Appendix C – Vegetation Modeling

Introduction

The BLM contracted with the forestry consulting firm of Mason, Bruce & Girard, Inc. of Portland, Oregon, to jointly develop and build the model described in this appendix. Personnel from both of these entities constituted the Modeling Team, and they are listed at the end of this appendix.

The BLM considered alternatives in this Proposed RMP/Final EIS that encompassed a range of approaches for managing BLM-administered forestlands to respond to the purpose and need for the action. The BLM did this by varying the land allocations and intensity with which the BLM would manage these forests. These different management approaches would result in a range of outcomes in terms of the forest structural stages and types of habitat over time and the sustained-yield timber harvest levels. The Modeling Team used models in this analysis to simulate the application of the land use allocations, management action, and forest development assumptions to characterize forest conditions 10, 20, 30, 40, 50, and 100+ years into the future. The Modeling Team also used models to determine the timber harvest level that the BLM would be able to sustain over time. The BLM used the outputs from modeling to provide a relative basis for comparing and evaluating these different land management strategies.

The vegetation modeling in this analysis is composed of three primary vegetation models:

- ORGANON version 9.1 – an individual tree growth model that the BLM used for the development of growth and yield projections for the major species groups on BLM-administered lands; Oregon State University developed ORGANON (http://www.cof.orst.edu/cof/fr/research/ORGANON/). In this appendix, ORGANON refers to the generic model available in the public domain.
- Forest Vegetation Simulator (FVS) (Dixon 2002, revised 2014) – an individual tree, distance-independent growth model that the BLM used for projections of northern spotted owl habitat and marbled murrelet habitat variables
- Remsoft Spatial Planning System (Woodstock) (version 2012.12.0) – a forest management model that the BLM used to project the forest conditions over time by simulating the land allocations and management action of the alternatives; Woodstock is proprietary software created by Remsoft Corp. http://www.remsoft.com.

All three of these models have been in use and under continued development for at least 20 years. These models provide a framework to bring the data and assumptions together to simulate these management scenarios.

This appendix provides an overview of the following key components used in formulating the models:

- BLM Forest Inventory
- Use of inventory data in modeling
- GIS – defining the land base and spatial projections
- Moist versus dry delineation
- Forest growth and yield modeling
- Forest
- Woodstock modeling
- Woodstock products

BLM Forest Inventory

The Modeling Team used three inventories in the vegetation modeling for this analysis:

- GIS vegetation mapping with stand level attributes
- Timber Production Capability Classification (TPCC)
- Current Vegetation Survey (CVS) – measured permanent plot data

GIS Vegetation Mapping – Forest Operations Inventory and Micro*Storms

The Forest Operations Inventory (FOI) is a GIS layer that delineates vegetation polygons across BLM-administered lands within the planning area. There are approximately 77,000 identified stands that average 32 acres in size. The BLM has set the minimum mapping feature size at 5 acres, but some finer scale non-forest vegetation and harvest features are identified. The BLM delineated polygons based on the vegetation attributes of cover condition, size class, density of trees, and age.

The Micro*Storms database contains the attributes for the FOI polygons. The vegetation classification represents stand average characteristics, which include:

- Cover condition – conifer, hardwood, mixed, or non-forest
- Single or multi-canopy layer stands
- Species – top five tree species with percent occupancy within a stand layer and listing of other species present
- Stocking class
- Size class – diameter of the tree species by stand layer in 10" groupings
- Diameter class
- Birthdate of the stand layer
- Ten-year age class of the managed stand layer

The BLM records land management treatment history in Micro*Storms for the FOI polygons. These treatments include timber harvest, site preparation, planting, stand maintenance/protection, pre-commercial thinning, fertilization, pruning, and a variety of other treatments.

The BLM updates data on stand characteristics on a regular basis as the BLM implements treatments and as conditions change. The FOI and its companion database, Micro*Storms, are operational datasets that are in daily use by the BLM offices for planning and tracking purposes.

The FOI and Micro*Storms data, as used in this analysis, reflects the conditions of the BLM-administered lands as of January 2013. The FOI data is the spatial representation of the forest conditions, while the Micro*Storms database provides a complete listing of treatments, conditions, and surveys that have occurred on that stand. The Modeling Team used these data to develop logical groupings called 'strata' that were the building blocks for the growth and yield curves. The Modeling Team stratified the Micro*Storms data by existing stand condition, modeling group, site productivity, age, and species groups.

Timber Production Capability Classification

The Timber Production Capability Classification (TPCC) is a classification of BLM-administered lands based on the physical and biological capability of the site to support and produce commercial forest products on a sustained-yield basis. The BLM classifies each TPCC unit based on four assessments:

- Forest/Non-forest
    - Forest – capable of 10 percent tree stocking

- Non-forest
- Commercial Forestlands
  - Commercial forestlands – capable of producing 20 cubic feet of wood per year of commercial species
  - Non-commercial forestlands – not capable of producing 20 cubic feet of wood per year of commercial species
  - Suitable Woodland – Non-commercial species or low site
- Fragile Conditions
  - Non-fragile – forest yield productivity is not expected to be reduced due to soil erosion, mass wasting, reduction in nutrient levels, reduction in moisture supplying capacity, and or the rise of ground water
  - Fragile – forest yield productivity may be expected to be reduced by soil erosion, mass wasting, reduction in nutrient levels, reduction in moisture supplying capacity, and or the rise of ground water table
  - Fragile sites are classified as:
    - Restricted – Special harvest and or restricted measures are required.
    - Non-suitable Woodland – Future production will be reduced even if special harvest and or restricted measures are applied due to the inherent site factors. These lands are not biologically and or environmentally capable of supporting a sustained yield of forest products.
- Reforestation
  - Problem – Sites where environmental, physical, and biological factors have the potential to reduce the survival and or growth of commercial tree seedlings. These factors include light, temperature, moisture, frost, surface rock, animals, and disease
  - Non-Problem – Sites that can be stocked to meet or exceed target stocking levels, of commercial species, within 5 years of harvest, using standard practices
  - Restricted – Commercial forestland where operational reforestation practices in addition to standard practices are necessary to meet or exceed the minimum stocking levels of commercial species within 5 years of harvest
  - Suitable Woodland – Operational practices will not meet or exceed minimum stocking levels of commercial species within 5 years of harvest. These sites are biologically capable of producing a sustained yield of timber products

The TPCC Handbook (BLM Manual 5251 – Timber Production Capability Classification; USDI BLM 1984) provides the standards for the TPCC Classification.

There are approximately 66,000 TPCC units mapped in GIS on the BLM-administered lands within the planning area. The minimum mapping feature is generally 5 acres, but the BLM identifies some finer scale non-forest features in the data. The BLM did the initial classification of all BLM-administered lands in the planning area in the late 1980s. The BLM updates the data as needed when new lands are acquired, or new information is obtained through field examination.

The data, as used in this analysis, reflects the classification of the BLM-administered lands as of January 2013. For this analysis, the Modeling Team used TPCC data to identify what portions of the BLM-administered lands would contribute to the Allowable Sale Quantity under each alternative and the Proposed RMP. The BLM does not include non-forest, suitable woodlands, and non-suitable woodland categories in the lands contributing to the Allowable Sale Quantity under the current plan.

Current Vegetation Survey – Measured Plot Inventory

The Current Vegetation Survey (CVS, Max *et al*. 1996) provides comprehensive information on vegetative resources on BLM-administered lands within western Oregon. The BLM did the initial data collection during the years 1997–2001. The BLM then did a complete re-measurement from 2001 to 2011. This analysis utilizes the re-measurement data. The CVS plot design consists of four 3.4-mile grids of field plots that are offset from one another to produce a single 1.7-mile grid across BLM-administered lands for 1,376 plots. The primary sampling unit is 1 hectare (approximately 2.5 acres) with 5, fixed-radius sets of nested subplots for measuring trees by size class:

- 0 to 2.9" DBH on the 11.8 feet radius subplot
- 3.0 to 12.9" DBH on a 24.0 feet radius subplot
- 13.0 to 47.9" DBH on a 51.1 feet radius subplot
- 48.0" DBH and larger on the 1/5-hectare (approximately 0.5-acre) nested subplots

There is one subplot located at the plot center and four subplots each in a cardinal direction and 133.9 feet from the center of the plot (**Figure C-1**). In addition, the BLM determines potential natural vegetation at each subplot using plant indicator keys, and the BLM measures down woody material along two transects. For specific information on the attributes that the BLM collects, refer to USDI BLM (2010).

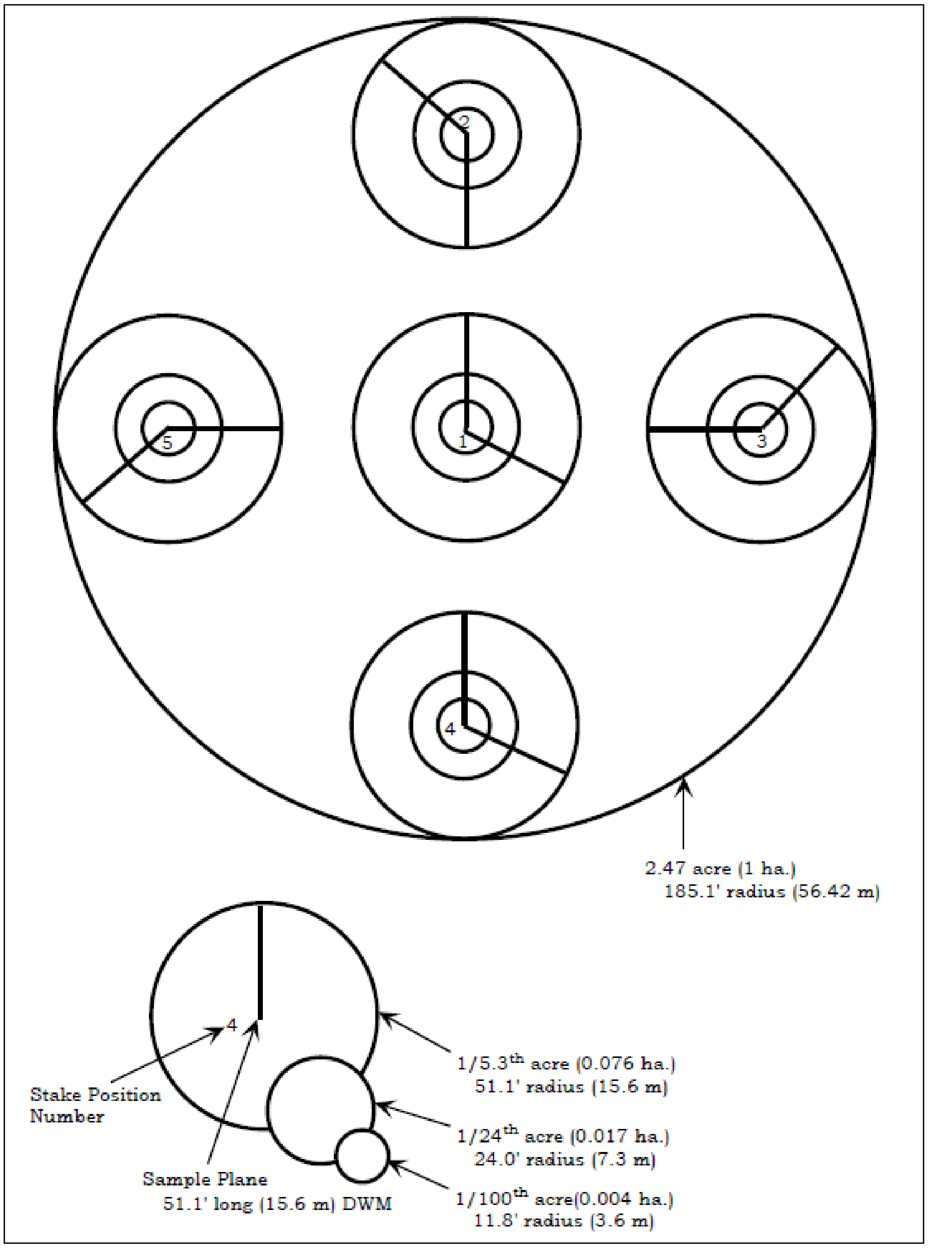

Figure C-1. CVS primary sample unit design

The location of the plot centers have differentially corrected GPS coordinates. Because the BLM located each subplot center at a precise distance from the plot center, the BLM calculated the coordinates for the subplot centers and included them in a GIS layer. The CVS inventory provides an independent, unbiased estimate of the forested BLM-administered lands in the planning area. In the graphic below (**Figure C-2**), the crosshair dot symbols are examples of CVS plot center locations on a 1.7-mile grid on top of the FOI units.

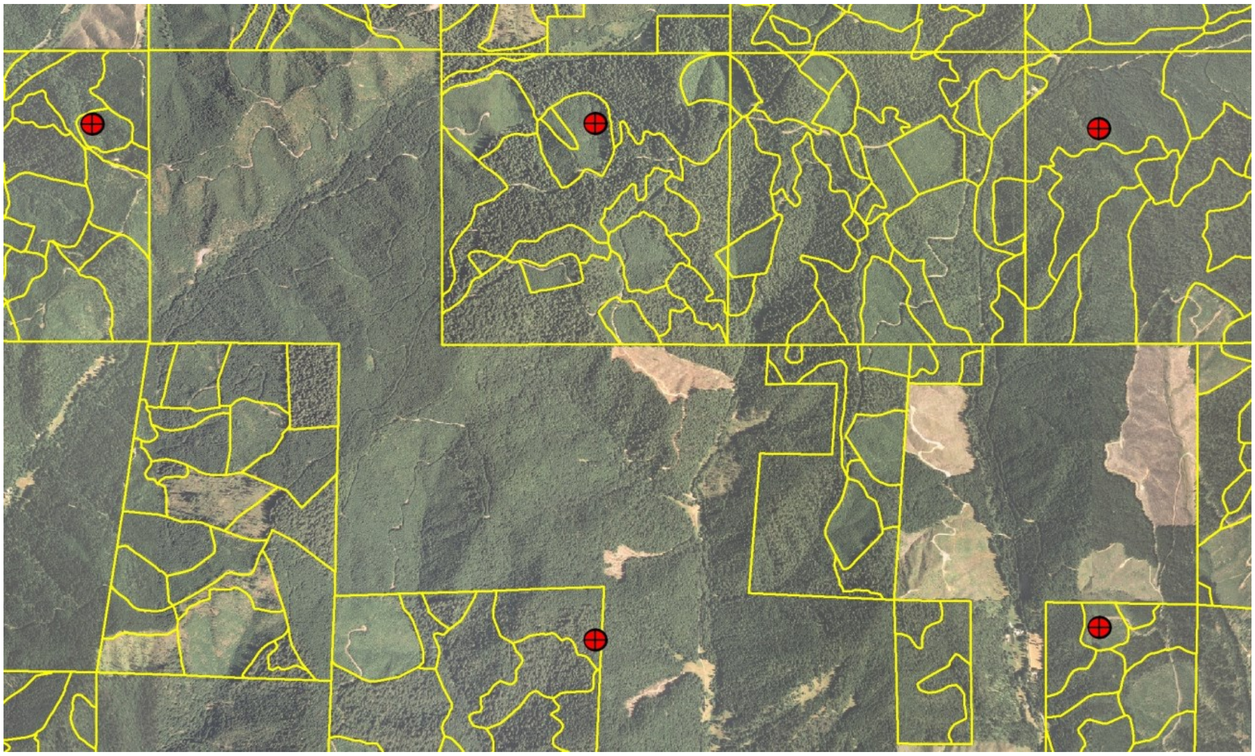
Figure C-2. CVS plot locations and FOI units

Use of the Inventory Data in the Modeling

Introduction

The Modeling Team divided the FOI and the Current Vegetation Survey (CVS) data into 1,582 unique categories, called 'strata,' and classified each stand (FOI unit) by the characteristics listed below. The CVS plots that overlay an FOI represent that FOI and all the FOI found in that stratum. The Modeling Team averaged the CVS tree lists for each stratum and developed a stand table from these average tree lists. The Modeling Team used four components to derive each of the stratums: modeling group, species group, ten-year age class, and site productivity class.

1) Modeling Groups

The purpose of these groups is to identify broad classes of stands that are sufficiently similar for growth and yield modeling (**Table C-1**). The Modeling Team placed each of the existing stands in to 79 different categories, based on their 'existing condition' (**Table C-2**). The existing stand condition (ESC) describes the type of harvest, the tree density, and other silvicultural information. The Modeling Team then further collapsed the existing stand condition categories into 16 different modeling groups that are shown in **Table C-1**.

Table C-1. Modeling groups used to develop strata.

2013 Modeling Group	Modeling Group–Definition and Description
MG_A	Pre-Northwest Forest Plan regeneration harvest units with target or greater level of stocking. Also includes age class 30 stands with past thinning (CT or DM), and unmanaged, well-stocked stands, age class < 50 (< 70) without legacy.
MG_B	Pre-Northwest Forest Plan regeneration harvest units with below target level of stocking. Also includes age class < 50 (< 70) stands from ESC 52 (no past management) categorized as having as low density and without legacy trees.
MG_C	Northwest Forest Plan regeneration harvest units with the full range of retention tree levels. Stand data merged across stock types (genetic vs. non-improved), stocking levels, and retention levels. Also includes age class < 50 stands with no past management and with a legacy tree component, similar to Northwest Forest Plan regeneration harvest structure.
MG_D1	DM and CT stands in age classes 40–90. Stands treated age 80+, now age class > 100 (mostly Salem), merged with no past management stands (MG_E)
MG_D2	DF species group only, DM and CT units (Roseburg and Medford), age class 40–90. Stands treated age 80+, now age class > 100, merged with no past management (MG_E).
MG_D3	Primarily Klamath Falls DM stands. Model all species groups together, and use age bands for low acreage age classes above 120 and below 50
MG_E1	No past management, limited mortality salvage, or conifer non-suitable woodlands; Non-conifer (hardwood) stands were merged with (red alder) stand conversions units in Northwest Oregon (MG_F) or with hardwood suitable woodlands in Southwest Oregon (MG_G).
MG_E2	Northwest Oregon stands with no past management, mature single story.
MG_E3	Southwest Oregon stands with no past management, mature single story.
MG_E4	Northwest Oregon stands with no past management, mature multi-story.
MG_E5	Southwest Oregon stands with no past management, mature multi-story.
MG_F	Northwest Oregon stand conversion opportunities or stands extracted from ESC 51 (no past management and essentially all red alder species group).
MG_G	Hardwood woodlands for all Southwest Oregon species groups; includes woodlands categorized as suitable, non-suitable, and non-commercial forest land. Also includes stands from ESC 51 (no past management) with hardwood species group or hardwood cover condition. The 6 FOIs from Northwest Oregon may be best modeled using Southwest Oregon growth curves.
MG_H	Conifer suitable woodlands; includes stands from ESCs 68 and 70 (hardwood suitable woodlands) identified with a conifer species group designation.
MG_J	Non-commercial forest land conifer suitable woodlands; conifer species groups only, including stands extracted from ESCs 68 and 70 (hardwood suitable woodlands), and stands with a juniper species group stands from any ESC code.
MG_X	Non-forest; Also includes stands from other ESCs with inconsistent cover condition or species group data, which denotes a non-forest unit.

CT = Commercial thinning
DM = Density management
ESC = Existing stand condition
DF = Douglas-fir
FOI = Forest Operations Inventory

Table C-2. Existing stand condition coding

Category	Description of Existing Stand Condition	Total Category Area (GIS Acres)
-	No category	8
1	GFMA target stocking (≥ 80%) and 250–400 TPA density (unimproved TI)	361,885
2	GFMA target stocking (≥ 80%) and 250–400 TPA density (unimproved TI); fertilized	98,712
3	GFMA minimum stocking (60–79%) and 150–249 TPA density (unimproved TI)	118,539
4	GFMA minimum stocking (60–79%) and 150–249 TPA density (unimproved TI); fertilized	25,021
5	GFMA below minimum stocking (< 60%) and 50–149 TPA density (unimproved TI)	18,846
6	GFMA overstocked/over-dense and> 400 TPA density (unimproved TI)	31,492
7	GFMA target stocking (≥ 80%) and 250–400 TPA density (TI genetic stock)	22,543
8	GFMA target stocking (≥ 80%) and 250–400 TPA density (TI genetic stock); fertilized	3,005
9	GFMA minimum stocking (60–79%) and 150–250 TPA density (TI genetic stock)	8,368
10	GFMA minimum stocking (60–79%) and 150–250 TPA density (TI genetic stock); fertilized	443
11	GFMA below minimum stocking (< 60%) and 50–149 TPA density (TI genetic stock)	1,457
12	GFMA overstocked/over-dense and > 400 TPA density (TI genetic stock)	3,634
13	6–8 retention trees - at GFMA target stocking and density (TI genetic stock)	2,594
14	6–8 retention trees - at GFMA minimum stocking and density (TI genetic stock)	242
15	6–8 retention trees - below GFMA minimum stocking and density (TI genetic stock)	662
16	6–8 retention trees - overstocked GFMA standard, needs PCT (TI genetic stock)	845
17	6–8 retention trees - at GFMA target stocking and density (unimproved stock TI)	19,188
18	6–8 retention trees - at GFMA minimum stocking and density (unimproved stock TI)	6,497
19	6–8 retention trees - below GFMA minimum stocking and density (unimproved stock TI)	2,312
20	6–8 retention trees - overstocked GFMA standard, needs PCT (unimproved stock)	2,451
21	12–18 retention trees - at GFMA target stocking and density (TI genetic stock)	480
22	12–18 retention trees - at GFMA minimum stocking and density (TI genetic stock)	358
23	12–18 retention trees - below GFMA minimum stocking and density (TI genetic stock)	130
24	12–18 retention trees - overstocked GFMA standard, needs PCT (TI genetic stock)	8
25	12–18 retention trees - at GFMA target stocking and density (unimproved stock TI)	1,091
26	12–18 retention trees - at GFMA minimum stocking and density (unimproved stock TI)	189
27	12–18 retention trees - below GFMA minimum stocking and density (unimproved stock TI)	108
28	12–18 retention trees - overstocked GFMA standard, needs PCT (unimproved stock TI)	518
30	Density Management at age class 30	1,310
31	Density Management at age class 40	7,251
32	Density Management at age class 50	12,964
33	Density Management at age class 60	14,625
34	Density Management at age class 70	8,562
35	Density Management at age class 80	6,594
36	Density Management at age class 90 Plus	49,611
37	Commercially thinned at age class 30	1,415
38	Commercially thinned and fertilized at age class 30	132
39	Commercially thinned at age class 40	11,323
40	Commercially thinned and fertilized at age class 40	689

Category	Description of Existing Stand Condition	Total Category Area (GIS Acres)
41	Commercially thinned at age class 50	33,402
42	Commercially thinned and fertilized at age class 50	4,644
43	Commercially thinned at age class 60	29,265
44	Commercially thinned and fertilized at age class 60	3,000
45	Commercially thinned at age class 70	21,726
46	Commercially thinned and fertilized at age class 70	505
47	Commercially thinned at age class 80	14,883
48	Commercially thinned at age class 90	8,541
49	Commercially thinned at age class 100	3,605
50	Commercially thinned at age class 110	9,928
51	Mortality Salvaged or Sanitation Cut	40,280
52	56–500 years old, no past silvicultural treatment	974,320
53	Brush field, hardwood, non-commercial conifer or backlog conversion opportunity	22,871
55	Cut, needs site preparation	139
57	Non-forest	126,922
58	> 18 (Southwest Oregon) or > 15 (Northwest Oregon) retention trees/acre - at GFMA target stocking and density (TI genetic stock)	149
62	> 18 (Southwest Oregon) or > 15 (Northwest Oregon) retention trees/acre - at GFMA target stocking and density (unimproved stock TI)	496
63	> 18 (Southwest Oregon) or > 15 (Northwest Oregon) retention trees/acre - at GFMA minimum stocking and density (unimproved stock TI)	31
64	> 18 (Southwest Oregon) or > 15 (Northwest Oregon) retention trees/acre - below GFMA minimum stocking and density (unimproved stock TI)	78
66	Hardwood-suitable woodland commercial forest land	2,642
67	Conifer-suitable woodland commercial forest land	78,034
68	Hardwood-non-suitable woodland commercial forest land	3,628
69	Conifer-non-suitable woodland commercial forest land	45,148
70	Hardwood-suitable woodland non-commercial forest land	34,426
71	Conifer-suitable woodland non-commercial forest land	152,345
72	GFMA target stocking (≥ 80%) and 250–400 TPA density (unimproved TI); pruned	8,887
73	GFMA target stocking (≥ 80%) and 250–400 TPA density (unimproved TI); fertilized; pruned	3,333
74	GFMA minimum stocking (60–79%) – 150–249 TPA density (unimproved TI) ; pruned	3,353
75	GFMA minimum stocking (60–79%) – 150 –249 TPA density (unimproved TI); fertilized; pruned	3,719
76	GFMA target stocking (≥ 80%) and 250–400 TPA density (TI genetic stock) ; pruned	1,372
77	GFMA target stocking (≥ 80%) and 250–400 TPA density (TI genetic stock); fertilized; pruned	47
78	GFMA minimum stocking (60–79%) – 150–250 TPA density (TI genetic stock) ; pruned	946
79	GFMA minimum stocking (60–79%) – 150–250 TPA density (TI genetic stock); fertilized; pruned	96
	Totals	**2,478,864**

GFMA = General Forest Management Area
TPA = Trees per acre
PCT = Pre-commercial thinning

2) Species Groups for RMP Modeling

The Micro*Storms database has a listing of the top five species within each stand layer, with a ranking of relative abundance. The Modeling Team utilized this data to classify each FOI into five broad groups—Douglas-fir, true fir, mixed conifer, conifer/hardwood mix, and hardwood—attributed by north or south within the planning area. In this context north includes the Coos Bay, Eugene, and Salem Districts, and the Roseburg District's Swiftwater Field Office. South includes the Klamath Falls Field Office, the Medford District, and Roseburg District's South River Field Office. The Modeling Team applied the northwest Oregon version of ORGANON to the northern species groups, and the southwest Oregon version of ORGANON to model the southern species groups. The Modeling Team modeled ponderosa pine and juniper species groups in southern Oregon only.

Douglas-fir (DF) – Stands with single species Douglas-fir and stands with minor quantities of other conifers or hardwoods. They would typically be 'FCO' stands (forest conifer), and have either single or multiple sizes and ages indicated.

Northern true fir (N_TF) – Noble or Silver fir are dominant, but other species are mixed in, such as Douglas-fir, western hemlock, or western red cedar.

Northern mixed conifer (N_MX_CON) – Stands with single species of western hemlock, western red cedar, Sitka spruce, or mixed conifer stands where Douglas-fir is not dominant. They would typically be 'FCO' stands (forest conifer).

Northern conifer/hardwood mix (N_CON_HWD) – These stands have both conifer and hardwood species listed, but they are dominated by neither. Conifers or hardwoods could be indicated in the dominant or secondary position. Hardwoods would include big leaf maple and red alder mixed with conifer species. Many FMX stands (forest conifer and hardwoods) would be located here.

Northern hardwood (N_HWD) – Maple/alder mixes and pure alder are here. Pure or nearly-pure alder stands, with limited maple fractions. FHD stand (forest-hardwoods) descriptions are here.

Southern mixed conifer (S_MX_CON) – Stands containing incense cedar, sugar pine, ponderosa pine, Douglas-fir and white fir in varying fractions, but not including pure types without any secondary species indicated; may include some hardwood, but less than the southern conifer/hardwood mix.

Southern conifer/hardwood mix (S_CON_HWD) – Stands with mixed conifer species and a component of southern hardwoods such as oak, madrone, tanoak, and myrtle that may be in the majority or minority. FMX types (forest-conifer and hardwoods) are here.

Southern hardwood (S_HWD) – Southern hardwood species are dominant with limited mixed conifer component. Hardwoods are the dominant species, possibly FHD types (forest conifer and hardwoods).

Southern true fir (S_TF) – This type includes Shasta red fir and white fir types. White fir types could have other secondary species such as Douglas-fir.

Ponderosa pine (PP) – Ponderosa pine is dominant; may include Douglas-fir, juniper or other species, but not as the dominant species.

Juniper (J) – This type is juniper dominant, but contains limited pine, occurs on dry, low site lands.

Depending on the district and the ORGANON variant used, lodgepole pine and knobcone pine types would go into northern mixed conifer or southern mixed conifer. Jeffery pine would go into a low site Ponderosa pine type. Mountain hemlock would go into northern true fir. Port-Orford-cedar would go into southern mixed conifer.

3) Ten-year Age Classes

Table C-3 displays forest stand ten-year age classes from Micro*Storms database as of January 1, 2013. Stand age is derived from the birth year of a stand, and uses the most recent source stand layer that is designated for management. If the stand has multiple tree layers, an assignment is made of the stand layer designated for management. These stand ages reflect the conditions of the forest at the beginning of the analysis period and were used for the modeling of the No Timber Harvest reference analysis, No Action alternative, Alternatives A–D, and Sub-alternatives B and C. The Modeling Team did not assign stand ages to the Eastside Management lands in the Klamath Falls Field Office for vegetation modeling purposes.

Table C-3. BLM western Oregon acreage by age class distribution and sustained yield unit as of January 1, 2013

10-year Age	Coos Bay (Acres)	Eugene (Acres)	Klamath Falls (Acres)	Medford (Acres)	Roseburg (Acres)	Salem (Acres)	Total Area (GIS Acres)
Non-forest	20,206	13,841	167,312	66,556	24,477	24,765	317,157
≤ 10	3,288	2,669	4,656	17,555	3,187	2,406	33,762
20	24,281	18,455	1,159	37,409	35,366	20,426	137,097
30	27,727	27,480	2,025	46,037	33,084	32,210	168,562
40	39,740	32,952	451	22,672	38,470	36,446	170,731
50	36,309	38,225	1,896	42,766	44,666	45,334	209,196
60	25,366	32,545	3,301	23,975	20,410	44,157	149,754
70	17,852	41,702	3,124	25,965	9,084	33,833	131,560
80	9,007	22,302	3,693	21,373	7,276	24,002	87,654
90	3,884	8,026	5,304	29,789	6,284	14,335	67,622
100	4,395	5,057	5,182	32,715	5,758	13,233	66,340
110	4,083	6,171	3,927	55,621	15,789	13,181	98,773
120	9,318	8,004	1,519	33,784	6,335	21,855	80,814
130	10,406	6,219	1,477	44,408	8,041	21,080	91,632
140	6,967	1,597	2,905	48,694	10,584	9,358	80,105
150	8,287	1,201	1,064	39,172	25,877	7,349	82,950
160	8,138	2,083	1,297	35,847	1,723	1,867	50,956
170	2,523	404	525	24,123	8,098	2,787	38,460
180	2,190	433	235	42,019	788	454	46,119
190	1,769	3,989	375	14,781	1,908	156	22,978
200+	58,499	37,707	2,657	101,414	116,433	29,923	346,634
Totals	**324,236**	**311,063**	**214,084**	**806,675**	**423,640**	**399,157**	**2,478,856**

During the summer of 2013, several large fires burned within the Klamath Falls Field Office and the Medford and Roseburg Districts, within the planning area and changed the stand conditions. These changes were incorporated into the stand ages for the Proposed RMP, reflecting the conditions of the forest at the beginning of the analysis as used for modeling of the Proposed RMP. In total, 22,712 acres were burned in either medium-, or high-severity fire, resulting in changes to acres in varying stand age classes on these districts.
Table C-4 shows the forest stand ten-year age classes used for the Proposed RMP.

Table C-4. BLM western Oregon acreage by age class distribution and sustained yield unit after 2013 large fire data adjustment

10-year Age	Coos Bay (Acres)	Eugene (Acres)	Klamath Falls (Acres)	Medford (Acres)	Roseburg (Acres)	Salem (Acres)	Total Area (GIS Acres)
Non-forest	20,206	13,841	167,312	66,556	24,477	24,765	317,157
10	3,288	2,669	5,442	22,889	4,490	2,406	41,184
20	24,281	18,455	1,179	36,885	35,153	20,426	136,380

10-year Age	Coos Bay (Acres)	Eugene (Acres)	Klamath Falls (Acres)	Medford (Acres)	Roseburg (Acres)	Salem (Acres)	Total Area (GIS Acres)
30	27,727	27,480	2,469	46,242	32,932	32,210	169,060
40	39,740	32,952	451	22,002	38,444	36,446	170,035
50	36,309	38,225	1,701	42,110	44,635	45,334	208,313
60	25,366	32,545	2,999	23,795	20,402	44,157	149,264
70	17,852	41,702	2,944	25,625	9,084	33,833	131,040
80	9,007	22,302	3,387	20,808	7,268	24,002	86,775
90	3,884	8,026	5,920	33,319	6,658	14,335	72,141
100	4,395	5,057	4,868	32,446	5,280	13,233	65,280
110	4,083	6,171	3,645	55,429	15,774	13,181	98,283
120	9,318	8,004	1,500	33,515	6,261	21,855	80,452
130	10,406	6,219	1,417	44,340	8,041	21,080	91,504
140	6,967	1,597	2,759	48,104	10,461	9,358	79,247
150	8,287	1,201	1,014	38,597	25,877	7,349	82,325
160	8,138	2,083	1,297	35,452	1,723	1,867	50,561
170	2,523	404	525	23,464	8,091	2,787	37,794
180	2,190	433	235	40,915	788	454	45,016
190	1,769	3,989	363	14,407	1,908	156	22,591
200+	58,499	37,707	2,657	99,776	115,893	29,923	344,456
Totals	**324,236**	**311,063**	**214,084**	**806,675**	**423,640**	**399,157**	**2,478,856**

4) Site Productivity Classes

The distribution of site class on each sustained-yield unit came directly from the measured site index trees on the Current Vegetation Survey (CVS) subplots. The Modeling Team assigned five site classes from highly productive (Site Class 1) to low productivity (Site Class 5). The Modeling Team used King (1966) Douglas-fir site index for the geographic area where the Northwest Oregon version of ORGANON was applicable, and the Hann and Scrivani (1987) Douglas-fir site index for areas where the Southwest Oregon version of ORGANON was appropriate. **Table C-5** shows the distribution of productivity classes within each sustained yield unit. The Modeling Team assigned a site class to each FOI based on the following order of priority:

1. Measured tree data from the CVS inventory associated with a FOI
2. Continuous forest inventory (CFI) data associated with a FOI
3. EcoSurvey (stand exam) data with site index averages associated with a FOI
4. Soil-type based classification from Natural Resources Conservation Service mapping or imputation based on climate variables (Latta *et al*. 2009)

The Modeling Team held the FOI unit-level productivity assignments constant for the Woodstock modeling under the Proposed RMP, and all alternatives and sub-alternatives.

Table C-5. Percentage of site productivity classes within each sustained-yield unit

Site Productivity Class	Coos Bay (Percent)	Eugene (Percent)	Klamath Falls (Percent)	Medford (Percent)	Roseburg (Percent)	Salem (Percent)
Site Class 1	20%	28%	-	-	7%	15%

Site Productivity Class	Coos Bay (Percent)	Eugene (Percent)	Klamath Falls (Percent)	Medford (Percent)	Roseburg (Percent)	Salem (Percent)
Site Class 2	42%	56%	-	6%	23%	48%
Site Class 3	25%	13%	22%	20%	32%	27%
Site Class 4	10%	2%	46%	43%	25%	6%
Site Class 5	1%	-	32%	30%	11%	3%

Note: Numbers have been rounded

Strata to Stand Table

Of the 1,582 unique strata that include all FOI polygons, 601 strata had at least 1 overlaying CVS plot (**Table C-6**). These strata represent 83 percent of the forested BLM-administered acres. The Modeling Team modeled the remaining 981 strata, 17 percent of the forested BLM-administered acreage, using the 'most similar' CVS tree list. By broadening FOI site class, species groups, or stand age classes, the Modeling Team developed a decision matrix to determine which tree list was most similar for unmatched strata. Each stratum has a stand table that the Modeling Team developed from at least one CVS subplot tree lists. Each stratum represented by more than one tree list had an average tree list developed to represent that stratum. The Modeling Team modeled all of the FOIs in a particular stratum using the same stand table.

Table C-6. Strata representation with CVS subplots

Current Vegetation Survey Subplot Coverage	Strata (Count)	Forested BLM-administered Land (Acres)
Stratum with CVS subplots	601	1,775,011
Stratum with no CVS subplots	981	353,671
Totals	**1,582**	**2,128,682**

Application of the Stratification in Growth and Yield Modeling

The consulting firm Mason, Bruce & Girard, Inc. (MBG) projected the stand table for each stratum in the ORGANON growth and yield model utilizing a software program called YTGTools, which is MBG's proprietary software. MBG used YTGTools to batch multiple ORGANON runs and convert the outputs into Woodstock-compatible yield tables. MBG modeled each stand table's growth for a 200-year planning horizon to simulate future development with and without future silvicultural treatments.

ORGANON Comparison to Measured CVS Growth

In an effort to understand how comparable the tree growth on BLM stands was with the ORGANON model, the first step was to test actual tree growth with the projected growth from ORGANON. The Modeling Team did this by comparing projected tree growth on 2,609 CVS subplots with the actual growth recorded on those subplots, between their first and second measurements. The Modeling Team compared two metrics: stand basal area and volume (Scribner Mbf) per acre. On average, the model predicted 95 percent of the basal area actual growth, and 102 percent of the actual Mbf per acre. The results of the basal area projection reflect the ability of the model to predict tree mortality and diameter growth. The volume growth projection reflects mortality rates and growth in both height and diameter. The Modeling Team did not make any adjustments to the ORGANON model, as the Modeling Team considered these differences to be minor, and the time frames used to make the estimates fairly short.

Comparison of Stratified Inventory to Regional Permanent Plot Inventories

The Modeling Team compared the net and gross total volume estimates from the stratified inventory data with the unbiased total inventory estimate from both the Forest Inventory and Analysis (FIA) plots and the CVS plots within that are located on BLM-administered lands within the planning area (**Table C-7**). The stratified total and net volume estimate, as represented by the No Timber Harvest modeling run (explained later in this appendix), was within one 95 percent confidence interval of both estimates, from both regional inventories.

Table C-7. Results from net inventory comparison (MMbf volume)

Inventory Comparison	CVS Plot Calculations (MMbf)	FIA Plot Calculations (MMbf)	No Timber Harvest Run (MMbf)
Net volume 2013	76,766	79,100	73,961
95% CI Upper	80,698	87,100	
95% CI Lower	72,833	71,100	

CVS = Current Vegetation Survey
FIA = Forest Inventory and Analysis
MMbf = million board feet

GIS – Defining the Land Base and Spatial Projections

Introduction

The Modeling Team used the Geographic Information System (GIS) data to develop a set of polygons with unique identifiers (RMPWO_ID), which cover the BLM-administered lands in the planning area. The Modeling Team defined the attribute data for each these polygons as well as the land base for application of modeling rules for simulation of the Proposed RMP, and alternatives and sub-alternatives. The Modeling Team used GIS data for mapping the Woodstock projections' results of forest conditions over time. This section provides an overview of the GIS process and the data the Modeling Team used for analyzing the Proposed RMP and alternatives. The BLM recorded the details of the GIS processing and datasets with GIS metadata.

Defining BLM-administered Lands

The Land Lines Information theme (LLI) is the BLM corporate GIS layer for land status – O&C lands, public domain, acquired, and Coos Bay Wagon Road lands. The FOI is the spatial vegetation layer used for the Woodstock modeling. The FOI and LLI themes are not vertically integrated in GIS, which results in slivering in the areas of misalignment. For analytical purposes, BLM-administered lands are defined by the area in which the FOI and LLI overlap. This FOI and LLI mask was subsequently used to minimize the slivers from all GIS layers used in the analysis.

Intersection vs. Majority Rules

Where the subdivision of the FOI was important for simulating different modeling rules within each stand (e.g., the Riparian Reserve and roads), the BLM intersected the data layers in GIS to create unique areas. Some data layers came from external sources that were captured at coarser scales than the FOI mapping and do not align well with BLM checkerboard ownership (e.g., northern spotted owl critical habitat units). In these situations, the BLM performed a majority rules analysis, where 50 percent or more of the FOI unit would need to coincide with the data theme, such as critical habitat, to receive the designation. The

BLM applied this majority rules process to themes where spatial subdivision of FOI polygons was unnecessary and stand level designation was sufficient for the analysis.

Rasterizing and Unique ID Assignment

To facilitate GIS processing, the BLM converted all vector GIS data layers to 10 × 10 m raster cells (1 cell = 0.025 acres – UTM zone 10, NAD83) and partitioned the data into tiles, which were based on 1:24,000 U.S. Geological Survey quadrangle grids (approximately 35,000 acres, 6 miles east/west by 8.5 miles north/south). Within each tile, the BLM intersected every unique combination of GIS data layers with the FOI. The BLM gave each resulting polygon a unique identifier (RMPWO_ID). The example in **Table C-8** illustrates one FOI unit (840369) being subdivided into four unique areas based on how the Riparian Reserve and roads intersected the forest stand. This GIS subdivision of the forest stands allows the Woodstock model to simulate how each portion of the stand would develop.

Table C-8. Example of one FOI unit subdivided into four unique areas

RMPWO_ID	FOI #	GIS Acres	Riparian Reserve	Road Buffer	Description
124000005	840369	28.84	N	N	Outside Riparian Reserve; outside of road buffer
124000008	840369	0.99	N	Y	Outside Riparian Reserve; within road buffer
124000004	840369	10.90	Y	N	Inside Riparian Reserve; outside of road buffer
124000013	840369	0.49	Y	Y	Inside Riparian Reserve; within road buffer

The unique ID (RMPWO_ID) carries through the Woodstock modeling projections for tracking each spatial entity. The Modeling Team stored the resultant information in 10 × 10 m pixels. The Modeling Team combined those pixels with the same information to form polygons. The Modeling Team returned Woodstock classification of allocations or projections of forest conditions to GIS as attributes with the unique IDs, which were linked back to the original grid to produce spatial products.

Data Vintage

The Modeling Team captured a snapshot of the Forest Operations Inventory (FOI), land use allocation (LUA), Timber Production Capability Classification (TPCC), occupied marbled murrelet sites (OMMS), and the Land Lines Information (LLI) data for this analysis. Many data layers were 'frozen' at the beginning of the analysis in 2013. **Table C-9** displays the GIS data themes that the Modeling Team used in the analysis for the Proposed RMP. Those data layers that have been updated to reflect changed conditions since 2013 are displayed in italics.

Table C-9. GIS data themes used in the analysis for the Proposed RMP

Source Data (Vector and Raster)	GIS Data Theme Description
pol_dob_a_v2_poly	BLM District
fst_foi_a_v3_poly	Forest Operation Inventory coincident with BLM ownership
trn_highways_aoi_a_v1_arc , trn_roads_aoi_a_v1_arc	Roads buffered 22.5 feet per side
hyd_waterbody_aoi_a_v1_poly , hyd_areas_aoi_a_v1_poly	Surface water (no buffers)
fst_tpc_a_v2_poly	No Timber Harvest-Harvest Land Base (N,X,Y)
fst_foi_a_v3_poly	Unique FOI identification
Microstorms (flat file)	Yield Strata identification
Microstorms (flat file)	Model Group by OI unit
Microstorms (flat file)	Species Group by OI unit
Microstorms (flat file)	Site Class by OI unit
Microstorms (flat file)	Ten-year Age Class by OI unit
Microstorms (flat file)	BLM District name by OI unit
Microstorms (flat file)	AgeInPeriods_TS (Starting Age by OI unit)
Microstorms (flat file)	Township/Range/Section by OI unit
Microstorms (flat file)	ORGANON variant by OI unit
lch_MoistDry_a_aoi_v2_poly	Moist/Dry by OI unit
fir_Predicted_FireSeverity_10m_a_v1_rst	Predicted fire severity decade 1, 2, 3, 4, 5
fst_tpc_a_v2_poly	TPCC primary management
fst_tpc_a_v2_poly	TPCC primary class
hyd_wbd_hu10_a_v2_poly	HUC 10 watersheds
hyd_wbd_hu12_a_v2_poly	HUC 12 watersheds
smg_ond_a_v2_poly	Other national designations
trn_pacificcresttrail_a_v1_arc	Pacific Crest Trail (25 feet buffer per side)
lsc_provphys_a_v2_poly	Physiographic Provinces
smg_wilderness_a_v2_poly	Wilderness
smg_wsrcorr_a_v2_poly	Wild and Scenic River corridors, designated
pol_cob_a_v2_poly	County Name
smg_wsa_a_v1_poly	Wilderness Study Areas
Rr_SR2	*Inner, Middle, Outer Riparian Reserve SR2 (1, 2, 3)*
EML_ripres_dis	Eastside Riparian Reserve
RR_Lakwet	Riparian Reserve areas from lakes and wetlands
smg_WildernessCharacteristics_a_aoi_v1_poly	Wilderness Characteristics
smg_wsrcorr_a_v2_poly	Wild and Scenic River corridors, designated, type
pol_ownership_blm_aoi_a_v3_poly	Land Status (OC, PD, CBWR, AQ)
FLORA_CHUs	Flora Critical Habitat Areas
Wld_FaunaCHUs_a_v2_polys	*Fauna Critical Habitat Areas*
wld_mmz_5mi_a_v1_poly	Marbled Murrelet zones w/ 5-mile bands
GB_FLORA_SITES	Flora Survey and Manage species 2001 list, buffered
GB_FAUNA_SITES	Fauna species group report units
lup_MAMU_predicted_SR2_a_v1_poly	*Predicted Marbled Murrelet*
lup_rtv_predicted_a_SR2_v1_poly	*Predicted Red Tree Voles*
GB_FAUNA_SITES	Fauna special status T&E species, buffered

Source Data (Vector and Raster)	GIS Data Theme Description
lup_ueamgt_a_altc_v1_poly	Uneven-aged Management, Alt. C/D
MSTDRYVDRY	Moist/Dry/VeryDry
wld_SR2_NSO_Large_Block_Reserves_poly	*SR2 NSO large block reserves*
lup_RA32_OldForest_a_SR2_v1_poly	*RA32 old forest, SR2 version*
smg_acec_aa_a_v1_poly	*ACECs SR2, unique identifier per ACEC*
Fir_2013_Fire_Severities_10m_a_v1_rst	*Raster Fire Occurrence, 2013*
SR3_RMAs_rst	*Recreation Management Areas*
fst_swissneedlecast_a_v1_poly	Swiss Needle Cast
min_fragile_soils_a_v1_poly	Fragile soils action alternatives
atm_frost_prone_med_a_v1_poly	Frost prone areas
lup_Kfalls_EastsideLands_a_v1_poly	Eastside Management Lands
pol_rab_a_v3_poly	Resource Area Name and Code
lsc_NWFP_NSO_MRegions_aoi_a_v1_poly	Northern Spotted Owl Modeling Groups
fir_2013_Fire_Severities_x_FOI	*Moderate and Severe Fire Occurrence, 2013*
wld_marbledmurrelet_chu_a_2011_v1_poly	Marbled Murrelet critical habitat
wld_nsochu_a_2013_v1_poly	Northern Spotted Owl critical habitat

Note: Italics indicate updated data layers.
FOI = Forest Operations Inventory
OI = operations inventory
TPCC = Timber Production Capability Classification
HUC = hydrologic unit code
SR = sensitivity run
OC = Oregon and California Railroad Act lands
PD = public domain lands
CBWR = Coos Bay Wagon Road lands
AQ = acquired lands
RA32 = Recovery Action 32 (northern spotted owl)

See the modeling rules section for further description of the GIS data themes used in the modeling.

Moist vs. Dry Delineation of BLM-administered Lands in the Planning Area

Moist vs. Dry Forests

The Modeling Team recognizes that forested lands fall within two broad categories—moist forests and dry forests—that are relevant to management decisions and analysis. The Modeling Team recognizes that the spectrum from moist to dry is more accurately described along a continuous gradient from moist to dry rather than a ‘one or the other’ binary classification. However, the Modeling Team has made these discrete classifications to facilitate specifying management objectives and direction based on mapped land use allocations. Recognizing and managing both moist and dry forests within the range of the northern spotted owl is a major underpinning in the Revised Recovery Plan for the Northern Spotted Owl (USDI FWS 2011, pp. III-17 – III-41).

Moist forests are typically highly productive, often with deep, nutrient-rich soils, abundant precipitation, and relatively cool, temperate climates. Historically, these forests have experienced relatively infrequent, high- or mixed-severity fires. Moist forests are concentrated in the coastal/northern districts (the Coos Bay and Eugene Districts, the north half of the Roseburg District, and the Salem District). Moist forests also occur in the southern/interior districts (the Klamath Falls Field Office, the Medford District, and the southern half of the Roseburg District), but they are less abundant, often on northern aspects, in higher elevations, or in coastal influence zones.

Dry forests are typically lower productivity forests, occurring in warmer and drier environments, and often on shallower, nutrient-poor soils when compared to moist forests. Historically, these forests have experienced frequent, low- to mixed-severity fires. Dry forests are concentrated in southern/interior districts (the southern half of the Roseburg District, Medford District, and the Klamath Falls Field Office). Dry forests also occur in the coastal/northern districts, but they are less abundant, often on southern aspects, ridge tops, and low-elevation valley margins.

The distinction between moist forests and dry forests represents a complicated relationship between climate, species, topography, soils, and disturbance history. For this reason, a map based on any one of these factors would likely create an incorrect representation of the spatial arrangement of these forests. Fortunately, the BLM and the U.S. Forest Service has collected and compiled data on Plant Association Groups (PAG), which are also the product of climate, species, topography, soils, and disturbance history. Therefore, the Modeling Team can use PAG to determine whether a forest stand is moist or dry (Franklin *et al*. 2013, pp. 12–23). Trained professionals in the field can readily make Plant Association Group determinations, and large spatial mapping datasets are available for many parts of the planning area.

The following plant association series and groups are generally considered moist (Franklin and Johnson 2012): western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), western redcedar (*Thuja plicata*), Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), subalpine fir-Engelmann spruce (*Abies lasiocarpa*-*Picea engelmanni*), moist grand fir (*Abies grandis*), and moist white fir (*Abies concolor*).

The following plant association series and groups are generally considered dry (Franklin and Johnson 2012): ponderosa pine (*Pinus ponderosa*), Oregon white oak (*Quercus garryana*), Douglas-fir (*Pseudotsuga menziesii*), Jeffrey pine (*Pinus jeffreyi*), dry grand fir (*Abies grandis*), and dry white fir (*Abies concolor*).

These very general categories provided the Modeling Team with a starting point for categorization of forested lands in the planning area. The Modeling Team produced a set of PAG moist/dry categorizations that were distributed to U.S. Forest Service regional ecologists and BLM experts for review. Based on this evaluation and review, the Modeling Team labeled each PAG in the planning area as either moist or dry.

The next challenge was to categorize forested stands in the decision area as either moist or dry. While PAG data is available for many regions, there is not a seamless coverage available for the entire decision area for this planning effort. However, the Integrated Landscape Assessment Project (ILAP) had derived a single, seamless coverage of Potential Vegetation Type (PVT) for the entire decision area. This PVT map consists of a raster grid to a 30-m pixel size derived from underlying PAG and necessary interpolation. The Modeling Team updated the southwest Oregon portion of the map to reflect the most up-to-date PAG information for the region. Then, the Modeling Team labeled each FOI unit (stand) in the database as either moist or dry based on the PVT map and a majority rules process. The Modeling Team labeled stands exactly split between moist and dry, an occurrence, which was very rare, as dry.

The Modeling Team sent these maps to BLM offices for review by experienced local experts. The BLM corrected mapping errors by location where the maps did not accurately reflect local knowledge of conditions on the ground. The accuracy of PVT for the Salem District was not satisfactory because they had very few dry forest acres. The Salem District BLM experts used a combination of biophysical setting data and local knowledge to select manually dry stands from their operational land base.

This mapping effectively produced a seamless, spatial moist/dry classification scheme for the entire decision area (**Table C-10**). **Table C-11** is a representation of the final categories that the BLM offices selected, prior to area corrections being applied. Roseburg N refers to the Roseburg District outside of the Klamath East or Klamath West modeling region, while Roseburg S refers to the Roseburg District inside of those modeling regions. The Modeling Team customized these calls based on local knowledge and spatial coverage for each district by local BLM ecological vegetation experts. Very Dry forests are a subset of dry forests that the Modeling Team modeled as uneven-aged management where they reside in the Harvest Land Base in Alternatives C and D, and Sub-alternative C.

Table C-10. Moist vs. dry forested acres by district

Forest Category	Coos Bay (Acres)	Eugene (Acres)	Klamath Falls (Acres)	Medford (Acres)	Roseburg (Acres)	Salem (Acres)	Totals (Acres)
Dry	2,300	1,010	43,043	715,509	170,588	6,851	**939,300**
Moist	301,837	296,212	4,968	24,610	228,575	367,690	**1,223,893**
Totals	**304,137**	**297,222**	**48,011**	**740,119**	**399,163**	**374,541**	**2,163,193**

Table C-11. Moist/dry potential vegetation type categorization by district

Plant Vegetation Type (PVT)	Coos Bay (Moist/Dry)	Eugene (Moist/Dry)	Klamath Falls (Moist/Dry)	Medford (Moist/Dry)	Roseburg N (Moist/Dry)	Roseburg S (Moist/Dry)	Salem (Moist/Dry)
Douglas-fir–Dry	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Douglas-fir–Moist	Moist	Dry	Dry	Dry	Dry	Dry	Moist
Douglas-fir–White oak	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Douglas-fir–Xeric	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Grand fir–Valley	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Grand fir–Warm/Dry	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Grand fir–Cool/Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Mixed Conifer–Moist	Moist	Moist	Dry	Dry	Moist	Moist	Moist
Mixed Conifer–Dry	Moist	Dry	Very Dry	Very Dry	Dry	Dry	Moist
Mixed Conifer–Cold/Dry	Moist	Dry	Very Dry	Very Dry	Dry	Dry	Moist
Mixed Conifer–Dry (pumice soils)	Moist	Dry	Very Dry	Very Dry	Dry	Dry	Moist
Mountain hemlock–Cold/Dry	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Mountain hemlock–Cold/Dry (Coastal/W. Cascades)	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Mountain hemlock–Intermediate	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Mountain hemlock–Wet	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Oregon white oak	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Oregon white oak-Ponderosa pine	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Pacific silver fir–Intermediate	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Pacific silver fir–Warm	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Ponderosa pine–Dry	Moist	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Moist
Ponderosa pine–Xeric	Moist	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Moist
Shasta red fir–Dry	Moist	Moist	Moist	Moist	Moist	Moist	Moist

Plant Vegetation Type (PVT)	Coos Bay (Moist/Dry)	Eugene (Moist/Dry)	Klamath Falls (Moist/Dry)	Medford (Moist/Dry)	Roseburg N (Moist/Dry)	Roseburg S (Moist/Dry)	Salem (Moist/Dry)
Shasta red fir–Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Sitka spruce	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Subalpine fir	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Subalpine fir–Cold/Dry	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Subalpine parkland	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Tan oak-Douglas-fir–Dry	Moist	Moist	Very Dry	Very Dry	Dry	Very Dry	Moist
Tan oak-Douglas-fir–Moist	Moist	Moist	Moist	Moist	Dry	Dry	Moist
Tan oak–Moist	Moist	Moist	Moist	Moist	Dry	Dry	Moist
Western hemlock–Coastal	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western hemlock–Cold	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western hemlock–Hyperdry	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western hemlock–Intermediate	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western hemlock–Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western hemlock–Moist (Coastal)	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western hemlock–Wet	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Western red cedar/Western hemlock–Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
White fir–Cool	Moist	Moist	Very Dry	Very Dry	Moist	Moist	Moist
White fir–Intermediate	Moist	Moist	Dry	Dry	Dry	Dry	Moist
White fir–Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
White fir–Warm Moist	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Lodgepole pine	Moist	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Moist
Ultramafic	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Moist
Other Non-forest	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Jeffrey Pine	Dry	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Dry
Lodgepole pine–Cold	Dry	Very Dry	Very Dry	Very Dry	Very Dry	Very Dry	Dry
Not Modeled	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Barren	Moist	Dry	Very Dry	Very Dry	Dry	Very Dry	Moist
Wetland	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Water or Ice	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Subalpine meadows-Green Fescue	Moist	Moist	Moist				Moist
Bitterbrush–With Juniper	-	-	Very Dry				-
Idaho fescue-Prairie junegrass	-	-	Very Dry				-
Low Sage-Mesic–No juniper	-	-	Very Dry				-
Low Sage-Mesic–With juniper	-	-	Very Dry				-
Montane and canyon shrubland	-	-	Very Dry				Dry
Mountain big sagebrush-With juniper	-	-	Very Dry				-
Mountain Mahogany	-	-	Very Dry				-

Plant Vegetation Type (PVT)	Coos Bay (Moist/Dry)	Eugene (Moist/Dry)	Klamath Falls (Moist/Dry)	Medford (Moist/Dry)	Roseburg N (Moist/Dry)	Roseburg S (Moist/Dry)	Salem (Moist/Dry)
Ponderosa Pine–Dry, with juniper	-	-	Very Dry				-
Ponderosa pine-Lodgepole pine	-	-	Very Dry				-
Salt desert shrub-lowland	-	-	Very Dry				-
Western juniper woodland	-	-	Very Dry				-
Wetland	Moist	Moist	Moist	Moist	Moist	Moist	Moist
Wyoming big sagebrush–No juniper	-	-	Very Dry				-
Wyoming big sagebrush–With juniper	-	-	Very Dry				-

Forest Growth and Yield Modeling

Introduction

This section describes the silvicultural systems, practices, modeling tools, and modeling assumptions for forest growth simulations at the stand level. The purpose of simulating forest stand growth and development is to permit analysis of the effects of different silvicultural systems and silvicultural practices (e.g., on timber yield, stand structural class, wildlife habitat, hydrologic function, and carbon budgets). The Modeling Team used the simulated growth and yield output tables described in this section in the Woodstock model to help answer the analytical questions for different resources identified in this RMP for each of the alternatives and the Proposed RMP.

Silvicultural Systems, Practices, and General Modeling Approaches

Silvicultural Systems and Associated Regeneration Harvest Types

A silvicultural system is a planned series of treatments for tending, harvesting, and re-establishing a stand to meet specific management objectives (i.e., a set of treatments that could be repeated in perpetuity). The system name is commonly based on the number of age classes created within a stand (Tappeiner *et al*. 2007). The regeneration harvest method associated with a particular silvicultural system defined by age class has such a decisive influence on stand form and development that the harvest method name is also commonly applied to the silvicultural system (Smith 1962). For example, the terms uneven-aged and selection system are often used interchangeably to characterize the same silvicultural system.

Within a land use allocation being managed with a particular silvicultural system, the planned series of treatments are fine-tuned to meet the specific conditions and growth potential of individual stands or modeling group. These more specific combination and sequence of treatments is called a silvicultural prescription or management regime.

The Modeling Team used three recognized silvicultural systems in simulating forest stand development and timber harvest on lands identified as contributing to sustained-yield management. These are even-aged (clearcut and shelterwood), two-aged (variable retention), and uneven-aged (selection). Two-aged and uneven-aged systems are described collectively as multi-aged (O’Hara 2014). The systems analyzed for this analysis exhibit a gradient of timber harvest intensity (**Figure C-3**) and stand structural complexity (**Figure C-4**). The system used depends on the land use allocation’s objectives of each alternative and the Proposed RMP (**Table C-12** and **Table C-13**).

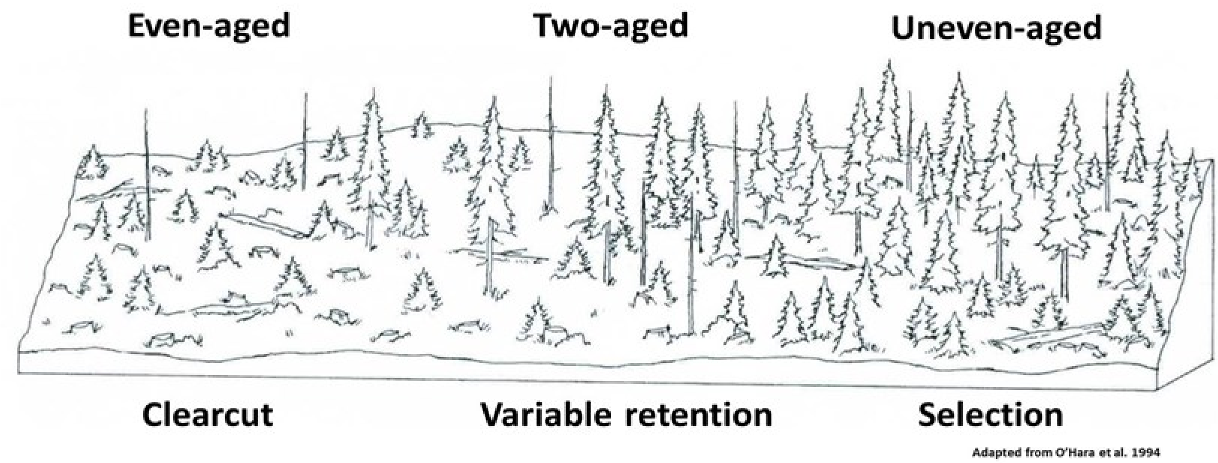

Figure C-3. Gradient of silvicultural systems and regeneration harvest methods

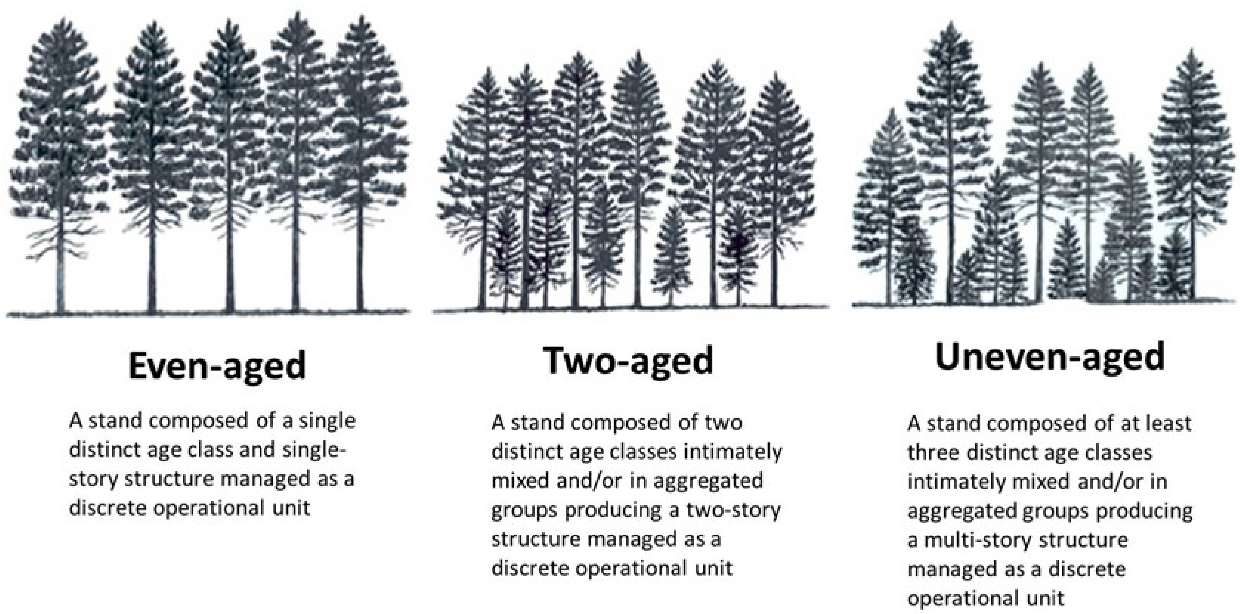

Figure C-4. Stand structural types produced by various silvicultural systems
Note: Figure adapted from USDA FS NCRS (no date).

Table C-12. Silvicultural systems/harvest method by land use allocation

Land Use Allocation	LUA Abbreviation	No Action (Method)	Alt. A (Method)	Alt. B (Method)	Alt. C (Method)	Alt. D (Method)	PRMP (Method)
General Forest Management Area	GFMA	Two-aged	-	-	-	-	-
Adaptive Management Area*	AMA	Two-aged	-	-	-	-	-
Moderate Intensity Timber Area	MITA	-	-	Two-aged	-	Two-aged	Two-aged
Connectivity/Diversity Block	CONN	Two-aged	-	-	-	-	-
Low Intensity Timber Area	LITA	-	-	Two-aged	-	-	Two-aged
Southern General Forest Management Area	SGFMA	Two-aged	-	-	-	-	-
Uneven-aged Timber Area	UTA	-	Uneven-aged	Uneven-aged	Uneven-aged	Uneven-aged	Uneven-aged
Owl Habitat Timber Area	OHTA	-	-	-	-	Uneven-aged	-
High Intensity Timber Area	HITA	-	Even-aged	-	Even-aged	-	-
Late-Successional Reserve	LSR	Thinning	Thinning‡	Thinning/ Uneven-aged§	Thinning/ Uneven-aged§	Thinning/ Uneven-aged§	Thinning/ Uneven-aged§
Adaptive Management Reserve†	AMR	Thinning	-	-	-	-	-
Riparian Reserve	RR	Thinning	Thinning‡	Thinning	Thinning	Thinning	Thinning

* Adaptive Management Area is represented by the General Forest Management Area in subsequent tables
† Adaptive Management Reserve is represented by the Late-Successional Reserve in subsequent tables
‡ No commercial harvest, cut trees are left on-site
§ Varies by moist forest (Thinning)–dry forest (Uneven-aged) classifications

Table C-13. Silvicultural systems selected modeling assumptions*

Land Use Allocation	Regeneration Harvest Method†	Target Stand Structure Type	Alternative/ Proposed RMP	Primary Regeneration Method and Simulation Timing‡	Pre-commercial Thinning Residual Density (Trees/Acre)	Genetic Improvement§	Commercial Thinning	Fertilize
GFMA	VRH	Two-aged	No Action	Plant–15	200-260	X	X	X
MITA	VRH	Two-aged	D	Plant–15	260	X	X	X
MITA	VRH	Two-aged	PRMP	Plant–15	260	X	X	X
MITA	VRH	Two-aged	B	Plant–30	260			
CONN	VRH	Two-aged	No Action	Plant–15	150-220		X	
LITA	VRH	Two-aged	B	Natural–30	220		X	
LITA	VRH	Two-aged	B	Natural–30	100			
LITA	VRH	Two-aged	B	None	0			
LITA	VRH	Two-aged	PRMP	Plant–15	260		X	
SGFMA	VRH	Two-aged	No Action	Plant–15	260		X	
UTA	Selection	Uneven-aged	A, B, C, D	Plant–15	260		X	
UTA	Selection	Uneven-aged	PRMP	Plant–15	260		X	
OHTA	Selection	Uneven-aged	D	Plant–15	260		X	
HITA	Clearcut	Even-aged	A, C	Plant–15	260	X	X	X
LSR	*Variable by Alternative/Proposed RMP*							
RR	N/A	Multi-aged	All	Natural	120			
RR	N/A	Multi-aged	PRMP	Natural	120			

* Actions that are applicable outside of fire scenario areas
† VRH = variable retention harvest
‡ 'Natural' indicates that no artificial regeneration (tree planting) is permitted; 'Plant' indicates a planting cost applies. The number following the primary regeneration method is the number of years post-harvest that a tree list representing 15-year-old trees is added to the growth simulation at a density reflecting post-pre-commercial thinning, or if less than 150 the assumed density reflecting stand density if below target density for that land use allocation.
§ Refer to use of genetically improved Douglas-fir seedlings for reforestation and use of growth modifiers in ORGANON simulations.

The even-aged system uses the clear-cutting or shelterwood harvest method to regenerate existing stands. Clear-cutting essentially removes all trees from an area in a single harvest operation (**Figure C-5**). Shelterwood harvest initially retains a number of 'shelter' trees to protect new tree regeneration by mitigation of detrimental on-site environmental conditions (e.g., heat or frost). Immediately post-harvest, a shelterwood has the appearance of a two-aged stand resulting from a variable retention harvest (**Figure C-3**). However, unlike the two-aged system, the shelter trees are only temporarily retained (approximately 10–20 years) and are harvested when they no longer required for protection of the new tree regeneration.

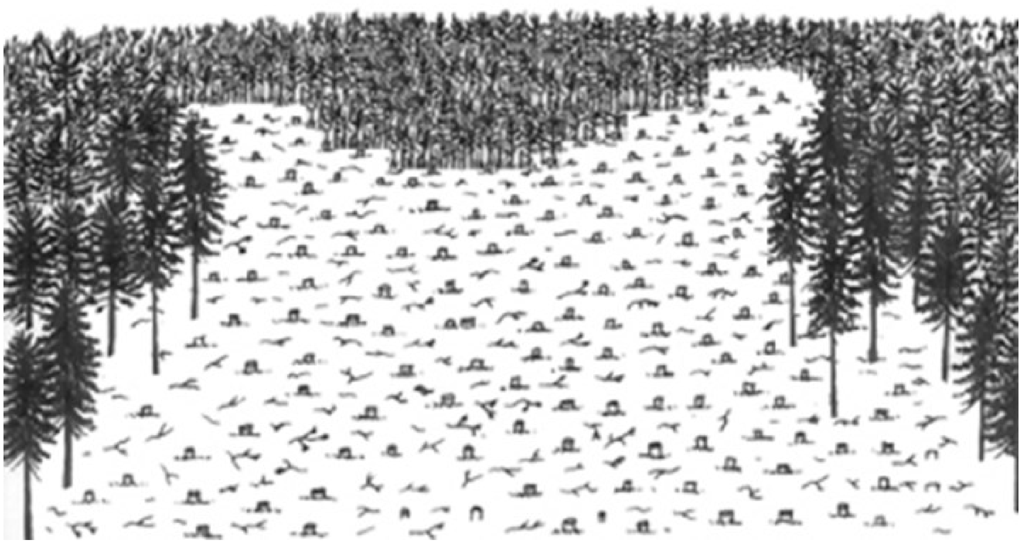

Figure C-5. Clearcut stand immediately post-harvest
Note: Figure adapted from USDA FS NCRS (no date).

The two-aged system uses a variable retention harvest method to achieve the goal of establishing new tree regeneration (**Figure C-3** and **Figure C-4**). At regeneration harvest, live trees are retained long-term (reserved from harvest) to facilitate the development of a two-aged stand structure. The retained trees may be left in a dispersed, aggregated, or mixed spatial pattern (**Figure C-6**). For modeling purposes, the Modeling Team assumed dispersed retention for variable retention harvests in the No Action alternative, Alternatives B and D, and the Proposed RMP.

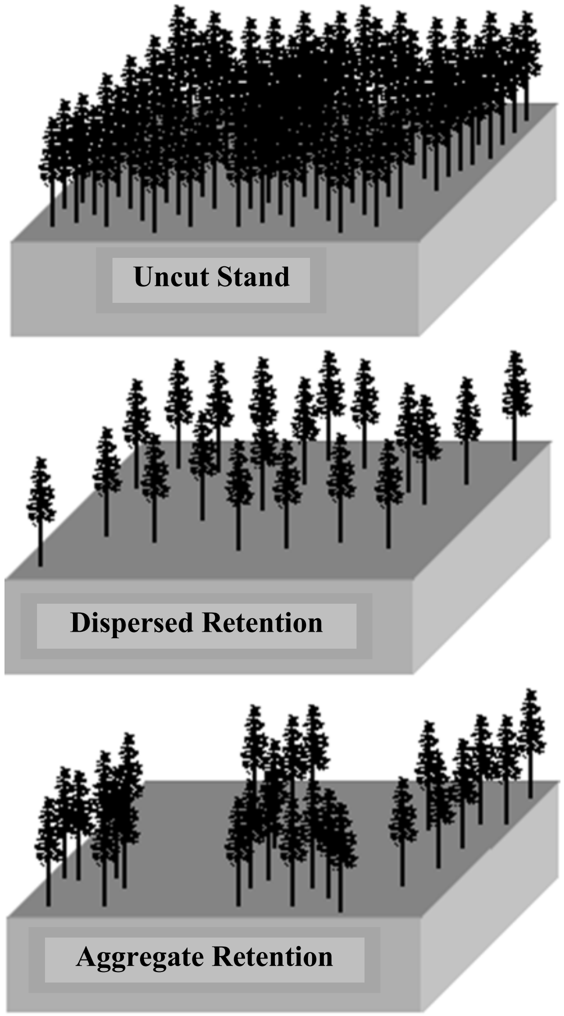

Figure C-6. Variable retention (regeneration) harvest-idealized retention patterns
Note: Figure adapted from USDA FS NCRS (no date).

The uneven-aged system uses selection harvests to establish new regeneration. Trees are harvested singly and/or in groups with the objective of creating an uneven-aged multi-story (canopy) stand structure (**Figure C-3**, **Figure C-4**, and **Figure C-7**). Classically defined uneven-aged management assumes that over time the entire area of the stand is harvested. A feature of the uneven-aged system in the action alternatives and the Proposed RMP is the long-term retention or reservation from harvest of a portion of each stand similar to retention concept of the two-aged system.

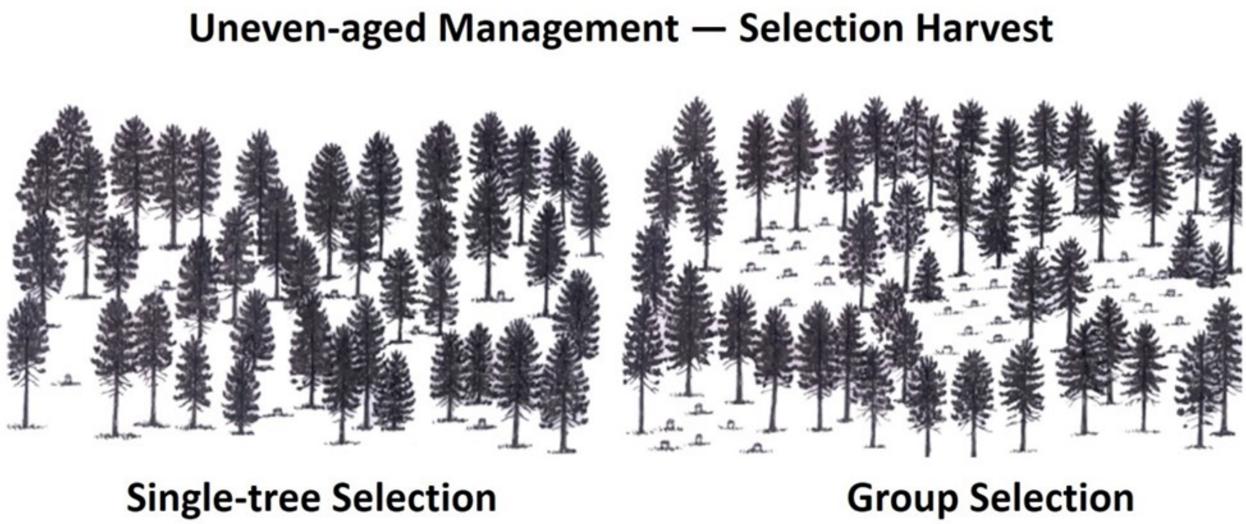

Figure C-7. Uneven-aged management/selection harvest – idealized harvest patterns
Note: Figure adapted from USDA FS NCRS (no date).

In addition to being used in simulating forest stand development and timber harvest on lands identified as contributing to sustained yield management, the Modeling Team modeled uneven-aged management in the 'dry forest' portions of the Late-Successional Reserve in the action alternatives and the Proposed RMP.

The Modeling Team modeled timber harvests on portions of land use allocations managed for emphases other than timber. For example, the Late-Successional Reserve would employ a harvest approach commonly referred to as variable-density thinning (Harrington *et al*. 2005). Variable-density thinning employs elements of commercial thinning and selection harvest of the uneven-aged system to promote stand heterogeneity through the development of a multi-story stand. Provision of conditions conducive to the initiation and growth of regeneration is an objective of variable-density thinning to encourage understory development to contribute to stand heterogeneity. Variable-density thinning in the context of the analyzed alternatives and the Proposed RMP is not a silvicultural system as such, since silvicultural treatments are assumed to end by a specified stand age (i.e., there is no assumption of a repeatable cycle of treatments in perpetuity). The Modeling Team modeled variable-density thinning as a series of proportional commercial thinnings with simulated tree regeneration following the thinning harvests in the Riparian Reserve in all alternatives and the Proposed RMP, Late-Successional Reserve in the No Action alternative, and 'moist forest' areas in the Late-Successional Reserve in the action alternatives and the Proposed RMP.

Silvicultural Practices and Modeling Assumptions

For each modeling group, the Modeling Team may plan a variety of practices in addition to harvesting for specific periods in the life of the stand. These practices act to keep forest stands on desired developmental trajectories. The type and timing sequence of those practices vary by the current and the desired future condition of the stand or modeling stratum.

The other major silvicultural practices besides regeneration harvesting that affect forest stand growth, value and structure are site preparation, regeneration (reforestation), stand maintenance and protection, pre-commercial thinning, commercial thinning, fertilization, and pruning. The Modeling Team derived estimates of the proportion of future treatment needs from historical experience in individual BLM offices and the specifics of the Proposed RMP and various alternatives.

Of these practices, the Modeling Team simulated regeneration harvest, regeneration, pre-commercial thinning, commercial thinning, and fertilization implementation in the growth and yield projections.

Site Preparation

The BLM conducts site preparation to prepare newly harvested or inadequately stocked areas for tree planting, artificial seeding, or natural regeneration. Objectives of site preparation are to provide physical access to planting sites, fuels management, influence the plant community that redevelops on the site, and influence or control animal populations. The types of site preparation techniques are prescribed burning, mechanical, and manual methods.

Regeneration (Reforestation)

Following a regeneration harvest or wildfire, the BLM establishes tree regeneration by artificial and natural regeneration. Artificial regeneration includes tree planting or seeding (or a combination of both). Natural regeneration is obtained from natural seed fall from adjacent forest stands of seed-bearing age or retention trees reserved at the time of timber harvest. Where available, the BLM may emphasize the planting of genetically improved seedlings for even-aged and two-aged systems with low levels of green-tree retention. Genetic improvements include increased growth (e.g., Douglas-fir and western hemlock) or disease resistance (e.g., sugar pine, western white pine, and Port-Orford-cedar). The BLM would plant trees outside of the Harvest Land Base to supplement, or in lieu of natural regeneration to enhance development of complex stand structure.

The Modeling Team based tree lists representing the tree regeneration component of future stands following a major stand disturbing event, such as a timber harvest or wildfire on an analysis done for the 2008 FEIS of the Current Vegetation Survey (CVS) plots in the then 5- to 20-year-old age classes (USDI BLM 2008). The Modeling Team stratified plots by species group and site class where possible. The Modeling Team assumed that future young reforested stand species composition would be similar to that of current young stands.

The ORGANON model lacks a ‘regeneration component’ to generate small seedlings (< 4.5 feet tall) that simulates a reforestation action. However, an ‘ingrowth’ function in the model permits the insertion of a regeneration tree list into a simulation when trees are larger than the minimum. For modeling purposes, the Modeling Team developed tree lists of species mix and size range appropriate to the various modeling groups from the database described above for the 2008 FEIS. The Modeling Team considers that these same lists are still appropriate for use in this analysis. The Modeling Team simulated a reforestation event by adding the regeneration tree lists with an YTGTools procedure, 15–35 years after a regeneration harvest or wildfire in the modeling sequence. The wide range in timing reflects varying assumptions of the Proposed RMP and alternatives on the level of residual live overstory trees present following harvest or wildfire, site productivity differences, lag time for natural regeneration, administrative delays in salvage harvest situations, and intensity of stand maintenance actions.

Regeneration for the Low Intensity Timber Area and the Moderate Intensity Timber Area of Alternative B were special cases. Management direction for the Low Intensity Timber Area would allow only natural regeneration for reforestation purposes. Management direction for the Moderate Intensity Timber Area would require delayed reforestation to maintain open stand conditions (≤ 30 percent tree canopy cover) for thirty years after a regeneration harvest. The Modeling Team could not readily develop assumptions on reforestation success using natural regeneration from existing BLM data, so the Modeling Team used regionwide data instead.

Reliance on natural regeneration following regeneration harvests on BLM-administered lands in western Oregon was common until about 1960. Around 1960, the BLM shifted to a paradigm of prompt reforestation by artificial seeding and tree planting. The BLM reforestation records from the earlier era of natural regeneration emphasis are spotty. However, pre-1960 regional studies and reports are available for approximating potential levels of natural regeneration success. Data in the pre-1960 literature on post-harvest natural regeneration (Isaac 1943, Lavender *et al.* 1956, USDA FS 1958) characterizes reforestation success in categories, which correspond closely to BLM stocking groupings of target (260 trees per acre), minimum/understocked (100 trees per acre), and non-stocked (0 trees per acre). The Modeling Team assumed that reforestation outcomes in the Low Intensity Timber Area in Alternative B would approximate proportions of 60 percent of harvested acres would achieve target stocking, 30 percent minimum/understocked, and 10 percent non-stocked. After regeneration harvest, the Modeling Team apportioned acres harvested as stated above and simulated further stand development. The Modeling Team doubled the lag time before inserting a regeneration tree list into the ORGANON growth simulations for natural regeneration, compared to prompt planting. This doubled lag time represented an extended seed-in period.

In the Moderate Intensity Timber Area in Alternative B, the Modeling Team assumed target stocking levels for all acres harvested but doubled the lag time before inserting a regeneration tree list in the growth simulations.

Newer literature on natural regeneration following wildfire was considered for evaluating reforestation success, but was rejected for this analysis. The reason is that un-salvaged wildfire stands, by virtue of fire effects and the generally high number of residual dead standing trees, create different microclimate conditions for natural regeneration than a harvested area.

Stand Maintenance and Protection

The BLM conducts stand maintenance and protection treatments after planting or seeding to promote the survival and establishment of trees and other vegetation by reducing competition from undesired plant species. Maintenance and protection techniques include mulching, cutting, or pulling of unwanted vegetation species, placing plastic tubes or netting over seedlings to protect from animal damage, and animal trapping.

The effects of past maintenance and protection treatments are reflected in the current condition of existing young forest stands. The Modeling Team assumed in the simulation of future regenerated stands that the same types and level of treatments would occur as in the current young existing stands that were used to derive the initial regeneration tree lists. Herbicides for stand maintenance were not available to the BLM during the time in which the current young stands developed, and the Modeling Team did not model herbicide use for stand maintenance in the Proposed RMP or any of the action alternatives. Therefore, the initial conditions of the future tree lists derived from current stands attributes should exhibit the effects of non-herbicide stand maintenance treatment methods only.

Pre-commercial Thinning

The BLM conducts pre-commercial thinning to reduce the densities of tree and shrubs, manipulate species composition, and promote dominance and growth of selected species. The BLM usually implements treatments during the mid-range of the stand establishment structural stage. For modeling purposes, the Modeling Team assumed pre-commercial thinning would occur at the time a regeneration tree list is inserted into the ORGANON simulation. Pre-commercial thinning enhances the growth and vigor of the residual trees by reducing inter-tree and shrub competition. The average number of trees remaining following treatment can vary by land use allocation and modeling group.

Commercial Thinning

Commercial thinnings are intermediate harvests implemented to recover anticipated mortality, control stand density for maintenance of stand vigor, provide revenue, and to alter or maintain stands on developmental paths so that desired stand characteristics result in the future. The BLM schedules commercial thinnings when stands reach a combination of relative density stem diameter and timber volume to permit an economical harvest entry.

The Modeling Team used the same basic silvicultural prescriptions developed for the 2008 FEIS for all silvicultural systems (USDI BLM 2008). The BLM formulated these prescriptions from iterative ORGANON simulations with four evaluation criteria:

1. Stand relative density (Curtis 1982)
2. Attainment of minimum average stand diameter
3. Minimum harvest volumes
4. Residual canopy cover (Late-Successional Reserve and Riparian Reserve only)

The Modeling Team based relative density (RD) thresholds on published recommendations, including Curtis and Marshall (1986), Hayes *et al.* (1997), Chan *et al.* (2006), and professional judgment. The Modeling Team scheduled thinning when relative density met or exceeded a minimum of 45–55, depending on the land use allocation objectives.

The Modeling Team based minimum diameter and volume thresholds for economically viable thinning sales on historical BLM timber sales experience. The Modeling Team assumed the minimum diameter to be 12", measured at breast height, and minimum volume thresholds of 8,000 board feet per acre on the Coos Bay, Eugene, Roseburg, and Salem Districts, and 5,000 board feet per acre on the Klamath Falls Field Office and the Medford District.

Relative density rules can vary by land use allocation within alternatives and the Proposed RMP. For example, the Modeling Team modeled commercial thinning prescriptions for land use allocations with higher timber production emphasis goals—Northern General Forest Management Area (No Action alternative), High Intensity Timber Area (Alternatives A and C), and Moderate Intensity Timber Area (Alternatives B and D and the Proposed RMP)—to maintain relative densities between approximately 35 and 55. The Modeling Team designed the timing and degree of the final thinning so that relative density would recover to a minimum of 55 at the long-term rotation age. The Modeling Team modeled thinnings for late-successional habitat development objectives within a lower range of relative density thresholds of 25–50 RD.

Commercial thinnings promote the establishment of conifer regeneration in the understory of thinned stands (Bailey and Tappeiner 1998). The Modeling Team simulated the recruitment of this regeneration in the growth simulations to reflect expected stand dynamics following commercial thinning harvests. The ORGANON growth and yield model (Hann 2011) uses 'diameters at breast height', which is the tree's diameter at 4.5 feet from the ground, to measure and calculate tree growth. As such, ORGANON does not recognize trees with heights less than 4.5 feet as part of forest stand calculations. Therefore, the Modeling Team developed regeneration tree lists using existing CVS data and growth relationships from current published and unpublished studies. The Modeling Team added regeneration trees to ORGANON simulations 20–25 years after any commercial thinning. The time lag represents the estimated time for all trees in the regeneration tree list to reach a minimum height of at least 4.5 feet where then they are recognized by ORGANON.

Fertilization

Stand growth in western Oregon is often limited by the supply of available nutrients, particularly nitrogen. The supply of soil nutrients can be augmented through fertilization (Miller *et al*. 1988). The Modeling Team modeled fertilization assuming the application of 200 pounds of fertilizer in the form of urea-based prill (46 percent available nitrogen). Occasionally, fertilizer may be applied in a liquid urea-ammonia form or with a mixture of other nutrient elements in addition to nitrogen. The Modeling Team simulated fertilization in the Harvest Land Base after a thinning action in stands that would be managed with even-aged or two-aged with low green tree retention, contain 80 percent or more Douglas-fir by basal area, and have a total stand age ≤ 70 years old.

Pruning

The objectives for pruning are the improvement of wood quality, disease mitigation (e.g., white pine blister rust), and fuels management. Pruning for wood quality usually removes the live and dead limbs on selected trees up to height of about 18 feet. The BLM generally implements pruning treatments as a two-phase process or 'lifts' between stand ages of approximately 15–40 years old. Timing varies by site productivity (i.e., treatments occur earlier on stands of higher site productivity). Removal of up to one-third to one-half of the live tree crown at each lift would not substantially affect diameter growth at breast height or height growth (Staebler 1963, Stein 1955, BCMOF 1995). Because the BLM would typically implement pruning treatments within this range and therefore would not have a substantial effect on tree growth, the Modeling Team did not simulate pruning in ORGANON.

Stand Modeling Process

The prediction of forest stand development requires the projection of growth of BLM's existing forest stand types into the future, with and without further silvicultural treatments, and the simulation of stands, which represent future stands (i.e., new stands created following future timber harvest or natural disturbance). Depending on the management direction of the alternatives and Proposed RMP, both existing and future stands may be subject to different intensities of silvicultural treatments. The Modeling Team used two linked computer models, ORGANON and YTGTools, to project the growth and development of forest stands under various silvicultural systems.

ORGANON Model Description

ORGANON is an individual-tree, distance-independent model developed by Oregon State University from data collected in western Oregon forest stands (Hann 2011). The architecture of the model makes it applicable for simulations of traditional and non-traditional silviculture (Hann 1998). Three variants of ORGANON are available for use in western Oregon. The Modeling Team used the northwest Oregon variant (NWO-ORGANON) to project the growth of forest stands located on the Coos Bay, Eugene, Roseburg (partial), and Salem Districts. The basic data underpinning of this variant of the model is from predominantly conifer forest stands with ages ranging from about 10–120 years old breast height age (Hann 2011). The Modeling Team used the southwest Oregon variant (SWO-ORGANON) to project forest stand growth on the Medford and Roseburg (partial) Districts, and the Lakeview District's Klamath Falls Field Office. The original basic data underpinning this variant of the model is from mixed-conifer forest stands with ages of the dominant trees ranging from about 13–138 years old breast height age (Ritchie and Hann 1985). Subsequently, additional new data has extended the applicability of the model to stands with older trees, higher proportions of hardwoods, and more complex spatial structure (Hann and Hanus 2001).

Simulations of the silvicultural prescriptions used in the alternatives and Proposed RMP extend beyond the ORGANON model's range of data for both variants. However, the timing of harvests and other silvicultural treatments generally occur within the range of the model's validated height growth projection and volume prediction capabilities. Height growth is the primary driving function in ORGANON (Ritchie 1999). Hann (1998) found that the SWO-ORGANON height growth equations can be extended to up to 245 years without loss of accuracy or precision.

The standard ORGANON configuration is not conducive to the efficient processing of large numbers of individual tree lists representing forest stands within a stratum. It is not configured to merge multiple simulation results to into average timber yield functions. In addition, the standard model does not produce specific stand structural characteristics that have utility for effects analysis on resources other than timber production, or for the incorporation of factors to simulate growth improvement of trees due to genetic improvement programs. To overcome these shortcomings, the Modeling Team linked ORGANON with the YTGTools computer program.

YTGTools

YTG Tools is a proprietary computer software program designed to create and analyze yield tables in conjunction with a growth and yield simulation model that flow into the Woodstock harvest scheduling model. MBG designed YTGTools to automate the process of simulating large amounts of management regime projections for many stand conditions and to facilitate analyzing and reporting attributes of the resulting yield tables. The Modeling Team used YTGTools in conjunction with a growth and yield model to project future timber yields and stand attributes under the various management regimes applied to different forest inventory strata (Mason, Bruce & Girard, Inc. 2006).

Existing Stands Modeling Description

The land base consists of existing forest stands that are the result of past harvests and natural disturbances, of various ages, structures, past management histories and potential for forest management. The Modeling Team stratified tree lists from CVS inventory subplots into modeling groups as described previously in this appendix. Using ORGANON and YTGTools, the Modeling Team used these modeling groups for depicting current stand condition and simulating future development with and without future silvicultural treatments. The Modeling Team applied the same base silvicultural prescription to each subplot within a modeling group.

Future Stands Modeling Description

The Modeling Team developed modeling groups and tree lists for forest stand types or silvicultural prescriptions for which little or no specific CVS data existed using tree lists developed for the 2008 FEIS (USDI BLM 2008). Stand projections of 'future' stands formed the basis for initiating new stands following regeneration harvests in all alternatives and the Proposed RMP. The future stands category includes 'existing' stand types created because of regeneration harvest prescriptions with green-tree retention under the current RMPs, which is due to the low number of CVS subplots representing this condition. The Modeling Team applied the same base silvicultural prescription to strata average stand tables within a modeling group.

Special Case – Swiss Needle Cast Zone (Salem District)

For all alternatives and the Proposed RMP, the Modeling Team developed a special subset of yield tables for modeling future stands within geographic areas currently identified with a high incidence of Swiss needle cast disease on the Salem District. The Modeling Team based future tree list species composition in the Swiss needle cast zone on an assumption of higher proportions of disease-resistant species (e.g., cedar and hemlock) being used for the reforestation of future harvested areas.

Special Case – Wildfire Modeling (All Districts)

For all alternatives and the Proposed RMP, the Modeling Team simulated future wildfire occurrence and severity (**Appendix D**). For growth and yield projections, the Modeling Team modeled two fire severity regimes – high and moderate. The Modeling Team did not model a low-severity regime, because the stand disturbance would not affect stand structural development enough to merit separate modeling. The Modeling Team assumed 90 percent tree mortality in the high-severity fire regime and 50 percent tree mortality in the moderate-severity fire regime. The Modeling Team modeled salvage of live and dead trees following both high-severity and moderate-severity fires in those alternatives and the Proposed RMP that would allow salvage, subject to management direction for green-tree, snag, and down wood retention.

The Modeling Team simulated four different conditions associated with wildfire. These include: (1) high-intensity fire with salvage, (2) high-intensity fire without salvage, (3) moderate-intensity fire with salvage, and (4) moderate-intensity fire without salvage. In an effort to reduce the unwieldy number of yield tables in the Woodstock growth model, the Modeling Team used the existing two-aged overstory tree lists in modeling for land use allocations with green-tree retention requirements in conjunction with their corresponding regeneration tree list. The Modeling Team modeled salvaged stands in the High Intensity Timber Area as clearcut harvests. The Modeling Team modeled stands that would experience moderate-intensity fire but would not be salvaged as thinning harvests and assumed tree regeneration ingrowth similar to that described under the commercial thinning section.

Types of Growth and Yield Tables

The ORGANON simulations produced two types of tables or curves for further use by the Woodstock model – simple and composite tables.

Simple Growth and Yield Tables

Simple tables are produced from simulations representing a single sequence of silvicultural actions applied to an entire forest stand within a land use allocation. In other words, the entire area of the stand receives the same prescribed treatment at the same time. Simple tables were produced for all land use allocations with the exception of those where an uneven-aged management system was used.

Composite Growth and Yield Tables

Uneven-aged management treatments required the construction of composite growth and yield tables. Simulating uneven-aged management requires subdividing the stand into four or five separate components, depending on the land use allocation. The Modeling Team simulated growths in each of these stand components separately in ORGANON. The components have the same starting condition, but diverge over time due to the difference in the timing of harvest treatments applied to each one independently. The Modeling Team created two separate varieties of uneven-aged management.

The first variety of uneven-aged management emphasizes the development of fire-resilient stand structures over time. The Modeling Team simulated this variety in the Uneven-aged Timber Area land use allocation. For modeling purposes, the Modeling Team divided stands into four separate components. The Modeling Team modeled three stand components, each comprising 30 percent of the stand area, to be available for harvest at repeating intervals. The Modeling Team modeled a fourth stand component, comprising 10 percent of the stand area, which would be reserved from future treatments.

The second variety of uneven-aged management primarily emphasizes the development and maintenance of northern spotted owl habitat. The Modeling Team simulated this variety in the Owl Habitat Timber Area and Late-Successional Reserve–Dry land use allocations. For modeling purposes, the Modeling Team divided stands into five separate components. The Modeling Team modeled four stand components, each comprising 15 percent of the stand area, to be available for harvest at repeating intervals. The Modeling Team modeled a fifth stand component, comprising 40 percent of the stand area, which would be reserved from future treatments.

The Modeling Team modeled the application of a combination of group selection (patch cut) harvests and thinning to various stand components at intervals of 40–50 years, depending on site productivity.

The Modeling Team created composite uneven-aged stand tables by combining the source stand tables in the proportions appropriate for each individual component's simulation. The Modeling Team created a single composite stand table with YTGTools that describes an 'average' condition across the stand. For some table attributes, such as trees per acre and timber volume, the combined data equals the weighted average of the components. Other outputs, such as canopy layers and conifer canopy cover, are a function of some stand parameters, and the calculation for the combined table does not equal the weighted average of the components.

Within both varieties of uneven-aged management, there are two kinds of silvicultural pathways. All eligible strata have a silvicultural prescription that begins with a group selection harvest if the initial relative density is too low to trigger a commercial thinning or the stand exceeds 80–90 years old. Strata less than 80–90 years old have a regime that starts with a commercial thinning if the initial relative density is high enough to trigger a thinning treatment and then is followed by group selection harvests. **Table C-14** shows stand component allocations for each land use allocation.

Table C-14. Uneven-aged management modeling strategies by land use allocation

Stand Component Number	Owl Habitat Timber Area*			Uneven-aged Timber Area		
	Percent of Stand	Option A	Option B	Percent of Stand	Option A	Option B
1	40%	Grow only	Grow only	10%	Grow only	Grow only
2	15%	1st GS	CT then 1st GS	30%	1st GS	CT then 1st GS
3	15%	2nd GS	CT then 2nd GS	30%	2nd GS	CT then 2nd GS
4	15%	3rd GS	CT then 3rd GS	30%	3rd GS	CT then 3rd GS
5	15%	4th GS	CT then 4th GS	N/A	N/A	N/A

* Also Late-Successional Reserve – Dry
GS = Group selection (patch cut) harvest
CT = Commercial thinning harvest

Growth and Yield Adjustments

The Modeling Team adjusted ORGANON projections of timber yields to account for the effects of genetic tree improvement and Swiss needle cast disease through direct inputs of growth modifiers to the ORGANON model. The Modeling Team accounted for other factors that could substantially affect recoverable commodity volumes as a percent reduction in volume. The Modeling Team applied reduction factors in the YTGTools program for timber defect and breakage, endemic insects and disease, soil compaction, future snag creation, future coarse woody debris creation, and green tree retention.

Tree Improvement (Genetics)

The BLM has selected Douglas-fir and western hemlock for genetically controlled characteristics such as high growth rates and tree form. The BLM, in cooperation with other landowners, has established field test sites using progeny from the selected trees. The BLM has established seed orchards to produce locally adapted seed from these selected trees for reforestation. The Modeling Team accounted for the increase in growth and yield from the planting of genetically improved Douglas-fir seedlings by the use of the regeneration tree lists and ORGANON growth modifiers of seven percent for height growth and eight percent for diameter growth. The Modeling Team used the tree lists to simulate tree planting following a regeneration harvest. After insertion of a tree list into a growth simulation, the growth modifiers act to increase the growth of Douglas-fir trees in the tree list (USDI BLM 2008). The Modeling Team applied these growth modifiers only to Douglas-fir trees within the General Forest Management Area (No Action alternative), High Intensity Timber Area (Alternatives A and C), and the Moderate Intensity Timber Area (Alternatives B and D, and the Proposed RMP).

Defect and Breakage

A proportion of harvested trees can contain defects, which reduce their utility from a commodity standpoint. In addition, damage can occur during harvesting that reduces recoverable timber volume. The proportion of volume that is not recoverable for commodity use increases with stand age. The Modeling Team reduced ORGANON-generated timber volumes by district-specific factors derived from historical timber sale cruise and scale data. **Table C-15** shows the district-specific deductions for defect and breakage applicable to all alternatives and the Proposed RMP.

Table C-15. Timber yield deductions due to defect and breakage by harvest stand age

Stand Age (Years)	Coos Bay Timber Yield Deduction (Percent)	Eugene Timber Yield Deduction (Percent)	Klamath Falls Timber Yield Deduction (Percent)	Medford Timber Yield Deduction (Percent)	Roseburg Timber Yield Deduction (Percent)	Salem Timber Yield Deduction (Percent)
30	3%	-	-	-	5%	4%
40	3%	5%	1%	1%	5%	5%
50	4%	5%	2%	2%	5%	5%
60	4%	5%	2%	2%	5%	5%
70	4%	6%	3%	3%	5%	6%
80	5%	6%	4%	4%	5%	6%
90	5%	7%	5%	5%	5%	7%
100	6%	8%	6%	6%	6%	8%
110	6%	9%	7%	7%	7%	9%
120	7%	10%	8%	8%	8%	10%
130	7%	11%	9%	9%	9%	11%
140	7%	12%	9%	9%	9%	12%
150	8%	13%	9%	9%	9%	13%
160	9%	14%	10%	10%	10%	14%
170	9%	15%	11%	11%	11%	15%
180	10%	16%	12%	12%	12%	16%
190	12%	17%	13%	13%	13%	17%
>200	17%	23%	20%	20%	20%	23%

Soil Compaction

The Modeling Team calculated district-specific deductions to timber yield from soil compaction based on assumptions of the proportion of harvest types and associated forested area lost to new road construction. The Modeling Team modeled the same percentage deductions in all alternatives and the Proposed RMP. **Table C-16** shows the assumed proportion of harvest types and soils deduction by district.

Table C-16. Timber yield deductions due to soil compaction

District/ Field Office	Proportion of Timber Harvest Yarding System Types		Total Timber Yield Deduction (Percent)
	Cable and Helicopter (Percent)	Ground-based (Percent)	
Coos Bay	95%	5%	1%
Eugene	94%	6%	2%
Klamath Falls	6%	94%	9%
Medford	81%	19%	4%
Roseburg	82%	18%	3%
Salem	69%	31%	4%

Snag Retention

The Modeling Team modeled the yield impact of retaining varying amount of green trees for the creation of future snags by applying a percent volume reduction to meet the minimum snag requirements at the time of harvest. Retention requirements vary by alternative and the Proposed RMP, land use allocation, and district or field office. Error! Reference source not found. shows the deductions applied to the action lternatives and Proposed RMP. The Modeling Team based the reduction per retained tree on analysis for the 2008 FEIS for the action alternatives and the Proposed RMP (USDI BLM 2008). The Modeling Team assumed a reduction for snags in the No Action alternative of one and one-half percent of the regeneration harvest volume for all districts.

Table C-17. Timber yield deductions due to snag retention by land use allocation

Alternative/PRMP	Land Use Allocation	Coos Bay Timber Yield Deduction (Percent)	Eugene Timber Yield Deduction (Percent)	Klamath Falls Timber Yield Deduction (Percent)	Medford Timber Yield Deduction (Percent)	Roseburg Timber Yield Deduction (Percent)	Salem Timber Yield Deduction (Percent)
Alt. A	Uneven-aged Timber Area	2%	2%	2%	2%	2%	2%
	High Intensity Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	2%	2%	2%	2%	2%	2%
	Riparian Reserve	2%	2%	2%	2%	2%	2%
Alt. B	Moderate Intensity Timber Area	2%	3%	2%	-	3%	2%
	Low Intensity Timber Area	2%	3%	2%	-	3%	2%
	Uneven-aged Timber Area	2%	3%	2%	-	3%	2%
	Late-Successional Reserve	10%	12%	7%	2%	10%	11%
	Riparian Reserve	10%	12%	7%	2%	10%	11%
Alt. C	Uneven-aged Timber Area	2%	2%	2%	2%	2%	2%
	High Intensity Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	2%	2%	2%	2%	2%	2%
	Riparian Reserve	2%	2%	2%	2%	2%	2%
Alt. D	Moderate Intensity Timber Area	2%	3%	2%	-	3%	2%
	Uneven-aged Timber Area	2%	3%	2%	-	3%	2%
	Owl Habitat Timber Area	2%	3%	2%	-	3%	2%
	Late-Successional Reserve	10%	12%	7%	2%	10%	11%
	Riparian Reserve	10%	12%	7%	2%	10%	11%
PRMP	Moderate Intensity Timber Area	2%	3%	2%	-	3%	2%
	Low Intensity Timber Area	2%	3%	2%	-	3%	2%
	Uneven-aged Timber Area	2%	3%	2%	-	3%	2%
	Late-Successional Reserve	10%	12%	7%	2%	10%	11%
	Riparian Reserve	10%	12%	7%	2%	10%	11%

Down Woody Material Retention

The Modeling Team modeled the yield deductions of retaining varying amounts for future down woody material as a percent volume reduction at the time of harvest. Retention requirements vary by alternative and the Proposed RMP, land use allocation, and district or field office.

Table C-18 shows the deductions applied to the action alternatives and the Proposed RMP. The Modeling Team based reduction per retained tree on analysis for the 2008 FEIS for the action alternatives and Proposed RMP (USDI BLM 2008). The Modeling Team assumed a down woody material deduction for the No Action alternative as a flat 300 cubic feet per acre for the Coos Bay District, the Klamath Falls Field Office, and the Medford and Roseburg Districts, and 600 cubic feet per acre for the Eugene and Salem Districts.

Table C-18. Timber yield deductions due to down woody material retention by the Proposed RMP and alternatives and land use allocation

Alternative/PRMP	Land Use Allocation	Coos Bay Timber Yield Deduction (Percent)	Eugene Timber Yield Deduction (Percent)	Klamath Falls Timber Yield Deduction (Percent)	Medford Timber Yield Deduction (Percent)	Roseburg Timber Yield Deduction (Percent)	Salem Timber Yield Deduction (Percent)
Alt. A	Uneven-aged Timber Area	5%	4%	4%	5%	5%	4%
	High Intensity Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	5%	4%	4%	5%	5%	4%
	Riparian Reserve	5%	4%	4%	5%	5%	4%
Alt. B	Moderate Intensity Timber Area	-	-	-	-	-	-
	Low Intensity Timber Area	-	-	-	-	-	-
	Uneven-aged Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	-	-	-	-	-	-
	Riparian Reserve	-	-	-	-	-	-
Alt. C	Uneven-aged Timber Area	5%	4%	4%	5%	5%	4%
	High Intensity Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	5%	4%	4%	5%	5%	4%
	Riparian Reserve	5%	4%	4%	5%	5%	4%
Alt. D	Moderate Intensity Timber Area	-	-	-	-	-	-
	Uneven-aged Timber Area	-	-	-	-	-	-
	Owl Habitat Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	-	-	-	-	-	-
	Riparian Reserve	-	-	-	-	-	-
PRMP	Low Intensity Timber Area	-	-	-	-	-	-
	Uneven-aged Timber Area	-	-	-	-	-	-
	Late-Successional Reserve	-	-	-	-	-	-
	Riparian Reserve	-	-	-	-	-	-
	Low Intensity Timber Area	-	-	-	-	-	-

Stocking Irregularity

A stand may contain non-stocked openings of a size sufficient to affect timber yield. These openings fall into two categories: openings permanently incapable of growing commercial tree species and openings temporarily unoccupied by desirable trees. Portions of stands may contain permanent areas of non-productive rock or other areas incapable of growing commercial tree species. The Modeling Team partially accounts for these openings through reductions in the Harvest Land Base as a result of the Timber Production Capability Classification. Temporarily non-stocked areas occur due to variation in reforestation success from a variety of non-permanent factors, such as vegetative competition or logging slash.

The ORGANON model accounts for stocking variation by assuming that the degree of local competition experienced by a tree is reflected in its crown size. Trees growing next to openings have longer crowns and poor growth reflected as stem taper which reduces the volume of a tree next to the opening, compared to a similar size tree with shorter crown in an area with more uniform tree distribution. As long as the crown characteristics of sample trees are measured, then any long-term spatial variation within the stand will be modeled appropriately (FORsight 2006). Since existing CVS data used for existing stands and the development of future stands modeling groups contain the necessary crown measurement, the Modeling Team applied no external adjustment for stocking irregularity to ORGANON yields.

Green-tree Retention

Green-tree retention is the long-term reservation of live trees within the context of a regeneration harvest to provide for various ecological functions. Green-tree retention has two effects from a stand growth and yield standpoint. First, otherwise harvestable volume is foregone for commodity use at the time of harvest. Second, retention trees compete for growing space with the newly regenerated trees (Di Lucca *et al.* 2004).

The Modeling Team modeled the first effect of retained trees on foregone harvest volume as a percent volume deduction applied to volume outputs. These yield deductions were the same ones calculated for the No Action alternative for the 2008 FEIS: the retention of 7–16 conifers over 20” in diameter at an average harvest age of 100 years old.

Table C-19 shows the deductions applied at the time of a regeneration harvest by land use allocation by alternative and the Proposed RMP for trees reserved from harvest.

Table C-19. Timber yield deductions from foregone harvest volume due to green tree retention by land use allocation

Land Use Allocation	Timber Yield Deduction					
	No Action (Percent)	Alt. A (Percent)	Alt. B (Percent)	Alt. C (Percent)	Alt. D (Percent)	PRMP (Percent)
General Forest Management Area	11%	-	-	-	-	-
Moderate Intensity Timber Area	-	-	11%	-	11%	11%
Connectivity/Diversity Block	18%	-	-	-	-	-
Low Intensity Timber Area	-	-	18%	-	-	18%
Southern General Forest Management Area	24%	-	-	-	-	-
Uneven-aged Timber Area*	-	11%	11%	11%	11%	11%
Owl Habitat Timber Area*	-	-	-	-	11%	-
High Intensity Timber Area*	-	-	-	-	-	-
Late-Successional Reserve†	-	11%	11%	11%	11%	11%
Riparian Reserve	-	-	-	-	-	-

* The Modeling Team applied green-tree deductions in Uneven-aged Timber Area and Owl Habitat Timber Area to reflect edge effect competition on regeneration in group selection and retention of some green trees in the larger group selection areas.
† Applies to uneven-aged management in the Late-Successional Reserve–Dry only

The Modeling Team modeled the second effect within ORGANON through retention of overstory trees when a stand is regeneration harvested. The retained trees slow the growth of the new understory regeneration trees relative to the amount of retained overstory trees. The Modeling Team used modeling group-specific (**Table C-1**) overstory tree lists to suppress regeneration growth and provide structural complexity. The Modeling Team used the same overstory tree lists for the General Forest Management Area in the No Action alternative, and the Moderate Intensity Timber Area in Alternatives B and D, and the Proposed RMP; and the Connectivity/Diversity Blocks in the No Action alternative, and the Low Intensity Timber Area in Alternative B and the Proposed RMP.

Disease

Portions of the Salem District are located in an area with a moderate to high occurrence of Swiss needle cast disease, a foliage disease specific to Douglas-fir caused by the fungal pathogen *Phaeocryptopus gaeumannii*, that reduces growth rates. It does not affect the growth of other tree species. The Modeling Team used a growth modifier in ORGANON to reflect the estimated growth reductions for Douglas-fir in the Swiss needle cast zone. For the 2008 FEIS, the BLM calculated a mean foliage retention value modifier of 2.41 for the Swiss needle cast zone. The Modeling Team considers this modifier to be adequate for modeling the impacts of Swiss needle cast disease for this analysis. See the 2008 FEIS (USDI BLM 2008) for more details.

The Modeling Team assumed that the effects of endemic levels of insects and disease other than Swiss needle cast on timber yields are reflected in part in the defect and breakage allowance described previously and the additional overstory mortality factor described below. In addition to those factors, the Modeling Team assumed a further reduction by adjusting timber yields down by a percent volume reduction. These factors generally vary from about 1–3 percent, increasing with stand age and are based on literature and professional judgment.

Constraint on Maximum Stand Density Index

Maximum values of basal area observed in preliminary simulations of various strata commonly exceeded values reported in empiric yield tables for well-stocked stands at later periods in the simulations. The probable cause is that the ORGANON model may be underestimating tree mortality from causes other than inter-tree competition, such as insects, disease, windthrow, and stem breakage (Tappeiner *et al.* 1997). This type of mortality is often irregular or episodic in nature, and is inherently difficult to predict the exact time in which it will occur (Franklin *et al*. 1987). Mortality from inter-tree competition becomes less significant as stands age, and irregular mortality caused by other factors becomes more substantial (Franklin *et al.* 2002).

Through sensitivity analysis, the Modeling Team determined that by setting the maximum stand density index (SDI) to 500 in ORGANON, the maximum basal area values were generally constrained below 400 square feet per acre. Simulation results with an SDI maximum of 500 were more in accordance with published normal and empiric yield tables at older ages (Chambers and Wilson 1978, Chambers 1980, McArdle *et al*. 1961, Schumacher 1930, Dunning and Reineke 1933).

Forest Structural Stage Classification

For this analysis, the Modeling Team classified forested land within the decision area in a five-stage structural classification:

- Early Successional
- Stand Establishment
- Young
- Mature
- Structurally-complex

The Modeling Team further sub-divided these five structural classes by additional structural divisions and by the moist/dry designation as described below.

Classification:

1. Early Successional–Moist
   Forests that are ≤ 30 years old, with < 30 percent canopy cover.

   1.1 (ES–WSL) with structural legacies
   ≥ 6 trees per acre ≥ 20” DBH

   1.2 (ES–WOSL) without structural legacies
   < 6 trees per acre ≥ 20” DBH

   Early Successional–Dry
   Forests that are ≤ 50 years old, with < 30 percent canopy cover.

   1.1 (ES–WSL) with structural legacies
   ≥ 6 trees per acre ≥ 20” DBH

   1.2 (ES–WOSL) without structural legacies
   < 6 trees per acre ≥ 20” DBH

2. Stand Establishment–Moist

Forests that are ≤ 30 years old, with ≥ 30 percent canopy cover.

2.1 (SE–WSL) with structural legacies
≥ 6 trees per acre ≥ 20” DBH

2.2 (SE–WOSL) without structural legacies
< 6 trees per acre ≥ 20” DBH

Stand Establishment–Dry
Forests that are ≤ 50 years old, with ≥ 30 percent canopy cover.

2.1 (SE–WSL) with structural legacies
≥ 6 trees per acre ≥ 20” DBH

2.2 (SE–WOSL) without structural legacies
< 6 trees per acre ≥ 20” DBH

3. Young–Moist
Forests that are over 30 years old

Young–High Density
Relative density (Curtis RD)[25] ≥ 25

3.1 (YHD–WSL) with structural legacies
< 24 trees per acre ≥ 20” DBH and the coefficient of variation of tree diameters over 10”[26] ≥ 0.35

3.2 (YHD–WOSL) without structural legacies
< 24 trees per acre ≥ 20” DBH and the coefficient of variation of tree diameters over 10” < 0.35

Young–Low Density
Relative density (Curtis RD) < 25

3.3 (YLD–WSL) with structural legacies
<2 4 trees per acre ≥ 20” DBH and the coefficient of variation of tree diameters over 10” ≥ 0.35

3.4 (YLD–WOSL) without structural legacies
< 24 trees per acre ≥ 20” DBH and the coefficient of variation of tree diameters over 10” < 0.35

Young–Dry
Forests that are over 50 years old

Young–High Density

[25] Curtis Relative Density = stand basal area/square root of the quadratic mean diameter.
[26] The coefficient of variation of tree diameters over 10” = standard deviation of the DBH/mean diameter breast height.

Relative density (Curtis RD) ≥ 25

3.1 (YHD–WSL) with structural legacies
< 12 trees per acre ≥ 2020" DBH and the coefficient of variation of tree diameters over 10" ≥ 0.35

3.2 (YHD–WOSL) without structural legacies
< 12 trees per acre ≥ 20" DBH and the coefficient of variation of tree diameters over 10" < 0.35

Young–Low Density
Relative density (Curtis RD) < 25

3.3 (YLD–WSL) with structural legacies
< 12 trees per acre ≥ 20" DBH and the coefficient of variation of tree diameters over 10" ≥ 0.35

3.4 (YLD–WOSL) without structural legacies
< 12 trees per acre ≥ 20" DBH and the coefficient of variation of tree diameters over 10" < 0.35

4. Mature–Moist
Forests that are over 30 years, ≥ 24 trees per acre, ≥ 20" DBH

4.1 (M–Single) Single-layered canopy
The coefficient of variation of tree diameters over 10" < 0.35

4.2 (M–Multi) Multi-layered canopy
The coefficient of variation of tree diameters over 10" ≥ 0.35 and < 4.7 trees per acre ≥ 40" DBH

Mature–Dry
Forests that are over 50 years, ≥12 trees per acre, ≥ 20" DBH

4.1 (M–Single) Single-layered canopy
The coefficient of variation of tree diameters over 10" < 0.34

4.2 (M–Multi) Multi-layered canopy
The coefficient of variation of tree diameters over 10" ≥ 0.34 and < 2.1 trees per acre ≥ 40" DBH

5. Structurally-complex

5.1 (SC–Dev) Developed Structurally-complex – Moist
Forests that are over 30 years old, ≥ 24 trees per acre that are ≥ 20" DBH, and ≥ 4.7 trees per acres ≥ 40" DBH. The coefficient of variation of tree diameters over 10" ≥ 0.35

Developed Structurally-complex – Dry
Forests that are over 50 years old, ≥ 12 trees per acre that are ≥ 20" DBH, and ≥ 2.1 trees per acres ≥ 40" DBH. The coefficient of variation of tree diameters over 10" ≥ 0.34

5.2 (SC–OF) Existing Old Forest
Stands currently ≥ 200 years old, but < 400 years old.

5.3 (SC–VOF) Existing Very Old Forest
Stands currently ≥ 400 years old

Woodstock Modeling

The Woodstock Model

The Woodstock model is at the heart of the Remsoft Spatial Planning System. Woodstock is a planning system used for decision support analyses and planning projects. It uses inventory and growth and yield data, and business rules to project forest growth and development over time, subject to management objectives and resource allocation constraints.

The Woodstock model is a linear programming model, which is inherently different from a simulation or scenario-based model such as the OPTIONS model that the BLM used for the 2008 FEIS (USDI BLM 2008). In a simulation model, the user decides what prescriptions to implement, and determines what order to implement them. In a linear programming (LP) model, the user decides what kind of outcome is desired, and the model determines the best means of accomplishing that objective.

Because there are many constraints that influence the management of BLM-administered lands within the planning areas, for this project, the Woodstock model functioned as an optimization model within a tightly controlled set of limitations. The Modeling Team used the optimization function primarily within the Harvest Land Base, to maximize the amount of sustainable volume produced through the 200-year modeling period.

The Woodstock system uses spatial data (ESRI geodatabases) to provide inputs to the model and to display maps of management schedules and forest conditions. It has been in use for over 20 years and is regularly updated and improved by the Remsoft Corporation. Remsoft software is currently being used for forest management planning by all ten Canadian provinces, six U.S. states, as well as the U.S. Army. The Washington Department of Natural Resources recently used Remsoft Spatial Planning to revise their management plans to create better northern spotted owl habitat in the long term and generate more revenue in the short-term without a significant decrease in the long-term sustainable harvest.

Woodstock Model Overview

Each Woodstock model has an objective function–the mathematical expression of what the model will optimize. The Modeling Team chose the objective function to maximize the sum of allowable sale quantity timber volume production over the full 200-year planning horizon. Within the constraints that the Modeling Team provided in the GIS-based modeling rules and the landscape-level modeling rules, the Woodstock model produced a solution with the highest possible level of timber volume production.

While this objective function works well for the goals and objectives of the Harvest Land Base, it is not appropriate for the reserve thinning in either the Riparian Reserve or the Late-Successional Reserve. In both of these land use allocations, the Modeling Team applied specific constraints for both acres and volume, to provide a realistic level of harvest, given the management direction of the alternative or Proposed RMP, and the extensive experience the BLM has with reserve thinning. These specific constraints varied by alternative and the Proposed RMP, and are presented later in this appendix.

The Woodstock model determines the timing and type of management activities needed to optimize the constrained objective function within a BLM sustained yield unit. Land management units are created in a GIS process that combines multiple layers of resource information and objectives into a single resultant layer. Examples of these resource layers include FOI units, administrative boundaries, Riparian Reserve, Late-Successional Reserve, and Visual Resource Management areas.

The Modeling Team built strata-based Woodstock models that respond to the modeling instructions. The Modeling Team developed Woodstock models for each BLM office and each alternative and the Proposed RMP. For each alternative and the Proposed RMP, the Modeling Team developed a model for a single 'test' district first. Once the Modeling Team checked and confirmed the test model outputs, the Modeling Team applied its essential structure to new Woodstock models for the other BLM offices. Using this methodology, the Modeling Team was able to develop adaptively modeling guidelines that represented the management direction in alternatives and the Proposed RMP.

The BLM and MBG conducted extensive quality control and quality assurance on each Woodstock model. In total, the Modeling Team developed 49 final Woodstock models for the No Timber Harvest reference analysis, No Action alternative, Alternatives A, B, C, and D, Sub-alternatives B and C, and the Proposed RMP. All of these Woodstock models had at least two iterations.

In the final step in the modeling process, the Modeling Team took the results from the strata-based models and allocated them back into the spatially explicit GIS polygons that represent the decision area. The Modeling Team used the Spatial Woodstock software for this final task. The Modeling Team then combined the results from Spatial Woodstock into Microsoft Access databases and pivot tables that the interdisciplinary team used for their analyses.

The Modeling Team used a 200-year planning horizon for the modeling runs, and all results were reported in 10-year periods. The Modeling Team chose this time length because it represents a long-term view for sustained yield calculations. The dataset behind the ORGANON growth and yield curves provides reasonable modeling results for this period.

Management Activities and Rules

Management Activities

Within the Woodstock model, forest management activities can occur on a stand level or landscape level. These management activities occur by either defining constraints or targets. Constraints are used to control the flow of outputs on a period-by-period basis. For example, even-flow of timber volume would force the model to keep a constant volume level over the planning horizon. Targets are specific goals that the model is trying to reach: for example, a specified number of Riparian Reserve acres to be harvested in a specific period. The Modeling Team defined each one of these different sets of instructions used within the model.

Stand-level silvicultural treatments include planting, pre-commercial thinning, pruning, and fertilization. Stand-level harvesting activities include commercial thinning, two-age harvest, selection harvest, salvage harvest, and clearcut harvest. Each one of these activities had specific controls within the ORGANON model or modifiers within the Woodstock model. The Modeling Team limited the number of potential pathways that any strata could have, as well as 'hardwired' certain treatments for certain strata. This was to limit the complexity of options that could be considered, in order to efficiently utilize the model resources and have the models run more quickly. For example, the BLM always included pre-commercial thinning in some strata and limited most thinning to stands less than 80 years old in the moist forest. The part of this appendix on Growth and Yield Modeling provides more detail on this topic.

Landscape-level constraints applied to all of the polygons within a particular region. For example, in the No Action alternative, the Modeling Team placed a constraint on each 5th field watershed to not harvest any older forest until at least 15 percent of the watershed was composed of older forest to reflect management direction in the 1995 RMPs.

The model would not apply specific silvicultural treatments unless all eligibility criteria were met for that treatment.

GIS-based Modeling Rules

This section will describe, by topic area, the modeling rules and GIS data as applied by the Modeling Team to simulate the alternatives and the Proposed RMP within the Woodstock model. The Woodstock model uses attributes associated with the GIS spatial data to identify where the modeling rules are applied.

The Modeling Team applied the following modeling rules to all alternatives and the Proposed RMP:

- **Sustained Yield Units –** The Modeling Team divided the decision area into sustained yield units for the purpose of defining the area in which the model would determine the allowable sale quantity. The Sustained Yield Units are the BLM-administered lands within the district boundaries for the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts, and the western portion of the Lakeview District's Klamath Falls Field Office (all land west of Highway 97). The eastern portion of the Klamath Falls Field Office does not contain any O&C lands, and is not a designated sustained yield unit. The Modeling Team used the district attribute in the FOI data as the basis for the sustained yield units in the Woodstock modeling. The Modeling Team used land use allocation data to segregate the Klamath Falls Field Office into the Klamath Falls Sustained Yield Unit and the Eastside Management Lands. The Modeling Team did provide an estimate of the sustainable harvest level for the Eastside Management Lands as part of this analysis.
- **Minimum Commercial Thinning Volumes** – The Modeling Team derived the minimum commercial thinning volumes from historical BLM data for economically viable timber sales. The definition of minimum commercial thinning volumes for a harvest removal varied by ORGANON variant:
    - Northwest ORGANON variant: northern Coos Bay, Eugene, north Roseburg, and Salem–8 Mbf/acre gross volume
    - Southwest ORGANON variant: southern Coos Bay, Klamath Falls, Medford, and southern Roseburg–5 Mbf/acre gross volume
- **Structural Stage Calculations –** The Forest Structural Stage Classification section earlier in this appendix describes the structural stage calculations for moist and dry forests.
- **Swiss Needle Cast (SNC) –** The Modeling Team used specific SNC yield tables and harvest yield tables in the Swiss Needle Cast zone, which are described in Forest Growth and Yield section earlier in this appendix.
- **Timing of Reporting Actions –** The model reported all actions in the period that they would occur. For example, if a thinning would occur in period 2, the harvest acres and volumes would be reported for period 2 after harvest. Modeled outputs are reported in 10-year periods.
- **Wildfire Modeling - Appendix D –** Modeling Large Stochastic Wildfires and Fire Severity within the Range of the Northern Spotted Owl describes how the BLM modeled wildfire. The location and intensity of the modeled wildfire did not vary among alternatives or the Proposed RMP, but the specific silvicultural prescriptions modeled in each alternative and the Proposed RMP *did* change in the wildfire areas. The Forest Growth and Yield section earlier in this appendix provides more information on wildfire modeling.

- **Riparian Reserve Thinning –** For all of the action alternatives and the Proposed RMP, the BLM divided the Riparian Reserve into inner zones and outer zones. The Modeling Team did not model timber harvest in the inner zone, and did model harvest in the outer zone in both moist and dry forests consistent with alternative-specific management direction. The Modeling Team modeled harvest in the Riparian Reserve as commercial thinning and included stands from 30 to 80 years old. The number of acres harvested and the volume removed varied by district and alternative. In the Woodstock model, constraints specified the maximum amount of average volume that could be removed. In Alternative A, the harvest in the outer zone of the moist Riparian Reserve did not produce any non-ASQ volume, consistent with Alternative A management direction. For the Proposed RMP, the Modeling team divided the Riparian Reserve into inner, middle, and outer zones. Inner and outer zones were treated similarly to the description above. The middle zone was treated similarly to the harvest modeled in the outer zone in Alternative A.

Modeling Direction Specific to the No Action Alternative

Connectivity/Diversity Blocks

The Modeling Team aggregated Connectivity/Diversity blocks based on BLM field office boundaries. The Modeling Team did not model regeneration harvest unless at least 25 percent of the forest acres in the block were in stands age 80 years or older. For each block, a maximum of 1/15 of the acres could be in age zero (regenerated) in any one decade of the projection to simulate the area control requirement.

15 Percent Standard and Guideline

Within each 5th field watershed, the Modeling Team did not model regeneration harvest until at least 15 percent of the forested area was in stands 80 years and older. In those watersheds that were in deficit, the Modeling Team earmarked the oldest stands for recruitment to meet the 15 percent target. Until the watershed reached the 15 percent level, the Modeling Team modeled only commercial thinning.

Minimum Harvest Age

The Modeling Team did not model regeneration harvest in stands below the minimum harvest ages described in **Table C-20**. The Modeling Team set these minimum ages by site productivity class 1 through 5, as shown in the following table.

Table C-20. Minimum harvest age by site productivity class for the No Action alternative

Location*	Site Productivity Class				
	5 (Minimum Harvest Age)	4 (Minimum Harvest Age)	3 (Minimum Harvest Age)	2 (Minimum Harvest Age)	1 (Minimum Harvest Age)
Northern Districts	110	100	90	90	80
Southern Districts	150	120	110	110	100

* Northern districts include the Coos Bay, Eugene, and Salem Districts; southern districts include the Klamath Falls Field Office and the Medford and Roseburg Districts.

Coos Bay – Projection of Future Marbled Murrelet Sites

The Modeling Team modeled all existing stands 120 years and older within approximately 4 townships of the coast as no harvest to simulate future occupied marbled murrelet sites.

Bald Eagle Management Areas (BEMA)

The Modeling Team modeled Bald Eagle Management Areas as available for commercial thinning only in stands less than 80 years old.

Salem Adaptive Management Area (AMA)

The Modeling Team modeled the Salem Adaptive Management Area with commercial thinning in stands less than 110 years old and no regeneration harvest.

Reserve Northern Spotted Owl Pair Areas

The Modeling Team modeled no harvest in the northern spotted owl habitat classified as suitable and next best dispersal categories within the reserve pair areas in the Salem District. The Modeling Team modeled no regeneration harvest in the northern spotted owl habitat classified as non-suitable dispersal, and non-habitat within the reserve pair areas in the Salem District.

Salvage Harvesting

The Modeling Team modeled salvage harvest in the Harvest Land Base after high-, moderate-, or multiple high-severity fires. The salvage harvest occurred in the same decade as the fire and contributed to the ASQ.

Modeling Direction Specific to Alternative A

Riparian Reserve

The Modeling Team modeled harvest in the outer zone of the Riparian Reserve differently in the moist and the dry forest. In the moist forest, the density management harvest treatment does not produce any volume. In the dry forest, harvest did contribute to non-ASQ timber volume. The Modeling Team modeled thinning up to age 80 in both the moist and dry forest. The Modeling Team assumed that 15 percent of the outer zone acreage would be eligible for thinning, and assumed an average volume harvested of 10 Mbf/acre.

Late-Successional Reserve

The Late-Successional Reserve consists of five different components: large block reserves–moist, large block reserves–dry; older forest reserves, occupied marbled murrelet sites, and existing red tree vole sites in the North Coast DPS. The Modeling Team modeled harvest only in the large block reserves, with different harvest treatments in the moist and the dry forests. In the dry forests, the harvest counted towards non-ASQ volume. The Modeling Team assumed no age limit on harvest in the dry forest. In the moist forest, the harvest did not count towards non-ASQ volume (assuming that cut trees would not be removed). The Modeling Team assumed that non-commercial thinning would occur up to age 80 in the moist forest. The Modeling Team assumed that older forest reserves, the occupied marbled murrelet sites, and the existing red tree vole sites would not have any harvest.

Table C-21 shows the volume and percent of eligible acre constraints in the Late-Successional Reserve and Riparian Reserve for Alternative A. The constraints were different for northern and southern districts within the Late-Successional Reserve and different for moist and dry forests. The target percentage of eligible treatment acres was met over the entire modeling period (20 decades) with the following exception: for Late-Successional Reserve–Dry, the target was met in the first five modeling periods (decades) in the Medford District and the Klamath Falls Field Office, and in the first four modeling periods in the Roseburg District.

Table C-21. Reserve harvesting constraints for Alternative A

Land Use Allocation (Region)	Maximum Average Volume (Mbf/Acre)	Eligible Acres Treated (Percent)
Riparian Reserve		
Northern District*	10	15
Southern District†	10	15
Late-Successional Reserve		
Northern District* Moist	10	15
Northern District* Dry	N/A	N/A
Southern District† Moist	10	15
Southern District†,‡ Dry	15	50

* Salem, Eugene, Coos Bay

† Roseburg, Medford, Klamath Falls

‡ Dry LSR has 2 constraints. The first constraint is that the maximum volume for the first 5 decades was 15 Mbf, and after 5 decades, it can be higher. The second constraint is that on the Roseburg District, 50 percent of the eligible acres were treated during the first 4 decades, and in the Medford District and Klamath Falls Field Office, 50 percent of the eligible acres were treated in the first 5 decades.

Harvest Land Base

The Harvest Land Base consists of two components, the Uneven-aged Timber Area and the High Intensity Timber Area. All harvest in the Harvest Land Base would contribute to the ASQ. The Modeling Team modeled that all acres in Uneven-aged Timber Area would be harvested within the first eight modeling periods (decades).

The Modeling Team modeled timber harvest on the Harvest Land Base using a combination of non-declining and even flow constraints. The Modeling Team modeled the High Intensity Timber Area using an even-flow constraint, in which timber harvest from this allocation does not vary from decade to decade. The Modeling Team modeled the Uneven-aged Timber Area using an even-flow constraint where it composed 10 percent or less of the Harvest Land Base by sustained yield unit area. Where the Uneven-aged Timber Area composed greater than 10 percent of the Harvest Land Base by sustained yield unit area, the Modeling Team used only a non-declining flow constraint. Non-declining flow constraints allow timber harvest to increase but not decrease from decade to decade. Where the Modeling Team used a non-declining flow constraint, the Modeling Team forced the timber harvest to also meet an even-flow constraint for the first four decades.

The Modeling Team applied a minimum regeneration harvest age of 50 years in the High Intensity Timber Area.

In the High Intensity Timber Area, the Modeling Team set a target of applying regeneration harvest on 8–17 percent of acres in the High Intensity Timber Area per decade. Because of this goal, the average rotation ages trended between 60–120 years.

The Modeling Team modeled salvage harvest in the Harvest Land Base after high-, moderate-, or multiple, high-severity burns. The salvage harvest occurred in the same decade as the burn and contributed to the ASQ.

Modeling Direction Specific to Alternative B

Scenarios

The Modeling Team modeled Alternative B and Sub-alternative B as two scenarios of the same alternative because of their overall similar design. Scenario 1 corresponds to Sub-alternative B, in which all known and historic northern spotted owl sites are included in the Late-Successional Reserve. Scenario 2 corresponds to Alternative B, in which some known and historic northern spotted owl sites are included in the Harvest Land Base.

Riparian Reserve

The Modeling Team assumed that 50 percent of the outer zone Riparian Reserve would be eligible for thinning in both the moist and dry forest, and assumed an average volume harvested of 20 Mbf/acre in the northern districts and 15 Mbf/acre in the southern districts.

Late-Successional Reserve

The Modeling Team modeled no harvest activities in the older forest reserve, occupied marbled murrelet sites, occupied red tree vole sites, and within known or historic northern spotted owl sites. In the large block reserves, the Modeling Team assumed that 50 percent of the Late-Successional Reserve – Moist that is less than or equal to 80 years old would be eligible for thinning, and that 50 percent of the Late-Successional Reserve – Dry would be eligible for uneven-aged management regardless of age. The Modeling Team assumed an average volume harvested of 20 Mbf/acre in the northern districts and 15 Mbf/acre in the southern districts.

The Modeling Team modeled the Late-Successional Reserve – Dry with two specific constraints. The Modeling Team assumed an average volume harvest of 15 Mbf for the first 5 decades, after which it could increase. Second, the Modeling Team assumed that 50 percent of the eligible acres in the Roseburg District would treated during the first four decades, and that 50 percent of the eligible acres in the Medford District and the Klamath Falls Field Office would be treated in the first five decades.

Harvest Land Base

The Harvest Land Base consists of three components: the Uneven-aged Timber Area, the Moderate Intensity Timber Area, and the Low Intensity Timber Area, each with different silvicultural prescriptions. The Modeling Team modeled regeneration harvest to occur on 8–17 percent of the area in the Moderate Intensity Timber Area in each decade. The Modeling Team modeled regeneration harvest to occur on 6–10 percent of the area in the Low Intensity Timber Area in each decade.

The Modeling Team modeled timber harvest on the Harvest Land Base using a combination of non-declining and even flow constraints. The Modeling Team modeled the Low Intensity Timber Area and Moderate Intensity Timber Area using an even-flow constraint, in which timber harvest from this allocation does not vary from decade to decade. The Modeling Team modeled the Uneven-aged Timber Area using an even-flow constraint where it composed 10 percent or less of the Harvest Land Base by sustained yield unit area. Where the Uneven-aged Timber Area composed greater than 10 percent of the Harvest Land Base by sustained yield unit area, the Modeling Team used only a non-declining flow constraint. Non-declining flow constraints allow timber harvest to increase but not decrease from decade to decade. Where the Modeling Team used a non-declining flow constraint, the Modeling Team forced the timber harvest to also meet an even-flow constraint for the first four decades.

The Modeling Team used the minimum harvest age constraints in the model shown in **Table C-22**. These constraints allowed the BLM to transition a relatively young land base to long rotations without excessively reducing the acreage available for short-term harvesting.

Table C-22. Minimum harvest age constraints by 10-year Woodstock period for Low Intensity Timber Area and Moderate Intensity Timber Area

Area (Intensity Type)	Periods 1 through 7 (Minimum Harvest Age)	Periods 8 through 20 (Minimum Harvest Age)
Northern Districts*		
Moderate Intensity Timber Area	50	90
Low Intensity Timber Area	50	110
Southern Districts†		
Moderate Intensity Timber Area	50	120
Low Intensity Timber Area	50	140

* Coos Bay, Eugene, Salem

† Klamath Falls, Medford, Roseburg

The Modeling Team modeled salvage harvest in the Harvest Land Base after high-, moderate-, or multiple, high-severity burns. The salvage harvest occurred in the same decade as the burn and contributed to the ASQ.

Modeling Direction Specific to Alternative C

Riparian Reserve

The Modeling Team assumed that 50 percent of the outer zone would be eligible for thinning in both the moist and dry forest, and assumed an average volume harvested of 20 Mbf/acre in the northern districts and 15 Mbf/acre in the southern districts.

Late-Successional Reserve

The Modeling Team modeled no harvest activities in the older forest reserve, occupied marbled murrelet sites, occupied red tree vole sites. In the large block reserves, the Modeling Team assumed that 50 percent of the Late-Successional Reserve–Moist that is less than or equal to 80 years old would be eligible for thinning, and that 50 percent of the Late-Successional Reserve–Dry would be eligible for uneven-aged management regardless of age. The Modeling Team assumed an average volume harvested of 20 Mbf/acre in the northern districts and 15 Mbf/acre in the southern districts.

The Modeling Team modeled the Late-Successional Reserve – Dry with two specific constraints. The Modeling Team assumed an average volume harvest of 15 Mbf for the first five decades, after which it could increase. Second, the Modeling Team assumed that 50 percent of the eligible acres in the Roseburg District would treated during the first four decades, and that 50 percent of the eligible acres in the Medford District and Klamath Falls Field Office would be treated in the first five decades.

The Modeling Team also modeled salvage harvest in the Late-Successional Reserve after high-severity fire events.

Harvest Land Base

The Harvest Land Base consists of two components, the Uneven-aged Timber Area and the High Intensity Timber Area. All harvest in the Harvest Land Base would contribute to the ASQ. The Modeling Team modeled that all acres in the Uneven-aged Timber Area would be harvested within the first eight modeling periods (decades).

The Modeling Team modeled timber harvest on the Harvest Land Base using a combination of non-declining and even flow constraints. The Modeling Team modeled the High Intensity Timber Area using an even-flow constraint, in which timber harvest from this allocation does not vary from decade to decade. The Modeling Team modeled the Uneven-aged Timber Area using an even-flow constraint where it composed 10 percent or less of the Harvest Land Base by sustained yield unit area. Where the Uneven-aged Timber Area composed greater than 10 percent of the Harvest Land Base by sustained yield unit area, the Modeling Team used only a non-declining flow constraint. Non-declining flow constraints allow timber harvest to increase but not decrease from decade to decade. Where the Modeling Team used a non-declining flow constraint, the Modeling Team forced the timber harvest to also meet an even-flow constraint for the first four decades.

The Modeling Team applied a minimum regeneration harvest age of 50 years in the High Intensity Timber Area.

In the High Intensity Timber Area, the Modeling Team set a target of applying regeneration harvest on 8–17 percent of acres in the High Intensity Timber Area per decade. Because of this goal, the average rotation ages trended between 60–120 years.

The Modeling Team modeled salvage harvest in the Harvest Land Base after high-, moderate-, or multiple, high-severity burns. The salvage harvest occurred in the same decade as the burn and contributed to the ASQ.

Modeling Direction Specific to Alternative D

Riparian Reserve

The Modeling Team assumed that 15 percent of the outer zone Riparian Reserve acreage would be eligible for thinning, and assumed an average volume harvested of 10 Mbf/acre.

Late-Successional Reserve

The Modeling Team assumed no harvest in the Late-Successional Reserve.

Harvest Land Base

The Harvest Land Base consists of six components: predicted marbled murrelet sites, predicted red tree vole sites, the home ranges of known and historic northern spotted owl sites, the Owl Habitat Timber Area, the Uneven-aged Timber Area, and the Moderate Intensity Timber Area.

The Modeling Team assumed no harvest in the predicted marbled murrelet sites or the predicted red tree vole sites, as surveys for these species are required under Alternative D and newly discovered sites would be included in the Late-Successional Reserve.

The Modeling Team modeled timber harvest in the Harvest Land Base using a combination of non-declining and even flow constraints. The Modeling Team modeled the Moderate Intensity Timber Area using an even-flow constraint, in which timber harvest from this allocation does not vary from decade to decade. The Modeling Team modeled the Owl Habitat Timber Area, Uneven-aged Timber Area, and the home ranges of known and historic northern spotted owl sites using the discounted non-declining flow constraint.

The Modeling Team used the minimum harvest age constraints for the Moderate Intensity Timber Area as shown for the Moderate Intensity Timber Area in **Table C-22**.

Modeling Direction Specific to the Proposed RMP

Riparian Reserve

The Modeling Team assumed that 15 percent of the stands that are 80 years or less in the middle zone Riparian Reserve would be eligible for non-commercial thinning, and assumed an average volume harvested of 10 Mbf/acre.

The Modeling Team modeled outer zone Riparian Reserve treatments differently in the moist and dry forest. The Modeling Team assumed in the dry forest that 50 percent of the stands that are less than or equal to 80 years old would be eligible for thinning, and assumed an average volume harvest of 10 Mbf/acre.

The Modeling Team assumed in the moist forest that 26 percent of the stands less than or equal to 80 years old would be eligible for thinning. The Modeling Team set the constraint for the average volume harvested in the northern districts as 20 Mbf/acre and 15 Mbf/acre in the southern districts.

Late-Successional Reserve

The Modeling Team modeled no harvest activities in the older forest reserve, occupied marbled murrelet sites, and occupied red tree vole sites. In the large block reserves, the Modeling Team assumed that 50 percent of the Late-Successional Reserve–Moist that is less than or equal to 80 years old would be eligible for thinning, and that 80 percent of the Late-Successional Reserve–Dry would be eligible for uneven-aged management regardless of age. The Modeling Team assumed an average volume harvested of 20 Mbf/acre in the northern districts and 15 Mbf/acre in the southern districts.

The Modeling Team modeled the Late-Successional Reserve–Dry with two specific constraints. The Modeling Team assumed an average volume harvest of 15 Mbf for the first 5 decades, after which it could increase. Second, the Modeling Team assumed that 50 percent of the eligible acres in the Roseburg District would treated during the first four decades, and that 50 percent of the eligible acres in the Medford District and the Klamath Falls Field Office would be treated in the first 5 decades.

Harvest Land Base

The Harvest Land Base consists of three components: the Uneven-aged Timber Area, the Moderate Intensity Timber Area, and the Low Intensity Timber Area, each with different silvicultural prescriptions. The Modeling Team modeled regeneration harvest to occur on 7–18 percent of the area in the Moderate Intensity Timber Area in each decade. The Modeling Team modeled regeneration harvest to occur on 6–10 percent of the area in the Low Intensity Timber Area in each decade.

The Modeling Team modeled timber harvest in the Harvest Land Base using a combination of non-declining and even flow constraints. The Modeling Team modeled the Low Intensity Timber Area and Moderate Intensity Timber Area using an even-flow constraint, in which timber harvest from this allocation does not vary from decade to decade. The Modeling Team modeled the Uneven-aged Timber Area using an even-flow constraint where it composed 10 percent or less of the Harvest Land Base by sustained yield unit area. Where the Uneven-aged Timber Area composed greater than 10 percent of the Harvest Land Base by sustained yield unit area, the Modeling Team used only a non-declining flow constraint. Non-declining flow constraints allow timber harvest to increase but not decrease from decade to decade. Where the Modeling Team used a non-declining flow constraint, the Modeling Team forced the timber harvest to also meet an even-flow constraint for the first four decades.

The Modeling Team used the minimum harvest age constraints for the Moderate Intensity Timber Area and Low Intensity Timber Area in the model as shown in **Table C-22**. These constraints allowed the BLM to transition a relatively young land base to long rotations without excessively reducing the acreage available for short-term harvesting.

GIS Data – Modeled Harvest and Contribution to ASQ

Table C-23 provides a summary of how the Modeling Team modeled each category of GIS data and which categories contribute to the Allowable Sale Quantity. A data code of X = non-forested; N=forested, modeled without any harvest; P= forested, modeled with non-ASQ harvest; Y=forested, modeled with ASQ harvest; S= forested, modeled with no harvest; L=forested, modeled with harvest does not contribute to either ASQ or non-ASQ harvest; and N/A = not applicable.

Table C-23. Modeled harvest and contribution to ASQ

GIS Modeling Data Category	No Action (Code)	Alt. A (Code)	Alt. B (Code)	Alt. C (Code)	Alt. D (Code)	PRMP (Code)
Roads	X	X	X	X	X	X
Water	X	X	X	X	X	X
TPCC Non Forest	X	X	X	X	X	X
TPCC Non Suitable Woodlands	N	N	N	N	N	N
TPCC Suitable Woodlands–Low Site and Non Commercial Species	N	N	N	N	N	N
TPCC Suitable Woodlands–Reforestation	N	N	N	N	N	N
Recreation Sites–Existing	N	N	N	N	N	N
Recreation Sites–Proposed	N/A	N	N	N	N	N
Visual Resource Management Class I	N	N	N	N	N	N
Visual Resources Management Class II	N	N	N	N	N	N
Areas of Critical Environmental Concern–Existing	N	N	N	N	N	N
Areas of Critical Environmental Concern–Proposed	Y/P	N/Y/P	N/Y/P	N/Y/P	N/Y/P	N/Y/P
Occupied Marbled Murrelet Sites	N	N	N	N	N	N
Simulated Future Murrelet Sites	N	N	N	N	N	N
Known Owl Activity Centers	N	N	N	N	N	N
Reserve Pair Areas (Salem only)	N	N/A	N/A	N/A	N/A	N/A
Survey and Manage Species	N	N/A	N/A	N/A	N/A	N/A
Special Status Species	N/A	N	N	N	N	N
Species Management Areas	N	N/A	N/A	N/A	N/A	N/A
LUA–Riparian Reserve	P	P/L/N	P/N	P/N	P	P/L/N
LUA–Congressionally Reserved	N	N	N	N	N	N
LUA–Administratively Reserved	N	N	N	N	N	N
LUA–Late-Successional Reserve	P	P/L/N	P/N	P/N	N	P/N
LUA–Adaptive Management Areas	Y	N/A	N/A	N/A	N/A	N/A
LUA–Adaptive Management Reserve	P	N/A	N/A	N/A	N/A	N/A
LUA–Harvest Land Base	N/A	Y	Y	Y	Y/S	Y
LUA–General Forest Management Areas	Y	N/A	N/A	N/A	N/A	N/A
LUA–Connectivity Diversity Blocks	Y	N/A	N/A	N/A	N/A	N/A
LUA–Southern General Forest Management Area	Y	N/A	N/A	N/A	N/A	N/A
LUA–District-Designated Reserve	N	N	N	N	N	N
Burned Areas	N/Y/P	N/Y/P	N/Y/P	N/Y/P	N/Y/P	N/Y/P
LUA–Eastside Management Lands	X	X	X	X	X	X
Fauna Critical Habitat	N/A	N	N	N	N	N
Flora Critical Habitat	N/A	N	N	N	N	N
Existing Red Tree Vole Sites	N/A	N	N	N	N	N
Predicted Red Tree Vole Sites	N/A	N	N	N	N	N
Pacific Crest Trail	N/A	N	N	N	N	N
Wild and Scenic Rivers, Designated Corridors	N	N	N	N	N	N
Wild and Scenic Rivers, eligible and suitable	N	N	N	N	N	N
Wilderness	N	N	N	N	N	N
Wilderness Study Areas	N	N	N	N	N	N
LUA–District-Designated Reserve – Lands Managed for their Wilderness Characteristics	N/A	N/Y/P	N/Y/P	N/Y/P	N/Y/P	N/Y/P

Note: Green and dark blue cells indicate codes contributing to ASQ.
X = non-forested
N = forested, modeled without any harvest
P = forested, modeled with non-ASQ harvest
Y = forested, modeled with ASQ harvest
S = forested, modeled with no harvest
L = forested, modeled with harvest does not contribute to either ASQ or non-ASQ harvest
N/A = not applicable

Reference Analysis and Sub-alternative Modeling Rules

No Timber Harvest

The Modeling Team tested and calibrated the data and the model by running the first model for 150 years without any management. This run provided the Modeling Team with a baseline for comparison to the action alternatives and the Proposed RMP. The Modeling Team conducted the No Timber Harvest reference analysis run both with and without wildfire. The Modeling Team modeled a full range of outputs, including stand structure, stand metrics, wildlife modeling metrics, and growth and yield. BLM inventory specialists reviewed the results to determine that attributes from GIS and strata were properly applied to the modeling and that stand metrics and projections were reasonable. In all, the Modeling Team completed five iterations of the No Timber Harvest reference analysis. As a result of these reviews, the Modeling Team made several revisions to the modeling process:

- Capped maximum stand density index (SDI) at 500 to prevent unrealistically high growth and volume projections
- Calculated canopy cover using ORGANON equations in addition to FVS
- Revised stand structural classifications to 'hardwire' reversion to early seral stages after regeneration harvests or fire, despite significant legacy retention
- Re-set stand age to zero after high-severity fire
- Tracked stands that are currently over 200 years old as a separate structural class, 'old', and currently over 400 years as 'very old'[27]

Sub-alternative B

The Modeling Team developed Sub-alternative B to provide a comparison for the effects of precluding harvest in the home ranges of the known and historic northern spotted owl sites. The BLM provided one input database to MBG that had the variables for both Alternative B and Sub-alternative B. This database had two sets of land use allocations, two sets of harvest modeling codes, and two sets of harvest modeling pieces[28].

Sub-alternative C

The Modeling Team developed Sub-alternative C to provide a comparison to Alternative C that precluded harvest in stands 80 years and older. The BLM provided one input database to MBG for both modeling runs.

Establishing Harvest Levels

The Modeling Team based harvest volume projections on the lands available for harvest, under the assumptions of each alternative and the Proposed RMP, within each sustained-yield unit. Due to the assumed timber management limitations, harvest from moist forest reserves (i.e., Late-Successional Reserve and Riparian Reserve) would diminish as stands grew past the conditions suitable for thinning and would not produce a sustainable harvest over time. The Modeling Team assumed that timber volume

[27] Throughout the modeling process, no new stands were allowed to grow into the 'old' and 'very old' classes. The purpose of this modification was for transparency of the fate of all stands currently over 200 years of age.
[28] Harvest modeling codes were applied to land use allocations or sub-allocations in the model and were used to direct the model in where the vegetation would be grown, where harvest would occur, and if the harvest counted toward ASQ. Harvest modeling pieces were used to assign specific forest management prescriptions, such as uneven-aged or even-aged management, to harvest modeling codes where harvest would occur.

from selection harvesting in Late-Successional Reserve–Dry would continue perpetually where the BLM would use timber harvest to maintain fire-resilient conditions.

The Modeling Team modeled the sustained-yield harvest level from the land base supporting the ASQ separately from the harvest volume from the reserves. Segregating the land base and modeling of harvest volume in this manner eliminated the interaction of these two types of allocations.

Within the Harvest Land Base, the Modeling Team applied two different harvest flow constraints. These include a non-declining, even-flow strategy and a non-declining discounted flow constraint. In the even-flow constraint, the harvest is constant throughout the planning horizon. In the non-declining flow constraint, the harvest in any period must be equal to or greater than harvest in the prior period. To find the non-declining flow harvest schedule that maximized the harvest in the early part of the planning horizon, we maximized discounted harvest over the planning horizon. The Modeling Team always applied the non-declining even-flow strategies to the High Intensity Timber Area, Low Intensity Timber Area, and Moderate Intensity Timber Area. The Modeling Team also applied this same non-declining, even-flow strategy to the Uneven-aged Timber Area and Owl Habitat Timber Area where they comprised 10 percent or less of the Harvest Land Base within a sustained yield unit (**Figure C-8**).

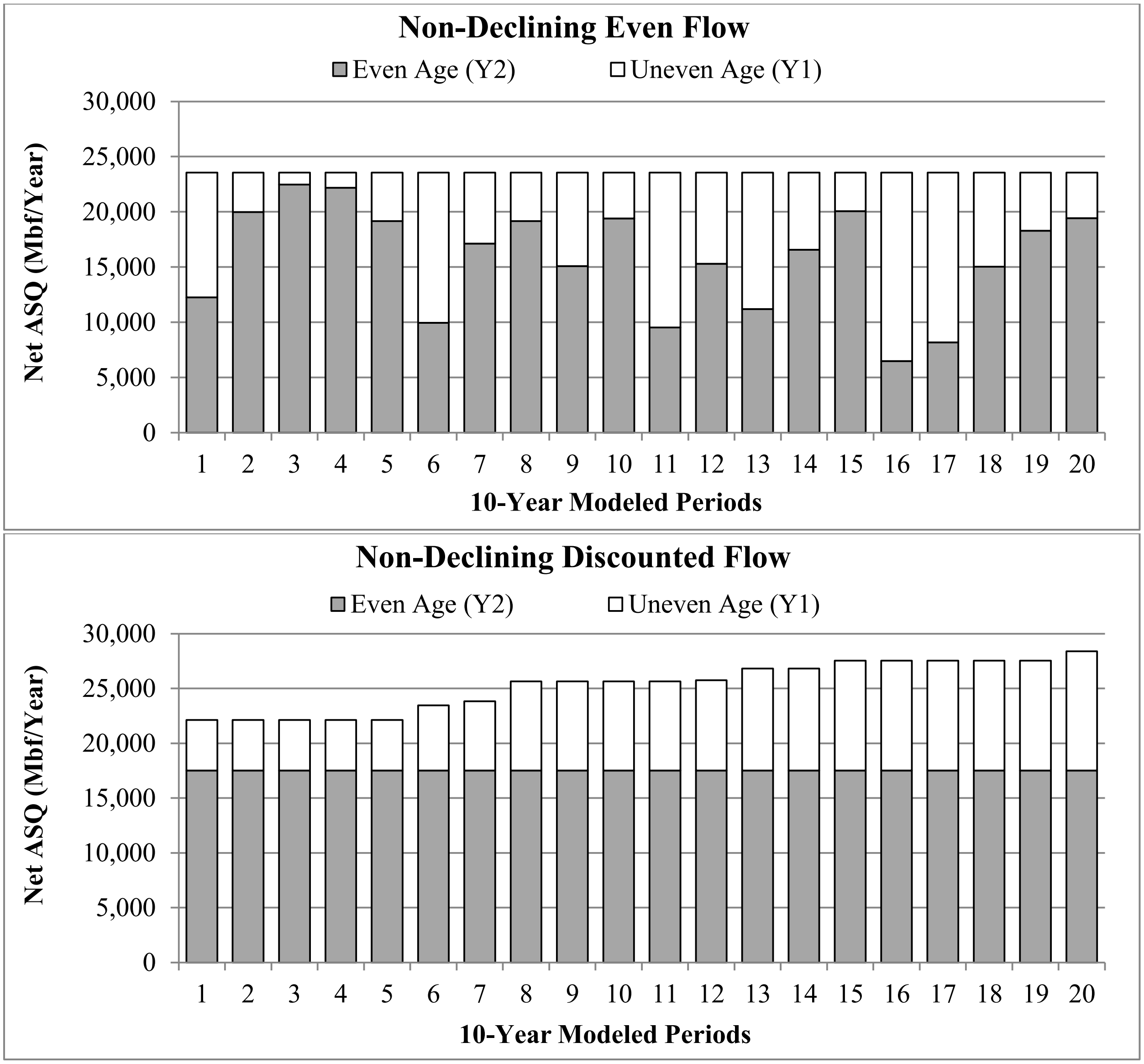

Figure C-8. Non-declining even-flow (top) and non-declining discounted flow (bottom)

Where the Uneven-aged Timber Area or Owl Habitat Timber Area comprised more than 10 percent of the Harvest Land Base in a sustained yield unit, the Modeling Team applied a non-declining discounted flow strategy, because it provided—

- A relatively even distribution of both selection harvest and even-aged harvest across the Harvest Land Base through time;
- A predictable, even-flow harvest in the even-aged components of the Harvest Land Base; and
- A relatively high level of ASQ in the selection harvest in the Harvest Land Base.

The selection prescriptions in Uneven-aged Timber Area and Owl Habitat Timber Area increased the amount of harvest volume that would be removed through time with successive entries. Without being able to adjust harvest levels in the course of the 200-year modeling horizon, it would not be possible to implement the management direction for the Uneven-aged Timber Area and Owl Habitat Timber Area.

Woodstock Products

The final product from all Woodstock modeling runs was a Microsoft Access relational database, covering the entire project area, and containing all of the output variables for each individual polygon (RMPWO_ID) (**Table C-24**). The model generated outputs for time steps: 0, 1, 2, 3, 4, 5, 10, and 20 (i.e., 2013, 2023, 2033, 2043, 2053, 2063, 2113, and 2213).

Table C-24. Woodstock modeling output variables

Table	Field Name	Description
Wildlife	District	District name (Woodstock Theme 9)
	RMPWO_ID	Unique polygon Identification Number
	GIS_ACRES	Area in acres
	Platforms1_yr2013	Murrelet platforms(1) per acre in period 0–after treatment
	Platforms2_yr2013	Murrelet platforms(2) per acre in period 0–after treatment
	QMDCON_yr2013	Quadratic mean diameter of all live conifers in centimeters in period 0–after treatment
	StructBLM_yr2013	Structural stage code in period 0–after treatment
	StructBLM_CurrentAge_yr2013	Current age of stand used for structural stage code in period 0
	StructBLM_StartingAge_yr2013	Starting age of stand used for structural stage code in period 0
	StructBLM_TPA20_yr2013	Trees per acre of trees ≥ 20" DBH used for structural stage code in period 0–after treatment
	StructBLM_TPA40_yr2013	Trees per acre of trees ≥ 40" DBH used for structural stage code in period 0–after treatment
	StructBLM_CV_yr2013	Current Vegetation of the DBH of all trees used for structural stage code in period 0–after treatment
	StructBLM_RD_yr2013	Curtis relative density used for structural stage code in period 0–after treatment
	StructBLM_Height_yr2013	Average height of reported trees greater or equal to 7" DBH, structural stage code–after treatment
	StructBLM_CanopyCover_yr2013	ORGANON Canopy cover from all trees used for structural stage code in period 0–after treatment
	DDivBLM_yr2013	Diameter Diversity Index in period 0–after treatment
	TPHaLgCon_yr2013	Trees per hectare of large conifers (≥ 30") in period 0–after treatment
	TFir_PCT_yr2013	Percent of total basal area in subalpine fir species list in period 0–after treatment
	Pine_PCT_yr2013	Percent of total basal area in pine species list in period 0–after treatment
	Oak_PCT_yr2013	Percent of total basal area in oak species list in period 0–after treatment
	EvgHdw_PCT_yr2013	Percent of total basal area in evergreen hardwoods species list in period 0–after treatment
	Redwd_PCT_yr2013	Percent of total basal area in redwood (always 0) in period 0–after treatment
	CCovCon_FVS_PCT_yr2013	Forest Vegetation Simulator canopy cover of all live conifers in percent in period 0–after treatment
	CCovCon_ORG_PCT_yr2013	ORGANON canopy cover of all live conifers in percent in period 0–after treatment
	CCovHdw_FVS_PCT_yr2013	FVS canopy cover of all live hardwoods in percent in period 0–after treatment
	CCovHdw_ORG_PCT_yr2013	ORGANON canopy cover of all live hardwoods in percent in period 0–after treatment

Table	Field Name	Description
	VegCl_1011_yr2013	Gradient Nearest Neighbor Vegetation Class code in period 0–after treatment
	TCanopyLyr_yr2013	Number of tree canopy layers present in period 0–after treatment
	StndDomHt_yr2013	Average height of dominant and co-dominant trees in meters in period 0–after treatment
Harvest	District	District name (Woodstock Theme 9)
	RMPWO_ID	Unique polygon Identification Number
	GIS_ACRES	Area in acres
	CurrPeriod_yr2013	Current period in 2013 = 0
	GrossToNet_yr2013	Adjustment factor for gross to net inventory volume in period 0
	TenYrAge_yr2013	Forest operations inventory 10-year age in years in period 0
	TotNetInv_yr2013	Net inventory volume per acre (Mbf/acre) commercial species 16 feet scale in period 0
	TotNetInv_Extended_yr2013	Net inventory total volume (Mbf) commercial species 16 feet scale (TotNetInv_yr2013 × GIS_ACRES) in period 0
	BlmTotGross_yr2013	Gross inventory volume per acre (Mbf/acre) all species 16 feet scale in period 0–after treatment
	BlmTotGross_Extended_yr2013	Gross inventory total volume (Mbf) all species 16 feet scale (BlmTotGross_yr2013 × GIS_ACRES) in period 0
	ASQ_yr2013	Gross inventory volume per acre (Mbf/acre) commercial species 16 feet scale in period 0–after treatment
	TPA_yr2013	Trees per acre in period 0–before treatment
	BA_yr2013	Basal area in square feet per acre in period 0–before treatment
	QMD_yr2013	Quadratic mean diameter in inches, all species in period 0–before treatment
	thin_acres	Acres of thinning in period 0
	clearcut_acres	Acres of clearcut in period 0 (NRTA only)
	selection_acres	Acres of selection (uneven-aged) harvest in period 0 (LSUMA prescription, UEMA, Owl Habitat Timber Area)
	salvage_acres	Acres of salvage harvest in period 0 (General Forest Management Area (No Action), Harvest Land Base in action alternatives and Proposed RMP, Late-Successional Reserve in Alt. C)
	thin_vol	Volume of thinning in period 0 (Alt. A only)
	clearcut_vol	Volume of clearcut harvest in period 0 (NRTA)
	selection_vol	Volume from selection (uneven-age) harvest in period 0 (net volume, 16 feet scale)
	salvage_vol	Volume of salvage harvest in period 0 (net volume, 16 feet scale)
	restoration_acres	Acres of restoration harvest in period 0 (Alt. A only)
	restoration_vol	Volume from restoration harvest (gross, does not count towards allowable sale quantity) Alt. A only
	2-age_acres	Acres of 2-age harvest in period 0 (General Forest Management Area, Connectivity SGFMA, LRTA and MRTA)
	2-age_vol	Volume from 2-age harvest in period 0 (net volume, 16 feet scale)
	Grade_1_vol	Volume harvested in size/grade class 1 in period 0 (net volume, 16 feet scale)
	Grade_2_vol	Volume harvested in size/grade class 2 in period 0 (net volume, 16 feet scale)
	Grade_3_vol	Volume harvested in size/grade class 3 in period 0 (net volume, 16 feet scale)

Table	Field Name	Description
	Grade_4_vol	Volume harvested in size/grade class 4 in period 0 (net volume, 16 feet scale)
	ASQ_harv_vol	Total volume harvested that counts towards allowable sale quantity (net volume, 16 feet scale)
	nonASQ_harv_vol	Total volume harvested that doesn't count towards allowable sale quantity (net volume, 16 feet scale)
Baseline	District	District name (Woodstock Theme 9)
	RMPWO_ID	Unique polygon Identification Number
	GIS_ACRES	Area in acres
	SUBJ_FOI	Forest operations inventory Stand Identification Number
	YieldStrataID	Timber stratification Yield Strata Identification Number (Woodstock Theme 1)
	Modeling_Group	Timber stratification Modeling Group (Woodstock Theme 2)
	Species_Group	Timber stratification Species Group (Woodstock Theme 3)
	Site_Class	Timber stratification Site Class (Woodstock Theme 4)
	Age_Group	Timber stratification Age Group (Woodstock Theme 5)
	LandUseAllocation_init	Land Use Allocation (Woodstock Theme 6)
	Regine_GrowOnly	Management regime; GrowOnly or Fire (Woodstock Theme 7)
	HarvestLandBaseCodes	Harvest Land Base code; Y, N, or X* (Woodstock Theme 8)
	Rotation	Current rotation; EX or RE† (Woodstock Theme 10)
	StartingTenYearAge	Forest Operations Inventory Ten Year Age in years in 2013 (Woodstock Theme 11)
	StartingAge_inPeriods	Timber stratification age in periods in 2013 (Woodstock Theme 12)
	Swiss_Needle_Cast	Swiss needle cast presence; Yes or No (Woodstock Theme 13)
	Burn_Regime	Burn regime timing and severity in periods (Woodstock Theme 14)
	Wet_Or_Dry_Site	Wet or dry site; W or D (Woodstock Theme 15)
Economic	RMPWO_ID	Unique polygon Identification Number
	GIS_ACRES	Area in acres
	oG_RevCC$	Gross Revenue from Clearcutting ($)
	oG_RevSL$	Gross Revenue from 2-Age ($)
	oG_Rev2A$	Gross Revenue from Selection ($)
	oG_RevThn$	Gross Revenue from Thins ($)
	oG_RevTot$	Total Gross Revenue ($)
	oLog_CC$	Clearcut Logging Cost ($)
	oLog_2A$	2-Age Logging Cost ($)
	oLog_SL$	Selection Logging Cost ($)
	oLog_Thn$	Thin Logging Cost ($)
	oLog_Tot$	Total Logging Costs ($)
	oUnd_Brn$	Underburn/Broadcast Burn Cost ($)
	oHnd_Brn$	Hand pile/Burn Cost ($)
	oLnd_Brn$	Landing Pile/Burn Cost ($)
	oMchn_Brn$	Machine Pile/Burn Cost ($)
	oSlsh_Sct$	Slashing/Lop/Scatter Cost ($)
	oMstctn$	Mastication Cost ($)
	oPlant$	Planting Cost ($)
	oManClear$	Manual Clearing Cost ($)
	oManCut$	Manual Cutting Cost ($)

Table	Field Name	Description
	oMulch$	Mulching Cost ($)
	oTubing$	Leader Protection Cost ($)
	oShading$	Shading Cost ($)
	oTrapping$	Trapping Cost ($)
	oScalp$	Scalping Cost ($)
	oHerb$	Herbicide Cost ($)
	oBlstCtrl$	Blister Rust Control Cost ($)
	oPCT$	Pre-commercial Thin Cost ($)
	oFert$	Fertilization Cost ($)
	oPrune$	Pruning Cost ($)
	oConversn$	Stand Conversion Cost ($)
	oTotCosts$	Total Costs ($)
	oNetRev$	Net Revenue ($)
Silviculture	RMPWO_ID	Unique polygon Identification Number
	GIS_ACRES	Area in acres
	oUnd_Brn_Ac	Underburn/Broadcast Burn Acres
	oHnd_Brn_Ac	Hand pile/Burn Acres
	oLnd_Brn_Ac	Landing Pile/Burn Acres
	oMchn_Brn_Ac	Machine Pile/Burn Acres
	oSlsh_Sct_Ac	Slashing/Lop/Scatter Acres
	oMstctn_Ac	Mastication Acres
	oPlant_Ac	Planting Acres
	oManClear_Ac	Manual Clearing Acres
	oManCut_Ac	Manual Cutting Acres
	oMulch_Ac	Mulching Acres
	oTubing_Ac	Leader Protection Acres
	oShading_Ac	Shading Acres
	oTrapping_Ac	Trapping Acres
	oScalp_Ac	Scalping Acres
	oHerb_Ac	Herbicide Acres
	oBlstCtrl_Ac	Blister Rust Control Acres
	oPCT_Ac	Pre-commercial Thin Acres
	oFert_Ac	Fertilization Acres
	oPrune_Ac	Pruning Acres
	oConversn_Ac	Stand Conversion Acres

* Y = forested, modeled with ASQ harvest; N = forested, modeled without any harvest; X= non-forest
Mbf = thousand board feet

Vegetation Modeling Team and Interdisciplinary Team Members

Modeling Team

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Kevin Carson	Forester (retired) BLM Roseburg District
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