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DOUGLAS -- FIR
THINNING HANDBOOK
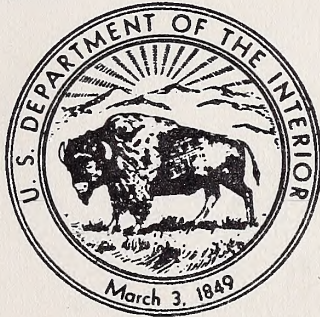
FIELD EDITION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
OREGON

BUREAU OF LAND MANAGEMENT
OREGON STATE OFFICE

THINNING HANDBOOK
DOUGLAS-FIR
October 1963

Field Edition
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Exhibits

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 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.

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

TOTAL NUMBER OF TREES

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

DIAMETER OF AVERAGE TREE AT BREASTHEIGHT

Age (years)	Site Class I			Site Class II			Site Class III			Site Class IV			Site Class V	
	Site index 210	Site index 200	Site index 190	Site index 180	Site index 170	Site index 160	Site index 150	Site index 140	Site index 130	Site index 120	Site index 110	Site index 100	Site index 90	Site index 80
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
20	6.2	5.7	5.3	4.9	4.5	4.2	3.8	3.4	3.0	2.6	2.2	1.8	1.5	1.3
30	9.8	9.0	8.3	7.6	7.0	6.5	6.0	5.5	4.9	4.4	3.9	3.4	3.0	2.6
40	13.3	12.2	11.2	10.2	9.4	8.7	8.0	7.4	6.8	6.1	5.5	4.9	4.4	3.8
50	16.7	15.3	14.0	12.8	11.8	10.9	10.1	9.3	8.5	7.7	7.0	6.3	5.6	4.9
60	19.9	18.2	16.6	15.2	14.0	12.9	12.0	11.1	10.2	9.3	8.5	7.6	6.8	6.0
70	22.8	20.9	19.1	17.5	16.0	14.8	13.8	12.8	11.8	10.8	9.8	8.8	7.9	7.0
80	25.5	23.3	21.3	19.6	17.9	16.6	15.4	14.3	13.1	12.0	10.9	9.9	8.9	7.9
90	28.0	25.6	23.3	21.4	19.6	18.2	16.9	15.6	14.3	13.1	11.9	10.8	9.7	8.7
100	30.1	27.6	25.1	23.1	21.2	19.7	18.2	16.9	15.5	14.2	12.8	11.6	10.5	9.4
110	32.2	29.4	26.9	24.6	22.6	21.0	19.5	18.0	16.6	15.2	13.7	12.4	11.3	10.1
120	34.2	31.1	28.5	26.1	24.0	22.3	20.7	19.1	17.6	16.1	14.6	13.2	11.9	10.7
130	36.0	32.7	30.0	27.5	25.3	23.5	21.7	20.1	18.5	16.9	15.3	13.9	12.5	11.3
140	37.8	34.3	31.4	28.8	26.5	24.5	22.8	21.1	19.4	17.7	16.0	14.5	13.1	11.9
150	39.4	35.8	32.8	30.0	27.7	25.6	23.8	22.0	20.2	18.4	16.7	15.1	13.7	12.4
160	41.0	37.2	34.1	31.2	28.9	26.6	24.7	22.8	21.0	19.1	17.4	15.7	14.2	12.9

TOTAL BASAL AREA

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
	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.	Sq. ft.
20	64	70	76	81	86	89	92	95	97	98	99	100	101	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

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
	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
20	520	620	730	870	990	1,120	1,250	1,380	1,490	1,550	1,650	1,730	1,830	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	6,880	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	8,000	9,100	10,150	11,060	11,900	12,660	13,300	13,950	14,500	15,080
80	4,580	5,510	6,530	7,690	9,000	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	19,300	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	8,720	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
	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
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,

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

Diameter, in.	Area, sq.ft.	Diameter, in.	Area, sq.ft.	Diameter, in.	Area, sq.ft.	Diameter, in.	Area, sq.ft.	Diameter, 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/
(1/8-inch kerf)

Age Period	SITE CLASS				
	I	II	III	IV	V
Years			Board Feet		
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
Years			Board Feet		
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.

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
Years			Board Feet		
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	7,800
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.

TABLE VIII

Cumulative Mortality per Acre for Fully Stocked Douglas-fir

Board Feet - Scribner Rule 1/

| Age | SITE CLASS | | | | |
	I	II	III	IV	V
Years			Board Feet		
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.

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</u> bd. ft.

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

CRUISING

All thinnings will be cruised 100%. The tally sheets,
Form No. A-87 (Exhibit e), can easily be used for cruis-
ing 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 neces-
sary 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 thin-
nings. 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 convert-
ing factor of .8.

Form No. A1-87
October 1961

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

District _Portland_
District Sale No. _P 10_   TALLY SHEET
Cruiser _Douglas Green_
Sheet No._____
Date _Oct. 1, 1963_
T. _15_ R. _15 W_ Sec. _1_   Sub. _NE ¼ NE ¼_

Computer Sale No._____
Subsale No._____
Species_____
Form Class_____
Defect Factor by Log
Grade Code: 1-3_____
       4-6_____

| 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. ⅛					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						36.3		1
14-100						2 74						40.0		1
14-120						3 46						48.0		1
18-120						5 40						74.0		1
18-140						6 72						88.0		1

Bd. ft. Volume 43 20
(Nearest M bd. ft.)   4M

Cu. ft. Volume 622.0

Cu. ft. ratio $\frac{622.0}{4.320}$

$\frac{622.0}{4.320} = 144$

144 x 4M (⅛ International rounded volume)
= 576

Approx Cu. ft volume for comparative purposes   580

Totals: Graded-Lines____ Trees____ Ungraded-Lines____ Trees____

INTERIOR—PORTLAND, OREGON

Exhibit e

12

EXAMPLE:

Pond value per Mbf	$42.00
Falling, bucking, yarding and loading	-18.90
	$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)   -8.60

Conversion return	$14.50	
Stumpage factor	x .5	
Stumpage per Mbf	$ 7.25	(rounded to nearest $0.05)

Stumpage ($7.25) x volume (4 M bd. ft.) = $29.00 (total value)

13

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

14

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

Board-foot volume when total height of tree in feet is

D.B.H. inches	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	---	36	52	66	84	102	120	138	158	180	200	---	---	---	---	---	---	---	---	---	---	---
11	---	46	62	80	102	124	146	168	194	218	242	---	---	---	---	---	---	---	---	---	---	---
12	---	54	76	98	122	148	174	200	230	260	288	320	---	---	---	---	---	---	---	---	---	---
13	---	64	90	114	144	176	206	238	270	302	336	374	416	---	---	---	---	---	---	---	---	---
14	---	---	104	134	166	202	240	274	310	346	388	430	480	524	---	---	---	---	---	---	---	---
15	---	---	---	154	190	232	270	312	352	392	440	486	544	592	---	---	---	---	---	---	---	---
16	---	---	---	176	214	260	304	350	394	440	494	546	612	662	---	---	---	---	---	---	---	---
17	---	---	---	198	238	290	338	388	438	490	548	608	678	734	814	---	---	---	---	---	---	---
18	---	---	---	---	264	322	372	426	484	540	606	672	747	812	894	974	---	---	---	---	---	---
19	---	---	---	---	288	349	405	466	528	588	659	734	813	886	974	1,061	1,143	---	---	---	---	---
20	---	---	---	---	---	378	442	507	576	642	718	799	883	969	1,063	1,156	1,250	1,341	---	---	---	---
21	---	---	---	---	---	---	479	550	623	693	775	864	955	1,053	1,152	1,254	1,358	1,454	---	---	---	---
22	---	---	---	---	---	---	519	594	672	747	834	930	1,028	1,139	1,244	1,354	1,468	1,575	---	---	---	---
23	---	---	---	---	---	---	559	637	720	798	893	997	1,102	1,221	1,336	1,456	1,578	1,696	1,829	---	---	---
24	---	---	---	---	---	---	599	682	768	852	953	1,065	1,177	1,308	1,429	1,559	1,690	1,821	1,969	2,099	---	---
25	---	---	---	---	---	---	640	727	817	907	1,013	1,134	1,256	1,392	1,524	1,664	1,803	1,951	2,104	2,251	---	---
26	---	---	---	---	---	---	683	774	868	964	1,075	1,206	1,336	1,481	1,620	1,770	1,921	2,078	2,245	2,405	---	---
27	---	---	---	---	---	---	728	824	922	1,023	1,141	1,280	1,420	1,571	1,719	1,879	2,043	2,211	2,389	2,564	---	---
28	---	---	---	---	---	---	---	874	978	1,086	1,210	1,354	1,506	1,663	1,824	1,991	2,170	2,351	2,537	2,726	---	---
29	---	---	---	---	---	---	---	---	1,038	1,150	1,281	1,432	1,597	1,759	1,930	2,104	2,300	2,494	2,692	2,894	---	---
30	---	---	---	---	---	---	---	---	1,096	1,215	1,351	1,509	1,688	1,851	2,034	2,223	2,428	2,636	2,849	3,066	---	---
31	---	---	---	---	---	---	---	---	1,154	1,282	1,423	1,582	1,775	1,942	2,139	2,343	2,560	2,776	3,006	3,238	---	---
32	---	---	---	---	---	---	---	---	---	1,347	1,495	1,660	1,863	2,036	2,248	2,461	2,688	2,921	3,164	3,416	3,678	3,930
33	---	---	---	---	---	---	---	---	---	1,411	1,563	1,737	1,952	2,128	2,348	2,583	2,820	3,063	3,321	3,593	3,865	4,132
34	---	---	---	---	---	---	---	---	---	1,477	1,635	1,818	2,043	2,223	2,454	2,701	2,951	3,206	3,484	3,771	4,060	4,350
35	---	---	---	---	---	---	---	---	---	1,540	1,705	1,897	2,120	2,316	2,556	2,813	3,080	3,347	3,646	3,948	4,250	4,562
36	---	---	---	---	---	---	---	---	---	1,605	1,779	1,974	2,199	2,408	2,658	2,930	3,212	3,493	3,803	4,125	4,452	4,769
37	---	---	---	---	---	---	---	---	---	1,667	1,851	2,052	2,278	2,499	2,759	3,041	3,338	3,636	3,964	4,301	4,646	4,985
38	---	---	---	---	---	---	---	---	---	1,733	1,926	2,133	2,359	2,592	2,865	3,169	3,469	3,784	4,127	4,479	4,846	5,233
39	---	---	---	---	---	---	---	---	---	---	---	2,210	2,438	2,685	2,968	3,288	3,598	3,931	4,284	4,651	5,043	5,435
40	---	---	---	---	---	---	---	---	---	---	---	2,290	2,517	2,778	3,071	3,408	3,730	4,078	4,444	4,828	5,240	5,642
41	---	---	---	---	---	---	---	---	---	---	---	---	2,597	2,870	3,178	3,525	3,860	4,225	4,603	5,003	5,432	5,847
42	---	---	---	---	---	---	---	---	---	---	---	---	2,675	2,962	3,285	3,645	3,989	4,367	4,765	5,177	5,629	6,054
43	---	---	---	---	---	---	---	---	---	---	---	---	2,756	3,052	3,387	3,764	4,116	4,514	4,922	5,352	5,816	6,263
44	---	---	---	---	---	---	---	---	---	---	---	---	2,835	3,157	3,492	3,882	4,247	4,657	5,080	5,527	6,014	6,471
45	---	---	---	---	---	---	---	---	---	---	---	---	2,915	3,247	3,597	4,001	4,376	4,804	5,237	5,702	6,208	6,678
46	---	---	---	---	---	---	---	---	---	---	---	---	2,995	3,341	3,701	4,121	4,515	4,949	5,394	5,881	6,403	6,890
47	---	---	---	---	---	---	---	---	---	---	---	---	3,075	3,433	3,806	4,239	4,635	5,098	5,554	6,058	6,597	7,097
48	---	---	---	---	---	---	---	---	---	---	---	---	3,153	3,526	3,911	4,359	4,763	5,251	5,704	6,236	6,793	7,303
49	---	---	---	---	---	---	---	---	---	---	---	---	3,234	3,618	4,012	4,475	4,885	5,403	5,856	6,413	6,985	7,510
50	---	---	---	---	---	---	---	---	---	---	---	---	3,315	3,710	4,118	4,592	5,017	5,555	6,013	6,595	7,180	7,722
51	---	---	---	---	---	---	---	---	---	---	---	---	3,394	3,802	4,220	4,709	5,148	5,705	6,168	6,772	7,374	7,916
52	---	---	---	---	---	---	---	---	---	---	---	---	3,472	3,894	4,327	4,829	5,281	5,859	6,329	6,949	7,569	8,113
53	---	---	---	---	---	---	---	---	---	---	---	---	3,551	3,986	4,434	4,946	5,411	6,011	6,484	7,126	7,761	8,310
54	---	---	---	---	---	---	---	---	---	---	---	---	3,634	4,079	4,540	5,066	5,546	6,164	6,645	7,304	7,946	8,503

Exhibit a

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	Cubic-foot volume when total height of tree in feet is																						
	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	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	2.0	3.0	4.0	5.1	6.0	7.1	8.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	2.7	4.1	5.4	6.8	8.0	9.5	11.1	12.1	13.2	14.6	16.0	---	---	---	---	---	---	---	---	---	---	---	---
9	3.6	5.3	7.1	8.7	10.4	12.3	14.1	15.4	16.9	18.7	20.4	---	---	---	---	---	---	---	---	---	---	---	---
10	4.5	6.6	8.7	10.6	12.9	15.1	17.2	18.8	20.7	22.9	24.8	27.3	---	---	---	---	---	---	---	---	---	---	---
11	---	8.1	10.7	13.0	15.7	18.2	21.2	22.8	25.0	27.9	30.2	33.0	---	---	---	---	---	---	---	---	---	---	---
12	---	9.7	12.6	15.5	18.6	21.3	24.3	26.6	29.4	32.9	35.7	38.7	42.2	46.0	---	---	---	---	---	---	---	---	---
13	---	11.2	14.7	18.0	21.7	24.9	28.5	31.4	34.7	38.3	41.8	45.2	49.3	53.6	---	---	---	---	---	---	---	---	---
14	---	12.8	16.8	20.6	24.8	28.6	32.8	36.3	40.0	43.6	48.0	51.8	56.4	61.2	65.8	70.0	---	---	---	---	---	---	---
15	---	---	19.2	23.5	28.1	32.7	37.8	41.5	45.6	49.4	54.5	58.6	64.1	69.4	74.4	79.7	---	---	---	---	---	---	---
16	---	---	21.6	26.5	31.5	36.8	41.9	46.7	51.2	55.2	61.0	65.5	71.8	77.7	83.0	89.4	96	102	---	---	---	---	---
17	---	---	---	29.6	35.3	41.0	46.5	51.9	57.2	61.4	67.5	72.7	79.9	86.8	92.5	99.7	107	114	---	---	---	---	---
18	---	---	---	32.8	39.2	45.2	51.2	57.1	63.3	67.7	74	80	88	96	102	110	118	126	136	---	---	---	---
19	---	---	---	36.1	43.1	49.7	56.2	62.5	69.2	74.1	81	88	96	105	112	121	130	139	150	---	---	---	---
20	---	---	---	39.5	47.0	54.2	61.2	67.9	75.1	80.6	88	96	105	114	123	133	143	153	164	174	187	---	---
21	---	---	---	43.2	50.9	58.8	66.4	73.6	81.0	87.3	96	104	113	123	133	143	155	166	178	189	203	---	---
22	---	---	---	47.0	54.8	63.5	71.6	79.3	86.9	94	103	112	121	133	144	154	167	179	192	205	219	234	---
23	---	---	---	---	59.1	68.3	76.7	85.1	92.5	100	110	119	129	141	153	165	179	192	207	221	236	251	---
24	---	---	---	---	63.5	73.2	81.9	91.0	98.2	107	117	126	137	150	163	177	191	206	222	238	254	269	287
25	---	---	---	---	---	---	87.3	97	105	114	124	134	145	160	174	188	204	220	238	255	272	288	308
26	---	---	---	---	---	---	92.8	103	112	121	131	142	154	170	185	200	218	235	253	273	291	308	329
27	---	---	---	---	---	---	---	108	119	128	139	150	163	179	195	212	231	250	269	290	311	328	351
28	---	---	---	---	---	---	---	113	126	136	147	159	172	189	206	224	244	265	286	307	331	349	374
29	---	---	---	---	---	---	---	120	132	143	154	167	181	199	217	236	258	280	301	325	350	370	398
30	---	---	---	---	---	---	---	128	139	150	161	175	190	209	228	248	272	296	317	343	370	392	423
31	---	---	---	---	---	---	---	---	145	156	169	183	199	219	239	260	286	310	333	360	389	414	446
32	---	---	---	---	---	---	---	---	152	163	177	191	208	229	251	273	300	324	350	378	408	436	469
33	---	---	---	---	---	---	---	---	---	170	184	199	217	239	263	285	312	338	366	396	427	458	492
34	---	---	---	---	---	---	---	---	---	178	191	208	227	250	276	297	325	352	382	414	447	481	516
35	---	---	---	---	---	---	---	---	---	---	198	216	236	260	286	309	338	366	398	432	467	503	540
36	---	---	---	---	---	---	---	---	---	---	206	224	245	271	296	321	351	381	415	450	488	526	565
37	---	---	---	---	---	---	---	---	---	---	213	232	254	281	306	332	364	396	432	468	508	548	589
38	---	---	---	---	---	---	---	---	---	---	221	241	263	291	316	344	377	411	449	486	529	570	613
39	---	---	---	---	---	---	---	---	---	---	---	---	271	299	325	355	390	425	465	505	550	593	638
40	---	---	---	---	---	---	---	---	---	---	---	---	280	307	335	366	403	440	482	524	571	616	663
41	---	---	---	---	---	---	---	---	---	---	---	---	---	---	345	378	415	455	498	542	591	638	687
42	---	---	---	---	---	---	---	---	---	---	---	---	---	---	356	390	428	470	515	561	611	661	712
43	---	---	---	---	---	---	---	---	---	---	---	---	---	---	366	401	441	485	532	580	632	685	739
44	---	---	---	---	---	---	---	---	---	---	---	---	---	---	377	413	455	501	550	600	653	709	762
45	---	---	---	---	---	---	---	---	---	---	---	---	---	---	387	425	468	515	566	619	673	731	789
46	---	---	---	---	---	---	---	---	---	---	---	---	---	---	397	437	481	529	583	638	694	753	816
47	---	---	---	---	---	---	---	---	---	---	---	---	---	---	407	448	493	544	600	656	714	775	838
48	---	---	---	---	---	---	---	---	---	---	---	---	---	---	417	460	506	559	617	674	735	798	861
49	---	---	---	---	---	---	---	---	---	---	---	---	---	---	427	471	519	573	634	694	755	820	885
50	---	---	---	---	---	---	---	---	---	---	---	---	---	---	437	483	532	587	652	714	776	843	910
51	---	---	---	---	---	---	---	---	---	---	---	---	---	---	447	495	544	602	668	732	796	866	934
52	---	---	---	---	---	---	---	---	---	---	---	---	---	---	458	507	557	617	685	751	817	889	959
53	---	---	---	---	---	---	---	---	---	---	---	---	---	---	468	518	570	631	703	770	836	911	983
54	---	---	---	---	---	---	---	---	---	---	---	---	---	---	478	530	583	646	721	790	855	934	1,008

Exhibit b

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 thin-
   nings 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 avail-
   able stands. Accordingly, sanitation and commercial thin-
   nings will usually be carried on simultaneously in most
   districts.

First Thinning at Indicated Years

Ten Years

Age	DBH	Trees	Spacing
10		302	12 x 12
20	7.	227	14 x 14
30	11.	165	16 x 16
40	14.5	130	18 x 18
50	17.5	108	20 x 20
60	20.3	92	21.5 x 21.5
70	22.8	81	23 x 23
80	25.0	81	23 x 23

Twenty Years

Age	DBH	Trees	Spacing
20	4.5	409	10 x 10
30	8.2	262	13 x 13
40	11.5	195	15 x 15
50	14.3	158	16.5 x 16.5
60	16.8	131	18 x 18
70	19.1	113	20 x 20
80	21.2	113	20 x 20

Thirty Years

Age	DBH	Trees	Spacing
30	7.	340	11 x 11
40	10.1	243	13 x 13
50	12.8	191	15 x 15
60	15.2	158	16.5 x 16.5
70	17.4	134	18 x 18
80	19.4	134	18 x 18

Forty Years

Age	DBH	Trees	Spacing
40	9.4	276	13 x 13
50	12.0	217	14 x 14
60	14.3	178	15.5 x 15.5
70	16.4	150	17 x 17
80	18.4	150	17 x 17

Fifty Years

Age	DBH	Trees	Spacing
50	11.8	227	14 x 14
60	14.0	187	15 x 15
70	16.0	157	16.5 x 16.5
80	18.0	157	16.5 x 16.5

Normal Stand

Age	DBH	Trees	Spacing
10			
20	4.5	880	7 x 7
30	7.0	555	9 x 9
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

First Thinning at Indicated Years

Ten Years

Age	DBH	Trees	Spacing
10		436	10 x 10
20	5.8	332	11 x 11
30	8.8	245	13 x 13
40	11.5	194	15 x 15
50	13.9	160	16.5 x 16.5
60	16.1	137	18 x 18
70	18.1	118	19 x 19
80	20.0	118	19 x 19

Twenty Years

Age	DBH	Trees	Spacing
10			
20	3.4	666	6.5 x 6.5
30	6.2	428	10 x 10
40	8.7	309	12 x 12
50	11.0	241	13 x 13
60	13.1	197	15 x 15
70	15.1	167	16 x 16
80	16.9	167	16 x 16

Thirty Years

Age	DBH	Trees	Spacing
10			
20			
30	5.5	520	9 x 9
40	7.9	367	11 x 11
50	10.1	283	12 x 12
60	12.1	230	14 x 14
70	14.0	190	15 x 15
80	15.8	190	15 x 15

Forty Years

Age	DBH	Trees	Spacing
10			
20			
30			
40	7.4	414	10 x 10
50	9.5	313	11 x 11
60	11.5	253	13 x 13
70	13.3	204	15 x 15
80	15.0	204	15 x 15

Fifty Years

Age	DBH	Trees	Spacing
10			
20			
30			
40			
50	9.3	330	11.5 x 11.5
60	11.2	264	13 x 13
70	13.0	223	14 x 14
80	14.6	223	14 x 14

Normal Stand

Age	DBH	Trees	Spacing
10			
20	3.4	1460	5.5 x 5.5
30	5.5	865	7 x 7
40	7.4	585	9 x 9
50	9.3	430	10 x 10
60	11.1	337	11 x 11
70	12.8	274	12.5 x 12.5
80	14.3	232	14 x 14

Site IV

Index 110

First Thinning at Indicated Years

Ten to Twenty Years

Age	DBH	Trees	Spacing
10-20		436	10 x 10
30	6.6	388	10.5 x 10.5
40	8.5	305	12 x 12
50	10.3	248	13 x 13
60	12.0	212	14 x 14
70	13.5	190	15 x 15
80	14.8	190	15 x 15

Thirty Years

Age	DBH	Trees	Spacing
30	3.9	864	7 x 7
40	5.7	592	8 x 8
50	7.4	441	10 x 10
60	9.0	357	11 x 11
70	10.4	303	12 x 12
80	11.7	303	12 x 12

Forty Years

Age	DBH	Trees	Spacing
20			
30			
40	5.5	643	8 x 8
50	7.1	484	9 x 9
60	8.6	394	10.5 x 10.5
70	9.9	337	11 x 11
80	11.1	337	11 x 11

Fifty Years

Age	DBH	Trees	Spacing
20			
30			
40			
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

Normal Stand

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 estab-
   lished at a selected location within the thinning
   area. See Exhibit g. The location should be repre-
   sentative 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. Dupli- cate 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 A1-159. 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 photo-
graph by a pinprick a nearby tree as the begin-
ning 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 refer-
ence 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 <u>control</u> 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.

<u>Site Tree</u> - 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.

<u>Estimator</u> - print full names of all crew
   members.

<u>Date</u> - 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 estab-
lished.

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.

Topog.	Plot Radii	%
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.

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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 nl.

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| Super-
impose an X over the circled tree number on the
tree position diagram and follow with the date.
Thus: (X2) 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: (X0) 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 1½ 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 1½ 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 1½ 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:

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

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

29

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

Keen Class

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

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:

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

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

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

30

(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 measure-
      ments 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 meas-
      ured 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.

Exhibit k

32

Thinned

Buffer Strip

1/10 acre

74.4'   50'

Control Plot
No Thinning

No Thinning

Thinned

Control Plot

1/10 acre

74.4

Sample Plot

Thinned
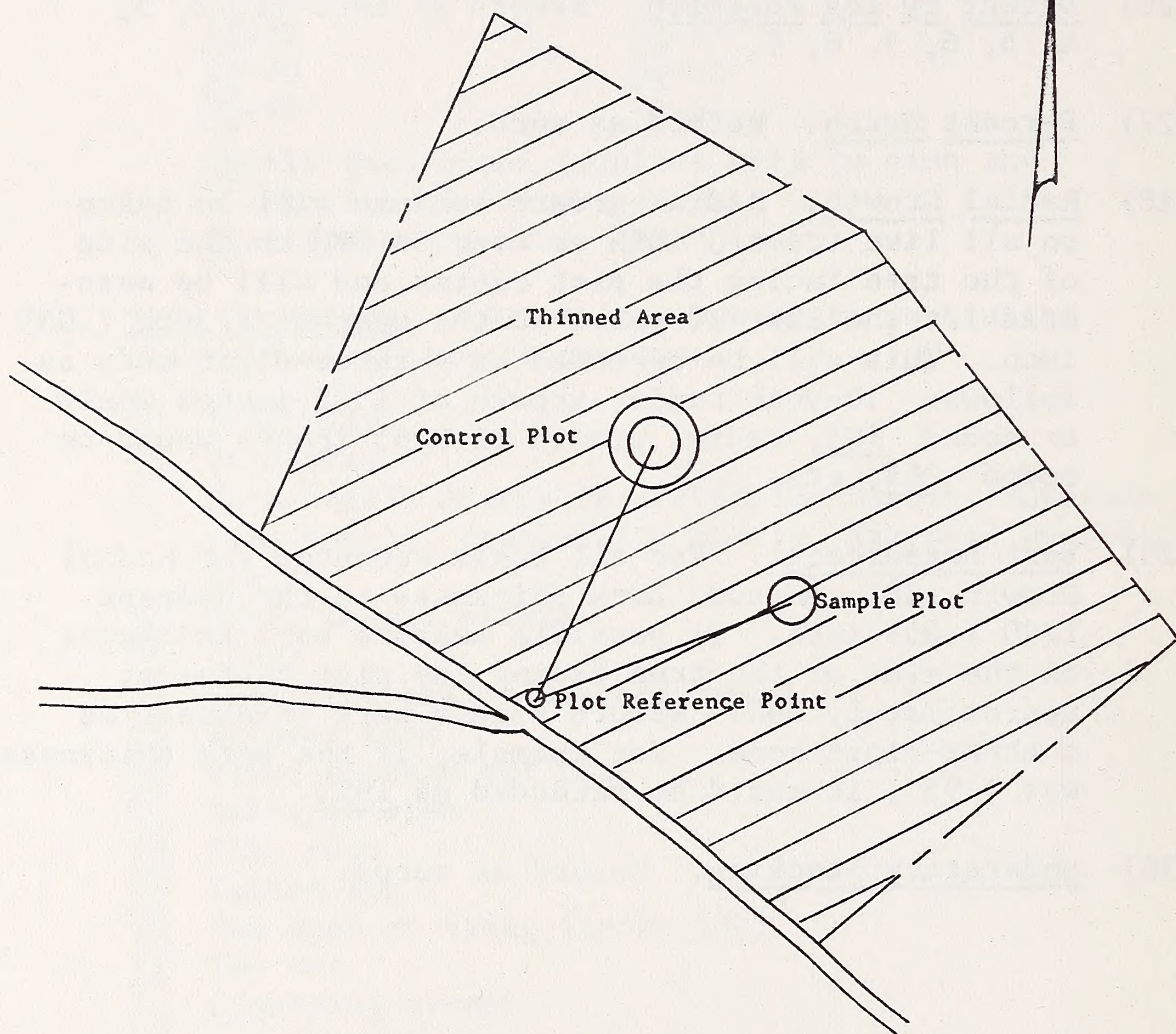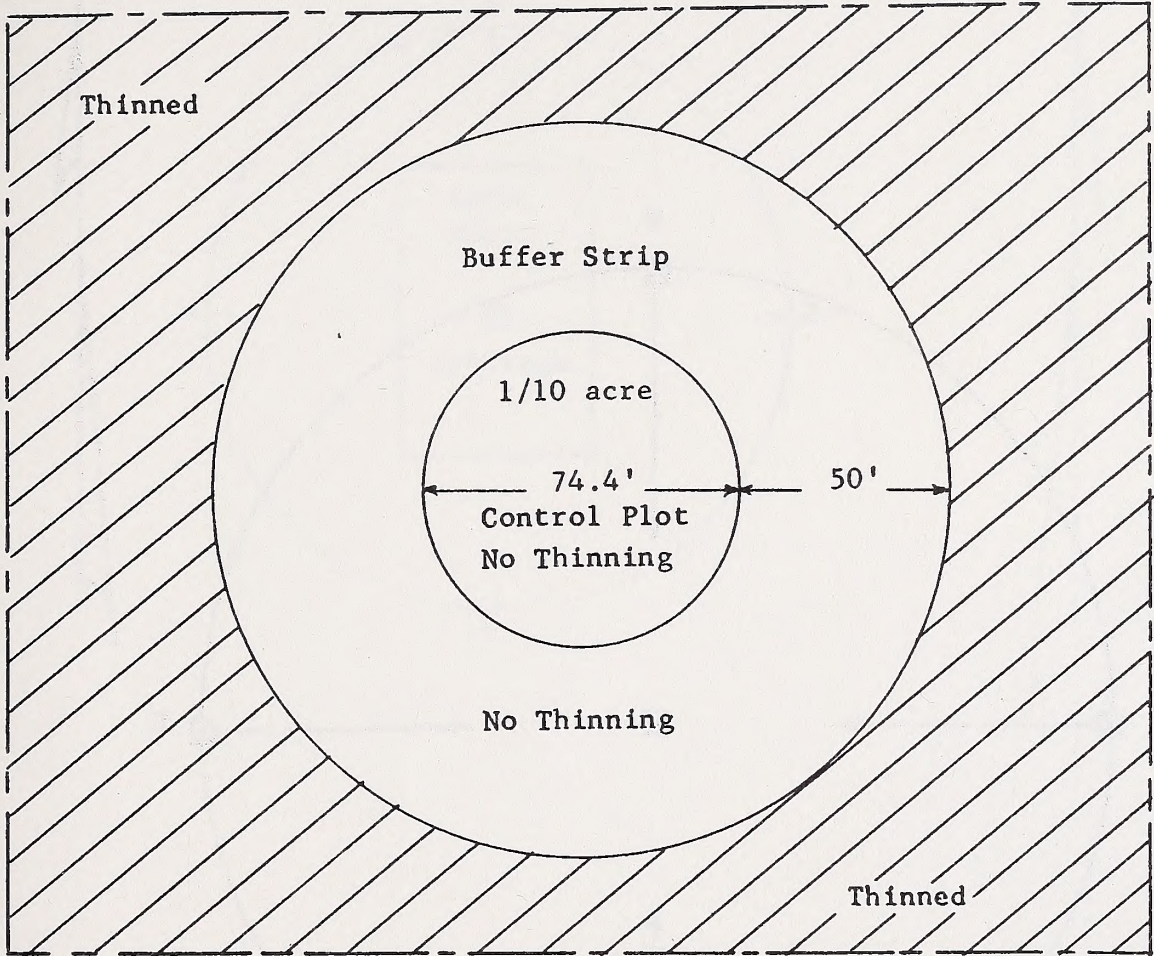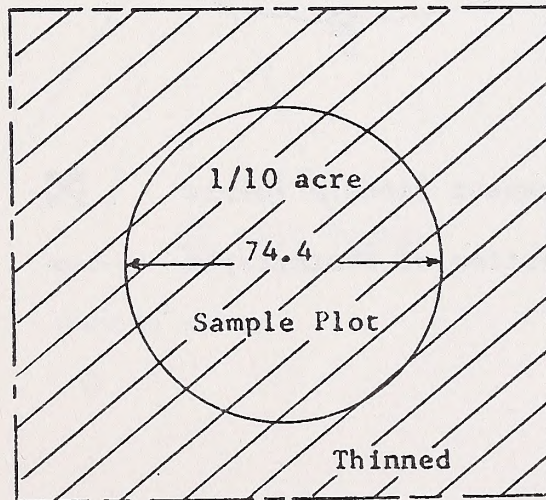
Sample Plot

Photograph Orientation
Interior Views

N

W   E

S
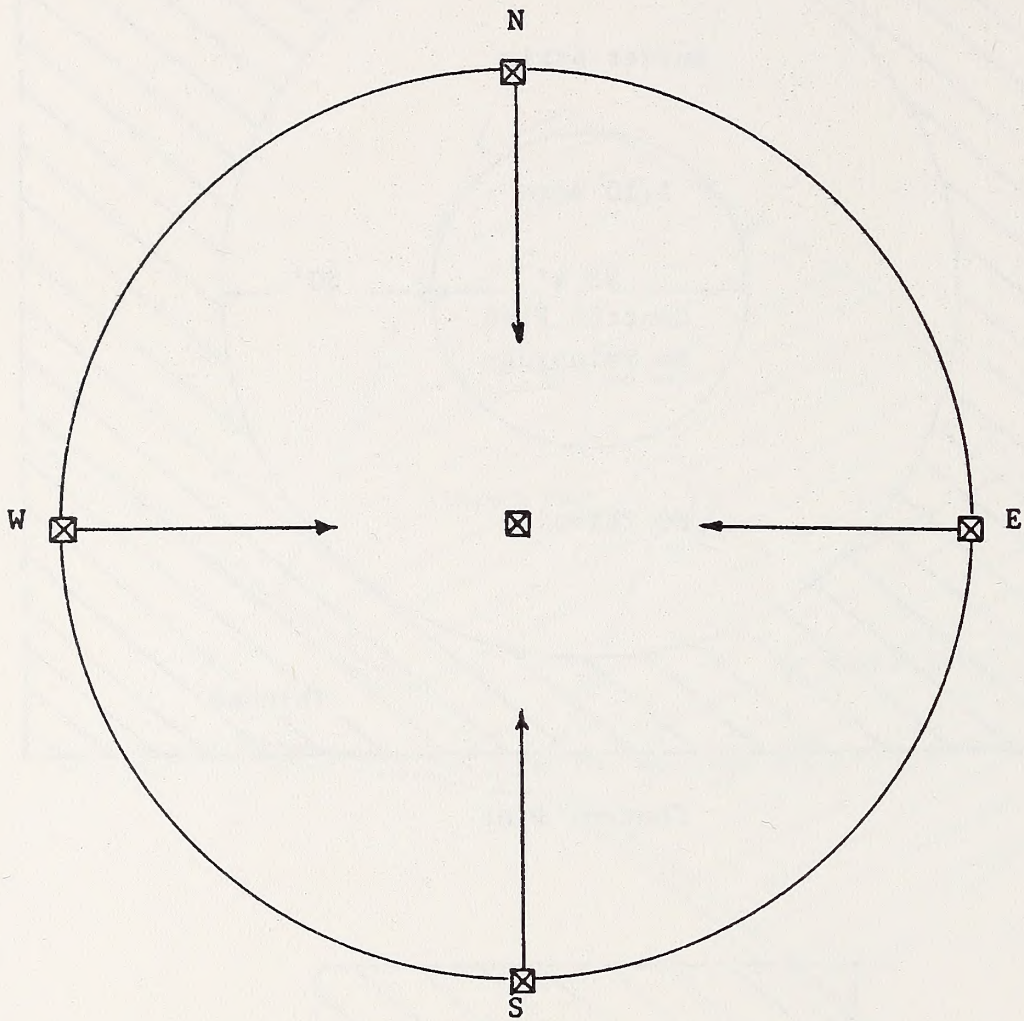
Permanent Picture Points   ⊠

Direction of Photographs   ⟶

Exhibit i

Photograph Orientation

Crown Closure
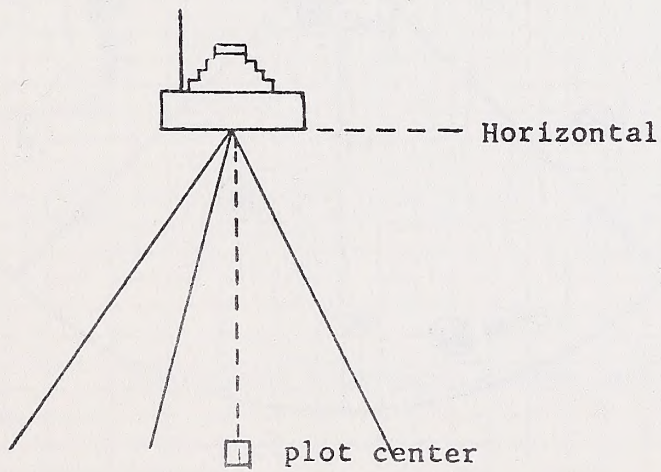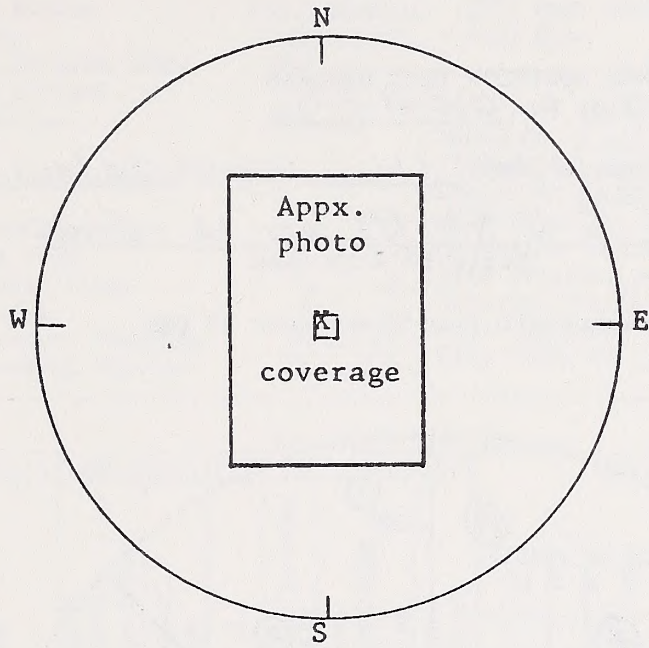
Camera setup

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

TREE POSITION PLOT DIAGRAM
Plot No. _O10-1_____

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
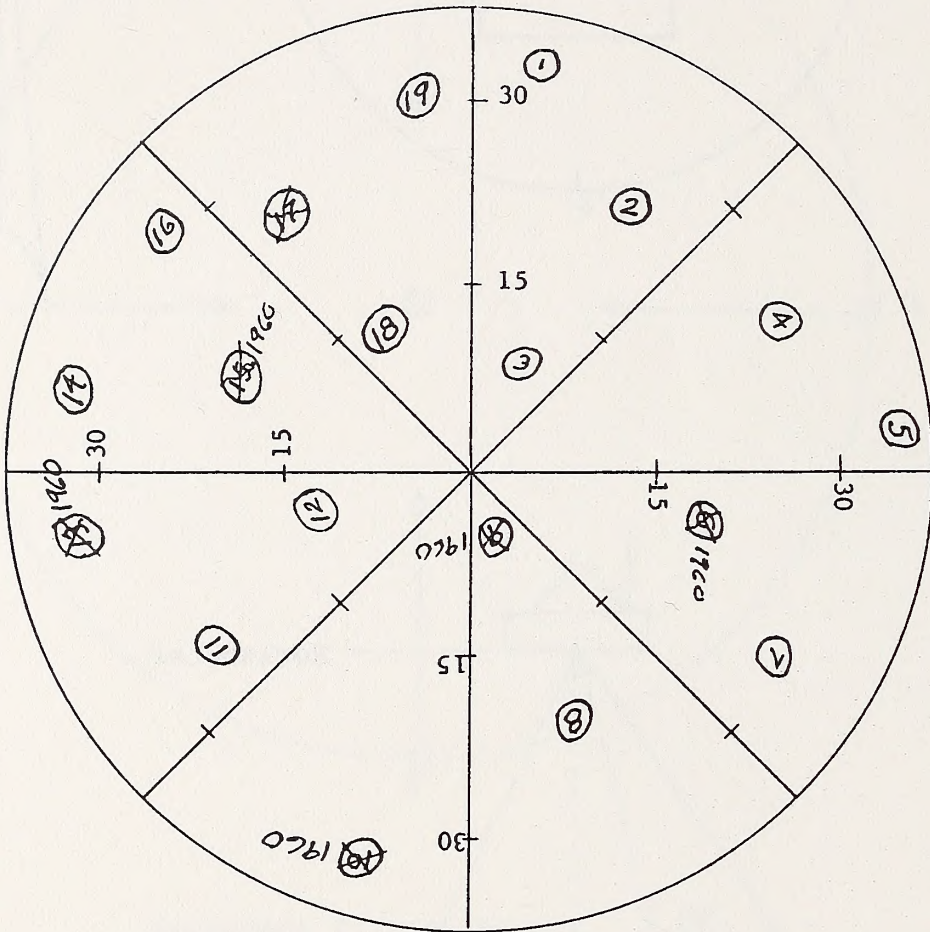
Legend

Plot trees -   tree number circled ------------- ⑫

Marked trees -   X over tree number and dated ---- Ⓧ 1960

Stumps -   X over tree number and dated ----- Ⓧ 1960

Form No. A1-159   *FIRST MEASUREMENT*
October, 1957   *After mark, before cutting*

(1) Plot Number   XXX-X _010-1_   (12) Past Cutting Record   X___0___
(2) County   XX _36_   (13) Site   XX _138_
(3) Geo. Stratum (FMA)   XXX _111_
(4) Kind of Plot   X _6_

(14) Not. Coded

(5) Stand Age   XXX _62_   MJOS

Photo No. _26A-1_ T. _3_ N R. _6_ W S. _17_
Plot RP:Sp. _01_ DBH _36"_ Dist. _11.35_ Ch.
Brg. fr. RP _N23E_ Plot Brg. — Decl. _21W_

(6) Volume Stratum   X ___0___   SP.Ref:Sp. _01_ DBH _14.5_ Ft. Brg. _S44W_ 15'
(7) Local Type   XXX _000_   SP.Ref:Sp. _01_ DBH _15.1"_ Ft. Brg. _7'S70E_
(8) St. Size Class   X _0_   Site Tree:Sp. _01_ Ht. _138_ Age _62_
(9) Stocking   X _0_   Estimator _Smith, Brown_ Date _12-6-60_
(10) Understory Stocking   XX _00_   Slope _20_ Aspect _NE_ Plot Rad. _37.2'_
(11) Understory Species   XX _00_   O&C, CBWR, PD _O&C_

ALL TREES 5.0" DBH +

	(15) Tree Number	(16) Species	(17) DBH	(18) Merch. Class	(19) Age Group	(20) Actual Age	(21) C.D.	(22) Crown or Keen Class	(23) Tree Condition	(24) Risk	(25) Total Height	(26) Defect by Log Position 1	2	3	4	5	6	7	8	9	(27) Percent Merch.	(28) Radial Growth	(29) Bark Thickness
(10)(11)(12)												10	11	12	13	14	15	16	17	18			
XXX	XXX	XX	XXXX	X	X	XXX	X	XX	XX	X	XXX	X	X	X	X	X	X	X	X	X	XX	XXX	XXX
211	001	01	0130	0	0	000	0	99	99	3	000	0	0	0	0	0	0	0	0	0	00	055	045
122	002	01	0141					99	14	3												075	055
222	003	01	0122					99	08	2												045	040
211	004	01	0133					99	99	3												055	040
111	005	01	0161			059		99	99	3	140											105	065
X 333	006	76	0093			000		99	06	2	000											020	040
323	007	01	0125					99	03	1												030	045
122	008	01	0141					99	14	3												060	055
X 422	009	18	0112					99	99	3												020	025
X 413	010	01	0099					99	02	1												025	030
211	011	01	0136					99	99	3												060	045
111	012	01	0152			064		99	99	3	138											075	055
X 312	013	01	0167			060		99	63	3	000											035	030
322	014	54	0139					99	10	3												025	025
X 413	015	01	0116					99	01	1												030	040
112	016	01	0156			063		99	99	3	136											060	055
X 312	017	01	0123			000		99	99	3	000											030	035
111	018	01	0151					99	99	3												085	060
221	019	01	0128					99	11	3												050	045

(Illustrates Recording Procedures Only)

Exhibit n