

Foothills Growth and Yield Association
Regenerated Lodgepole Pine Trial

Field Manual Version 4.2

Thinning Supplement

May 2013



Table of Contents

1	TRIAL LAYOUT AND TREATMENT CATEGORIES	2
2	THINNING SCHEDULE	3
3	THINNING METHOD	5
3.1	Tree Selection	5
3.2	Work Quality	7
	APPENDIX 1. PREFERRED THINNING SCHEDULE	9

1 Trial Layout and Treatment Categories

The split-plot design consists of 102 whole-plots or “installations” (5 ecological site classes x 6 planting densities, replicated 3-5 times). Each 1-hectare installation is split into 4 weeding and thinning sub-plots or “treatment plots” (see Table 1).

Table 1. Plot Vegetation Management Treatments

Plot	Treatment	Treatment Description
C	Control	Do not apply vegetation management treatments or otherwise disturb vegetation
W	Weeding	Apply herbicide to (or manually weed) herbaceous and deciduous vegetation exceeding competition thresholds
WT	Weeding and Thinning	Apply both weeding (“W”) and thinning (“T”) treatments
T	Thinning	Remove remaining deciduous trees and shrubs, and thin coniferous trees to target density

The installations are organized in 17 groups of 6, each installation within a group having a different target crop tree density. The target densities are shown in Table 2 as stems per ha, per treatment plot (0.25ha), and per measurement plot (0.1ha). Weeding treatments are complete. The thinning treatment, applicable to the WT and T treatment plots, will involve identifying and retaining the appropriate number of target trees and removing all other coniferous and deciduous trees (including willow and alder shrubs). In planted installations the target after-thinning density (stems per ha) is the same as the original target planting density. In non-planted installations, natural coniferous regeneration in the WT and T plots will be thinned if its density exceeds 4,444 stems per ha (i.e. the maximum planting density). One installation (4-2-0), scheduled as non-planted but erroneously planted, will not be retained in the experiment and has been excluded from the thinning schedule.

Table 2. Target Densities and Equivalent Inter-tree Distances

Code	Target Density (stems/ha)	Target Plot Densities (stems per treatment and measurement plot)	Desired Inter-tree Distance (m)
0 or 9	0	1111/444 ¹	1.5 ²
816	816	204/82	3.5
1111	1111	278/111	3.0
1600	1600	400/160	2.5
2500	2500	625/250	2.0
4444	4444	1111/444	1.5

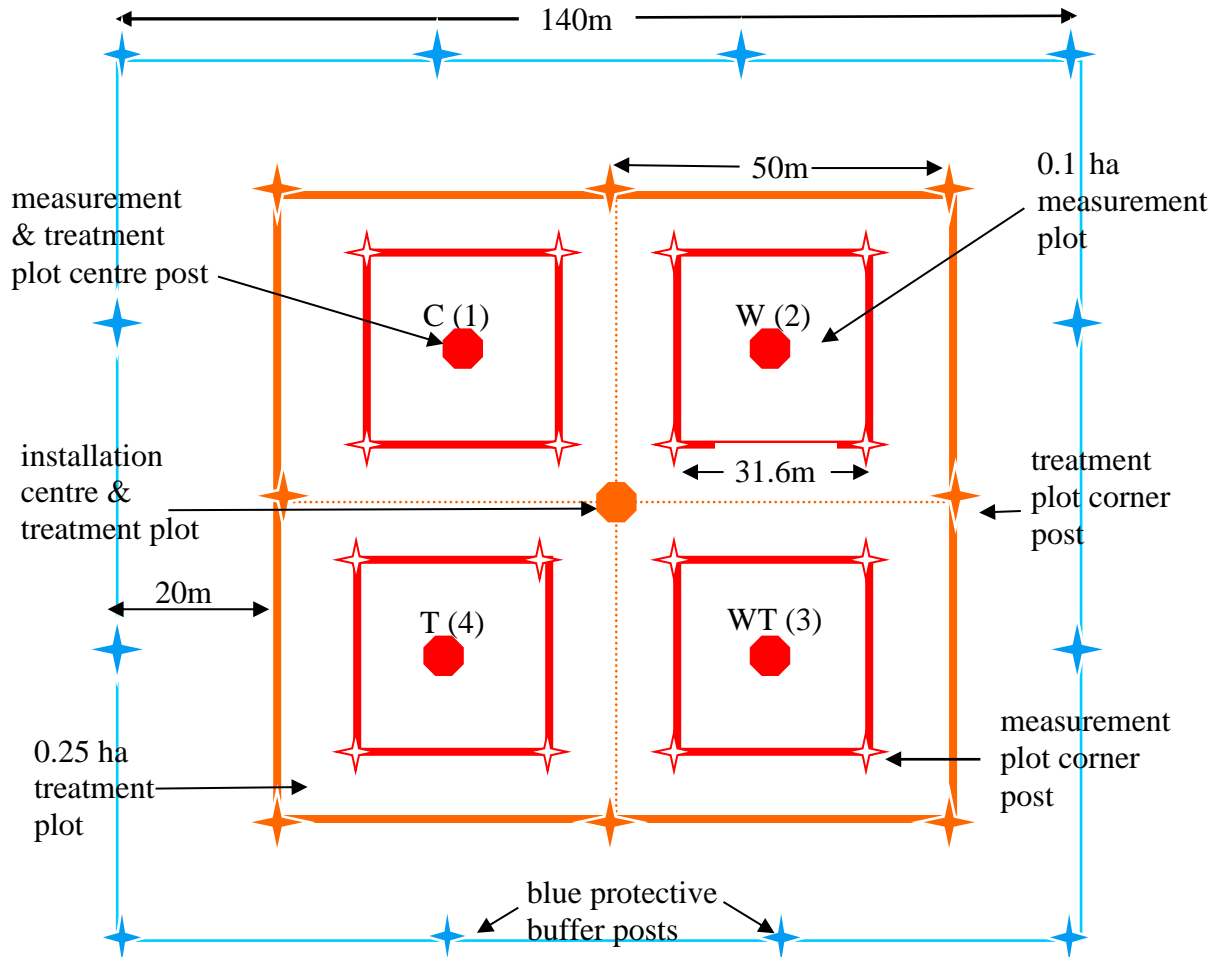
Figure 1 shows the layout of a standard installation. In some installations treatment plots have been re-aligned or separated to fit into the targeted site. In one installation the designated treatments have had to

¹ Or less depending on the actual density of natural regeneration.

² Or more depending on the actual density of natural regeneration.

be switched between treatment plots because of accidental thinning. Careful attention must therefore be paid to plot maps and the thinning schedule to ensure that the correct plots are thinned.

Figure 1. Installation Diagram



2 Thinning Schedule

A *preferred thinning window* (preferred earliest and latest year for thinning) was established for each installation using the following criteria:

- Earliest – the first year that the average height of pine in either the T or WT treatment plot is projected to exceed 3.0m by the end of the growing season;
- Latest – the earliest of either 2014 or the first year that the average height of pine in either the T or WT treatment plot is projected to exceed 5.0m by the end of the growing season.

All T and WT plots within each group of installations should be thinned during the same year, even though this may mean that some of the plots are not within the preferred thinning window. A *preferred group thinning year* has been identified for each group as follows:

- 2011: Group 4-1 (contains an installation disturbed accidentally in 2010);
- 2012: Remaining groups where all planted installations are forecast to be within the preferred thinning window;
- 2013: Remaining groups where the majority of installations (4 or more out of 6) are within the preferred thinning window;
- 2014: Remaining groups.

The resulting Preferred Thinning Schedule is shown in Appendix 1. The schedule is also available in Microsoft Excel format, together with details of the scheduling information and calculations.

Information contained in the *schedule* was calculated as follows.

- *Average Pine Height.* Projected to the end of the growing season of the preferred group thinning year from the latest full measurement (conducted in 2010 or 2011), based on the periodic annual increment observed since the previous measurement.
- *Retained Stems per Ha.* For planted plots this always equates to the Target Planting Density. (Mortality, although considerable on some plots, has so far always been more than offset by ingress of natural regeneration.) For non-planted plots the retained stems per ha will be the lesser of 4,444 or the actual ingress stems per ha.
- *Retained Stems per Treatment Plot and per Measurement Plot* (0.25ha and 0.1ha respectively). Calculated from the retained stems per ha.
- *Removed Conifer Stems per Treatment Plot and Measurement Plot.* Calculated from the total live coniferous stems per ha estimated as of 2011, based on the last full measurement (2010 or 2011) and planting stock survival to 2011, less the retained stems per ha as calculated above.
- *Removed Deciduous Stems per Treatment Plot and Measurement Plot.* Number of deciduous stems (30cm+ in height) as measured and estimated at the last full measurement (2010 or 2011). The estimate does not include willow and alder.

Note that no adjustments are made for changes in densities that may occur as a result of ingress or mortality between the last measurement and the thinning. The schedule will be updated each year as new data becomes available. If possible, thinning should be conducted for each group of installations in the indicated preferred group thinning year. The numbers of groups currently scheduled per year are:

- 2011 1
- 2012 8
- 2013 6
- 2014 2

Thinning will be undertaken after July 15 of the year scheduled, and after the plot has been measured (full or check). It must be done while the plot is snow-free, and completed for the whole group before May 31 of the following calendar year. If adherence to the preferred schedule is not possible, thinning of the group should be conducted the year following the preferred group thinning year, and completed for all installations in the trial by May 31, 2015. The identities of tagged and numbered trees that are

removed during the thinning operation are to be recorded during the first routine plot measurement following thinning.

3 Thinning Method

The trial involves an experimental range of thinning intensities and target post-thinning densities. In all other respects the thinning method will follow or approximate the best operating practices of FGYA members. Thinning will be conducted on all T and WT treatment plots where deciduous competition exists and / or where the actual number of live coniferous stems per plot exceeds the target identified in the schedule.

3.1 Tree Selection

All deciduous trees (including willow and alder shrubs) 30cm+ in height are to be removed.

Coniferous trees to be removed and “keep” trees to be retained after thinning will be identified based on two sometimes conflicting sets of criteria: spacing between trees and tree characteristics. Ideally, retained trees will be distributed at inter-tree distances approximating the squarely-spaced planting densities shown in Table 2. In practice, the distance between a retained tree and its nearest neighbor will be permitted to exceed the inter-tree distances shown in Table 2 depending on tree health and condition (see below). Post-thinning inter-tree distances less than 50% of the values in Table 2 will normally be avoided, except where no other alternatives exist to maintain target densities (e.g. in plots with a very high incidence of trees with priority 1 or 2 for removal). Conifer trees less than 15cm in height are not required to be removed.

Priority rules for coniferous tree removal are listed below. Note that the rules make a distinction between *target plot density* (the scheduled numbers of retained trees per treatment and measurement plot) and *desired inter-tree distance* (the distance between any retained tree and its nearest neighbor). Target plot densities and equivalent desired inter-tree distances are shown in Table 2.

1. Trees always to be removed, regardless of target plot density and desired inter-tree distances:
 - Dead;
 - Infected by *Armillaria* root disease;
 - Attacked by Warren root collar weevil and unlikely to survive (vigour = AU).
 - With western gall rust encircling more than 50% of the main stem and unlikely to survive (vigour = AU).
2. Trees which are to be removed in preference to maintenance of desired inter-tree distances, but to be left if removal would result in failure to meet the target plot density:
 - Injured or deformed: dead top, mechanical or browsing damage, severe J-root, crook or lean;
 - Diseased: needle casts, blister and gall rusts, *Atropellis* canker;
 - Within 2m of trees that have died from *Armillaria* root disease.

Trees that are mildly or moderately injured, deformed or diseased may be retained where necessary to fill gaps that are otherwise likely to result in permanent loss of tree cover, providing that the retained trees are considered likely to survive until rotation and unlikely to threaten the health of other trees.

3. Trees which are to be removed providing that the distance between retained trees does not exceed the planned inter-tree distance (Table 2) by more than 50%, and that the target plot density is met:
 - Sub-dominant or suppressed crowns;
 - Poor stem form (e.g. lack of straightness, replaced leader, forked) relative to alternative trees;
 - Poor height, diameter and / or terminal growth relative to alternative trees;
 - Balsam or alpine fir.
4. Other trees to be removed as required to reduce density to target levels:
 - Select so as to equalize distances between retained trees.

It follows that retained trees must be alive, free from Armillaria root disease, and not dying as a result of attack by Hylobius or western gall rust. To the extent permitted by pre-thinning densities and tree removal rules, retained trees should also be:

- Pine or spruce ;
- With healthy dominant or co-dominant crowns;
- Without serious injury or disease;
- Straight stemmed;
- Vigorous in growth;
- Evenly spaced.

“Keep” trees in the planted 0.1ha measurement plots will be flagged with ribbon ahead of the thinning operation, preferably during the preceding scheduled full or check measurement, according to the following procedure.

1. Locate where possible every tree that was originally planted and tagged. (Copies of the tree information table from the trial database will be made available for this purpose.)
2. At each original individual tree planting location determine, based on the removal priority rules described above, whether the tree is to be kept, and / or if there is an adjacent conifer with lower priority for removal that should be retained instead.
3. Flag the trees provisionally identified for retention according to step 2.
4. Count the total number of trees flagged in the measurement plot, and again using the removal priority rules described above, add or remove flags to achieve the targeted retention density. (The number of retained coniferous stems must be within 5% of the scheduled value for the measurement plot.)
5. Ensure that ribbon is conspicuously placed on lateral branches and orientated with regard to the direction of swathes to be followed during the thinning operation. There is no requirement to permanently tag previously unmarked trees at this stage of the trial, and ribbon must not be tied in such a way that it will restrict growth or damage the tree.

The flagging procedure is not applicable for non-planted plots or the portions of planted treatment plots outside the measurement plots. In these situations thinning may be carried out by trained and orientated operators without prior flagging of keep trees, using the following procedure.

1. Become orientated to the required levels of retention and removal by first completing thinning of the pre-flagged planted measurement plot. (In the case of non-planted plots orientation may be based on planted measurement plots thinned to the maximum target density of 4,444 stems per ha.)
2. Proceed to thin a small area (not more than 100m²) based on the orientation, removal priority rules, and target inter-tree distances.
3. Establish a “back plot” in the area thinned, count the number of retained trees in the back plot and check that removal priority rules have been adhered to.
4. Proceed to thin the remainder of the plot, adjusting the thinning intensity according to the results of the back plot.
5. Continue to establish back plots after thinning small areas until results confirm that the thinning targets and priorities are being achieved. (The average number of retained coniferous stems must be within 5% of the scheduled value for the measurement plot, and within 10% of the scheduled value for the whole treatment plot.)
6. Place a minimum of 4 back plots (one on each of the 4 sides) in the portions of the treatment plot lying outside the measurement plot, and a minimum of 4 back plots in each non-planted measurement plot.

It is suggested that back plots be square and the sizes (dependent on target densities) be as shown in Table 3. The sizes are selected to fit within the areas between the perimeters of the measurement and treatment plots, and to accommodate 5 to 11 target stems.

Table 3. Back-Plot Sizes and Target Tree Counts

Target Stems per Ha	Plot Size (m)	Target Stems per Plot
816	8 x 8	5
1111	8 x 8	7
1600	8 x 8	10
2500	5 x 5	6
4444	5 x 5	11

3.2 Work Quality

The following criteria will be used to judge the quality of the thinning work.

1. Deciduous removal:

- No aspen, poplar, birch, willow or alder 30cm+ should remain on the plot.
2. Retained conifer stems per plot and inter-tree distances:
 - The number of retained coniferous stems must be within 5% of the scheduled value for the measurement plot, and within 10% of the scheduled value for the whole treatment plot.
 - Inter-tree distance should not be less than 50% of the desired value, and should not exceed the desired value by more than 50% EXCEPT where this is necessitated by removal priority rule #1 or 2 (see Section 3.1).
 3. Retained tree characteristics:
 - No retained trees should be dead, or be dying from attack by Armillaria, Hylobius or western gall rust.
 - Retained trees should show as many of the following characteristics as are possible given the removal priority rules:
 - Pine or spruce species;
 - Healthy dominant or co-dominant crowns;
 - No serious injury or disease;
 - Straight stems;
 - Good terminal growth.
 4. Thinning damage:
 - Retained trees must not have thinning-related damage.
 - No ribbon should remain on main stems and ribbon on lateral branches should be either removed or loose enough not to restrict growth.
 - Every effort must be made to avoid cutting trees designated for retention in the plot being thinned or any tree in the adjacent C or W plot. If the thinner unintentionally cuts a designated leave tree in a T or WT plot, he should replace it with the closest tree that best meets the priority rules for retention.
 5. Thinning debris:
 - No cut trees or brush are to be left leaning against or lying on retained trees.
 - The leader of any retained tree must be free of debris.
 - All downed slash must be less than 1m above the ground.
 - No cut trees or brush are to be left in the C or W treatment plot.
 6. Stumps:
 - Stumps of thinned trees are to be less than 15cm tall.
 - Stems must be completely cut through, with no hinges.

Appendix 1. Preferred Thinning Schedule

Group	Preferred Group Thinning Year	Installation ID	Planting Density (stems per ha)	Treatment Plot Id	Treatment (actual)	Target Stems per Ha	Av. Pine Height (cm)	Retained Stems per Ha	Retained Stems per Treatment Plot (0.25ha)	Removed Conifer Stems per Treatment Plot	Removed Deciduous Stems per Treatment Plot	Retained Stems per Measure - ment Plot (0.1ha)	Removed Conifer Stems per Measure - ment Plot	Removed Deciduous Stems per Measure - ment Plot
1-1	2013	SLS_1_1_0	0	T	T	n/a	285.9	4444	1111	22373	1078	444	8949	431
		SLS_1_1_0	0	WT	WT	n/a	304.5	4444	1111	13920	469	444	5568	188
		SLS_1_1_816	816	T	T	816	190.9	816	204	4140	31	82	1656	13
		SLS_1_1_816	816	WT	WT	816	209.1	816	204	4259	63	82	1703	25
		SLS_1_1_1111	1111	T	T	1111	309.0	1111	278	5360	688	111	2144	275
		SLS_1_1_1111	1111	WT	WT	1111	316.9	1111	278	9415	1734	111	3766	694
		SLS_1_1_1600	1600	T	T	1600	277.3	1600	400	16803	1281	160	6721	513
		SLS_1_1_1600	1600	WT	WT	1600	259.9	1600	400	11466	1000	160	4586	400
		SLS_1_1_2500	2500	T	T	2500	357.8	2500	625	6137	2375	250	2455	950
		SLS_1_1_2500	2500	WT	WT	2500	363.0	2500	625	6099	4609	250	2440	1844
		SLS_1_1_4444	4444	T	T	4444	433.4	4444	1111	4854	438	444	1942	175
		SLS_1_1_4444	4444	WT	WT	4444	394.4	4444	1111	2808	47	444	1123	19
1-2	2013	WEYGP_1_2_0	0	T	T	n/a	228.9	4444	1111	2686	0	444	1074	0
		WEYGP_1_2_0	0	WT	WT	n/a	330.5	4444	1111	1905	0	444	762	0
		WEYGP_1_2_816	816	T	T	816	408.5	816	204	1952	0	82	781	0
		WEYGP_1_2_816	816	WT	WT	816	373.3	816	204	689	62	82	276	25
		WEYGP_1_2_1111	1111	T	T	1111	282.7	1111	278	2979	813	111	1192	325
		WEYGP_1_2_1111	1111	WT	WT	1111	337.1	1111	278	965	0	111	386	0
		WEYGP_1_2_1600	1600	T	T	1600	198.7	1600	400	6378	0	160	2551	0
		WEYGP_1_2_1600	1600	WT	WT	1600	199.2	1600	400	4723	0	160	1889	0
		WEYGP_1_2_2500	2500	T	T	2500	221.1	2500	625	8036	31	250	3214	13
		WEYGP_1_2_2500	2500	WT	WT	2500	182.5	2500	625	6439	0	250	2576	0
		WEYGP_1_2_4444	4444	T	T	4444	409.2	4444	1111	47	0	444	19	0
		WEYGP_1_2_4444	4444	WT	WT	4444	430.9	4328	1082	0	0	433	0	0
1-3	2013	SPI_1_3_0	0	T	T	n/a	298.1	4444	1111	9780	703	444	3912	281
		SPI_1_3_0	0	WT	WT	n/a	317.2	4444	1111	7108	1047	444	2843	419
		SPI_1_3_816	816	T	T	816	376.5	816	204	3370	94	82	1348	38
		SPI_1_3_816	816	WT	WT	816	421.4	816	204	2078	125	82	831	50
		SPI_1_3_1111	1111	T	T	1111	392.7	1111	278	5421	391	111	2168	156
		SPI_1_3_1111	1111	WT	WT	1111	469.7	1111	278	4214	266	111	1686	106
		SPI_1_3_1600	1600	T	T	1600	393.1	1600	400	3809	313	160	1524	125
		SPI_1_3_1600	1600	WT	WT	1600	341.7	1600	400	2253	47	160	901	19
		SPI_1_3_2500	2500	T	T	2500	324.7	2500	625	2442	141	250	977	56
		SPI_1_3_2500	2500	WT	WT	2500	381.3	2500	625	3273	141	250	1309	56
		SPI_1_3_4444	4444	T	T	4444	294.8	4444	1111	2372	0	444	949	0
		SPI_1_3_4444	4444	WT	WT	4444	290.7	4444	1111	3118	0	444	1247	0

Group	Preferred Group Thinning Year	Installation ID	Planting Density (stems per ha)	Treatment Plot Id	Treatment (actual)	Target Stems per Ha	Av. Pine Height (cm)	Retained Stems per Ha	Retained Stems per Treatment Plot (0.25ha)	Removed Conifer Stems per Treatment Plot	Removed Deciduous Stems per Treatment Plot	Retained Stems per Measure - ment Plot (0.1ha)	Removed Conifer Stems per Measure - ment Plot	Removed Deciduous Stems per Measure - ment Plot
2-1	2012	WWC_2_1_0	0	T	T	n/a	320.9	4444	1111	5420	16	444	2168	6
		WWC_2_1_0	0	WT	WT	n/a	291.5	4444	1111	7358	78	444	2943	31
		WWC_2_1_816	816	T	T	816	429.0	816	204	6329	438	82	2532	175
		WWC_2_1_816	816	WT	WT	816	402.3	816	204	10137	297	82	4055	119
		WWC_2_1_1111	1111	T	T	1111	334.8	1111	278	8673	453	111	3469	181
		WWC_2_1_1111	1111	WT	WT	1111	360.6	1111	278	11145	563	111	4458	225
		WWC_2_1_1600	1600	T	T	1600	364.0	1600	400	4816	31	160	1927	13
		WWC_2_1_1600	1600	WT	WT	1600	384.7	1600	400	7346	47	160	2939	19
		WWC_2_1_2500	2500	T	T	2500	398.4	2500	625	7766	375	250	3107	150
		WWC_2_1_2500	2500	WT	WT	2500	386.7	2500	625	6492	281	250	2597	113
		WWC_2_1_4444	4444	T	T	4444	387.4	4444	1111	11435	0	444	4574	0
WWC_2_1_4444	4444	WT	WT	4444	407.3	4444	1111	7935	0	444	3174	0		
2-2	2013	ANC_2_2_0	0	T	T	n/a	251.3	4444	1111	2092	1578	444	837	631
		ANC_2_2_0	0	WT	WT	n/a	354.5	4444	1111	1905	250	444	762	100
		ANC_2_2_816	816	T	T	816	353.7	816	204	4374	1203	82	1749	481
		ANC_2_2_816	816	WT	WT	816	427.4	816	204	1557	141	82	623	56
		ANC_2_2_1111	1111	T	T	1111	420.1	1111	278	926	31	111	370	13
		ANC_2_2_1111	1111	WT	WT	1111	426.8	1111	278	1749	250	111	699	100
		ANC_2_2_1600	1600	T	T	1600	253.5	1600	400	258	16	160	103	6
		ANC_2_2_1600	1600	WT	WT	1600	306.0	1600	400	118	47	160	47	19
		ANC_2_2_2500	2500	T	T	2500	467.2	2500	625	4202	531	250	1681	213
		ANC_2_2_2500	2500	WT	WT	2500	563.8	2500	625	2844	63	250	1138	25
		ANC_2_2_4444	4444	T	T	4444	262.2	4444	1111	12	0	444	5	0
ANC_2_2_4444	4444	WT	WT	4444	262.8	4444	1111	153	16	444	61	6		
2-3	2014	WEYGP_2_3_0	0	T	T	n/a	193.6	4444	1111	983	109	444	393	44
		WEYGP_2_3_0	0	WT	WT	n/a	266.6	4444	1111	1514	31	444	606	13
		WEYGP_2_3_816	816	T	T	816	298.1	816	204	1965	16	82	786	6
		WEYGP_2_3_816	816	WT	WT	816	364.6	816	204	2274	0	82	910	0
		WEYGP_2_3_1111	1111	T	T	1111	336.1	1111	278	1635	125	111	654	50
		WEYGP_2_3_1111	1111	WT	WT	1111	415.0	1111	278	659	0	111	264	0
		WEYGP_2_3_1600	1600	T	T	1600	311.8	1600	400	2338	0	160	935	0
		WEYGP_2_3_1600	1600	WT	WT	1600	310.3	1600	400	1829	78	160	732	31
		WEYGP_2_3_2500	2500	T	T	2500	306.9	2500	625	1116	16	250	446	6
		WEYGP_2_3_2500	2500	WT	WT	2500	265.1	2500	625	522	47	250	209	19
		WEYGP_2_3_4444	4444	T	T	4444	338.8	4444	1111	1832	0	444	733	0
WEYGP_2_3_4444	4444	WT	WT	4444	363.7	4444	1111	3547	16	444	1419	6		

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3-1	2012	WEYGP_3_1_0	0	T	T	n/a	248.7	4444	1111	3077	609	444	1231	244
		WEYGP_3_1_0	0	WT	WT	n/a	255.6	3250	813	0	406	325	0	163
		WEYGP_3_1_816	816	T	T	816	370.0	816	204	3157	688	82	1263	275
		WEYGP_3_1_816	816	WT	WT	816	403.0	816	204	3954	125	82	1582	50
		WEYGP_3_1_1111	1111	T	T	1111	177.6	1111	278	499	3469	111	199	1388
		WEYGP_3_1_1111	1111	WT	WT	1111	383.5	1111	278	1394	31	111	558	13
		WEYGP_3_1_1600	1600	T	T	1600	259.1	1600	400	1931	1406	160	772	563
		WEYGP_3_1_1600	1600	WT	WT	1600	317.0	1600	400	1348	16	160	539	6
		WEYGP_3_1_2500	2500	T	T	2500	342.4	2500	625	2561	1453	250	1025	581
		WEYGP_3_1_2500	2500	WT	WT	2500	329.7	2500	625	6801	0	250	2721	0
		WEYGP_3_1_4444	4444	T	T	4444	351.4	4444	1111	2697	0	444	1079	0
		WEYGP_3_1_4444	4444	WT	WT	4444	344.3	4444	1111	378	0	444	151	0
3-2	2013	SPI_3_2_9	0	T	T	n/a	91.6	4444	1111	452	3969	444	181	1588
		SPI_3_2_9	0	WT	WT	n/a	102.2	4444	1111	389	5234	444	156	2094
		SPI_3_2_816	816	T	T	816	362.9	816	204	1186	500	82	474	200
		SPI_3_2_816	816	WT	WT	816	331.9	816	204	1637	1719	82	655	688
		SPI_3_2_1111	1111	T	T	1111	338.0	1111	278	1467	2672	111	587	1069
		SPI_3_2_1111	1111	WT	WT	1111	369.4	1111	278	960	1063	111	384	425
		SPI_3_2_1600	1600	T	T	1600	299.4	1600	400	5654	1094	160	2262	438
		SPI_3_2_1600	1600	WT	WT	1600	394.7	1600	400	5094	609	160	2038	244
		SPI_3_2_2500	2500	T	T	2500	313.9	2500	625	2934	656	250	1174	263
		SPI_3_2_2500	2500	WT	WT	2500	272.1	2500	625	4441	1547	250	1776	619
		SPI_3_2_4444	4444	T	T	4444	294.7	4444	1111	1010	1500	444	404	600
		SPI_3_2_4444	4444	WT	WT	4444	289.7	4444	1111	450	1188	444	180	475
3-3	2012	SDA_3_3_0	0	T	T	n/a	208.3	4444	1111	5686	47	444	2274	19
		SDA_3_3_0	0	WT	WT	n/a	199.3	4444	1111	5920	16	444	2368	6
		SDA_3_3_816	816	T	T	816	396.1	816	204	8182	250	82	3273	100
		SDA_3_3_816	816	WT	WT	816	436.3	816	204	8239	62	82	3295	25
		SDA_3_3_1111	1111	T	T	1111	354.2	1111	278	4384	0	111	1753	0
		SDA_3_3_1111	1111	WT	WT	1111	357.7	1111	278	8259	0	111	3303	0
		SDA_3_3_1600	1600	T	T	1600	403.9	1600	400	3489	516	160	1396	206
		SDA_3_3_1600	1600	WT	WT	1600	378.7	1600	400	3508	469	160	1403	188
		SDA_3_3_2500	2500	T	T	2500	328.7	2500	625	8408	16	250	3363	6
		SDA_3_3_2500	2500	WT	WT	2500	297.1	2500	625	7704	47	250	3082	19
		SDA_3_3_4444	4444	T	T	4444	363.5	4444	1111	5853	0	444	2341	0
		SDA_3_3_4444	4444	WT	WT	4444	368.7	4444	1111	4577	78	444	1831	31

Group	Preferred Group Thinning Year	Installation ID	Planting Density (stems per ha)	Treatment Plot Id	Treatment (actual)	Target Stems per Ha	Av. Pine Height (cm)	Retained Stems per Ha	Retained Stems per Treatment Plot (0.25ha)	Removed Conifer Stems per Treatment Plot	Removed Deciduous Stems per Treatment Plot	Retained Stems per Measure - ment Plot (0.1ha)	Removed Conifer Stems per Measure - ment Plot	Removed Deciduous Stems per Measure - ment Plot
3-4	2012	WEYDV_3_4_0	0	T	T	n/a	235.3	2063	516	0	203	206	0	81
		WEYDV_3_4_0	0	WT	WT	n/a	188.2	1438	359	0	0	144	0	0
		WEYDV_3_4_816	816	T	T	816	468.5	816	204	1271	94	82	508	38
		WEYDV_3_4_816	816	WT	WT	816	440.2	816	204	904	47	82	362	19
		WEYDV_3_4_1111	1111	T	T	1111	492.3	1111	278	1475	109	111	590	44
		WEYDV_3_4_1111	1111	WT	WT	1111	522.4	1111	278	995	0	111	398	0
		WEYDV_3_4_1600	1600	T	T	1600	514.5	1600	400	364	109	160	146	44
		WEYDV_3_4_1600	1600	WT	WT	1600	574.3	1600	400	410	0	160	164	0
		WEYDV_3_4_2500	2500	T	T	2500	438.9	2398	599	0	297	240	0	119
		WEYDV_3_4_2500	2500	WT	WT	2500	573.6	2500	625	519	0	250	208	0
		WEYDV_3_4_4444	4444	T	T	4444	531.8	4444	1111	525	16	444	210	6
WEYDV_3_4_4444	4444	WT	WT	4444	580.4	4444	1111	925	0	444	370	0		
3-5	2012	WEYED_3_5_0	0	T	T	n/a	172.6	875	219	0	2703	88	0	1081
		WEYED_3_5_0	0	WT	WT	n/a	310.3	2000	500	0	31	200	0	13
		WEYED_3_5_816	816	T	T	816	365.9	816	204	598	2406	82	239	963
		WEYED_3_5_816	816	WT	WT	816	506.0	816	204	1100	47	82	440	19
		WEYED_3_5_1111	1111	T	T	1111	422.3	1111	278	807	5828	111	323	2331
		WEYED_3_5_1111	1111	WT	WT	1111	548.0	1111	278	2749	0	111	1099	0
		WEYED_3_5_1600	1600	T	T	1600	392.2	1600	400	589	3766	160	236	1506
		WEYED_3_5_1600	1600	WT	WT	1600	601.5	1600	400	921	172	160	369	69
		WEYED_3_5_2500	2500	T	T	2500	400.8	2500	625	117	4797	250	47	1919
		WEYED_3_5_2500	2500	WT	WT	2500	462.0	2500	625	1026	0	250	411	0
		WEYED_3_5_4444	4444	T	T	4444	408.8	4444	1111	1228	3125	444	491	1250
WEYED_3_5_4444	4444	WT	WT	4444	495.7	4444	1111	936	0	444	374	0		
4-1	2011	WWC_4_1_0	0	T	T	n/a	265.5	4444	1111	952	141	444	381	56
		WWC_4_1_0	0	WT	WT	n/a	288.2	4444	1111	2983	0	444	1193	0
		WWC_4_1_816	816	T	T	816	443.6	816	204	3884	78	82	1553	31
		WWC_4_1_816	816	WT	WT	816	473.1	816	204	1348	16	82	539	6
		WWC_4_1_1111	1111	T	T	1111	508.7	1111	278	1890	219	111	756	88
		WWC_4_1_1111	1111	WT	WT	1111	467.3	1111	278	1356	125	111	542	50
		WWC_4_1_1600	1600	T	T	1600	506.2	1600	400	298	1063	160	119	425
		WWC_4_1_1600	1600	WT	WT	1600	519.5	1600	400	509	16	160	204	6
		WWC_4_1_2500	2500	T	T	2500	486.2	2500	625	1512	109	250	605	44
		WWC_4_1_2500	2500	WT	WT	2500	346.4	2500	625	1795	219	250	718	88
		WWC_4_1_4444	4444	C	T	4444	480.3	4444	1111	1540	391	444	616	156
WWC_4_1_4444	4444	W	WT	4444	496.5	4444	1111	563	0	444	225	0		

Group	Preferred Group Thinning Year	Installation ID	Planting Density (stems per ha)	Treatment Plot Id	Treatment (actual)	Target Stems per Ha	Av. Pine Height (cm)	Retained Stems per Ha	Retained Stems per Treatment Plot (0.25ha)	Removed Conifer Stems per Treatment Plot	Removed Deciduous Stems per Treatment Plot	Retained Stems per Measure - ment Plot (0.1ha)	Removed Conifer Stems per Measure - ment Plot	Removed Deciduous Stems per Measure - ment Plot
4-2	2012	WWC_4_2_816	816	T	T	816	314.0	816	204	270	937	82	108	375
		WWC_4_2_816	816	WT	WT	816	434.4	816	204	871	172	82	348	69
		WWC_4_2_1111	1111	T	T	1111	402.9	1111	278	53	125	111	21	50
		WWC_4_2_1111	1111	WT	WT	1111	438.0	1111	278	540	391	111	216	156
		WWC_4_2_1600	1600	T	T	1600	412.1	1600	400	14	1359	160	6	544
		WWC_4_2_1600	1600	WT	WT	1600	443.8	1600	400	476	62	160	191	25
		WWC_4_2_2500	2500	T	T	2500	372.0	2023	506	0	859	202	0	344
		WWC_4_2_2500	2500	WT	WT	2500	466.0	2500	625	341	62	250	137	25
		WWC_4_2_4444	4444	T	T	4444	414.7	4444	1111	217	0	444	87	0
WWC_4_2_4444	4444	WT	WT	4444	411.9	4444	1111	278	31	444	111	13		
4-3	2012	CFPGP_4_3_0	0	T	T	n/a	42.9	188	47	0	6234	19	0	2494
		CFPGP_4_3_0	0	WT	WT	n/a	130.8	1625	406	0	0	163	0	0
		CFPGP_4_3_816	816	T	T	816	320.9	816	204	189	563	82	75	225
		CFPGP_4_3_816	816	WT	WT	816	340.6	816	204	310	406	82	124	163
		CFPGP_4_3_1111	1111	T	T	1111	349.6	1111	278	394	7563	111	158	3025
		CFPGP_4_3_1111	1111	WT	WT	1111	435.2	1111	278	398	422	111	159	169
		CFPGP_4_3_1600	1600	T	T	1600	332.4	1600	400	443	1531	160	177	613
		CFPGP_4_3_1600	1600	WT	WT	1600	313.5	1600	400	465	172	160	186	69
		CFPGP_4_3_2500	2500	T	T	2500	353.0	1605	401	0	6625	161	0	2650
		CFPGP_4_3_2500	2500	WT	WT	2500	486.9	2500	625	2862	234	250	1145	94
		CFPGP_4_3_4444	4444	T	T	4444	397.9	4444	1111	773	3578	444	309	1431
		CFPGP_4_3_4444	4444	WT	WT	4444	430.2	4444	1111	2085	859	444	834	344
5-1	2014	MWFP_5_1_0	0	T	T	n/a	140.1	4444	1111	1030	94	444	412	38
		MWFP_5_1_0	0	WT	WT	n/a	178.4	4444	1111	764	234	444	306	94
		MWFP_5_1_816	816	T	T	816	381.8	816	204	725	78	82	290	31
		MWFP_5_1_816	816	WT	WT	816	320.0	816	204	3199	172	82	1279	69
		MWFP_5_1_1111	1111	T	T	1111	400.1	1111	278	1107	94	111	443	38
		MWFP_5_1_1111	1111	WT	WT	1111	416.3	1111	278	1110	94	111	444	38
		MWFP_5_1_1600	1600	T	T	1600	261.7	1600	400	855	62	160	342	25
		MWFP_5_1_1600	1600	WT	WT	1600	312.0	1600	400	1196	391	160	478	156
		MWFP_5_1_2500	2500	T	T	2500	251.2	2500	625	174	47	250	70	19
		MWFP_5_1_2500	2500	WT	WT	2500	297.9	2500	625	952	94	250	381	38
		MWFP_5_1_4444	4444	T	T	4444	320.9	4444	1111	1148	406	444	459	163
MWFP_5_1_4444	4444	WT	WT	4444	336.4	4444	1111	1405	1125	444	562	450		
5-2	2013	BRL_5_2_0	0	T	T	n/a	73.9	3500	875	0	94	350	0	38
		BRL_5_2_0	0	WT	WT	n/a	123.7	4444	1111	280	16	444	112	6

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5-2	(cont.)	BRL_5_2_816	816	T	T	816	301.6	816	204	1504	78	82	602	31
		BRL_5_2_816	816	WT	WT	816	290.0	816	204	2106	31	82	842	13
		BRL_5_2_1111	1111	T	T	1111	309.7	1111	278	3701	266	111	1480	106
		BRL_5_2_1111	1111	WT	WT	1111	291.1	1111	278	2355	78	111	942	31
		BRL_5_2_1600	1600	T	T	1600	246.8	1600	400	2156	16	160	863	6
		BRL_5_2_1600	1600	WT	WT	1600	255.0	1600	400	3087	63	160	1235	25
		BRL_5_2_2500	2500	T	T	2500	240.2	2500	625	488	188	250	195	75
		BRL_5_2_2500	2500	WT	WT	2500	311.1	2500	625	549	63	250	220	25
		BRL_5_2_4444	4444	T	T	4444	321.0	4444	1111	625	109	444	250	44
		BRL_5_2_4444	4444	WT	WT	4444	324.2	4444	1111	658	78	444	263	31
5-3	2012	WWC_5_3_0	0	T	T	n/a	221.8	3438	859	0	1313	344	0	525
		WWC_5_3_0	0	WT	WT	n/a	127.4	250	63	0	31	25	0	13
		SPI_5_3_816	816	T	T	816	329.0	816	204	1541	109	82	616	44
		SPI_5_3_816	816	WT	WT	816	318.7	816	204	1165	734	82	466	294
		WWC_5_3_1111	1111	T	T	1111	292.6	1073	268	0	125	107	0	50
		WWC_5_3_1111	1111	WT	WT	1111	304.2	1105	276	0	0	111	0	0
		SPI_5_3_1600	1600	T	T	1600	359.9	1600	400	2716	297	160	1086	119
		SPI_5_3_1600	1600	WT	WT	1600	375.8	1600	400	2604	250	160	1042	100
		WWC_5_3_2500	2500	T	T	2500	343.6	2500	625	93	63	250	37	25
		WWC_5_3_2500	2500	WT	WT	2500	325.8	2500	625	106	281	250	43	113
		WWC_5_3_4444	4444	T	T	4444	276.2	4393	1098	0	31	439	0	13
		WWC_5_3_4444	4444	WT	WT	4444	344.8	4444	1111	217	1375	444	87	550