Pine Monitoring on the Waters Thin Project

Galice Ranger District
Siskiyou National Forest

Establishment Report

Southwest Oregon Forest Insect and Disease Technical Center
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SWOFIDTC 97-2

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Southwest Oregon Forest Insect and Disease Technical Center

Area and Project Description

The Waters Thin Project area is located on the headwaters of Waters and Salt Creeks in T36S, R7W, Sections 28, 29, 30, 31, 32, and 33 (Figures 1 and 2). Mixed conifer/hardwood forests composed of Douglas-fir, incense cedar, ponderosa pine, sugar pine, madrone, California black oak, and canyon live oak occur over much of the area. In the last few years, many pole-sized to mature stands have experienced considerable mortality in their pine components due to bark beetle infestation. Sugar pine has been attacked and killed by mountain pine beetle (*Dendroctonus ponderosae*), and ponderosa pine has been infested by both mountain pine beetle and western pine beetle (*D. brevicomis*). Bark beetle activity has been attributed to the extremely heavy stocking common to stands in the area, and there is concern that undesirably high levels of mortality may continue or even accelerate in the future if stands remain overstocked. One of the major objectives of the Waters Thin Project is to reduce probability of bark beetle-caused pine mortality in the future. Treatments will reduce stand densities in 20 units containing 736 acres. Stands are to be thinned to basal areas of 80 to 140 square feet per acre.

Pre-Treatment Plot Establishment

In summer 1996, the Southwest Oregon Forest Insect and Disease Technical Center established monitoring plots in six randomly selected units of the Waters Thin Project: units 6, 7, 12, 14, 17, and 20 (Figure 2). Purposes of the monitoring are to track the effectiveness of the thinning project in a) reducing stocking around pine trees to recommended levels, b) increasing vigor of residual pines, and c) minimizing infestation of residual pines by bark beetles.

Sample points were established systematically on 2 by 5 or 3 by 5 chain grids across each unit. At each point, a variable-radius plot (BAF 40) was established to measure trees per acre and basal area per acre for trees larger than five inches DBH. A 1/100 acre fixed-area circular plot was established at each point to measure numbers of small trees (six inches tall to five inches DBH) and shrubs per acre. All ponderosa and sugar pines in variable radius plots that were marked for retention were tagged and photographed from permanently established points. Photographs are on file at the Southwest Oregon Forest Insect and Disease Technical Center. For each of the tagged pines, data were collected on

diameter, last 10 year's radial growth, live crown ratio, crown color, needle retention, and surrounding ground cover.

Pre-Treatment Stand Conditions

The baseline survey shows the following:

1) All sampled stands have large numbers of live trees and high basal areas per acre (Tables 1-12). Among sample units, average number of trees ≥ five inches DBH varied from 201.21 to 309.60 per acre, and average basal area varied from 192 square feet per acre to 289 square feet per acre. The numbers of small trees (< five inch DBH) are especially high, averaging from 808 to 2494 stems per acre in the sample units. All stands have significant pine components, and many have very large pines (30 inch DBH or greater). For the sample units, pines constitute 2, 8, 16, 1, 9, and 5 percent of the live trees representing 4, 20, 25, 15, 24, and 23 percent of the live tree basal area respectively. Judging from the distribution of species by size class in sampled stands, it is probable that these stands have changed dramatically in the last 100 years. Most likely, these were rather lightly stocked stands with pines constituting a much higher proportion of the stocking prior to fire exclusion. Excluding the fires that formerly regulated stocking has allowed Douglas-fir and hardwood densities to increase greatly.

2) On sites like those in the Waters Thin Project area, entomologists consider a live pine to be at high risk of bark beetle infestation whenever surrounding basal area exceeds 180 square feet per acre. Of the 100 tagged sample trees in the survey, 91 have surrounding basal areas that exceed this threshold, in many cases by two-fold or more (Table 13). Furthermore, the large numbers of small trees around most pines accentuate the need for concern. Clearly, the live pines remaining in all sample stands are at high risk of bark beetle infestation, and the need for thinning and understory treatment is great if retaining pines is a desired management objective. Data on pine growth and crown condition are presented in Table 14. Crowns of most sample pines currently show good color and needle retention but low live crown ratios and small 10-year growth increments suggest that there is need for concern about the immediate futures of many individual pines.

3) Recent bark beetle caused mortality has in fact already been significant in the Waters Thin Project area. Of the stands sampled, four of six exhibited pine mortality caused by bark beetles. In these four stands (units 6, 12, 17, and 20), 29, 12, 5, and 15 percent respectively of the pines have been killed by beetles within the last 10 years.

Future Monitoring

All monitoring plots will be revisited following the harvest and understory treatments to measure post-treatment basal areas and trees per acre. Subsequently, all plots will be visited at two-year intervals to monitor incidence of pine mortality, cause of mortality, tree growth rates, changes in crown condition parameters, and amount of ingrowth of small trees and shrubs around pines. Monitoring will be continued for 20 years.

Figure 1: Location of Waters Thin Project Area

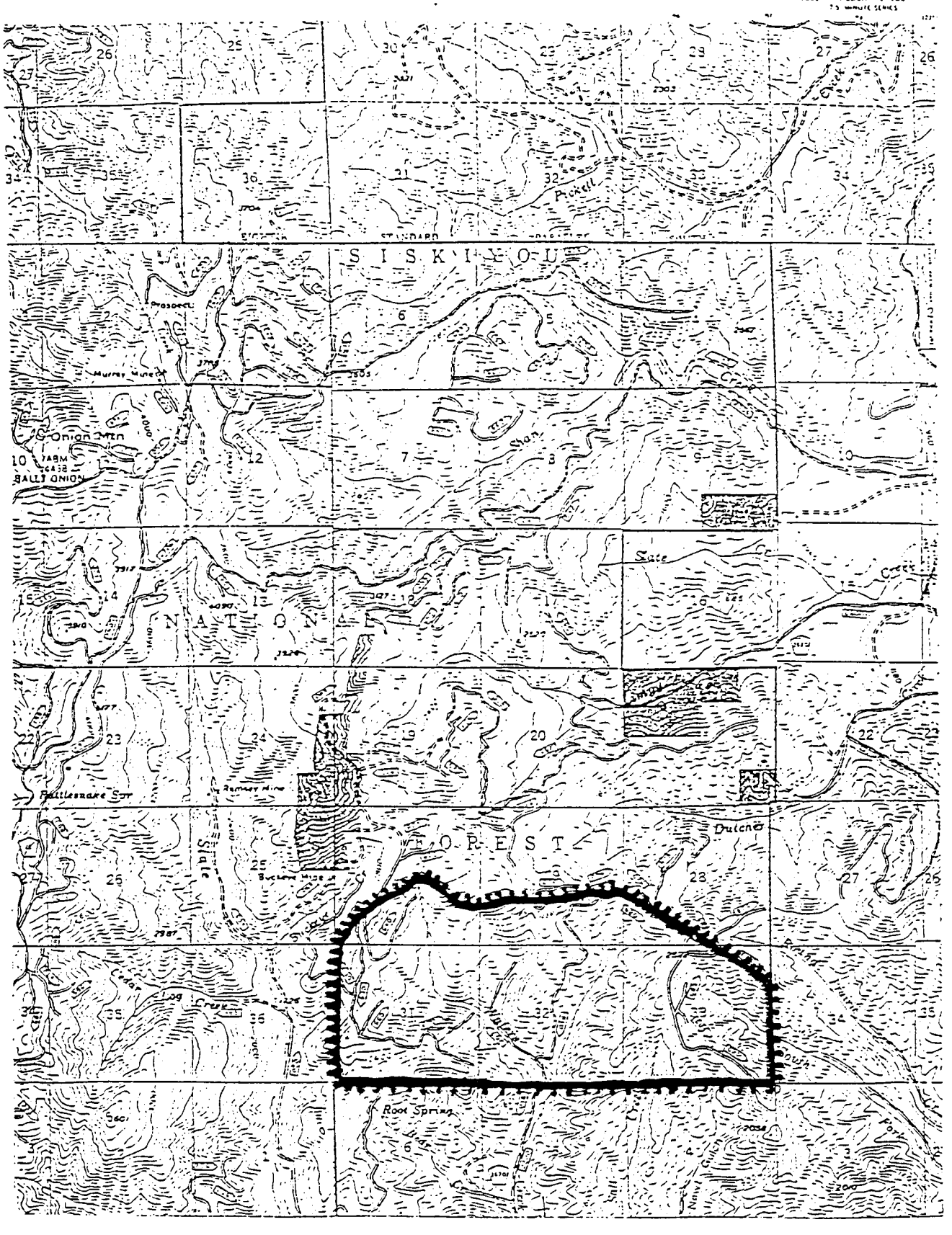

Figure 2: Location of Treatment Units in waters Thin Project area. Darkened units were surveyed in this evaluation.

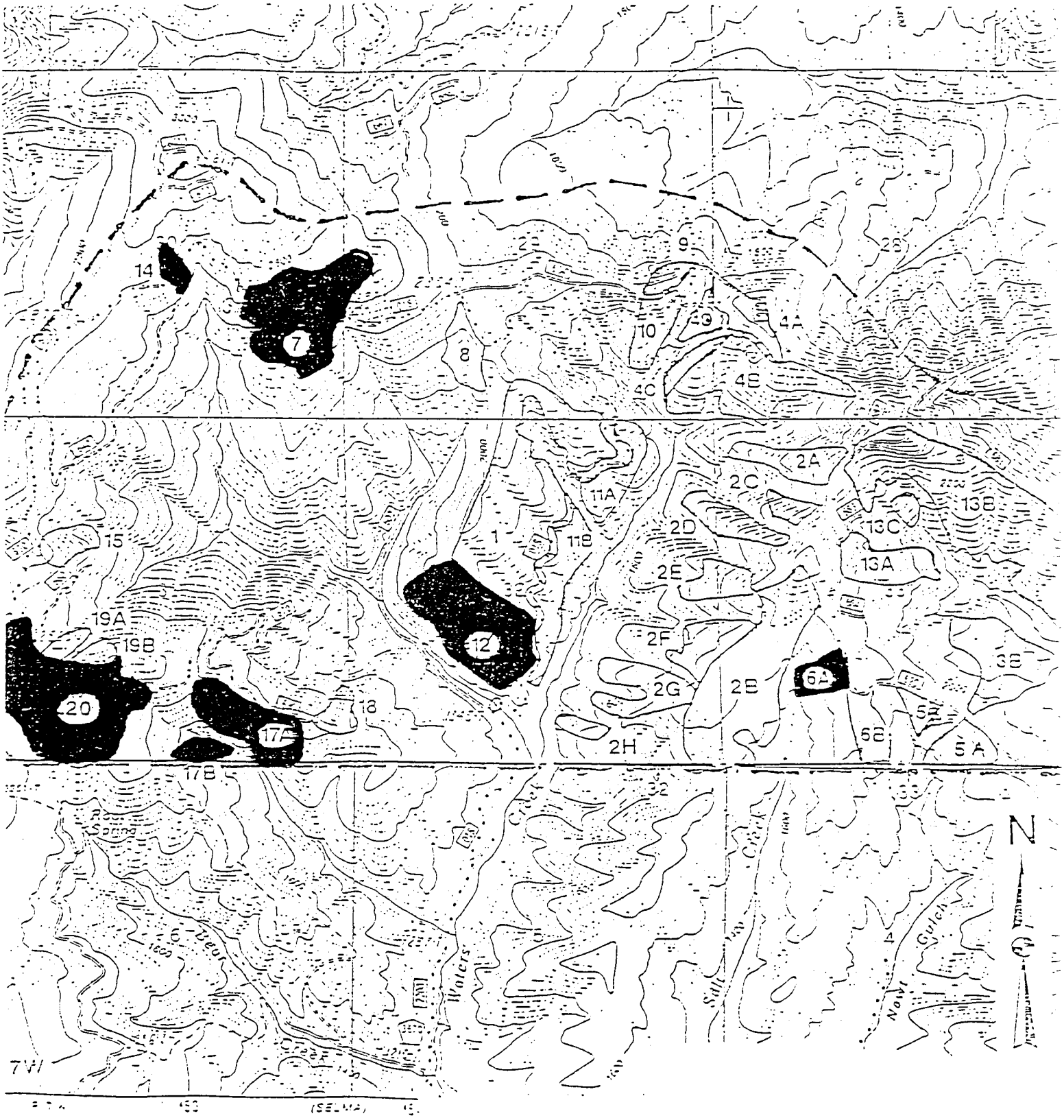

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Table 1: Average numbers of live trees per acre by species and diameter class, unit 6, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	QUCH	All Species
<5	-	-	-	-	-	-	-	1790
6							122.29	122.29
8							57.32	57.32
10							7.34	7.34
12	5.10	5.10					30.57	40.77
14							3.74	3.74
16	5.73					2.86		8.59
18	2.26						2.26	4.52
20					1.83			1.83
22	6.06							6.06
24	8.92		1.27					10.19
26	1.09							1.09
28							0.94	0.94
30	1.63							1.63
32	0.72							0.72
34				0.63				0.63
36	0.57						0.57	1.14
38								
40	0.46							0.46
42								
44	0.76							0.76
Total All Classes≥ 6	33.30	5.10	1.27	0.63	1.83	2.86	225.03	270.22

Table 2: Average live tree basal area (square feet per acre) by species and diameter class, unit 6, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	QUCH	All Species
6							24.00	24.00
8							20.00	20.00
10							4.00	4.00
12	4.00	4.00					24.00	32.00
14							4.00	4.00
16	8.00					4.00		12.00
18	4.00						4.00	8.00
20					4.00			4.00
22	16.00							16.00
24	28.00		4.00					32.00
26	4.00							4.00
28							4.00	4.00
30	8.00							8.00
32	4.00							4.00
34				4.00				4.00
36	4.00						4.00	8.00
38								
40	4.00							4.00
42								
44	8.00							8.00
Total All Classes	84.00	4.00	4.00	4.00	4.00	4.00	88.00	192.00

Table 3: Average numbers of live trees per acre by species and diameter class, unit 7, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	QUCH	All Species
<5	-	-	-	-	-	-	-	1855
6	61.15						50.96	112.11
8	17.20				11.46		11.46	40.12
10	14.68	11.01			14.68	3.67	14.68	58.72
12	15.29			2.54	5.08		2.54	25.45
14	3.74			3.74	1.87		1.87	11.22
16	1.43		1.43	1.43	4.29			8.58
18	5.66				1.13	1.13	1.13	9.05
20		0.92	1.84	4.60				7.36
22	1.52		0.76	1.52				3.80
24	3.18	0.63	1.26	0.63	0.63			6.33
26			1.09	1.09				2.18
28	0.47		0.94	0.94				2.35
30	1.63			0.41			0.41	2.45
32	0.36		0.72	0.72				1.80
34	0.63		0.31	0.31				1.25
36	0.57	0.57		0.28				1.42
38	0.25	0.50	0.25					1.00
40	0.69		0.23					0.92
42	0.21		0.21					0.42
44	0.19							0.19
46	0.17							0.17
48	0.16							0.16
50								
52	0.14	0.14						0.28
54	0.13							0.13
56								
58		0.11						0.11
60								
62				0.10				0.10
Total All Classes ≥ 6	129.45	13.88	9.04	18.31	39.14	4.80	83.07	297.69

Table 4: Average live tree basal area (square feet per acre) by species and diameter class, unit 7, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	QUCH	All Species
6	12.00						10.00	22.00
8	6.00				4.00		4.00	14.00
10	8.00	6.00			8.00	2.00	8.00	32.00
12	12.00			2.00	4.00		2.00	20.00
14	4.00			4.00	2.00		2.00	12.00
16	2.00		2.00	2.00	6.00			14.00
18	10.00				2.00	2.00	2.00	16.00
20		2.00	4.00	10.00				16.00
22	4.00		2.00	4.00				10.00
24	10.00	2.00	4.00	2.00	2.00			20.00
26			4.00	4.00				8.00
28	2.00		4.00	4.00				10.00
30	8.00			2.00			2.00	12.00
32	2.00		4.00	4.00				10.00
34	4.00		2.00	2.00				8.00
36	4.00	4.00		2.00				10.00
38	2.00	4.00	2.00					8.00
40	6.00		2.00					8.00
42	2.00		2.00					4.00
44	2.00							2.00
46	2.00							2.00
48	2.00							2.00
50								
52	2.00	2.00						4.00
54	2.00							2.00
56								
58		2.00						2.00
60								
62				2.00				2.00
Total All Classes	108.00	22.00	32.00	44.00	28.00	4.00	30.00	268.00

Table 5: Average number of live trees per acre by species and diameter class, unit 12, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	All Species
<5	-	-	-	-	-	-	2000
6	81.53	20.38					101.91
8	63.06	5.73				11.46	80.25
10	18.34			3.67	3.67	7.34	33.02
12	10.19	7.64		2.55	2.55		22.93
14	7.49	3.74				3.74	14.97
16	7.17						7.17
18	2.26	2.26		1.13	1.13		6.78
20	0.92	0.92			0.92	1.84	5.60
22	1.52	1.52			0.76	1.52	5.32
24	1.27						1.27
26	0.54	1.08					1.64
28	1.87						1.87
30	1.22	0.41					1.63
32	0.72	0.36					1.08
34							
36	0.28						0.28
38	0.51	0.76	0.25				1.52
40	0.23	0.46					0.69
42	0.62	0.21					0.83
44		0.19					0.19
46	0.35	0.35					0.70
48							
50							
52							
54							
56		0.12			0.12		0.24
58		0.11					0.11
Total All Classes ≥ 6	200.09	46.23	0.25	7.37	9.43	25.90	289.28

Table 6: Average live tree basal area (square feet per acre) by species and diameter class, unit 12, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	All Species
6	16.00	4.00					20.00
8	22.00	2.00				4.00	28.00
10	10.00			2.00	2.00	4.00	18.00
12	8.00	6.00		2.00	2.00		18.00
14	8.00	4.00				4.00	16.00
16	10.00						10.00
18	4.00	4.00		2.00	2.00		12.00
20	2.00	2.00			2.00	4.00	10.00
22	4.00	4.00			2.00	4.00	14.00
24	4.00						4.00
26	2.00	4.00					6.00
28	8.00						8.00
30	6.00	2.00					8.00
32	4.00	2.00					6.00
34							
36	2.00						2.00
38	4.00	6.00	2.00				12.00
40	2.00	4.00					6.00
42	6.00	2.00					8.00
44		2.00					2.00
46	4.00	4.00					8.00
48							
50							
52							
54							
56		2.00			2.00		4.00
58		2.00					2.00
Total All Classes	126.00	54.00	2.00	6.00	12.00	20.00	220.00

Table 7: Average number of live trees per acre by species and diameter class, unit 14, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	All Species
<5	-	-	-	-	1575
6	50.96				50.96
8	57.32			57.32	114.64
10				55.03	55.03
12	25.48			12.74	38.22
14					
16	14.33			7.16	21.49
18	5.66				5.66
20				4.59	4.59
22	3.79				3.79
24	3.18			3.18	6.36
26					
28	2.34				2.34
30					
32					
34			1.59		1.59
36					
38					
40	1.15				1.15
42					
44			0.95		0.95
46	0.87				0.87
48					
50	0.73				0.73
52		0.68			0.68
54					
56					
58			0.55		0.55
Total All Classes ≥ 6	165.81	0.68	3.09	140.02	309.60

Table 8: Average live tree basal area (square feet per acre) by species and diameter class, unit 14, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	All Species
6	10.00				10.00
8	20.00			20.00	40.00
10				30.00	30.00
12	20.00			10.00	30.00
14					
16	20.00			10.00	30.00
18	10.00				10.00
20				10.00	10.00
22	10.00				10.00
24	10.00			10.00	20.00
26					
28	10.00				10.00
30					
32					
34			10.00		10.00
36					
38					
40	10.00				10.00
42					
44			10.00		10.00
46	10.00				10.00
48					
50	10.00				10.00
52		10.00			10.00
54					
56					
58			10.00		10.00
Total All Classes	140.00	10.00	30.00	90,00	270.00

Table 9: Average numbers of live trees per acre by species and diameter class, unit 17, Waters Thin Project.

DBH Class	PSME	PILA	CADE3	ARME	QUKE	QUCH	All Species
<5	-	-	-	-	-	-	2494
6	11.32		22.65			33.97	67.94
8	12.74		6.37			6.37	25.48
10	12.23		4.08		16.31		32.62
12	11.32	2.83		5.66	5.66	2.83	28.30
14	2.08	4.16	2.08		2.08		10.40
16			1.59		1.59		3.18
18		3.77		1.26			.5.03
20	3.06	1.02					4.08
22	0.84	1.68				0.84	3.36
24	2.12	0.71					2.83
26	3.02						3.02
28	1.04						1.04
30	1.81						1.81
32	0.80	1.19					1.99
34	0.35	0.71					1.06
36	1.26	0.31					1.57
38	1.41						1.41
40	1.27						1.27
42	0.92	0.46					1.38
44	0.21	0.63					0.84
46		0.39					0.39
48	0.18	0.35					0.53
50	0.33						0.33
52							
54	0.28						0.28
56							
58		0.12					0.12
Total All Classes ≥ 6	68.59	18.33	36.77	6.92	25.64	44.01	201.21

Table 10: Average live tree basal area (square feet per acre) by species and diameter class, unit 17, Waters Thin Project.

DBH Class	PSME	PILA	CADE3	ARME	QUKE	QUCH	All Species
6	2.22		4.44			6.67	13.33
8	4.44		2.22			2.22	8.88
10	6.67		2.22		8.89		17.78
12	8.89	2.22		4.44	4.44	2.22	22.21
14	2.22	4.44	2.22		2.22		11.10
16			2.22		2.22		4.44
18		6.67		2.22			8.89
20	6.67	2.22					8.89
22	2.22	4.44				2.22	8.88
24	6.67	2.22					8.89
26	11.11						11.11
28	4.44						4.44
30	8.89						8.89
32	4.44	6.67					11.11
34	2.22	4.44					6.66
36	8.89	2.22					11.11
38	11.11						11.11
40	11.11						11.11
42	8.89	4.44					13.33
44	2.22	6.67					8.89
46		4.44					4.44
48	2.22	4.44					6.66
50	4.44						4.44
52							
54	4.44						4.44
56							
58		2.22					2.22
Total All Classes	124.42	57.75	13.32	6.66	17.77	13.33	237.69

Table 11: Average number of live trees per acre by species and diameter class, unit 20, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	QUCH	All Species
<5	-	-	-	-				807
6	21.84			14.56	14.56		7.28	58.24
8	20.47			8.19				28.66
10	23.59			2.62	18.34	4.09	4.09	52.73
12	12.74			1.82	3.64		9.10	27.30
14	9.36		1.34	2.68	6.69	1.34	1.34	22.75
16	8.19		2.05	1.02	3.07			14.33
18	4.85		0.81	0.81	2.43	0.81	1.62	11.33
20	5.90		0.66			0.66	1.98	9.20
22	3.79		2.17			0.54	0.54	7.04
24	0.45		0.90	0.45				1.80
26	0.78		1.16		0.39			2.33
28	0.67		1.05					1.72
30	0.29	0.29	0.58			0.29	0.29	1.74
32	0.51	0.25	0.51			0.25		1.52
34	0.68		0.68					1.36
36	0.20		0.61	0.20		0.20		1.21
38	0.18	0.18	0.18					0.54
40	0.16		0.49					0.65
42			0.45					0.45
44								
46	0.12		0.12					0.24
48								
50			0.10					0.10
52								
54			0.09					0.09
Total All Classes ≥ 6	114.77	0.72	13.95	33.82	49.12	8.18	26.24	266.80

Table 12: Average live tree basal area (square feet per acre) by species and diameter class, unit 20, Waters Thin Project.

DBH Class	PSME	PILA	PIPO	CADE3	ARME	QUKE	QUCH	All Species
6	4.29			2.86	2.86		1.43	11.44
8	7.14			2.86				10.00
10	12.86			1.43	10.00	1.43	1.43	27.15
12	10.00			1.43	2.86		7.14	21.43
14	10.00		1.43	2.86	7.14	1.43	1.43	24.29
16	11.43		2.86	1.43	4.29			20.01
18	8.57		1.43	1.43	4.29	1.43	2.86	20.01
20	12.86		1.43			1.43	4.29	20.01
22	10.00		5.71			1.43	1.43	18.57
24	1.43		2.86	1.43	1.43			7.15
26	2.86		4.29					7.15
28	2.86		4.29					7.15
30	1.43	1.43	2.86			1.43	1.43	8.58
32	2.86	1.43	2.86			1.43		8.58
34	4.29		4.29					8.58
36	1.43		4.29	1.43		1.43		8.58
38	1.43	1.43	1.43					4.29
40	1.43		4.29					5.72
42			4.29					4.29
44								
46	1.43		1.43					2.86
48								
50			1.43					1.43
52								
54			1.43					1.43
Total All Classes	108.68	4.29	52.91	17.16	32.89	11.44	21.45	248.82

Table 13: Data on pines sampled in 6 randomly selected units, Waters Thin Project: species, diameters, surrounding basal area, and surrounding density of small trees.

Tree#	Stand	Species	DBH (inches)	Surrounding Basal Area (sq.ft./acre)	Surrounding Small Trees (≤5" dbh)/acre
201	20	PIPO	27.2	240	900
202	20	PIPO	22.0	240	900
203	20	PILA	31.9	320	1200
204	20	PILA	38.7	240	600
205	20	PIPO	42.4	160	300
206	20	PIPO	53.8	240	300
207	20	PIPO	24.7	240	200
208	20	PIPO	34.5	240	200
209	20	PIPO	21.4	240	200
210	20	PIPO	29.0	240	400
211	20	PIPO	28.4	200	1000
212	20	PIPO	34.6	360	1000
213	20	PIPO	42.3	360	1000
214	20	PIPO	36.0	360	1000
215	20	PIPO	40.6	360	1000
216	20	PIPO	50.8	360	1000
217	20	PIPO	32.7	360	1000
218	20	PIPO	19.0	320	1100
219	20	PIPO	17.2	120	800
220	20	PIPO	16.7	360	400
221	20	PIPO	35.1	360	400
222	20	PIPO	35.4	360	400
223	20	PIPO	25.7	360	400
224	20	PIPO	34.4	240	800
225	20	PIPO	24.8	240	500
226	20	PIPO	37.1	440	600
227	20	PIPO	46.6	440	600
228	20	PIPO	25.8	240	1200
229	20	PIPO	21.7	240	1200
230	20	PIPO	29.2	240	1200
231	20	PIPO	25.1	320	600
232	20	PIPO	41.4	320	600
233	20	PILA	25.9	320	1800
234	20	PIPO	32.6	320	1800
235	6A	PIPO	24.8	240	1800
236	6A	PILA	12.4	80	1300
237	14	PIPO	34.9	360	2800
238	14	PILA	51.2	280	2000

Table: 13 (continued).

Tree#	Stand	Species	DBH (inches)	Surrounding Basal Area (sq.ft./acre)	Surrounding Small Trees (≤5" dbh)/acre
239	14	PIPO	43.2	280	2000
240	14	PIPO	57.5	120	800
241	12	PILA	18.4	320	1100
242	12	PILA	26.3	200	4500
243	12	PILA	29.9	200	4500
244	12	PILA	40.4	240	4400
245	12	PILA	46.8	240	2700
246	12	PILA	37.6	240	2700
247	12	PILA	14.5	240	1600
248	12	PILA	17.7	440	400
249	12	PILA	12.0	440	400
250	12	PILA	40.1	240	3000
251	12	PILA	41.1	200	1500
252	12	PILA	46.5	280	1100
253	12	PILA	58.5	280	1100
254	12	PIPO	36.0	280	3200
255	12	PILA	11.0	280	3200
256	12	PILA	13.4	200	2200
257	12	PILA	55.1	240	2800
258	12	PILA	43.6	240	2900
259	12	PILA	22.2	240	4300
260	12	PILA	21.0	240	4300
261	12	PILA	20.5	240	1400
262	12	PILA	38.1	240	1400
263	17A	PILA	45.0	400	2200
264	17A	PILA	34.3	400	2200
265	17A	PILA	47.1	200	3000
266	17A	PILA	17.0	280	3200
267	17A	PILA	33.3	280	3200
268	17A	PILA	43.9	200	6700
269	17A	PILA	57.0	240	3000
270	17A	PILA	32.0	240	3000
271	17A	PILA	47.3	240	3000
272	17A	PILA	32.9	160	1000
273	17A	PILA	13.1	160	1000
274	17A	PILA	22.4	320	1000
275	17A	PILA	44.5	320	1500
276	17A	PILA	18.0	400	1800
277	17A	PILA	42.5	400	1800

Table: 13 (continued).

Tree#	Stand	Species	DBH (inches)	Surrounding Basal Area (sq.ft./acre)	Surrounding Small Trees (≤5" dbh)/acre
278	17A	PILA	46.5	320	1800
279	17A	PILA	42.4	320	1800
280	17A	PILA	43.9	320	1800
281	17A	PILA	32.6	280	2000
282	7	PIPO	19.7	80	3800
283	7	PILA	37.0	440	2700
284	7	PIPO	40.5	280	2200
285	7	PIPO	34.4	360	3400
286	7	PIPO	37.7	360	3400
287	7	PIPO	32.2	240	1400
288	7	PILA	24.3	400	3700
289	7	PILA	9.6	400	3700
290	7	PILA	52.0	160	1000
291	7	PILA	35.4	240	1400
292	7	PILA	36.5	480	1500
293	7	PILA	37.6	480	1500
294	7	PILA	58.5	120	900
295	7	PILA	27.5	240	600
296	7	PILA	19.5	240	600
297	7	PIPO	26.1	280	1000
298	7	PIPO	27.0	280	1000
299	7	PIPO	21.8	280	1000
300	7	PIPO	31.1	360	100

Table 14: Data on pines sampled in 6 randomly selected units on the Waters Thin Project: radial growth, live crown ratios and widths, foliage color, and needle retention.

Tree #	Species	10 yr growth (1/20 inches)	LCR (%)	Crown diam. (feet)	Crown Color by thirds from top[1]	Needle Retention by thirds from top[2]
201	PIPO	18	40	25	G G G	F F M
202	PIPO	17	40	20	G G M	F M P
203	PILA	21	50	25	G G G	F F F
204	PILA	11	60	25	G G M	F F M
205	PIPO	20	60	20	M M M	M F M
206	PIPO	8	35	30	M G G	P F F
207	PIPO	19	50	20	G G G	F F P
208	PIPO	11	35	30	G G M	F F M
209	PIPO	9	35	20	G G G	F F F
210	PIPO	15	50	25	G G G	F F M
211	PIPO	10	35	25	G G M	M F P
212	PIPO	9	35	20	M M M	M M M
213	PIPO	8	40	25	G G G	F F F
214	PIPO	7	20	20	M M M	M M M
215	PIPO	6	50	20	M M M	P M M
216	PIPO	5	50	40	M M M	M M M
217	PIPO	14	50	35	G G M	F M M
218	PIPO	13	40	25	G G G	F F M
219	PIPO	16	50	20	G G G	F F F
220	PIPO	6	25	15	G G G	F F M
221	PIPO	14	45	30	G G G	F F M
222	PIPO	8	25	20	M M M	M M M
223	PIPO	10	35	25	G G G	F F M
224	PIPO	8	50	30	G G M	F F M
225	PIPO	13	20	15	G G M	F F M
226	PIPO	8	20	30	G G G	F F M
227	PIPO	15	35	25	G G M	F M M
228	PIPO	16	40	25	G G G	F F M
229	PIPO	12	50	20	G G G	F F M
230	PIPO	11	35	25	G G M	F M M
231	PIPO	11	35	20	M M M	F M M
232	PIPO	9	50	25	G G G	F F F
233	PILA	18	40	25	G G G	F F M
234	PIPO	15	50	25	M M M	M M P

[1] G = dark green; M = intermediate green; C = Chlorotic.
[2] F = Full; M = Intermediate; P = Poor.

Table: 14 (continued).

Tree #	Species	10 yr growth (1/20 inches)	LCR (%)	Crown diam. (feet)	Crown Color by thirds from top	Needle Retention by thirds from top
235	PIPO	10	60	15	G G M	F M M
236	PILA	11	50	15	M M M	F M M
237	PIPO	8	50	15	G M C	F M P
238	PILA	15	35	20	G G G	F F F
239	PIPO	13	50	15	G G G	F F F
240	PIPO	8	70	25	M M C	M M P
241	PILA	18	50	20	G G G	F F F
242	PILA	5	35	25	G G G	F F M
243	PILA	17	50	30	G G G	F F F
244	PILA	9	40	35	G G G	P P M
245	PILA	10	50	40	G G G	F M M
246	PILA	9	35	35	G M M	F M M
247	PILA	15	40	20	G G G	F F F
248	PILA	19	35	20	G G G	F F F
249	PILA	20	20	12	G G G	F F M
250	PILA	22	40	30	G G G	F M M
251	PILA	9	50	40	G G G	F F M
252	PILA	10	60	15	G G G	F M F
253	PILA	9	60	30	G G G	F M F
254	PIPO	12	40	35	G G G	M M M
255	PILA	11	35	10	G G G	M F M
256	PILA	10	25	15	G G G	F F F
257	PILA	8	50	30	G G G	M M M
258	PILA	7	40	25	G G G	M P P
259	PILA	12	40	20	G G G	F F F
260	PILA	20	25	10	G G G	F F F
261	PILA	20	50	15	G G G	F F F
262	PILA	14	50	30	G G G	F M M
263	PILA	12	60	40	G G G	F F M
264	PILA	11	40	30	G G G	F F M
265	PILA	8	65	25	G G G	P M M
266	PILA	15	40	15	G G G	F P M
267	PILA	16	50	25	G G G	F F M
268	PILA	10	60	30	G G G	M F M
269	PILA	6	50	35	G G G	M M M
270	PILA	12	30	20	G G G	M M M
271	PILA	6	30	40	G G G	M M M
272	PILA	16	60	30	G G G	F F M
273	PILA	15	50	15	G G G	F F F

Table: 14 (continued).

Tree #	Species	10 yr growth (1/20 inches)	LCR (%)	Crown diam. (feet)	Crown Color by thirds from top	Needle Retention by thirds from top
274	PILA	11	25	15	G G G	F F M
275	PILA	10	25	25	G G G	F F M
276	PILA	24	65	15	G G G	F F F
277	PILA	14	60	45	G G G	M M F
278	PILA	6	60	40	G G G	M M F
279	PILA	6	50	30	G G G	M M F
280	PILA	6	50	35	G G G	M M M
281	PILA	8	30	25	G G G	F M M
282	PIPO	17	50	25	G G G	F F F
283	PILA	16	40	40	G G G	F F M
284	PIPO	15	35	30	M M M	F M M
285	PIPO	6	50	30	G G M	F F M
286	PIPO	4	50	30	M M M	P P M
287	PIPO	20	60	30	G G G	F F M
288	PILA	20	35	30	G G G	F F F
289	PILA	9	20	10	G G G	F M M
290	PILA	20	40	35	G G G	P M M
291	PILA	10	70	30	G G G	M M F
292	PILA	13	35	35	G G G	F F F
293	PILA	15	50	25	G G G	F F M
294	PILA	15	60	40	G G G	M F M
295	PILA	31	60	30	G G G	F F F
296	PILA	28	50	20	G G G	F F F
297	PIPO	18	50	25	G G G	F F P
298	PIPO	24	35	20	G G G	F F F
299	PIPO	24	40	20	G G G	F F M
300	PIPO	22	35	25	G G G	F F F