140	150	160	170	180	190	200	210
110.....	83	93	104	114	124	135	145	155	166	176	187	197	207	218
120.....	85	96	106	117	128	138	149	160	170	181	192	202	213	224
130.....	87	98	109	119	131	141	152	163	174	185	196	207	218	228
140.....	88	99	110	121	133	144	154	166	177	188	199	210	221	232
150.....	89	101	112	123	134	145	156	168	179	190	201	213	224	235
160.....	90	102	113	124	136	147	158	170	181	192	203	215	226	237

As an example, if the age of the stand is 50 years, and the average total height of the dominant and codominant trees is 98 feet, Table 1 shows that this height at 50 years corresponds to site index 140,

BASAL AREAS IN SQUARE FEET
CORRESPONDING TO DIAMETERS IN INCHES

Diameter, inches	Diameter, tenths of an inch									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	Area, square feet									
1	0.006	0.007	0.008	0.009	0.011	0.012	0.014	0.016	0.018	0.020
2	0.022	0.024	0.026	0.029	0.031	0.034	0.037	0.040	0.043	0.046
3	0.049	0.052	0.056	0.059	0.063	0.067	0.071	0.075	0.079	0.083
4	0.087	0.092	0.096	0.101	0.106	0.111	0.115	0.121	0.126	0.131
5	0.136	0.142	0.147	0.153	0.159	0.165	0.171	0.177	0.184	0.190
6	0.196	0.203	0.210	0.216	0.223	0.230	0.238	0.245	0.252	0.260
7	0.267	0.275	0.283	0.291	0.299	0.307	0.315	0.323	0.332	0.340
8	0.349	0.358	0.367	0.376	0.385	0.394	0.403	0.413	0.422	0.432
9	0.442	0.452	0.462	0.472	0.482	0.492	0.503	0.513	0.524	0.535
10	0.545	0.556	0.568	0.579	0.590	0.601	0.613	0.625	0.636	0.648
11	0.660	0.672	0.684	0.697	0.709	0.721	0.734	0.747	0.760	0.772
12	0.785	0.799	0.812	0.825	0.839	0.852	0.866	0.880	0.894	0.908
13	0.922	0.936	0.950	0.965	0.979	0.994	1.009	1.024	1.039	1.054
14	1.069	1.084	1.100	1.115	1.131	1.147	1.163	1.179	1.195	1.211
15	1.227	1.244	1.260	1.277	1.294	1.310	1.327	1.344	1.362	1.379
16	1.396	1.414	1.431	1.449	1.467	1.485	1.503	1.521	1.539	1.558
17	1.576	1.595	1.614	1.632	1.651	1.670	1.689	1.709	1.728	1.748
18	1.767	1.787	1.807	1.827	1.847	1.867	1.887	1.907	1.928	1.948
19	1.969	1.990	2.011	2.032	2.053	2.074	2.095	2.117	2.138	2.160
20	2.181	2.204	2.226	2.248	2.270	2.292	2.315	2.337	2.360	2.383
21	2.405	2.428	2.451	2.475	2.498	2.521	2.545	2.568	2.592	2.616
22	2.640	2.664	2.688	2.712	2.737	2.761	2.786	2.810	2.835	2.860
23	2.885	2.910	2.936	2.961	2.986	3.012	3.038	3.064	3.089	3.115
24	3.142	3.168	3.194	3.221	3.247	3.275	3.301	3.328	3.355	3.382
Diam- eter, in.	Area, sq. ft.	Diam- eter, in.	Area, sq. ft.	Diam- eter, in.	Area, sq. ft.	Diam- eter, in.	Area, sq. ft.	Diam- eter, in.	Area, sq. ft.	
25	3.41	32	5.59	39	8.30	46	11.54	53	15.32	
26	3.69	33	5.94	40	8.73	47	12.05	54	15.90	
27	3.98	34	6.30	41	9.17	48	12.57	55	16.50	
28	4.28	35	6.68	42	9.62	49	13.10	56	17.10	
29	4.59	36	7.07	43	10.08	50	13.64	57	17.72	
30	4.91	37	7.47	44	10.56	51	14.19	58	18.35	
31	5.24	38	7.88	45	11.04	52	14.75	59	18.99	

TABLE VI

Periodic Annual Mortality per Acre for Fully Stocked Douglas-fir

Board Feet - International Rule 1/
(1/3-inch kerf)

Age Period	SITE CLASS				
	I	II	III	IV	V
<u>Years</u>	<u>Board Feet</u>				
20 - 30	40	30	--	--	--
30 - 40	220	140	100	30	--
40 - 50	390	250	160	80	10
50 - 60	560	350	210	140	50
60 - 70	730	430	260	170	60
70 - 80	910	520	300	170	80
80 - 90	960	600	330	170	80
90 - 100	970	660	360	160	80
100 - 110	950	690	370	160	90
110 - 120	930	700	380	160	80
120 - 130	910	690	390	150	80
130 - 140	890	680	390	150	80
140 - 150	860	660	380	150	90
150 - 160	830	640	380	140	80

1/ All trees 7 inches D.B.H. and larger to 5-inch top. Stump height 1.5 feet. Scaling length 16 feet with 0.3 feet trim allowance.

Gross Yield and Mortality Tables for Fully-stocked Stands of Douglas-fir
Pacific Northwest Forest and Range Experiment Station
Research Paper No. 14

TABLE VII

Periodic Annual Mortality per Acre for Fully Stocked Douglas-fir

Board Feet - Scribner Rule 1/

Age Period	SITE CLASS				
	I	II	III	IV	V
<u>Years</u>	<u>Board Feet</u>				
20 - 30	--	--	--	--	--
30 - 40	50	20	--	--	--
40 - 50	90	40	20	--	--
50 - 60	180	80	40	10	--
60 - 70	370	120	50	20	--
70 - 80	600	180	70	30	10
80 - 90	680	300	80	40	10
90 - 100	700	400	110	40	10
100 - 110	700	460	140	50	10
110 - 120	690	480	180	50	10
120 - 130	690	480	230	40	20
130 - 140	680	480	250	40	20
140 - 150	670	470	250	40	20
150 - 160	660	450	240	40	20

1/ All trees 12 inches D.B.H. and larger to 8-inch top. Stump height 2.0 feet. Scaling length 16 feet with 0.3 feet trim allowance.

Gross Yield and Mortality Tables for Fully-stocked Stands of Douglas-fir
Pacific Northwest Forest and Range Experiment Station
Research Paper No. 14

TABLE IX

Cumulative Mortality per Acre for Fully Stocked Douglas-fir

Board Feet - International Rule 1/
(1/8-inch kerf)

Age	SITE CLASS				
	I	II	III	IV	V
<u>Years</u>	<u>Board Feet</u>				
30	400	300	--	--	--
40	2,600	1,700	1,000	300	--
50	6,500	4,200	2,600	1,100	100
60	12,100	7,700	4,700	2,500	600
70	19,400	12,000	7,300	4,200	1,200
80	28,500	17,200	10,300	5,900	2,000
90	38,100	23,200	13,600	7,600	2,800
100	47,800	29,800	17,200	9,200	3,600
110	57,300	36,700	20,900	10,800	4,500
120	66,600	43,700	24,700	12,400	5,300
130	75,700	50,600	28,600	13,900	6,100
140	84,600	57,400	32,500	15,400	6,900
150	93,200	64,000	36,300	16,900	7,300
160	101,500	70,400	40,100	18,300	8,600

1/ All trees 7 inches D.B.H. and larger to 5-inch top. Stump height 1.5 feet. Scaling length 16 feet with 0.3 feet trim allowance.

Gross Yield and Mortality Tables for Fully-stocked Stands of Douglas-fir
Pacific Northwest Forest and Range Experiment Station
Research Paper No. 14

TABLE VIII

Cumulative Mortality per Acre for Fully Stocked Douglas-fir

Board Feet - Scribner Rule 1/

Age	SITE CLASS				
	I	II	III	IV	V
<u>Years</u>	<u>Board Feet</u>				
40	500	200	--	--	--
50	1,400	600	200	--	--
60	3,200	1,400	600	100	--
70	6,900	2,600	1,100	300	--
80	12,900	4,400	1,800	600	100
90	19,700	7,400	2,600	1,000	200
100	26,700	11,400	3,700	1,400	300
110	33,700	16,000	5,100	1,900	400
120	40,600	20,800	6,900	2,400	500
130	47,500	25,600	9,200	2,800	700
140	54,300	30,400	11,700	3,200	900
150	61,000	35,100	14,200	3,600	1,100
160	67,600	39,600	16,600	4,000	1,300

1/ All trees 12 inches D.B.H. and larger to 8-inch top. Stump height 2.0 feet. Scaling length 16 feet with 0.3 feet trim allowance.

Gross Yield and Mortality Tables for Fully-stocked Stands of Douglas-fir
Pacific Northwest Forest and Range Experiment Station
Research Paper No. 14

EXAMPLES OF MORTALITY CALCULATIONS

Example One:

70 year old stand site III
First thinning at age 70
Thinning interval - 10 years
From Table VI, mortality for period
70-80 years - 3,000 bd. ft.

This anticipated mortality volume including any dead merchantable trees may be removed at age 70.

Example Two:

Second thinning same stand at 80 years
From Table VI, mortality for period 80-90 years,
3,300 bd. ft.

This anticipated mortality volume may be removed in the second thinning at age 80.

Example Three:

Age of stand 90 years, site III
Length rotation 100 years
Average age at time of cutting 120 years
From Table IX

Cumulative mortality	120 years	24,700 bd. ft.
Cumulative mortality	90 years	<u>13,600 bd. ft.</u>

Anticipated mortality which may be removed in first and only thinning at 90 years of age	11,100 bd. ft.
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CRUISING

All thinnings will be cruised 100%. The tally sheets, Form No. A-87 (Exhibit e), can easily be used for cruising thinnings. However, any type of tally sheet may be used, as the cruiser sees fit. Trees need be tallied only by DBH in 2" classes from 8" to 20" (20" class includes trees with 21.9" DBH) and total height to the nearest 10' - no form class and no log grade. Of course, it will be necessary to keep notes on any cull material present. Volumes are quite easily determined by multiplying each tally by the volume of each DBH-Height category as found in the volume table (Exhibit a). Logs will not be graded.

APPRAISALS

1. General

The same general system used for appraising regular Douglas-fir sales will be used for appraising thinnings. That is, the milling and logging costs will be deducted from the realization value to determine a conversion return which is multiplied by .50 to derive the stumpage value.

2. Realization Values

As pointed out in the section on cruising, there will not be different realization values for different log grades or diameters. Only one realization value will be determined and it will be effective for the range of DBH classes up to 20". Material larger than this should be cruised and appraised under the conventional system.

3. Milling Costs

Use one milling cost, that for the group of logs having the range of lowest volumes, those up to 80 board feet, for all thinning sales. (Timber Sales Handbook, Chapter III-F, Exhibit a)

4. Logging Costs

Falling, bucking, yarding, loading per Mbf - \$18.90.

A weight equivalent of 11,000 lbs. per M bd.ft. Scribner Decimal C is used as the key to the transportation cost tables.

Pond value: November 18, 1963
\$39.50

5. Conversion Factor

Scribner Decimal C Volume for Reporting Purposes

When the occasion arises in which it is necessary to determine the volume of the material in thinnings in terms of the Scribner Decimal C rule, the International 1/8 inch rule volume should be multiplied by the converting factor of .8.

UNITED STATES
 Form No. AI-87 DEPARTMENT OF THE INTERIOR Computer Sale No. _____
 October 1961 BUREAU OF LAND MANAGEMENT Subsale No. _____
 District Portland Species _____
 District Sale No. P10 TALLY SHEET Form Class _____
 Cruiser Douglas Green Defect Factor by Log _____
 Sheet No. _____ Grade Code: 1-3 _____
 Date Oct. 1, 1963 4-6 _____
 T. 15 R. 15 N Sec. 1 Sub. NE 1/4 NE 1/4

DBH Logs	Log Code per Position													No. of Trees
	1	2	3	4	5	6	7	8	9	10	11	12	13	
						Bd. ft. Volume Int. %					Cu. ft. Volume			
8-70						1	04					19.0		" 2
8-80							64					11.1		" 1
10-90						2	40					37.6		" 2
10-100						6	90				1	03.5		" 5
12-110						11	50				1	64.5		" 5
14-90						2	50					363		" 1
14-100						2	74					40.0		" 1
14-120						3	46					48.0		" 1
18-120						5	40					74.1		" 1
18-140						6	72					88.0		" 1
						Bd. ft. Volume 4320 (Nearest M bd. ft.) 4M					Cu. ft. Volume 622.0 Cu. ft. ratio 622.0 4.320			
											622.0 = 144 4.320			
											144 x 4M (1/8 International rounded Volume)			
											= 576			
											Approx Cu. ft. Volume for comparative purposes 580			

Totals: Graded-Lines _____ Trees _____ Ungraded-Lines _____ Trees _____

INTERIOR - PORTLAND, OREGON

Exhibit e

EXAMPLE:

Pond value per Mbf	\$42.00
Falling, bucking, yarding and loading	<u>-18.90</u>
	\$23.10

Transportation Cost

(95% recovery, 11,000# per M;
2% rise and fall; 10-20% rise;
3 miles dirt, 20 miles gravel,
5 miles surfaced)

	<u>-8.60</u>
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Conversion return	\$14.50
Stumpage factor	x <u>.5</u>

Stumpage per Mbf	\$ 7.25	(rounded to nearest \$0.05)
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Stumpage (\$7.25) x volume (4 M bd. ft.) = \$29.00 (total value)

Exhibit f

This volume table is to be used for estimates only. Volumes for appraisal purposes will be obtained from form factor volume tables.

VOLUME TABLE FOR YOUNG GROWTH DOUGLAS-FIR

Volumes for trees are determined by the International 1/8-inch log rule for 16' log lengths to a top diameter of 5 inches inside the bark

D.B.H. inches	Board-foot volume when total height of tree in feet is																						
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	
7	12	18	24	32	40	48	56	66	78	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
8	16	22	32	42	52	64	76	88	102	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
9	20	30	42	54	66	82	96	112	128	144	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
10	24	36	52	68	84	102	120	138	158	180	200	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
11	28	46	62	80	102	124	146	168	194	218	242	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
12	32	54	76	98	122	148	174	200	230	260	288	320	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
13	36	64	90	114	144	176	206	238	270	302	336	374	416	-----	-----	-----	-----	-----	-----	-----	-----	-----	
14	40	72	104	134	166	202	240	274	310	346	388	430	480	524	-----	-----	-----	-----	-----	-----	-----	-----	
15	44	80	112	144	180	220	260	300	340	380	420	460	500	540	580	-----	-----	-----	-----	-----	-----	-----	
16	48	88	124	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800	840	880	
17	52	96	136	176	220	264	308	352	396	440	484	528	572	616	660	704	748	792	836	880	924	968	
18	56	104	148	192	240	288	336	384	432	480	528	576	624	672	720	768	816	864	912	960	1008	1056	
19	60	112	160	208	260	312	360	408	456	504	552	600	648	696	744	792	840	888	936	984	1032	1080	
20	64	120	172	224	280	336	392	448	504	560	616	672	728	784	840	896	952	1008	1064	1120	1176	1232	
21	68	128	184	240	300	360	420	480	540	600	660	720	780	840	900	960	1020	1080	1140	1200	1260	1320	
22	72	136	196	256	320	384	448	512	576	640	704	768	832	896	960	1024	1088	1152	1216	1280	1344	1408	
23	76	144	208	272	340	408	476	544	612	680	748	816	884	952	1020	1088	1156	1224	1292	1360	1428	1496	
24	80	152	216	288	360	432	504	576	648	720	792	864	936	1008	1080	1152	1224	1296	1368	1440	1512	1584	
25	84	160	224	304	384	464	544	624	704	784	864	944	1024	1104	1184	1264	1344	1424	1504	1584	1664	1744	
26	88	168	232	316	400	488	576	664	752	840	928	1016	1104	1192	1280	1368	1456	1544	1632	1720	1808	1896	
27	92	176	240	328	416	508	600	696	792	888	984	1080	1176	1272	1368	1464	1560	1656	1752	1848	1944	2040	
28	96	184	248	336	432	528	624	720	816	912	1008	1104	1200	1296	1392	1488	1584	1680	1776	1872	1968	2064	
29	100	192	256	344	448	544	640	736	832	928	1024	1120	1216	1312	1408	1504	1600	1696	1792	1888	1984	2080	
30	104	200	264	352	464	560	656	752	848	944	1040	1136	1232	1328	1424	1520	1616	1712	1808	1904	1999	2095	
31	108	208	272	360	472	568	664	760	856	952	1048	1144	1240	1336	1432	1528	1624	1720	1816	1912	2007	2103	
32	112	216	280	368	480	576	672	768	864	960	1056	1152	1248	1344	1440	1536	1632	1728	1824	1920	2015	2111	
33	116	224	288	376	488	584	680	776	872	968	1064	1160	1256	1352	1448	1544	1640	1736	1832	1928	2023	2119	
34	120	232	296	384	496	592	688	784	880	976	1072	1168	1264	1360	1456	1552	1648	1744	1840	1936	2031	2127	
35	124	240	304	392	504	600	696	792	888	984	1080	1176	1272	1368	1464	1560	1656	1752	1848	1944	2039	2135	
36	128	248	312	400	512	608	704	800	896	992	1088	1184	1280	1376	1472	1568	1664	1760	1856	1952	2047	2143	
37	132	256	320	408	520	616	712	808	904	1000	1096	1192	1288	1384	1480	1576	1672	1768	1864	1960	2055	2151	
38	136	264	328	416	528	624	720	816	912	1008	1104	1200	1296	1392	1488	1584	1680	1776	1872	1968	2063	2159	
39	140	272	336	424	536	632	728	824	920	1016	1112	1208	1304	1400	1496	1592	1688	1784	1880	1976	2071	2167	
40	144	280	344	432	544	640	736	832	928	1024	1120	1216	1312	1408	1504	1600	1696	1792	1888	1984	2079	2175	
41	148	288	352	440	552	648	744	840	936	1032	1128	1224	1320	1416	1512	1608	1704	1800	1896	1992	2087	2183	
42	152	296	360	448	560	656	752	848	944	1040	1136	1232	1328	1424	1520	1616	1712	1808	1904	1999	2095	2191	
43	156	304	368	456	568	664	760	856	952	1048	1144	1240	1336	1432	1528	1624	1720	1816	1912	2007	2103	2199	
44	160	312	376	464	576	672	768	864	960	1056	1152	1248	1344	1440	1536	1632	1728	1824	1920	2015	2111	2207	
45	164	320	384	472	584	680	776	872	968	1064	1160	1256	1352	1448	1544	1640	1736	1832	1928	2023	2119	2215	
46	168	328	392	480	592	688	784	880	976	1072	1168	1264	1360	1456	1552	1648	1744	1840	1936	2031	2127	2223	
47	172	336	400	488	600	696	792	888	984	1080	1176	1272	1368	1464	1560	1656	1752	1848	1944	2039	2135	2231	
48	176	344	408	496	608	704	800	896	992	1088	1184	1280	1376	1472	1568	1664	1760	1856	1952	2047	2143	2239	
49	180	352	416	504	616	712	808	904	1000	1096	1192	1288	1384	1480	1576	1672	1768	1864	1960	2055	2151	2247	
50	184	360	424	512	624	720	816	912	1008	1104	1200	1296	1392	1488	1584	1680	1776	1872	1968	2063	2159	2255	
51	188	368	432	520	632	728	824	920	1016	1112	1208	1304	1400	1496	1592	1688	1784	1880	1976	2071	2167	2263	
52	192	376	440	528	640	736	832	928	1024	1120	1216	1312	1408	1504	1600	1696	1792	1888	1984	2079	2175	2271	
53	196	384	448	536	648	744	840	936	1032	1128	1224	1320	1416	1512	1608	1704	1800	1896	1992	2087	2183	2279	
54	200	392	456	544	656	752	848	944	1040	1136	1232	1328	1424	1520	1616	1712	1808	1904	1999	2095	2191	2287	

Reprinted from: "Table 7, Volume Tables for Pacific Northwest Trees" - Agriculture Handbook No. 92.

CUBIC FOOT VOLUME TABLE FOR YOUNG GROWTH DOUGLAS-FIR

Volumes for trees are determined to a top diameter inside bark of 4" from a stump height equal to the diameter breast height with a maximum of 24"

D.B.H. inches	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
6	1.2	1.9	2.7	3.4	4.1	4.8	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	11.2	11.9	12.6	13.3	14.0	14.7	15.4	16.1	16.8
7	2.0	3.0	4.0	5.1	6.0	7.1	8.3	9.4	10.5	11.6	12.7	13.8	14.9	16.0	17.1	18.2	19.3	20.4	21.5	22.6	23.7	24.8	25.9
8	2.7	4.1	5.4	6.8	8.0	9.5	11.1	12.4	13.8	15.1	16.5	17.8	19.2	20.5	21.9	23.2	24.6	25.9	27.3	28.6	29.9	31.2	32.5
9	3.6	5.3	7.1	8.7	10.4	12.3	14.1	15.8	17.5	19.2	20.9	22.6	24.3	26.0	27.7	29.4	31.1	32.8	34.5	36.2	37.9	39.6	41.3
10	4.5	6.6	8.7	10.6	12.9	15.1	17.2	19.3	21.4	23.5	25.6	27.7	29.8	31.9	34.0	36.1	38.2	40.3	42.4	44.5	46.6	48.7	50.8
11	5.4	7.9	10.4	12.9	15.4	17.9	20.4	22.9	25.4	27.9	30.4	32.9	35.4	37.9	40.4	42.9	45.4	47.9	50.4	52.9	55.4	57.9	60.4
12	6.3	9.1	12.0	15.0	18.0	21.0	24.0	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0	51.0	54.0	57.0	60.0	63.0	66.0	69.0	72.0
13	7.2	10.4	13.7	17.0	20.3	23.6	26.9	30.2	33.5	36.8	40.1	43.4	46.7	50.0	53.3	56.6	59.9	63.2	66.5	69.8	73.1	76.4	79.7
14	8.1	11.5	14.9	18.3	21.7	25.1	28.5	31.9	35.3	38.7	42.1	45.5	48.9	52.3	55.7	59.1	62.5	65.9	69.3	72.7	76.1	79.5	82.9
15	9.0	12.6	16.2	19.8	23.4	27.0	30.6	34.2	37.8	41.4	45.0	48.6	52.2	55.8	59.4	63.0	66.6	70.2	73.8	77.4	81.0	84.6	88.2
16	10.0	13.8	17.6	21.4	25.2	29.0	32.8	36.6	40.4	44.2	48.0	51.8	55.6	59.4	63.2	67.0	70.8	74.6	78.4	82.2	86.0	89.8	93.6
17	11.0	15.0	19.0	23.0	27.0	31.0	35.0	39.0	43.0	47.0	51.0	55.0	59.0	63.0	67.0	71.0	75.0	79.0	83.0	87.0	91.0	95.0	99.0
18	12.0	16.2	20.4	24.6	28.8	33.0	37.2	41.4	45.6	49.8	54.0	58.2	62.4	66.6	70.8	75.0	79.2	83.4	87.6	91.8	96.0	100.2	104.4
19	13.0	17.4	21.8	26.2	30.6	35.0	39.4	43.8	48.2	52.6	57.0	61.4	65.8	70.2	74.6	79.0	83.4	87.8	92.2	96.6	101.0	105.4	109.8
20	14.0	18.6	23.2	27.8	32.4	37.0	41.6	46.2	50.8	55.4	60.0	64.6	69.2	73.8	78.4	83.0	87.6	92.2	96.8	101.4	106.0	110.6	115.2
21	15.0	19.8	24.6	29.4	34.2	39.0	43.8	48.6	53.4	58.2	63.0	67.8	72.6	77.4	82.2	87.0	91.8	96.6	101.4	106.2	111.0	115.8	120.6
22	16.0	20.8	25.6	30.4	35.2	40.0	44.8	49.6	54.4	59.2	64.0	68.8	73.6	78.4	83.2	88.0	92.8	97.6	102.4	107.2	112.0	116.8	121.6
23	17.0	21.8	26.6	31.4	36.2	41.0	45.8	50.6	55.4	60.2	65.0	69.8	74.6	79.4	84.2	89.0	93.8	98.6	103.4	108.2	113.0	117.8	122.6
24	18.0	22.8	27.6	32.4	37.2	42.0	46.8	51.6	56.4	61.2	66.0	70.8	75.6	80.4	85.2	90.0	94.8	99.6	104.4	109.2	114.0	118.8	123.6
25	19.0	23.8	28.6	33.4	38.2	43.0	47.8	52.6	57.4	62.2	67.0	71.8	76.6	81.4	86.2	91.0	95.8	100.6	105.4	110.2	115.0	119.8	124.6
26	20.0	24.8	29.6	34.4	39.2	44.0	48.8	53.6	58.4	63.2	68.0	72.8	77.6	82.4	87.2	92.0	96.8	101.6	106.4	111.2	116.0	120.8	125.6
27	21.0	25.8	30.6	35.4	40.2	45.0	49.8	54.6	59.4	64.2	69.0	73.8	78.6	83.4	88.2	93.0	97.8	102.6	107.4	112.2	117.0	121.8	126.6
28	22.0	26.8	31.6	36.4	41.2	46.0	50.8	55.6	60.4	65.2	70.0	74.8	79.6	84.4	89.2	94.0	98.8	103.6	108.4	113.2	118.0	122.8	127.6
29	23.0	27.8	32.6	37.4	42.2	47.0	51.8	56.6	61.4	66.2	71.0	75.8	80.6	85.4	90.2	95.0	99.8	104.6	109.4	114.2	119.0	123.8	128.6
30	24.0	28.8	33.6	38.4	43.2	48.0	52.8	57.6	62.4	67.2	72.0	76.8	81.6	86.4	91.2	96.0	100.8	105.6	110.4	115.2	120.0	124.8	129.6
31	25.0	29.8	34.6	39.4	44.2	49.0	53.8	58.6	63.4	68.2	73.0	77.8	82.6	87.4	92.2	97.0	101.8	106.6	111.4	116.2	121.0	125.8	130.6
32	26.0	30.8	35.6	40.4	45.2	50.0	54.8	59.6	64.4	69.2	74.0	78.8	83.6	88.4	93.2	98.0	102.8	107.6	112.4	117.2	122.0	126.8	131.6
33	27.0	31.8	36.6	41.4	46.2	51.0	55.8	60.6	65.4	70.2	75.0	79.8	84.6	89.4	94.2	99.0	103.8	108.6	113.4	118.2	123.0	127.8	132.6
34	28.0	32.8	37.6	42.4	47.2	52.0	56.8	61.6	66.4	71.2	76.0	80.8	85.6	90.4	95.2	100.0	104.8	109.6	114.4	119.2	124.0	128.8	133.6
35	29.0	33.8	38.6	43.4	48.2	53.0	57.8	62.6	67.4	72.2	77.0	81.8	86.6	91.4	96.2	101.0	105.8	110.6	115.4	120.2	125.0	129.8	134.6
36	30.0	34.8	39.6	44.4	49.2	54.0	58.8	63.6	68.4	73.2	78.0	82.8	87.6	92.4	97.2	102.0	106.8	111.6	116.4	121.2	126.0	130.8	135.6
37	31.0	35.8	40.6	45.4	50.2	55.0	59.8	64.6	69.4	74.2	79.0	83.8	88.6	93.4	98.2	103.0	107.8	112.6	117.4	122.2	127.0	131.8	136.6
38	32.0	36.8	41.6	46.4	51.2	56.0	60.8	65.6	70.4	75.2	80.0	84.8	89.6	94.4	99.2	104.0	108.8	113.6	118.4	123.2	128.0	132.8	137.6
39	33.0	37.8	42.6	47.4	52.2	57.0	61.8	66.6	71.4	76.2	81.0	85.8	90.6	95.4	100.2	105.0	109.8	114.6	119.4	124.2	129.0	133.8	138.6
40	34.0	38.8	43.6	48.4	53.2	58.0	62.8	67.6	72.4	77.2	82.0	86.8	91.6	96.4	101.2	106.0	110.8	115.6	120.4	125.2	130.0	134.8	139.6
41	35.0	39.8	44.6	49.4	54.2	59.0	63.8	68.6	73.4	78.2	83.0	87.8	92.6	97.4	102.2	107.0	111.8	116.6	121.4	126.2	131.0	135.8	140.6
42	36.0	40.8	45.6	50.4	55.2	60.0	64.8	69.6	74.4	79.2	84.0	88.8	93.6	98.4	103.2	108.0	112.8	117.6	122.4	127.2	132.0	136.8	141.6
43	37.0	41.8	46.6	51.4	56.2	61.0	65.8	70.6	75.4	80.2	85.0	89.8	94.6	99.4	104.2	109.0	113.8	118.6	123.4	128.2	133.0	137.8	142.6
44	38.0	42.8	47.6	52.4	57.2	62.0	66.8	71.6	76.4	81.2	86.0	90.8	95.6	100.4	105.2	110.0	114.8	119.6	124.4	129.2	134.0	138.8	143.6
45	39.0	43.8	48.6	53.4	58.2	63.0	67.8	72.6	77.4	82.2	87.0	91.8	96.6	101.4	106.2	111.0	115.8	120.6	125.4	130.2	135.0	139.8	144.6
46	40.0	44.8	49.6	54.4	59.2	64.0	68.8	73.6	78.4	83.2	88.0	92.8	97.6	102.4	107.2	112.0	116.8	121.6	126.4	131.2	136.0	140.8	145.6
47	41.0	45.8	50.6	55.4	60.2	65.0	69.8	74.6	79.4	84.2	89.0	93.8	98.6	103.4	108.2	113.0	117.8	122.6	127.4	132.2	137.0	141.8	146.6
48	42.0	46.8	51.6	56.4	61.2	66.0	70.8	75.6	80.4	85.2	90.0	94.8	99.6	104.4	109.2	114.0	118.8	123.6	128.4	133.2	138.0	142.8	147.6
49	43.0	47.8	52.6	57.4	62.2	67.0	71.8	76.6	81.4	86.2	91.0	95.8	100.6	105.4	110.2	115.0	119.8	124.6	129.4	134.2	139.0	143.8	148.6
50	44.0	48.8	53.6	58.4	63.2	68.0	72.8	77.6	82.4	87.2	92.0	96.8	101.6	106.4	111.2	116.0	120.8	125.6	130.4	135.2	140.0	144.8	149.6
51	45.0	49.8	54.6	59.4	64.2	69.0	73.8	78.6	83.4	88.2	93.0	97.8	102.6	107.4	112.2	117.0	121.8	126.6	131.4	136.2	141.0	145.8	150.6
52	46.0	50.8	55.6	60.4	65.2	70.0	74.8	79.6	84.4	89.2	94.0	98.8	103.6	108.4	113.2	118.0	122.8	127.6	132.4	137.2	142.0	146.8	151.6
53	47.0	51.8	56.6	61.4	66.2	71.0	75.8	80.6	85.4	90.2	95.0	99.8	104.6	109.4	114.2	119.0	123.8	128.6	133.4	138.2	143.0	147.8	152.6
54	48.0	52.8	57.6	62.4	67.2	72.0	76.8	81.6	86.4	91.2	96.0	100.8	105.6	110.4	115.2	120.0	124.8	129.6	134.4	139.2	144.0	148.8	153.6

Reprinted from: "Table 5, Volume Tables for Pacific Northwest Trees" - Agriculture Handbook No. 92.

PRIORITIES OF THINNING

1. Precommercial

Limitations of funds available for the purpose, the existing degree of stocking, and site productivity will require a determination by priority of areas to be precommercially thinned. Site, accessibility, stocking, age, and topography will be prime matters of consideration.

2. Commercial and Sanitation

The older young growth stands qualifying for sanitation thinnings contain large volumes of merchantable material in imminent danger of loss. This is a serious economic matter both from the standpoint of the loss of values involved and the loss of raw products needed by industry. Therefore, top priority will be given to sanitation thinnings in order to recover these values and volumes.

Stands qualifying for commercial release thinnings also face these losses of values and volumes. However, due to the younger ages of these stands, potential volume and value losses are much less, comparatively, and the situation is judged less critical than that which exists in the older stands. For that reason a lower economic priority is given to stands qualifying for commercial release thinning.

A clearcut decision confining thinning on a basis of priority exclusively to the sanitation type cannot be made. The operational feasibility of individual areas and the access to them among other things are determining factors in the type of stands available for thinning.

The type of thinning will be fitted to the needs of available stands. Accordingly, sanitation and commercial thinnings will usually be carried on simultaneously in most districts.

Site II
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First Thinning at Indicated Years

<u>Ten Years</u>				<u>Twenty Years</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
10		302	12 x 12				
20	7.	227	14 x 14	20	4.5	409	10 x 10
30	11.	165	16 x 16	30	8.2	262	13 x 13
40	14.5	130	18 x 18	40	11.5	195	15 x 15
50	17.5	108	20 x 20	50	14.3	158	16.5 x 16.5
60	20.3	92	21.5 x 21.5	60	16.8	131	18 x 18
70	22.8	81	23 x 23	70	19.1	113	20 x 20
80	25.0	81	23 x 23	80	21.2	113	20 x 20

<u>Thirty Years</u>				<u>Forty Years</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
30	7.	340	11 x 11				
40	10.1	243	13 x 13	40	9.4	276	13 x 13
50	12.8	191	15 x 15	50	12.0	217	14 x 14
60	15.2	158	16.5 x 16.5	60	14.3	178	15.5 x 15.5
70	17.4	134	18 x 18	70	16.4	150	17 x 17
80	19.4	134	18 x 18	80	18.4	150	17 x 17

<u>Fifty Years</u>				<u>Normal Stand</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
50	11.8	227	14 x 14	10			
60	14.0	187	15 x 15	20	4.5	880	7 x 7
70	16.0	157	16.5 x 16.5	30	7.0	555	9 x 9
80	18.0	157	16.5 x 16.5	40	9.4	385	10.5 x 10.5
				50	11.8	290	12 x 12
				60	14.0	228	14 x 14
				70	16.0	180	15 x 15
				80	17.9	159	16.5 x 16.5

Site III

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First Thinning at Indicated Years

<u>Ten Years</u>				<u>Twenty Years</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
10		436	10 x 10	10			
20	5.8	332	11 x 11	20	3.4	666	6.5x 6.5
30	8.8	245	13 x 13	30	6.2	428	10 x 10
40	11.5	194	15 x 15	40	8.7	309	12 x 12
50	13.9	160	16.5 x 16.5	50	11.0	241	13 x 13
60	16.1	137	18 x 18	60	13.1	197	15 x 15
70	18.1	118	19 x 19	70	15.1	167	16 x 16
80	20.0	118	19 x 19	80	16.9	167	16 x 16

<u>Thirty Years</u>				<u>Forty Years</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
10				10			
20				20			
30	5.5	520	9 x 9	30			
40	7.9	367	11 x 11	40	7.4	414	10 x 10
50	10.1	283	12 x 12	50	9.5	313	11 x 11
60	12.1	230	14 x 14	60	11.5	253	13 x 13
70	14.0	190	15 x 15	70	13.3	204	15 x 15
80	15.8	190	15 x 15	80	15.0	204	15 x 15

<u>Fifty Years</u>				<u>Normal Stand</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
10							
20				20	3.4	1460	5.5x 5.5
30				30	5.5	865	7 x 7
40				40	7.4	585	9 x 9
50	9.3	330	11.5 x 11.5	50	9.3	430	10 x 10
60	11.2	264	13 x 13	60	11.1	337	11 x 11
70	13.0	223	14 x 14	70	12.8	274	12.5 x 12.5
80	14.6	223	14 x 14	80	14.3	232	14 x 14

Site IV

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First Thinning at Indicated Years

Ten to Twenty Years				<u>Thirty Years</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
10-20		436	10 x 10				
30	6.6	388	10.5 x 10.5	30	3.9	864	7 x 7
40	8.5	305	12 x 12	40	5.7	592	8 x 8
50	10.3	248	13 x 13	50	7.4	441	10 x 10
60	12.0	212	14 x 14	60	9.0	357	11 x 11
70	13.5	190	15 x 15	70	10.4	303	12 x 12
80	14.8	190	15 x 15	80	11.7	303	12 x 12

<u>Forty Years</u>				<u>Fifty Years</u>			
Age	DBH	Trees	Spacing	Age	DBH	Trees	Spacing
20				20			
30				30			
40	5.5	643	8 x 8	40			
50	7.1	484	9 x 9	50	7.0	659	8 x 8
60	8.6	394	10.5 x 10.5	60	8.5	500	9 x 9
70	9.9	337	11 x 11	70	9.8	405	10 x 10
80	11.1	337	11 x 11	80	10.9	345	11 x 11

<u>Normal Stand</u>			
Age	DBH	Trees	Spacing
20	2.2	3069	4 x 4
30	3.9	1472	5 x 5
40	5.5	927	7 x 7
50	7.0	659	8 x 8
60	8.5	500	9 x 9
70	9.8	405	10 x 10
80	10.9	345	11 x 11

PROCEDURES

For the establishment and measurement of Thinning Sample Plots.

The use of this condensation should be preceded by a study of the procedures in full.

PLOT TYPES

The system will require the use of a minimum of two 1/10 acre circular plots on each thinning area. One will be a permanent control plot. One will be a permanent sample plot.

The Permanent Control Plot should be located within the body of the stand to be thinned in a position which represents an average of stand conditions, type, site, aspect, and slope. The 1/10 acre plot is to have a buffer strip surrounding it of not less than 50 feet in width. See Exhibit g.

The 1/10 acre Permanent Sample Plot is to be established at a selected location within the thinning area. See Exhibit g. The location should be representative of the average stand, however, the plot should be free of large openings.

PHOTOGRAPHIC RECORDS

Establish equidistant about the perimeter of each permanent plot four permanent photographic reference points. Duplicate photographs should be taken immediately before and immediately after thinning. At the same times photograph crown closure from the plot center. See Exhibits i, j.

PROCEDURES

Plot description, data, measurements, and procedures will be taken under the following adaptation of the Permanent Sample Plot procedure as set forth in the Outline of Forest Inventory Procedure dated June 1959. Data will be recorded on Form Al-159. Omit items (6), (7), (8), (9), (10), (11), (12), (18), (19), (26) and (27) by entering the proper number of zeros in data spaces.

RECORDATION

(1) (2) (3) Record in office.

(4) Kind of Plot. Record as a single-digit code as follows:

- 5. Permanent BLM Control Plot
- 6. Permanent BLM Sample Plot

(5) Stand Age. Record as a three-digit code on each plot card. A specific stand age is assigned to each even-aged plot stand. Stand age is the actual age as determined from the subsequent measurement of selected trees. See (20) and (14) Site Tree.

(6) Volume Stratum. Record as zero.

(7) Local Type. Record as zero zero zero.

(8) Stand-size Class. Record as zero.

(9) Stocking. Record as zero.

*(10) Understory Stocking. Record as zero.

*(11) Understory Species. Record as zero.

*(12) Past Cutting Record. Record as zero.

(13) Site. Record site index not site as a three-digit code as follows:

Actual site index - to nearest foot.

Determine this from the averaged data recorded under Site Tree.

(14) Not Coded. All items in the block are to be filled out on each permanent plot record card.

Photo No. List the photo project symbol, the flight and print number.

T. R. S. Township, range and section in which the plot is located.

Plot R. P. Establish a plot reference point by selecting a prominent cultural or topographic feature within a reasonable distance of the

plot. See Exhibit k. Identify on the photograph by a pinprick a nearby tree as the beginning point to the plot. Attach an aluminum plot reference tag to the tree at a height on the bole which ordinarily will be below stump height if the tree is cut. To facilitate relocation attach a second tag at a point higher on the bole where it will be readily visible. The second tag need not bear reference data. Record on the lower tag the symbol "RP", plot number, bearing, and measured distance to the plot. Example:

RP
010-0
N23°E
10.35 ch.

Pinprick the plot position on the photograph and project connecting lines to RP.

Enter on the back of the photograph and on the plot record the following information:

SP. - species of the plot reference tree.

DBH - Diameter of the plot reference tree.

Dist.- measured distance from the R.P. to the plot.

Brg. fr. R.P. - record to nearest degree the bearing from the R.P. to the plot.

Decl. - record the local declination used to take bearings.

Sp. Ref. - establish the 1/10 acre plot by setting a permanent marker at the plot center. Select two live trees near the plot center as witness trees. (For permanent sample plots, these should be trees which are unlikely to be cut.) The trees chosen should vary in bearing from the plot center by at least 60 degrees. On each plot witness tree attach, facing the plot center, an aluminum reference tag at the DBH point. Designate on each tag

the plot number, the bearing and distance in feet from the witness tree to the plot center. Example: permanent control plot nine:

009-0
N32°W
15'

Permanent sample plots will be numbered as was the case with subplots under the inventory procedure system. Example, permanent control plot number nine, adjacent permanent sample plot number one:

009-1
N32°W
15'

Additional permanent sample plots, if any, will be numbered consecutively.

On the plot record card, list for each witness tree, the species, DBH, distance to the plot center in feet and the bearing.

Supplement the plot reference data with a sketch map of the area showing existing and proposed roads in relation to plot location. This map is to be revised as road construction progresses in the area.

Site Tree - three site tree measurements are required for each plot. Measure the heights of three of the tallest dominant trees on the plot. Average these measurements for recorded height. Measure the actual age of these trees and record the average age. Individual measurements for these trees are to be recorded under (20) and (25). These instructions are intended primarily for use with the predominant species of the stand.

Estimator - print full names of all crew members.

Date - record month, day and year of plot establishment.

Slope - measure average slope of the 1/10 acre on topographic abney. If two distinct slopes are found on a subplot, record the average.

Aspect - record one of the following aspects: NE, E, SE, S, SW, W, NW, W, or level (less than 4 on a topographic abney).

Plot rad. - record the plot radius in feet.

O&C, CBWR, PD - record the ownership class of the land on which the plot is established.

Distances must be taped and corrected for slope. This applies to the determination of the plot boundary and not to the mapping of individual trees.

The radius of a horizontal 1/10 acre circular plot is 37.2 feet. An increase in slope will change the shape of the plot on the slope to that of an ellipse. The following table gives the slope radius to be used in measuring 1/10 acre circular horizontal plots.

<u>Topog.</u>	<u>Plot Radii</u>	<u>%</u>
0	37.2	0
4	37.3	6
8	37.5	12
12	37.8	18
16	38.3	24
20	38.9	30
24	39.6	36
28	40.4	42
32	41.4	48
36	42.4	55
40	43.5	61
44	44.7	67
48	46.0	73
52	47.4	79
56	48.8	85
60	50.2	91
64	51.8	97
66	52.6	100

(10)(11)(12) Tree Class. This will be used for all species. Record in the left hand margin adjacent to column (15) as a three-digit code using the following classification:

The first digit will denote canopy position; the second, stem quality; the third, crown condition.

The four canopy classes are:

1. Dominant	2. Codominant
3. Intermediate	4. Suppressed

The three stem classes are:

1. Good stem	2. Slightly defective stem
3. Very defective stem	

The stem quality should be viewed in respect to that most desirable in the ultimate crop tree.

The three crown classes are:

1. Good crown	2. Fair crown	3. Poor crown

Canopy class described crown position, crown class describes crown condition found in each canopy class.

Examples of Coding:

A codominant tree having a good stem and a fair crown would be coded 212.

An intermediate tree having decay in the stem and a poor crown would be coded 333.

A suppressed tree having a badly scarred stem, but with an excellent crown considering its canopy class would be coded 431.

(15) Tree Number. Each plot will be oriented to the north. The upper-right quadrant of the plot will always be the NE quadrant and all trees will be tallied by quadrants in sequence clockwise from the north. Measure and identify each live tree tallied, 5.0" DBH and larger, with a numbered aluminum tag placed at DBH (4.5') measured from the "up-hill" side of the tree, each tag facing the plot center. Record consecutively as a three-digit code.

Example: tree number 12 - record as 012.

Each tree so numbered is to be mapped in place on the Tree Position Plot Diagram. See Exhibit h, page 80. Start in the NE quadrant and proceed clockwise. Each tree's position will be indicated on the map by its individual number circled.

Thus: tree number 12 (12) See Exhibit n1.

If trees to be cut in thinning have been marked prior to the time of initial measurement of the permanent sample plot, then the marked trees will be measured concurrently with the trees with which they are intermingled. The data will be recorded on the same sheet. The tree numbers of marked trees will be preceded by an X on the data sheet.

See Exhibit n, page 37. Thus: X 012. Superimpose an X over the circled tree number on the tree position diagram and follow with the date.

Thus: ~~(12)~~ 1960. Place the tree identification tag below probable stump height.

In a plot established after thinning, the stumps of trees which have been cut will be mapped and dated as of time of cutting. Thus: ~~(10)~~ 1958.

A number will be assigned preceded by an X on the data sheet and stump DIB will be recorded as DBH for these missing trees. No other items will be recorded. All required data will be secured for live trees. Plot history will include the average per acre volume of the material removed from the stand as a whole in the first cutting.

No measurements will be taken for trees which are dead at the time of establishment of permanent plots since it is the subsequent development of the living trees which will be studied. Trees which die or are windthrown after the establishment of permanent plots are to be identified as dead and fully accounted for at the time of remeasurement.

Precommercial thinning in the very small dbh classes imposes conditions not anticipated when the sampling procedures were devised. The 5 inch dbh minimum tree measurement limitation is too restrictive to enable dealing adequately with stands composed of very small stems. In order to obtain representative data the dbh measurement standard must be reduced.

DOUGLAS-FIR

Control Plot. On the N.E. quadrant of the plot, count the total number of live trees estimated to be $1\frac{1}{2}$ inches dbh and over. Tally the count by one inch dbh classes. Derive the average dbh. Do not use tree position map.

Sample Plot. Before thinning count the total number of live trees on the N.E. quadrant of the plot estimated to be $1\frac{1}{2}$ inches dbh and over. Tally the count by one inch dbh classes. Derive the average dbh.

For all quadrants tag, measure and record data for all residual trees of $1\frac{1}{2}$ inches dbh, and over. Map position of residual trees. Do not map position of trees cut in thinning.

PONDEROSA PINE

Control Plot. On the N. E. quadrant of the plot, count the total number of live trees estimated to be .6 inch dbh and over. Tally the count by one inch dbh classes. Derive the average dbh. Do not map tree positions.

Sample Plot. Before thinning count the total number of live trees on the N. E. quadrant of the plot estimated to be .6 inch dbh and over. Tally the count by one inch dbh classes. Derive the average dbh.

For all quadrants tag, measure and record data for all residual trees of .6 inches dbh and over. Map position of residual trees. Do not map position of trees cut in thinning.

(16) Species. Record as a two-digit code using the following code:

<u>01</u>	Douglas-fir	<u>32</u>	Shasta red fir
<u>11</u>	Ponderosa pine	<u>33</u>	Grand fir
<u>12</u>	Jeffrey pine	<u>34</u>	Pacific silver fir
<u>13</u>	Sugar pine	<u>35</u>	Noble fir
<u>14</u>	Western white pine	<u>36</u>	Subalpine fir
<u>15</u>	Lodgepole pine	<u>41</u>	Engelmann spruce
<u>24</u>	Knobcone pine	<u>42</u>	Sitka spruce
<u>26</u>	White bark pine	<u>46</u>	Brewers spruce
<u>31</u>	White fir	<u>47</u>	Mountain hemlock

<u>48</u>	Western hemlock	<u>76</u>	Maple
<u>51</u>	Incense cedar	<u>77</u>	Willow
<u>52</u>	Alaska cedar	<u>81</u>	Black oak
<u>53</u>	Port Orford cedar	<u>84</u>	Canyon live oak
<u>54</u>	Western red cedar	<u>86</u>	Oregon white oak
<u>55</u>	Western larch	<u>87</u>	Tan oak
<u>56</u>	Alpine larch	<u>91</u>	California laurel
<u>62</u>	Pacific yew	<u>93</u>	Golden chinquapin
<u>63</u>	Western juniper	<u>94</u>	Madrone
<u>71</u>	Alder	<u>95</u>	Dogwood
<u>72</u>	Ash	<u>96</u>	Sycamore
<u>75</u>	Cottonwood	<u>98</u>	All other hardwood

(17) DBH. Measure all diameters to the nearest 0.1" and record as a four-digit code, i.e., a 10.5" DBH tree would be coded as 0105, a 30.5" DBH would be 0305, a 6.5" DBH would be 0065.

(18) Merch. Class. Record as zero.

(20) Actual Age. For each plot determine total age of three tallest dominant trees. Record each tree's age in three digits. Record average age of these trees under site tree (14). Also record the average age under (5).

See site tree (14)

See Item (25)

(21) C.D. (Cause of Death) Only when remeasurements are made, tally cause of death for all trees which have died since the initial measurements, using the following codes:

- 0 Live tree
- 1 Insect-killed tree
- 2 Disease-killed tree
- 3 Fire-killed tree
- 4 Other cause of death
- 8 Windthrow
- 9 Logging damage

Actual death will probably be due to secondary causes. However, if such attacks followed severe logging damage, such damage will be considered the primary cause of death.

(22) Keen Class. This crown classification system was designed for and has specific application to ponderosa pine. However, we believe it adaptable to other pine species for

descriptive purposes. Record as a two-digit code for all species of pine using the following classification:

Keen Class

<u>11</u> -1A	<u>31</u> -3A
<u>12</u> -1B	<u>32</u> -3B
<u>13</u> -1C	<u>33</u> -3C
<u>14</u> -1D	<u>34</u> -3D
<u>21</u> -2A	<u>41</u> -4A
<u>22</u> -2B	<u>42</u> -4B
<u>23</u> -2C	<u>43</u> -4C
<u>24</u> -2D	<u>44</u> -4D

00-All dead trees (applies only to pine and
at time of remeasurement)

99-All species other than pine

- (23) Tree Condition. Record as a two-digit code using the following classifications:

<u>00</u>	Tree dead
<u>99</u>	Tree okay
<u>01</u>	Bark-beetle attack (western pine beetle, mountain pine beetle, Douglas-fir beetle, Engraver beetle, etc.)
<u>02</u>	Other insect attack
<u>03</u>	Conks
<u>04</u>	Mistletoe and/or witches-broom
<u>05</u>	Blister rust
<u>06</u>	Other disease and rot
<u>07</u>	Multiple stem
<u>08</u>	Fire scar
<u>09</u>	Forked top
<u>10</u>	Top dead or dying (spike top)
<u>11</u>	Top out
<u>12</u>	Lightning struck
<u>13</u>	Logging damage
<u>14</u>	Winter injury
<u>15</u>	Other mechanical injury

- (24) Risk. Record risk as a one-digit code for all trees 5.0" and larger DBH.

<u>0</u>	<u>Dead</u> tree
<u>1</u>	<u>Dying</u> tree - one which will probably die within the next ten years
<u>2</u>	<u>Weak</u> tree - one of declining vigor, but which will probably not die within the next ten years
<u>3</u>	<u>Thrifty</u> tree - one of apparent good vigor and showing no indications of a dangerous decline

- (25) Total Height Feet. For each plot measure total height of three tallest dominant trees. Also, record average height of these trees under Site Tree (14). See instructions Site Tree (14) Time permitting, important supplemental measurements of actual tree heights can be obtained at the time marked trees are cut on the sample plots. The data should be recorded by tree number on the tally sheet.
- (26) Defect by Log Position. Record as zero 1, 2, 3, 4, 5, 6, 7, 8, 9.
- (27) Percent Merch. Record as zero.
- (28) Radial Growth. Radial growth borings will be taken on all live trees 5" DBH or over at DBH on the side of the tree facing the plot center and will be measured for the last 10 years to the nearest 1/20th (.05) inch. This will be recorded as a three-digit code as follows: 10-year radial growth of 1.05 inches would be coded 105, radial growth of 0.65 inches would be coded 065, etc.
- (29) Bark Measurement. For all trees recorded for Radial Growth (28), measure bark thickness to the nearest 1/20 (.05) inch. If possible measure bark thickness on the side of the tree facing the plot center at approximately DBH. Record single bark thickness as a three-digit code. For example, if the bark thickness was 1.95", it would be recorded as 195.
- (30) Understory Stocking. Record as zeros.

Permanent Plot Reference

Exhibit k

Permanent Plot Layout

Control Plot

Sample Plot

Photograph Orientation

Interior Views

Permanent Picture Points

Direction of Photographs

Exhibit 1

Photograph Orientation

Crown Closure

Camera setup

Exhibit j

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
State Office

TREE POSITION PLOT DIAGRAM

Plot No. 010-1

Geographic Stratum (FMA) 111 District Salem

Recorder C. S. Smith Date 12-6-60

Scale 1" = 15 feet

Record all live trees over 5" DBH

Legend

- Plot trees - tree number circled ----- (12)
Marked trees - X over tree number and dated ---- (X) 1960
Stumps - X over tree number and dated ---- (X) 1960

Exhibit n1

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(6) Volume Stratum	X	0	SP.Ref:Sp. <u>01</u> DBH <u>14.5</u> Ft.Brg. <u>544</u> W. <u>1</u>
(7) Local Type	XXX	000	SP.Ref:Sp. <u>01</u> DBH <u>15.1</u> Ft.Brg. <u>715</u> 70E
(8) St. Size Class	X	0	Site Tree:Sp. <u>01</u> Ht. <u>138</u> Age <u>62</u>
(9) Stocking	X	0	Estimator <u>Smith, Brown</u> Date <u>12-6-60</u>
(10) Understory Stocking	XX	00	Slope <u>20</u> Aspect <u>NE</u> Plot Rad. <u>37.2</u>
(11) Understory Species	XX	00	O&C, CBWR, PD <u>O&C</u>

(14) Not. Coded
 MJOS
 Photo No. 26 A-1 T. 3 N R. 6 W S. 17
 Plot RP: Sp. 01 DBH 36" Dist. 11.35 Ch.
 Brg. fr. RP N 23 E Plot Brg. — Decl. 2.1 W
 SP. Ref: Sp. 01 DBH 14.5 Ft. Brg. 544 W 15'
 SP. Ref: Sp. 01 DBH 15.1 Ft. Brg. 7' 570 E
 Site Tree: Sp. 01 Ht. 138 Age 62
 Estimator Smith, Brown Date 12-6-60
 Slope 20 Aspect NE Plot Rad. 37.2'
 O&C, CBWR, PD O&C

[illegible]