WHITE PAPER

USDA Forest Service Pacific Northwest Region Umatilla National Forest

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Calculated Values of Basal Area and Board-Foot Timber Volume for Existing (Known) Values of Canopy Cover[1]

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INTRODUCTION. The USDA Forest Service uses a variety of planning processes, many of which occur at different scales:

- Bioregional assessments such as the Interior Columbia Basin Ecosystem Management Project (Quigley et al. 1996 and many other citations) apply at a very broad scale;
- Land and Resource Management Plans for national forests (such as USDA Forest Service 1990) result from a broad-scale planning process;
- Ecosystem Analysis at the Watershed Scale (REO 1995) is an example of mid-scale assessment; and
- Project-scale plans direct implementation of natural resource management activities under the National Environmental Policy Act – an example is the environmental impact statement for the School Fire Salvage Recovery Project (USDA Forest Service 2006).

For planning efforts occurring at the fine and project scales, it is common to have incomplete information when characterizing existing vegetation conditions. To deal with incomplete information, vegetation analysts often need to relate one metric for which they have data to another metric for which data is lacking.

Fine-scale and project planning often rely on low-resolution data sources derived from remote imagery or interpretation of aerial photography, and these sources generally provide an analyst with canopy cover data for characterizing stand density. For these sources, an analyst seldom has access to basal area or higher-resolution data for characterizing stand density.

If fine-scale planning requires that vegetation conditions be characterized using a metric that is not available in the database, then an analyst essentially has two choices: acquire additional data by con-

[1] White papers are internal reports receiving only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of the USDA Forest Service.

ducting field inventories or procuring additional imagery, or derive (calculate) the missing metric by relating it to another metric that is available in the database.

The eight tables provided in this report show how existing (known) amounts of canopy cover were used to calculate corresponding amounts of basal area, and how the basal area values were then related to board-foot timber volume for three common tree-size classes. Tables are provided for seven individual tree species, and for a mixed-conifer forest type.

METHODOLOGY. The tables provide calculated amounts of basal area (ft^2/acre) for existing (known) values of canopy cover. Calculations are based on equations developed during an elk thermal cover study for the Blue Mountains (Dealy 1985), where canopy cover percentage was sampled for 609 unmanaged stands by using a type A spherical densiometer.

Dealy's equations require measured values of basal area (ft^2/acre) as an input variable to calculate canopy cover (percent) as the output variable or result. Since Dealy's equations use basal area as an input, they had to be "reverse solved" to calculate basal area as the output result when canopy cover is used as an input. This reverse solving process was accomplished by using the Goal Seek function in Excel (this function is available from Excel's Tools menu).

The calculated values of basal area were then related to a potential board foot volume per acre by using "volume/basal area ratios" (VBAR). The VBAR factors were calculated by Glenn Fischer from Current Vegetation Survey data for the Umatilla National Forest, and they are presented by tree species and diameter class (appendix A).

To analyze potential board foot yields, three different size class scenarios were used: a pole size class with a quadratic mean diameter (QMD) of 8", a small size class with a QMD of 12", and a medium size class with a QMD of 16".

The board-foot volumes shown in the tables could be used to estimate treatment yields by:

1. First, select a cover type (species) best representing the stand being evaluated;
2. Then, select a size class for the stand (pole, small, or medium);
3. Then, obtain the stand's existing canopy cover from a vegetation database;
4. Then, use the canopy cover value to look up its corresponding basal area value (use 2nd column for basal area estimates);
5. Then, assume what proportion of the stand's basal area would be removed by a proposed treatment; and
6. Finally, calculate the potential board foot yield by multiplying the removal proportion by the total MBF/Acre value from the table.

As an example of this calculation methodology, assume a ponderosa pine stand with a small size class and 60% canopy cover, of which half is to be removed in a thinning treatment: the treatment yield would then be estimated as:

11.6 total MBF/Acre (from small size class column and 60% canopy cover line) ×
.5 (removal proportion) = 5.8 MBF/Acre for the treatment (assuming a proportional thinning that removes trees in roughly equal proportions from all merchantable size classes).

CAUTIONS AND CAVEATS. Dealy's (1985) sample included unmanaged stands only (defined as no evidence of timber harvest), so his mature-stand dataset did not include a wide range of basal areas. I suspect that the calculated basal area values shown in the gray cells for each of the tables might be beyond the effective range of his equation for these tree species.

Table 1: Calculated basal area and board-foot timber volume values for ponderosa pine.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	12.26	1.01	1.28	1.65
25	16.32	1.34	1.71	2.20
30	21.60	1.78	2.26	2.91
35	28.51	2.34	2.98	3.84
40	37.52	3.08	3.93	5.05
45	49.28	4.05	5.16	6.64
50	64.63	5.31	6.76	8.71
55	84.68	6.96	8.86	11.41
60	110.84	9.11	11.60	14.93
65	144.99	11.92	15.18	19.53
70	189.59	15.59	19.84	25.54
75	247.79	20.37	25.93	33.38
80	323.77	26.62	33.89	43.62
85	422.94	34.77	44.27	56.98
90	552.41	45.42	57.82	74.42
95	721.42	59.32	75.50	97.19

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 2: Calculated basal area and board-foot timber volume values for Douglas-fir.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	2.71	0.27	0.31	0.38
25	4.06	0.40	0.47	0.57
30	5.88	0.58	0.67	0.83
35	8.37	0.83	0.96	1.18
40	11.75	1.16	1.35	1.65
45	16.36	1.62	1.88	2.30
50	22.63	2.24	2.60	3.18
55	31.16	3.08	3.58	4.38
60	42.79	4.23	4.91	6.02
65	58.60	5.79	6.72	8.24
70	80.13	7.92	9.19	11.27
75	109.44	10.82	12.55	15.39
80	149.34	14.76	17.13	21.01
85	203.65	20.13	23.36	28.65
90	277.58	27.44	31.84	39.05
95	378.22	37.38	43.39	53.20

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 3: Calculated basal area and board-foot timber volume values for grand fir.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	3.11	0.28	0.37	0.47
25	4.43	0.40	0.53	0.67
30	6.16	0.55	0.73	0.93
35	8.44	0.76	1.00	1.27
40	11.45	1.03	1.36	1.73
45	15.42	1.39	1.83	2.33
50	20.66	1.86	2.45	3.12
55	27.57	2.48	3.27	4.16
60	36.68	3.30	4.35	5.54
65	48.70	4.38	5.78	7.35
70	64.55	5.81	7.66	9.75
75	85.45	7.69	10.14	12.90
80	113.02	10.17	13.41	17.06
85	149.38	13.44	17.73	22.55
90	197.34	17.75	23.42	29.80
95	260.60	23.44	30.93	39.35

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 4: Calculated basal area and board-foot timber volume values for western larch.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	8.20	1.13	1.32	1.57
25	11.12	1.53	1.79	2.13
30	14.96	2.06	2.41	2.87
35	20.03	2.76	3.23	3.84
40	26.69	3.68	4.30	5.12
45	35.47	4.89	5.71	6.81
50	47.04	6.48	7.58	9.03
55	62.27	8.58	10.03	11.95
60	82.33	11.35	13.26	15.80
65	108.76	14.99	17.52	20.87
70	143.56	19.78	23.12	27.55
75	189.40	26.10	30.51	36.34
80	249.78	34.42	40.23	47.93
85	329.30	45.38	53.04	63.18
90	434.04	59.81	69.91	83.28
95	571.97	78.82	92.13	109.74

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 5: Calculated basal area and board-foot timber volume values for lodgepole pine.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	8.20	1.15	1.31	1.57
25	11.12	1.56	1.77	2.13
30	14.96	2.10	2.39	2.87
35	20.03	2.81	3.19	3.84
40	26.69	3.74	4.26	5.12
45	35.47	4.97	5.66	6.81
50	47.04	6.59	7.50	9.03
55	62.27	8.72	9.93	11.95
60	82.33	11.53	13.14	15.80
65	108.76	15.24	17.35	20.88
70	143.56	20.11	22.90	27.56
75	189.40	26.53	30.22	36.36
80	249.78	34.99	39.85	47.95
85	329.30	46.13	52.54	63.21
90	434.04	60.80	69.25	83.31
95	571.97	80.13	91.25	109.79

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 6: Calculated basal area and board-foot timber volume values for Engelmann spruce.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	3.15	0.33	0.42	0.51
25	4.52	0.48	0.61	0.74
30	6.33	0.67	0.85	1.03
35	8.75	0.92	1.17	1.43
40	11.96	1.26	1.60	1.95
45	16.22	1.71	2.17	2.65
50	21.89	2.31	2.93	3.57
55	29.42	3.10	3.94	4.80
60	39.44	4.16	5.28	6.43
65	52.75	5.56	7.07	8.61
70	70.44	7.43	9.44	11.49
75	93.96	9.91	12.59	15.33
80	125.21	13.20	16.77	20.43
85	166.76	17.58	22.34	27.21
90	221.98	23.40	29.73	36.22
95	295.36	31.14	39.56	48.19

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 7: Calculated basal area and board-foot timber volume values for subalpine fir.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	3.15	0.27	0.32	0.41
25	4.52	0.39	0.46	0.59
30	6.33	0.55	0.65	0.83
35	8.75	0.76	0.90	1.14
40	11.96	1.04	1.23	1.56
45	16.22	1.41	1.66	2.11
50	21.89	1.90	2.24	2.85
55	29.42	2.55	3.02	3.84
60	39.44	3.42	4.04	5.14
65	52.75	4.58	5.41	6.88
70	70.44	6.11	7.22	9.18
75	93.96	8.16	9.63	12.25
80	125.21	10.87	12.83	16.32
85	166.76	14.48	17.09	21.74
90	221.98	19.27	22.75	28.93
95	295.36	25.64	30.27	38.50

Sources/Notes: Refer to the cautions and caveats section for an explanation of the gray cells.

Table 8: Calculated basal area and board-foot timber volume values for the mixed-conifer type.

Existing (known) Canopy cover %	Calculated Basal Area (Ft^2/Ac)	Pole Size Class: 8" DBH; 82.2 BF/SF (MBF/Acre)	Small Size Class: 12" DBH; 104.7 BF/SF (MBF/Acre)	Medium Size Class: 16" DBH; 134.7 BF/SF (MBF/Acre)
20	12.26	1.01	1.28	1.65
25	16.32	1.34	1.71	2.20
30	21.60	1.78	2.26	2.91
35	28.51	2.34	2.98	3.84
40	37.52	3.08	3.93	5.05
45	49.28	4.05	5.16	6.64
50	47.04	6.48	7.58	9.03
55	62.27	8.58	10.03	11.95
60	82.33	11.35	13.26	15.80
65	58.60	5.79	6.72	8.24
70	80.13	7.92	9.19	11.27
75	109.44	10.82	12.55	15.39
80	149.34	14.76	17.13	21.01
85	149.38	13.44	17.73	22.55
90	197.34	17.75	23.42	29.80
95	260.60	23.44	30.93	39.35

Sources/Notes: The 20-45% lines came from the ponderosa pine table; the 50-60% lines came from western larch; the 65-80% lines from Douglas-fir, and the 85-95% lines from grand fir.

APPENDIX A: TREE VOLUMES BY SPECIES AND DIAMETER CLASS

SPECIES	DIAMETER	CUBIC FEET	BOARD FEET	BF/CF	BF VOLUME/SF	CF VOLUME/SF
DOUGLAS-FIR (BASIS: 5,604 TREES)	8	6.5	34.5	5.31	98.84	18.62
	10	11.8	55.6	4.71	101.94	21.64
	12	19.3	90.1	4.67	114.72	24.57
	14	28.5	138.2	4.85	129.28	26.66
	16	39.8	196.4	4.93	140.67	28.51
	18	54.2	278.3	5.13	157.49	30.67
	20	69.7	373.6	5.36	171.25	31.95
	22	87.3	486.7	5.58	184.37	33.07
	24	109.6	632.5	5.77	201.34	34.89
	26	130.6	779.5	5.97	211.42	35.42
	28	156.1	955.3	6.12	223.41	36.51
	30	183.9	1155.3	6.28	235.36	37.46
	32	223.7	1444.5	6.46	258.64	40.05
	34	247.8	1632.0	6.59	258.85	39.30
	36	285.5	1930.8	6.76	273.16	40.39
	38	329.9	2233.3	6.77	283.57	41.89
	40	332.5	2254.1	6.78	258.31	38.10
	42	386.0	2616.4	6.78	271.95	40.12
	44	444.0	3017.9	6.80	285.81	42.05
	46	490.3	3368.1	6.87	291.85	42.48
	48	528.6	3660.8	6.93	291.33	42.07
	50	571.9	4006.1	7.00	293.81	41.94
LODGEPOLE PINE (BASIS: 1,043 TREES)	6	3.9	18.9	4.90	96.26	19.66
	8	9.0	48.9	5.43	140.09	25.78
	10	15.8	76.2	4.82	139.71	28.97
	12	25.1	125.3	4.99	159.54	31.96
	14	36.3	183.3	5.05	171.47	33.96
	16	51.0	268.0	5.25	191.95	36.53
	18	66.8	372.5	5.58	210.80	37.80
	20	84.0	477.6	5.69	218.92	38.50
	22	104.6	631.3	6.04	239.15	39.63
	24	132.0	835.6	6.33	265.99	42.02
SUBALPINE FIR (BASIS: 977 TREES)	8	5.8	30.3	5.22	86.81	16.62
	10	11.1	53.5	4.82	98.09	20.35
	12	17.9	80.5	4.50	102.50	22.79
	14	26.9	129.7	4.82	121.33	25.16
	16	37.4	182.0	4.87	130.35	26.79
	18	50.4	355.0	7.04	200.89	28.52
	20	64.7	342.8	5.30	157.13	29.66
	22	77.4	421.2	5.44	159.56	29.32
	24	98.7	548.1	5.55	174.47	31.42
	26	103.9	600.8	5.78	162.96	28.18
	28	146.2	883.3	6.04	206.57	34.19

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SPECIES	DIAMETER	CUBIC FEET	BOARD FEET	BF/CF	BF VOLUME/SF	CF VOLUME/SF
GRAND FIR (BASIS: 5,936 TREES)	8	6.0	31.4	5.23	89.96	17.19
	10	11.5	55.1	4.79	101.03	21.09
	12	19.7	93.2	4.73	118.67	25.08
	14	29.8	146.9	4.93	137.42	27.88
	16	41.9	210.8	5.03	150.98	30.01
	18	57.7	303.3	5.26	171.64	32.65
	20	74.2	406.0	5.47	186.10	34.01
	22	93.8	530.6	5.66	201.00	35.53
	24	114.0	664.5	5.83	211.52	36.29
	26	140.0	851.4	6.08	230.93	37.97
	28	165.1	1025.6	6.21	239.85	38.61
	30	205.9	1321.4	6.42	269.20	41.95
	32	230.6	1499.5	6.50	268.49	41.29
	34	262.6	1738.4	6.62	275.73	41.65
	36	304.1	2070.2	6.81	292.88	43.02
	38	341.4	2339.4	6.85	297.04	43.35
	40	379.0	2628.9	6.94	301.26	43.43
	42	435.3	3031.2	6.96	315.07	45.25
	44	478.0	3327.8	6.96	315.16	45.27
	46	505.8	3565.2	7.05	308.93	43.83
	48	583.4	4056.9	6.95	322.85	46.43
	50	620.9	4376.4	7.05	320.97	45.54
	52	703.2	5028.9	7.15	341.00	47.68
ENGELMANN SPRUCE (BASIS: 1,638 TREES)	8	6.8	36.8	5.41	105.43	19.48
	10	12.9	62.5	4.84	114.59	23.65
	12	22.1	105.2	4.76	133.95	28.14
	14	31.8	156.9	4.93	146.77	29.75
	16	45.0	227.8	5.06	163.15	32.23
	18	60.8	315.6	5.19	178.60	34.41
	20	79.2	437.1	5.52	200.36	36.30
	22	93.7	523.0	5.58	198.13	35.50
	24	119.1	692.0	5.81	220.28	37.91
	26	140.0	839.6	6.00	227.72	37.97
	28	168.7	1046.0	6.20	244.62	39.45
	30	198.7	1255.8	6.32	255.84	40.48
	32	229.2	1470.8	6.42	263.35	41.04
	34	266.5	1759.2	6.60	279.02	42.27
	36	288.0	1924.1	6.68	272.21	40.74
	38	355.4	2433.8	6.85	309.03	45.13
	40	378.2	2596.0	6.86	297.49	43.34
	42	424.4	2969.8	7.00	308.68	44.11
	44	517.5	3620.0	7.00	342.84	49.01

APPENDIX A: TREE VOLUMES BY SPECIES AND DIAMETER CLASS

SPECIES	DIAMETER	CUBIC FEET	BOARD FEET	BF/CF	BF VOLUME/SF	CF VOLUME/SF
PONDEROSA PINE (BASIS: 3,352 TREES)	8	5.6	28.7	5.13	82.22	16.04
	10	11.0	50.6	4.60	92.78	20.17
	12	17.9	82.2	4.59	104.66	22.79
	14	26.7	127.2	4.76	118.99	24.98
	16	38.6	188.1	4.87	134.72	27.65
	18	52.4	268.5	5.12	151.94	29.65
	20	68.2	365.2	5.35	167.40	31.26
	22	92.5	525.9	5.69	199.22	35.04
	24	115.8	686.4	5.93	218.49	36.86
	26	138.3	842.1	6.09	228.40	37.51
	28	168.6	1060.1	6.29	247.92	39.43
	30	200.0	1281.3	6.41	261.03	40.74
	32	242.5	1607.1	6.63	287.76	43.42
	34	281.9	1923.7	6.82	305.12	44.71
	36	316.8	2163.6	6.83	306.10	44.82
	38	362.3	2498.9	6.90	317.30	46.00
	40	410.0	2841.6	6.93	325.63	46.98
	42	461.6	3177.9	6.88	330.31	47.98
	44	534.9	3718.5	6.95	352.17	50.66
	46	544.4	3773.6	6.93	326.98	47.17
	48	620.9	4392.4	7.07	349.55	49.41
	50	733.7	5354.8	7.30	392.72	53.81
WESTERN LARCH (BASIS: 1,843 TREES)	8	8.6	48.1	5.59	137.80	24.64
	10	15.7	78.8	5.02	144.48	28.79
	12	25.8	126.5	4.90	161.07	32.85
	14	37.0	187.2	5.06	175.12	34.61
	16	51.7	267.9	5.18	191.87	37.03
	18	68.0	362.7	5.33	205.25	38.48
	20	87.5	490.1	5.60	224.65	40.11
	22	109.9	639.8	5.82	242.37	41.63
	24	138.3	831.9	6.02	264.81	44.02
	26	157.1	982.8	6.26	266.57	42.61
	28	193.0	1229.7	6.37	287.59	45.14
	30	235.0	1535.6	6.53	312.84	47.88
	32	253.1	1684.7	6.66	301.65	45.32
	34	302.7	2073.3	6.85	328.84	48.01
	36	341.6	2360.0	6.91	333.88	48.33
	38	389.8	2737.9	7.02	347.64	49.49
	40	417.3	2953.7	7.08	338.48	47.82
	42	465.6	3263.1	7.01	339.17	48.39

Sources/Notes: Compiled by Glenn Fischer from Current Vegetation Survey (CVS) data for the Umatilla National Forest. Values are an average of all live trees in a diameter class. BF/CF is a board foot/cubic foot ratio. "BF Volume/SF" and "CF Volume/SF" refer to the board foot or cubic foot volume, respectively, per square foot of basal area; calculated as: Board Feet (or CF)/(Diameter^2 × .005454).

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APPENDIX: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).

(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.

(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]

(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.

(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.

(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.

(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new product. Examples include papers dealing with historical products: (a) historical fire extents for the Tucannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a

description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

The following papers are available from the Forest's website: Silviculture White Papers

Paper #	Title
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of dry forests in the Blue Mountains: silvicultural considerations
5	Site productivity estimates for upland forest plant associations of the Blue and Ochoco Mountains
6	Fire regimes of the Blue Mountains
7	Active management of moist forests in the Blue Mountains: silvicultural considerations
8	Keys for identifying forest series and plant associations of the Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking level, and reforestation standards from the Umatilla National Forest land and resource management plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: a process paper
16	Douglas-fir tussock moth: a briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of the Blue and Wallowa Mountains
21	Historical fires in the headwaters portion of the Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important insects and diseases of the Blue Mountains
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: some ecosystem management considerations
28	Common plants of the south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of the Umatilla National Forest
30	Potential vegetation mapping chronology
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of the "Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins" – forest vegetation
33	Silviculture facts

Paper #	Title
34	Silvicultural activities: description and terminology
35	Site potential tree height estimates for the Pomeroy and Walla Walla ranger districts
36	Tree density protocol for mid-scale assessments
37	Tree density thresholds as related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: forestry direction
39	Updates of maximum stand density index and site index for the Blue Mountains variant of the Forest Vegetation Simulator
40	Competing vegetation analysis for the southern portion of the Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for the Umatilla National Forest
42	Life history traits for common conifer trees of the Blue Mountains
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: vegetation management considerations
46	The Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in the northern Blue Mountains: regeneration ecology and silvicultural considerations
48	The Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for the Umatilla National Forest: a range of variation analysis
51	Restoration opportunities for upland forest environments of the Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: an environmental education activity
55	Silviculture certification: tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman national forests
57	The state of vegetation databases on the Malheur, Umatilla, and Wallowa-Whitman national forests

REVISION HISTORY

January 2014: minor formatting and text edits were made throughout the document, and a new appendix was added describing the white paper system, including a list of available white papers.