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Klamath Mountains (NC) Variant Overview

Forest Vegetation Simulator

Forested land on the Klamath National Forest
(Todd Drake, FS-R5)

Klamath Mountains (NC) Variant Overview

Forest Vegetation Simulator

Authors and Contributors:

The FVS staff has maintained model documentation for this variant in the form of a variant overview since its release in 1989. The original authors were Gary Dixon and Ralph Johnson. In 2008, the previous document was replaced with this updated variant overview. Gary Dixon, Christopher Dixon, Robert Havis, Chad Keyser, Stephanie Rebain, Erin Smith-Mateja, and Don Vandendriesche were involved with this major update. Stephanie Rebain cross-checked information contained in this variant overview with the FVS source code.

Keyser, Chad E. comp. 2008 (Revised June 28, 2021). Klamath Mountains (NC) Variant Overview – Forest Vegetation Simulator. Internal Rep. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Forest Management Service Center. 61p.

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Quick Guide to Default Settings

Parameter or Attribute	**Default Setting**	
Number of Projection Cycles	1 (10 if using FVS GUI)	
Projection Cycle Length	5 years	
Location Code (National Forest)	505 Klamath	
Plant Association Code (Region 5 /Region 6)	0 (Unknown) / 46 (CWC221 ABCO-PSME)	
Slope	5 percent	
Aspect	0 (no meaningful aspect)	
Elevation	45 (4500 feet)	
Latitude / Longitude	Latitude	Longitude
All location codes	42	123
Site Species (Region 5 / Region 6)	DF / Plant Association Code Specific	
Site Index (Region 5 / Region 6)	90 feet / Plant Association Code Specific	
Maximum Stand Density Index (R5 /R6)	Species specific / Plant Association Code specific	
Maximum Basal Area	Based on maximum stand density index	
Volume Equations	National Volume Estimator Library	
Merchantable Cubic Foot Volume Specifications:		
Minimum DBH / Top Diameter	KP	All Other Species
Region 5	6.0 / 6.0 inches	7.0 / 6.0 inches
Region 6	6.0 / 4.5 inches	7.0 / 4.5 inches
Stump Height	1.0 foot	1.0 foot
Merchantable Board Foot Volume Specifications:		
Minimum DBH / Top Diameter	KP	All Other Species
Region 5	6.0 / 6.0 inches	7.0 / 6.0 inches
Region 6	6.0 / 4.5 inches	7.0 / 4.5 inches
Stump Height	1.0 foot	1.0 foot
Sampling Design:		
Large Trees (variable radius plot)	40 BAF	
Small Trees (fixed radius plot)	1/300th Acre	
Breakpoint DBH	5.0 inches	

1.0 Introduction

The Forest Vegetation Simulator (FVS) is an individual tree, distance independent growth and yield model with linkable modules called extensions, which simulate various insect and pathogen impacts, fire effects, fuel loading, snag dynamics, and development of understory tree vegetation. FVS can simulate a wide variety of forest types, stand structures, and pure or mixed species stands.

New "variants" of the FVS model are created by imbedding new tree growth, mortality, and volume equations for a particular geographic area into the FVS framework. Geographic variants of FVS have been developed for most of the forested lands in the United States.

The NC variant was developed in 1989, and overlaps some of the geographic range of the Inland California (CA) variant. Data used in building the NC variant came from forest inventories, silvicultural stand examinations, and special plots installed in plantations. The forest inventories came from the Forest Service as well as the Hoopa Indian Reservation and Simpson Timber Company. Models for sugar pine, incense cedar, and red fir are from work done by Leroy Dolph for the Westside Sierra (WS) variant.

To fully understand how to use this variant, users should also consult the following publication:

- Essential FVS: A User's Guide to the Forest Vegetation Simulator (Dixon 2002)

This publication may be downloaded from the Forest Management Service Center (FMSC), Forest Service website. Other FVS publications may be needed if one is using an extension that simulates the effects of fire, insects, or diseases.

2.0 Geographic Range

The NC variant was fit to data representing forest types in the Klamath Mountains of California and Oregon. Data used in initial model development came from forest inventories, silvicultural stand examinations, and special plots installed in plantations. The forest inventories came from the Forest Service as well as the Hoopa Indian Reservation and Simpson Timber Company. Distribution of data samples for species fit from this data are shown in Appendix A.

The NC variant covers forest types in northwest California and southwest Oregon. The suggested geographic range of use for the NC variant is shown in figure 2.0.1.

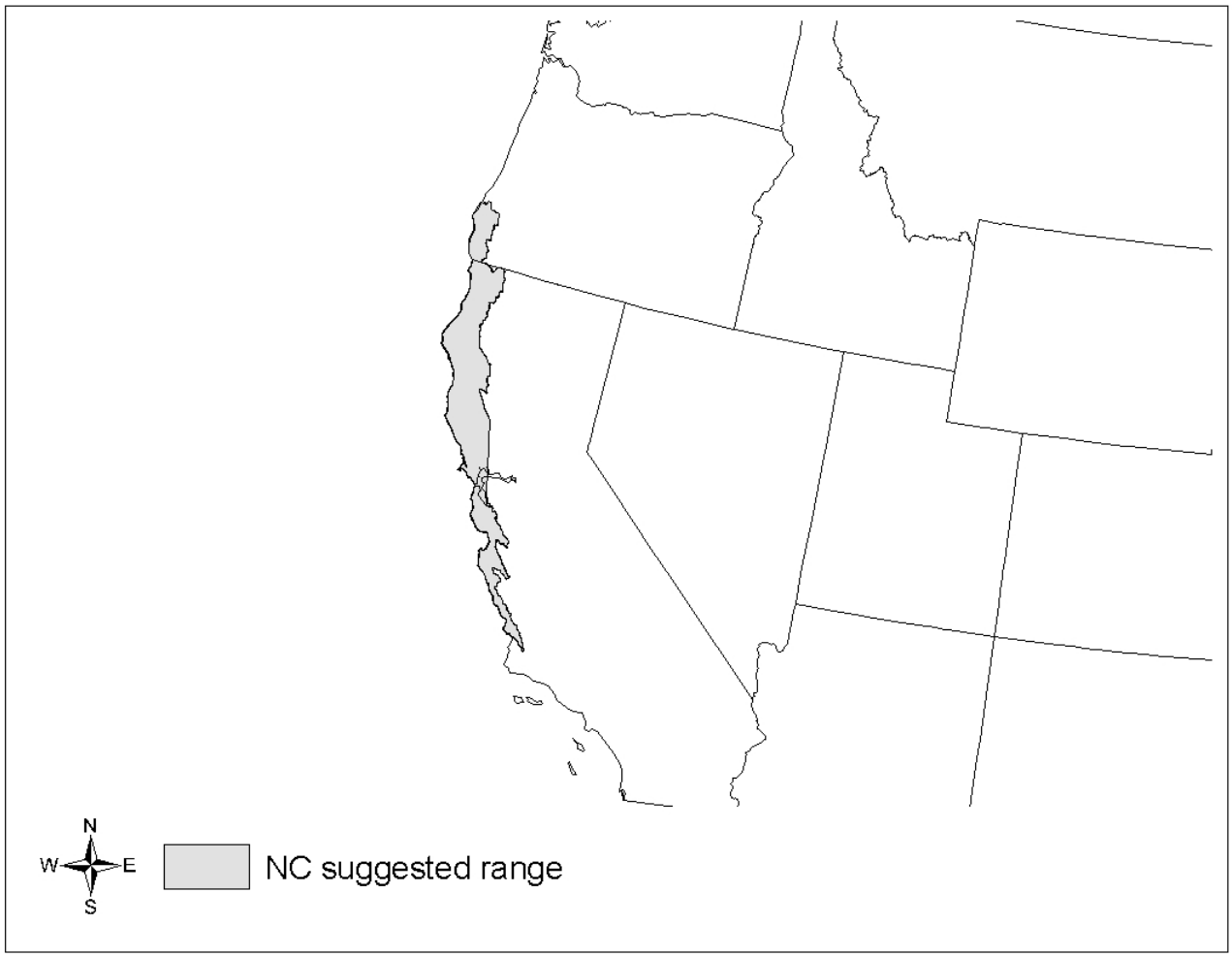

Figure 2.0.1 Suggested geographic range of use for the NC variant.

Within USFS Region 5, the following forests and districts should use the NC variant: Happy Camp and Ukonom districts of the Klamath NF; Monterey District of the Los Padres NF; Covelo and Upper Lake districts of the Mendocino NF; and all districts of the Six Rivers NF (Warbington 2004, based on Spreadsheet provided by Ralph Warbington, R5 Ecosystem Planning Staff, Remote Sensing Lab, http://www.fs.fed.us/r5/rsl/).

3.0 Control Variables

FVS users need to specify certain variables used by the NC variant to control a simulation. These are entered in parameter fields on various FVS keywords usually brought into the simulation through the SUPPOSE interface data files or they are read from an auxiliary database using the Database Extension.

3.1 Location Codes

The location code is a 3- or 4-digit code where, in general, the first digit of the code represents the Forest Service Region Number, and the last two digits represent the Forest Number within that region. In some cases, a location code beginning with a "7" or "8" is used to indicate an administrative boundary that doesn't use a Forest Service Region number (for example, other federal agencies, state agencies, or other lands).

If the location code is missing or incorrect in the NC variant, a default forest code of 505 (Klamath National Forest) will be used. Location codes recognized in the NC variant are shown in tables 3.1.1 and 3.1.2.

Table 3.1.1 Location codes used in the NC variant.

Location Code	Location
505	Klamath National Forest
510	Six Rivers National Forest
514	Shasta-Trinity National Forest
611	Siskiyou National Forest
705	Hoopa Indian Reservation
712	BLM Coos Bay
715, 800	Simpson Timber (715 mapped to 800)
507	Los Padres National Forest (mapped to 510)
508	Mendocino National Forest (mapped to 510)
518	Trinity National Forest (mapped to 514)

Table 3.1.2 Bureau of Indian Affairs reservation codes used in the NC variant.

Location Code	Location
7806	Dry Creek Rancheria (mapped to 508)
7807	Robinson Rancheria (mapped to 508)
7810	Hopland Rancheria (mapped to 508)
7813	Laytonville Rancheria (mapped to 508)
7815	Manchester-Pt. Arena Rancheria (mapped to 508)
7816	Middletown Rancheria (mapped to 508)
7820	Redwood Valley Rancheria (mapped to 508)
7821	Round Valley Off-Reservation Trust Land (mapped to 508)
7824	Stewarts Point Rancheria (mapped to 508)
7830	Sherwood Valley Rancheria (mapped to 508)
7831	Sulphur Bank Rancheria (mapped to 508)

Location Code	Location
7833	Upper Lake Rancheria (mapped to 508)
7834	Coyote Valley Reservation (mapped to 508)
7839	Elk Valley Off-Reservation Trust Land (mapped to 510)
7841	Yurok Reservation (mapped to 510)
7843	Trinidad Rancheria (mapped to 510)
7845	Karuk Off-Reservation Trust Land (mapped to 505)
8103	Coos, Lower Umpqua, Siuslaw Reservation (mapped to 611)
8105	Coquille Reservation (mapped to 611)

3.2 Species Codes

The NC variant recognizes 11 species. You may use FVS species codes, Forest Inventory and Analysis (FIA) species codes, or USDA Natural Resources Conservation Service PLANTS symbols to represent these species in FVS input data. Any valid western species codes identifying species not recognized by the variant will be mapped to the most similar species in the variant. The species mapping crosswalk is available on the variant documentation webpage of the FVS website. Any non-valid species code will default to the other hardwoods category.

Either the FVS sequence number or species code must be used to specify a species in FVS keywords and Event Monitor functions. FIA codes or PLANTS symbols are only recognized during data input, and may not be used in FVS keywords. Table 3.2.1 shows the complete list of species codes recognized by the NC variant.

Table 3.2.1 Species codes used in the NC variant.

Species Number	Species Code	Common Name	FIA Code	PLANTS Symbol	Scientific Name
1	OS	other softwoods	298	2TE	
2	SP	sugar pine	117	PILA	*Pinus lambertiana*
3	DF	Douglas-fir	202	PSME	*Pseudotsuga menziesii*
4	WF	white fir	015	ABCO	*Abies concolor*
5	MA	Pacific madrone	361	ARME	*Arbutus menziesii*
6	IC	incense-cedar	081	CADE27	*Lebocedrus decurrens*
7	BO	California black oak	818	QUKE	*Querqus keloggii*
8	TO	tanoak	631	LIDE3	*Lithocarpus densiflorus*
9	RF	California red fir	020	ABMA	*Abies magnifica*
10	PP	ponderosa pine	122	PIPO	*Pinus ponderosa*
11	OH	other hardwoods	998	2TD	

3.3 Habitat Type, Plant Association, and Ecological Unit Codes

Plant association codes recognized in the NC variant are shown in Appendix B. If an incorrect plant association code is entered or no code is entered, FVS will use the default plant association code, which is CWC221 for Region 6 forests, and 0 (unknown) in Region 5 forests. In Region 6 forests, plant

association codes are used as site level information to obtain the default site species type, site indices, and maximum stand density indices. The site species, site index and maximum stand density indices can be reset via FVS keywords. In Region 5 and 6, the plant association codes are used in the Fire and Fuels Extension (FFE) to set fuel loading in cases where there are no live trees in the first cycle and in Region 6 it is used in predicting snag dynamics. Users may enter the plant association code or the plant association FVS sequence number on the STDINFO keyword, when entering stand information from a database, or when using the SETSITE keyword without the PARMS option. If using the PARMS option with the SETSITE keyword, users must use the FVS sequence number for the plant association.

3.4 Site Index

Site index is used in some of the growth equations in the NC variant. Users should always use the same site curves that FVS uses, which are shown in table 3.4.1. If site index is available, a single site index for the whole stand can be entered, a site index for each individual species in the stand can be entered, or a combination of these can be entered. A site index value must be greater than or equal to 8, otherwise the value is considered a R5 site class code, see section 3.4.1.

Table 3.4.1 Site index reference curves for species in the NC variant.

Species Codes	Reference	BHA or TTA*	Base Age	Region
All species	Dunning (1942); Dunning and Reineke (1933) or R5 Site class	BHA**	50	5
OS, DF	King (1966) Weyerhaeuser Forestry Paper No. 8	BHA	50	6
WF, IC, RF	Dolph (1987) Research Paper PSW 185	BHA	50	6
MA, TO, OH	Porter and Wiant (1965) J. of Forestry April 1965 p286	TTA	50	6
BO	Powers (1972) Research Note PSW 262	BHA	50	6
SP, PP	Powers and Oliver (1978) Research Paper PSW 128	TTA	50	6

* Equation is based on total tree age (TTA) or breast height age (BHA)

** Height at BHA 50 should be entered even though the original site curve was a TTA curve

In Region 5 forests, site index values can either be entered directly or based on the Region 5 Site Class Code. See section 3.4.1 for Region 5 Site Class information. If site index is missing or incorrect, the site species is set to Douglas-fir with a default site index set to 90. In Region 6 forests, the default site species and site index are determined by plant association codes and shown in Appendix B. If the plant association code is missing or incorrect, the site species is set to Douglas-fir with a default site index set to 92.

Site indices for species not assigned a site index are determined based on the site index of the site species (height at base age) with an adjustment for the reference age differences between the site species and the target species. For tanoak and other hardwoods, the site index estimate is adjusted by multiplying the site index estimate by an adjustment factor of 0.85.

3.4.1 Region 5 Site Class

In Region 5 forests, the site index values can either be entered directly or based on the Region 5 site class (0-7) as shown in table 3.4.1.1. Site class codes of 0-5 were adapted for Region 5 by Jack Levitan from Duncan Dunning's site index curves (Dunning 1942, Dunning & Reineke 1933).

If a Region 5 site class is entered, it is converted to a site index for each species within the model using a two-step process. First, the Region 5 site class is converted to a 50-year site index as shown in table 3.4.1.1 (personal communication with Ralph Warbington in March 2008).

Table 3.4.1.1 Region 5 site class values converted into 50-year site index in the NC variant.

REGION 5 SITE CLASS	(BREAST HT AGE) 50-YEAR SITE INDEX
0	106
1	90
2	75
3	56
4	49
5	39
6	31
7	23

Second, site index for an individual species is determined by multiplying the 50-year site index by a species-specific adjustment factor which is shown in table 3.4.1.2

Table 3.4.1.2 Region 5 adjustment factors for 50-year site index values in the NC variant.

Species Code	Adjustment Factor
OS	0.90
SP	0.90
DF	1.00
WF	1.00
MA	0.57
IC	0.76
BO	0.57
TO	0.57
RF	1.00
PP	1.00
OH	0.57

3.5 Maximum Density

Maximum stand density index (SDI) and maximum basal area (BA) are important variables in determining density related mortality and crown ratio change. Maximum basal area is a stand level metric that can be set using the BAMAX or SETSITE keywords. If not set by the user, a default value is calculated from maximum stand SDI each projection cycle. Maximum stand density index can be set for each species using the SDIMAX or SETSITE keywords. If not set by the user, a default value is assigned

as discussed below. Maximum stand density index at the stand level is a weighted average, by basal area proportion, of the individual species SDI maximums.

In Region 5, the default maximum SDI is set by species or a user specified basal area maximum. If a user specified basal area maximum is present, the maximum SDI for all species is computed using equation {3.5.1}; otherwise, species SDI maximums are assigned from the SDI maximums shown in table 3.5.1.

For Region 5 forests, stand SDI is calculated using the Zeide calculation method (Dixon 2002).

{3.5.1} $SDIMAX_i = BAMAX / (0.5454154 * SDIU)$

where:

$SDIMAX_i$ is species-specific SDI maximum
BAMAX is the user-specified stand basal area maximum
SDIU is the proportion of theoretical maximum density at which the stand reaches actual maximum density (default 0.85, changed with the SDIMAX keyword)

In Region 6 forests and BLM Lakeview locations, the default maximum SDI is set based on a user-specified, or default, plant association code or a user specified basal area maximum. If a user specified basal area maximum is present, the maximum SDI for all species is computed using equation {3.5.1}; otherwise, the maximum SDI for the site species is assigned from the SDI maximum associated with the site species for the plant association code shown in Appendix B. SDI maximums were set based on growth basal area (GBA) analysis developed by Hall (1983) or an analysis of Current Vegetation Survey (CVS) plots in USFS Region 6 by Crookston (2008). Once maximum SDI is determined for the site species, maximum SDI for all other species not assigned a value is estimated using a relative adjustment as seen in equation {3.5.2}. Some SDI maximums associated with plant associations are unreasonably large, so SDI maximums are capped at 850.

{3.5.2} $SDIMAX_i = SDIMAX(SSEC) * (SDIMAX(S) / SDIMAX(SS))$

where:

$SDIMAX_i$ is species-specific SDI maximum
SDIMAX(SSEC) is maximum SDI for the plant association from Appendix B
SDIMAX(SS) is maximum SDI for the site species shown in table 3.5.1
SDIMAX(S) is maximum SDI for the target species shown in table 3.5.1

Table 3.5.1 Stand density index maximums by species in the NC variant.

Species Code	SDI Maximum*	Mapped to
OS	365	ponderosa pine
SP	561	
DF	570	
WF	800	
MA	515	
IC	576	
BO	406	

Species Code	SDI Maximum*	Mapped to
TO	785	
RF	1000	
PP	365	
OH	785	tanoak

*Source of SDI maximums is an unpublished analysis of FIA data by John Shaw.

4.0 Growth Relationships

This chapter describes the functional relationships used to fill in missing tree data and calculate incremental growth. In FVS, trees are grown in either the small tree sub-model or the large tree sub-model depending on the diameter.

4.1 Height-Diameter Relationships

Height-diameter relationships in FVS are primarily used to estimate tree heights missing in the input data, and occasionally to estimate diameter growth on trees smaller than a given threshold diameter. In the NC variant, FVS will dub in heights by one of two methods. By default, the NC variant will use the Curtis-Arney functional form as shown in equation {4.1.1} (Curtis 1967, Arney 1985). If the input data contains at least three measured heights for a species, then FVS will default to a logistic height-diameter equation {4.1.2} (Wykoff, et.al 1982) that may be calibrated to the input data. However, the default in the NC variant is to use equation {4.1.1}.

FVS will not automatically use equation {4.1.2} even if you have enough height values in the input data. To override this default, the user must use the NOHTDREG keyword and change field 2 to a 1. Coefficients for all height-diameter equations are given in table 4.1.1.

{4.1.1} Curtis-Arney functional form

$DBH \geq 3.0$": $HT = 4.5 + P_2 * \exp[-P_3 * DBH \wedge P_4]$
$DBH < 3.0$": $HT = [(4.5 + P_2 * \exp[-P_3 * 3.0 \wedge P_4] - 4.51) * (DBH - 0.3) / 2.7] + 4.51$

{4.1.2} Wykoff functional form

$$HT = 4.5 + \exp(B_1 + B_2 / (DBH + 1.0))$$

where:

HT	is tree height
DBH	is tree diameter at breast height
B_1 - B_2	are species-specific coefficients shown in table 4.1.1
P_2 - P_4	are species-specific coefficients shown in table 4.1.1

Table 4.1.1 Coefficients for the height-diameter relationship equations {4.1.1} and {4.1.2} in the NC variant.

Species Number	Species Code	Curtis-Arney Coefficients			Wykoff Coefficients	
		P_2	P_3	P_4	Default B_1	B_2
1	OS	523.0987	5.7243	-0.4109	4.78737	-7.317
2	SP	819.8690	6.4531	-0.3434	4.74961	-7.191
3	DF	523.0987	5.7243	-0.4109	4.78737	-7.317
4	WF	604.8450	5.9835	-0.3789	4.80268	-8.4066
5	MA	160.6821	4.1677	-0.4954	4.73881	-9.4491
6	IC	1530.3300	7.0811	-0.2544	4.89619	-12.559

Species Number	Species Code	Curtis-Arney Coefficients			Wykoff Coefficients	
		P_2	P_3	P_4	Default B_1	B_2
7	BO	48.6795	8.9420	-1.4832	4.8042	-9.9242
8	TO	679.1972	5.5698	-0.3074	4.66181	-8.3312
9	RF	202.8860	8.7469	-0.8317	4.83642	-7.048
10	PP	1348.0419	7.0463	-0.3076	4.23251	-8.3171
11	OH	679.1972	5.5698	-0.3074	4.66181	-8.3312

4.2 Bark Ratio Relationships

Bark ratio estimates are used to convert between diameter outside bark and diameter inside bark in various parts of the model. Equations used in the NC variant are shown in equations {4.2.1} and {4.2.2}. Coefficients (b_1 and b_2) and equation reference for these equations by species are shown in table 4.2.1.

{4.2.1} $DBT = b_1 + (b_2 * DBH)$ $\quad BRATIO = (DBH - DBT) / DBH$

{4.2.2} $DIB = b_1 + (b_2 * DBH)$ $\quad BRATIO = DIB / DBH$

where:

BRATIO is species-specific bark ratio (bounded to $0.80 \leq BRATIO \leq 0.99$)
DBT is double bark thickness
DBH is tree diameter at breast height
DIB is tree diameter inside bark at breast height
b_1, b_2 is a species-specific coefficient shown in table 4.2.1

Table 4.2.1 Coefficients and equation reference for equations {4.2.1} – {4.2.2} in the NC variant.

Species Code	b_1	b_2	Equation Used
OS	0.1429	0.1137	{4.2.1}
SP	0.1429	0.1137	{4.2.1}
DF	0.1045	0.1661	{4.2.1}
WF	0.1593	0.1089	{4.2.1}
MA	-0.01348	0.98155	{4.2.2}
IC	-0.0549	0.1626	{4.2.1}
BO	-0.26824	0.95767	{4.2.2}
TO	-0.26824	0.95354	{4.2.2}
RF	0.1593	0.1089	{4.2.1}
PP	0.4448	0.1033	{4.2.1}
OH	-0.26824	0.95767	{4.2.2}

4.3 Crown Ratio Relationships

Crown ratio equations are used for three purposes in FVS: (1) to estimate tree crown ratios missing from the input data for both live and dead trees; (2) to estimate change in crown ratio from cycle to

cycle for live trees; and (3) to estimate initial crown ratios for regenerating trees established during a simulation.

4.3.1 Crown Ratio Dubbing

In the NC variant, crown ratios missing in the input data are predicted using different equations depending on tree species and size. Live trees less than 1.0" in diameter and dead trees of all sizes use equation {4.3.1.1} and {4.3.1.2} to compute crown ratio. Equation coefficients are found in table 4.3.1.1.

{4.3.1.1} $X = R_1 + R_2 * DBH + R_3 * HT + R_4 * BA + R_5 * PCCF + R_6 * HT_{Avg} / HT + R_7 * HT_{Avg} + R_8 * BA * PCCF + R_9 * MAI$

{4.3.1.2} $CR = 1 / (1 + \exp(X + N(0,SD)))$ where absolute value of $(X + N(0,SD)) < 86$

where:

CR	is crown ratio expressed as a proportion (bounded to $0.05 \leq CR \leq 0.95$)
DBH	is tree diameter at breast height
HT	is tree height
BA	is total stand basal area
PCCF	is crown competition factor on the inventory point where the tree is established
HT_{Avg}	is average height of the 40 largest diameter trees in the stand
MAI	is stand mean annual increment
N(0,SD)	is a random increment from a normal distribution with a mean of 0 and a standard deviation of SD
$R_1 – R_9$	are species-specific coefficients shown in table 4.3.1

Table 4.3.1.1 Coefficients for the crown ratio equation {4.3.1.1} in the NC variant.

	Species Code					
Coefficient	**OS, SP**	**DF, WF, MA, TO, RF**	**IC**	**BO**	**PP**	**OH**
R_1	-1.66949	-0.42669	-0.42669	-1.66949	-1.66949	-2.19723
R_2	-0.209765	-0.093105	-0.093105	-0.209765	-0.209765	0
R_3	0	0.022409	0.022409	0	0	0
R_4	0.003359	0.002633	0.002633	0.003359	0.003359	0
R_5	0.011032	0	0	0.011032	0.011032	0
R_6	0	-0.045532	-0.045532	0	0	0
R_7	0.017727	0	0	0.017727	0.017727	0
R_8	-0.000053	0.000022	0.000022	-0.000053	-0.000053	0
R_9	0.014098	-0.013115	-0.013115	0.014098	0.014098	0
SD	0.5	0.6957	0.9310	0.6124	0.4942	0.2

A Weibull-based crown model developed by Dixon (1985) as described in Dixon (2002) is used to predict crown ratio for all trees 1.0" in diameter or larger. To estimate crown ratio using this methodology, the average stand crown ratio is estimated from stand density index using equation {4.3.1.3}. Weibull parameters are then estimated from the average stand crown ratio using equations in equation set {4.3.1.4}. Individual tree crown ratio is then set from the Weibull distribution, equation

{4.3.1.5} based on a tree's relative position in the diameter distribution and multiplied by a scale factor, shown in equation {4.3.1.6}, which accounts for stand density. Crowns estimated from the Weibull distribution are bounded to be between the 5 and 95 percentile points of the specified Weibull distribution. Equation coefficients for each species are shown in table 4.3.1.2.

{4.3.1.3} $ACR = d_0 + d_1 * RELSDI * 100.0$

$RELSDI = SDI_{stand} / SDI_{max}$

{4.3.1.4} Weibull parameters A, B, and C are estimated from average crown ratio

$A = a_0$
$B = b_0 + b_1 * ACR \quad (B \geq 1)$
$C = c_0 + c_1 * ACR \quad (C \geq 2)$

{4.3.1.5} $Y = 1\text{-}exp(-((X\text{-}A)/B)^C)$

{4.3.1.6} $SCALE = 1.5 - RELSDI$

$RELSDI = SDI_{stand} / SDI_{max}$

where:

ACR	is predicted average stand crown ratio for the species
SDI_{stand}	is stand density index of the stand
SDI_{max}	is maximum stand density index
X	is a tree's crown ratio expressed as a percent / 10
Y	is a trees rank in the diameter distribution (1 = smallest; ITRN = largest) divided by the total number of trees (ITRN) multiplied by *SCALE*
A, *B*, *C*	are parameters of the Weibull crown ratio distribution
SCALE	is a density dependent scaling factor (bounded to $0.3 \leq SCALE \leq 1.0$)

a_0, $b_{0\text{-}1}$, $c_{0\text{-}1}$, and $d_{0\text{-}1}$ are species-specific coefficients shown in table 4.3.1.2

Table 4.3.2 Coefficients for the Weibull parameter equations {4.3.1.3} and {4.3.1.4} in the NC variant.

Species Code	Model Coefficients						
	a_0	b_0	b_1	c_0	c_1	d_0	d_1
OS	0	0.52909	1.00677	-3.48211	1.3878	7.48846	-0.02899
SP	0	0.25115	1.05987	0.33383	0.63833	6.92893	-0.04053
DF	0	0.52909	1.00677	-3.48211	1.3878	7.48846	-0.02899
WF	0	0.48464	1.01272	-2.78353	1.27283	7.44422	-0.04779
MA	0	0.08402	1.10297	0.91078	0.45819	3.64292	-0.00317
IC	0	0.29964	1.05398	-1.0927	0.80687	5.12357	-0.01042
BO	0	0.06607	1.10705	2.04714	0.1507	6.82187	-0.02247
TO	0	0.25667	1.06474	0.11729	0.61681	5.95912	-0.01812
RF	0	0.16601	1.0815	0.9142	0.45768	6.14578	-0.02781
PP	0	0.03685	1.09499	4.0134	0.04946	6.04928	-0.01091
OH	0	0.25667	1.06474	0.11729	0.61681	5.95912	-0.01812

4.3.2 Crown Ratio Change

Crown ratio change is estimated after growth, mortality and regeneration are estimated during a projection cycle. Crown ratio change is the difference between the crown ratio at the beginning of the cycle and the predicted crown ratio at the end of the cycle. Crown ratio predicted at the end of the projection cycle is estimated for live tree records using the Weibull distribution, equations {4.3.1.3}-{4.3.1.6}. Crown change is checked to make sure it doesn't exceed the change possible if all height growth produces new crown. Crown change is further bounded to 1% per year for the length of the cycle to avoid drastic changes in crown ratio. Equations {4.3.1.1} and {4.3.1.2} are not used when estimating crown ratio change.

4.3.3 Crown Ratio for Newly Established Trees

Crown ratios for newly established trees during regeneration are estimated using equation {4.3.3.1}. A random component is added in equation {4.3.3.1} to ensure that not all newly established trees are assigned exactly the same crown ratio.

{4.3.3.1} $CR = 0.89722 - 0.0000461 * PCCF + RAN$

where:

CR	is crown ratio expressed as a proportion (bounded to $0.2 \leq CR \leq 0.9$)
PCCF	is crown competition factor on the inventory point where the tree is established
RAN	is a small random component

4.4 Crown Width Relationships

The NC variant calculates the maximum crown width for each individual tree, based on individual tree and stand attributes. Crown width for each tree is reported in the tree list output table and used for percent canopy cover (*PCC*) calculations in the model.

4.4.1 Region 5 Crown Width

Crown width in Region 5 forests and Hoopa Indian Reservation is calculated by using equations {4.4.1.1} – {4.4.1.5}. If a tree has a *DBH* greater than or equal to its threshold diameter (given as DBH_T), then it uses equation {4.4.1.1}, {4.4.1.2}, or {4.4.1.3} depending on the species. If a tree has a *DBH* less than its threshold diameter, then it uses equation {4.4.1.4} or {4.4.1.5} depending on the height of the tree. Coefficients, equation reference, and threshold diameter values for these equations are shown in table 4.4.1.1 by species.

{4.4.1.1} $DBH \geq DBH_T$: $CW = a_1 + a_2 * DBH$

{4.4.1.2} $DBH \geq DBH_T$: $CW = a_1 * DBH^{a_2}$

{4.4.1.3} $DBH \geq DBH_T$: $CW = a_1 + a_2 * DBH + a_3 * DBH^2$

{4.4.1.4} $HT < 4.5$' and $DBH < DBH_T$: $CW = HT * s_1$

{4.4.1.5} $HT \geq 4.5$' and $DBH < DBH_T$: $CW = d_1 + d_2 * DBH$

where:

CW	is maximum tree crown width

DBH is tree diameter at breast height
DBH_T is threshold diameter shown in table 4.4.1.1
HT is tree height
s_1, $d_{1\text{-}2}$, and $a_{1\text{-}3}$ are species-specific coefficients shown in table 4.4.1.1

Table 4.4.1.1 Coefficients and equation reference for R5 Crown Width equations {4.4.1.1} – {4.4.1.5} in the NC variant.

Species Code	Equation Used*	DBH_T	d_1	d_2	a_1	a_2	a_3	s_1
OS	{4.4.2.1}	5	3.5	1.1	6	0.6	0	0.7778
SP	{4.4.2.1}	7.4	3.5	0.338	-1.476	1.01	0	0.7778
DF	{4.4.2.1}	5	3.62	1.37	6.81	0.732	0	0.7778
WF	{4.4.2.1}	5	3.26	1.103	5.82	0.591	0	0.7778
MA	{4.4.2.1}	5	3.11	1.008	1	1.43	0	0.5556
IC	{4.4.2.1}	5	3.5	1.192	7.11	0.47	0	0.7778
BO	{4.4.2.1}	5	2.5	2.7	10	1.2	0	0.5556
TO	{4.4.2.1}	13.4	2.23	1.63	10	1.05	0	0.5556
RF	{4.4.2.1}	5	3.5	1.063	6.71	0.421	0	0.7778
PP	{4.4.2.2}	5	3.77	0.7756	2.24	0.763	0	0.7778
OH	{4.4.2.1}	5	2.5	1.4	2	1.5	0	0.5556

*Equation refers to the species-specific equation used when $DBH \geq DBH_T$

4.4.2 Region 6 Crown Width

Crown width for region 6 forests, Bureau of Land Management and Simpson Lumber locations are calculated using equations {4.4.2.1} – {4.4.2.3}, and coefficients for these equations are shown in table 4.4.2.1. The minimum diameter and bounds for certain data values are given in table 4.4.2.2. Equation numbers in table 4.4.2.1 are given with the first three digits representing the FIA species code, and the last two digits representing the equation source.

{4.4.2.1} Bechtold (2004); Equation 02

DBH ≥ *MinD*: $CW = a_1 + (a_2 * DBH) + (a_3 * DBH^2) + (a_4 * CR\%) + (a_5 * BA) + (a_6 * HI)$
DBH < *MinD*: $CW = [a_1 + (a_2 * MinD) + (a_3 * MinD^2) + (a_4 * CR\%) + (a_5 * BA) + (a_6 * HI)] * (DBH / MinD)$

{4.4.2.2} Crookston (2005); Equation 05

DBH ≥ *MinD*: $CW = (a_1 * BF) * DBH^{a_2} * HT^{a_3} * CL^{a_4} * (BA + 1.0)^{a_5} * \exp(EL)^{a_6}$
DBH < *MinD*: $CW = [CW = (a_1 * BF) * MinD^{a_2} * HT^{a_3} * CL^{a_4} * (BA + 1.0)^{a_5} * \exp(EL)^{a_6}] * (DBH / MinD)$

{4.4.2.3} Donnelly (1996); Equation 06

DBH ≥ *MinD* $CW = a_1 * DBH^{a_2}$
DBH < *MinD* $CW = [a_1 * MinD^{a_2}] * (DBH / MinD)$

where:

BF is a species-specific coefficient based on forest code (*BF* = 1.0 in the AK variant)
CW is tree maximum crown width
CL is tree crown length
DBH is tree diameter at breast height
HT is tree height
BA is total stand basal area
EL is stand elevation in hundreds of feet
MinD is the minimum diameter
HI is the Hopkins Index
HI = (ELEVATION - 5449) / 100) * 1.0 + (LATITUDE - 42.16) * 4.0 + (-116.39 -LONGITUDE) * 1.25
$a_1 - a_6$ are species-specific coefficients shown in table 4.4.2

Table 4.4.2.1 Coefficients for crown width equations {4.4.2.1}-{4.4.2.3} in the NC variant.

Species Code	Equation Number*	a_1	a_2	a_3	a_4	a_5	a_6
OS	12205	4.7762	0.74126	-0.28734	0.17137	-0.00602	-0.00209
SP	11705	3.593	0.63503	-0.22766	0.17827	0.04267	-0.0029
DF	20205	6.0227	0.54361	-0.20669	0.20395	-0.00644	-0.00378
WF	01505	5.0312	0.5368	-0.18957	0.16199	0.04385	-0.00651
MA	36102	4.9133	0.9459	0	0.0611	0	0.0523
IC	08105	5.0446	0.47419	-0.13917	0.1423	0.04838	-0.00616
BO	81802	1.6306	0.9867	0	0.0556	0	-0.1199
TO	63102	3.115	0.7966	0	0.0745	-0.0053	0.0523
RF	02006	3.1146	0.578	0	0	0	0
PP	12205	4.7762	0.74126	-0.28734	0.17137	-0.00602	-0.00209
OH	81802	1.630	0.9867	0	0.0556	0	-0.1199

*Equation number is a combination of the species FIA code (###) and equation source (##).

Table 4.4.2.2 *MinD* values and data bounds for equations {4.4.2.1}-{4.4.2.3} in the NC variant.

Species Code	Equation Number*	*MinD*	*EL min*	*EL* max	*HI* min	*HI* max	*CW* max
OS	12205	1.0	13	75	n/a	n/a	50
SP	11705	1.0	5	75	n/a	n/a	56
DF	20205	1.0	1	75	n/a	n/a	80
WF	01505	1.0	2	75	n/a	n/a	35
MA	36102	5.0	n/a	n/a	-55	15	43
IC	08105	1.0	5	62	n/a	n/a	78
BO	81802	5.0	n/a	n/a	-47	-8	52
TO	63102	5.0	n/a	n/a	-55	15	41
RF	02006	1.0	n/a	n/a	n/a	n/a	65
PP	12205	1.0	13	75	n/a	n/a	50
OH	81802	5.0	n/a	n/a	-47	-8	52

Table 4.4.2.3 *BF* values for equation {4.4.2.2} in the NC variant.

Species Code	Location Code
	611, 712, 800
IC	0.821
DF	0.961
PP	0.951

*Any *BF* values not listed in Table 4.4.2.3 are assumed to be *BF* = 1.0

4.5 Crown Competition Factor

The NC variant uses crown competition factor (*CCF*) as a predictor variable in some growth relationships. Crown competition factor (Krajicek and others 1961) is a relative measurement of stand density that is based on tree diameters. Individual tree CCF_t values estimate the percentage of an acre that would be covered by the tree's crown if the tree were open-grown. Stand *CCF* is the summation of individual tree (CCF_t) values. A stand *CCF* value of 100 theoretically indicates that tree crowns will just touch in an unthinned, evenly spaced stand.

Crown competition factor for an individual tree is calculated using equation {4.5.1} (Paine and Hahn 1982). All species coefficients are shown in table 4.5.1.

{4.5.1} *CCF* equations

$DBH \geq 1.0$": $CCF_t = R_1 + (R_2 * DBH) + (R_3 * DBH^2)$
0.1" < DBH < 1.0": $CCF_t = R_4 * DBH^{R_5}$
$DBH \leq 0.1$": $CCF_t = 0.001$

where:

CCF_t is crown competition factor for an individual tree
DBH is tree diameter at breast height
$R_1 – R_5$ are species-specific coefficients shown in table 4.5.1

Table 4.5.1 Coefficients for *CCF* equations {4.5.1} – {4.5.3} in the NC variant.

Species Code	Model Coefficients				
	R_1	**R_2**	**R_3**	**R_4**	**R_5**
OS	0.0388	0.0269	0.00466	0.009884	1.6667
SP	0.0392	0.018	0.00207	0.007244	1.8182
DF	0.0388	0.0269	0.00466	0.017299	1.5571
WF	0.069	0.0225	0.00183	0.015248	1.7333
MA	0.0212	0.0167	0.0033	0.011109	1.725
IC	0.0194	0.0142	0.00261	0.008915	1.78
BO	0.0204	0.0246	0.0074	0.009187	1.76
TO	0.0356	0.0273	0.00524	0.007875	1.736
RF	0.0172	0.00877	0.00112	0.011402	1.756
PP	0.0219	0.0169	0.00325	0.007813	1.778
OH	0.0356	0.0273	0.00524	0.011109	1.725

4.6 Small Tree Growth Relationships

Trees are considered "small trees" for FVS modeling purposes when they are smaller than some threshold diameter. The threshold diameter is set to 3.0" for all species in the NC variant.

The small tree model is height-growth driven, meaning height growth is estimated first and diameter growth is estimated from height growth. These relationships are discussed in the following sections.

4.6.1 Small Tree Height Growth

The small-tree height increment model predicts 5-year height growth (*HTG*) for small trees. Height growth in the NC variant is estimated by using equations {4.6.1.1} - {4.6.1.3}. Equation reference, coefficients, and site index adjustment factors are shown in table 4.6.1.1.

{4.6.1.1} $HTG = -2.193 + (4.292 * RELHT) + (0.0566 * CR^2) + (0.1699 * HT) + (-0.00828 * BA) + (0.00768 * SI)$

{4.6.1.2} $HTG = \exp[c_1 + c_2 * \ln(BA)]$

{4.6.1.3} *RELHT* equations

HT or *AVH* are 0: *RELHT* = 1
HT > 0, *AVH* > 0, *PCCF* > 75: *RELHT* = *HT* / *AVH*
HT > 0, *AVH* > 0, *PCCF* $\leq$ 75: *RELHT* = 1 – [(((HT / AVH) – 1) / 75) * PCCF]

where:

HTG	is estimated height growth for the cycle
RELHT	is a relative tree height variable; bounded so RELHT $\leq$ 1.5
CR	is crown ratio expressed as a percent divided by 10
HT	is tree height
BA	is total stand basal area
SI	is species site index
AVH	is average height of the 40 largest diameter trees in the stand
PCCF	is crown competition factor or the inventory point on which the tree is located
c_1 and c_2	are species specific coefficients shown in table 4.6.1.1

Table 4.6.1.1 Equation reference, diameter bounds, and coefficients by species for small-tree height growth in the NC variant.

Species Code	*POTHTG* Equation	c_1	c_2	X_{min}	X_{max}
OS	{4.6.1.1}	0	0	2.0	5.0
SP	{4.6.1.1}	0	0	2.0	5.0
DF	{4.6.1.1}	0	0	2.0	5.0
WF	{4.6.1.1}	0	0	2.0	5.0
MA	{4.6.1.2}	3.560	-0.54648	2.0	5.0
IC	{4.6.1.1}	0	0	2.0	5.0
BO	{4.6.1.2}	3.817	-0.78296	2.0	5.0
TO	{4.6.1.2}	3.385	-0.58984	2.0	5.0

Species Code	*POTHTG* Equation	c_1	c_2	X_{min}	X_{max}
RF	{4.6.1.1}	0	0	2.0	5.0
PP	{4.6.1.1}	0	0	2.0	5.0
OH	{4.6.1.2}	3.385	-0.54984	2.0	5.0

For all species, a small random error is then added to the height growth estimate. The estimated height growth (*HTG*) is then adjusted to account for cycle length, user defined small-tree height growth adjustments, and adjustments due to small tree height model calibration from the input data.

Height growth estimates from the small-tree model are weighted with the height growth estimates from the large tree model over a range of diameters (X_{min} and X_{max}) in order to smooth the transition between the two models. For example, the closer a tree's *DBH* value is to the minimum diameter (X_{min}), the more the growth estimate will be weighted towards the small-tree growth model. The closer a tree's *DBH* value is to the maximum diameter (X_{max}), the more the growth estimate will be weighted towards the large-tree growth model. If a tree's *DBH* value falls outside of the range given by X_{min} and X_{max}, then the model will use only the small-tree or large-tree growth model in the growth estimate. The weight applied to the growth estimate is calculated using equation {4.6.1.3}, and applied as shown in equation {4.6.1.4}. The range of diameters where this weighting occurs for each species is shown above in table 4.6.1.1.

{4.6.1.3}

$DBH \leq X_{min}$: $XWT = 0$
$X_{min} < DBH < X_{max}$: $XWT = (DBH - X_{min}) / (X_{max} - X_{min})$
$DBH \geq X_{max}$: $XWT = 1$

{4.6.1.4} Estimated growth = [(1 - *XWT*) * *STGE*] + [*XWT* * *LTGE*]

where:

XWT	is the weight applied to the growth estimates
DBH	is tree diameter at breast height
X_{max}	is the maximum *DBH* where weighting between small and large tree models occurs
X_{min}	is the minimum *DBH* where weighting between small and large tree models occurs
STGE	is the growth estimate obtained using the small-tree growth model
LTGE	is the growth estimate obtained using the large-tree growth model

4.6.2 Small Tree Diameter Growth

As stated previously, for trees being projected with the small tree equations, height growth is predicted first, and then diameter growth. So both height at the beginning of the cycle and height at the end of the cycle are known when predicting diameter growth. Small tree diameter growth for trees over 4.5 feet tall is calculated as the difference of predicted diameter at the start of the projection period and the predicted diameter at the end of the projection period, adjusted for bark ratio. These two predicted diameters are estimated using the species-specific height-diameter relationships discussed in section 4.1. By definition, diameter growth is zero for trees less than 4.5 feet tall.

4.7 Large Tree Growth Relationships

Trees are considered "large trees" for FVS modeling purposes when they are equal to, or larger than, some threshold diameter. This threshold diameter is set to 3.0" for all species in the NC variant.

The large-tree model is driven by diameter growth meaning diameter growth is estimated first, and then height growth is estimated from diameter growth and other variables. These relationships are discussed in the following sections.

4.7.1 Large Tree Diameter Growth

The large tree diameter growth model used in most FVS variants is described in section 7.2.1 in Dixon (2002). For most variants, instead of predicting diameter increment directly, the natural log of the periodic change in squared inside-bark diameter (ln(*DDS*)) is predicted (Dixon 2002; Wykoff 1990; Stage 1973; and Cole and Stage 1972). For variants predicting diameter increment directly, diameter increment is converted to the *DDS* scale to keep the FVS system consistent across all variants.

In the NC variant, two different function forms are used to estimate large-tree diameter growth. Sugar pine (2), incense cedar (6), and red fir (9) use equation 4.7.1.1 to yield a 10-year estimate of ln(DDS). This 10-year estimate is then converted to a 5-year estimate using equation 4.7.1.2. All other species use equation 4.7.1.3 which yields a 5-year estimate of ln(DDS).

{4.7.1.1} $LDDS = b_1 + (b_2 * EL) + (b_3 * SI) + (b_4 * SL) + (b_5 * SL\text{^}2) + b_6 * \ln(DBH)) + (b_7 * DBH\text{^}2 / 1000) + (b_8 * ICR\text{^}2 / (\ln(DBH + 1.0)) * 1000) + (b_9 * PBAL / (\ln(DBH + 1)) * 100) + (b_{10} * \ln(PBA))$

{4.7.1.2} $\ln(DDS) = \ln(\exp(LDDS) / 2.0)$

{4.7.1.3} $\ln(DDS) = b_1 + (b_2 * EL\text{^}2) + (b_3 * \ln(SI)) + (b_4 * \sin(ASP) * SL) + (b_5 * \cos(ASP) * SL) + (b_6 * SL) + (b_7 * SL\text{^}2) + (b_8 * \ln(DBH)) + (b_9 * CR) + (b_{10} * CR\text{^}2) + (b_{11} * DBH\text{^}2) + (b_{12} * BAL / (\ln(DBH + 1.0))) + (b_{13} * PCCF) + (b_{14} * RELHT) + (b_{15} * \ln(CCF)) + (b_{16} * \ln(BA)) + b_{17}$

where:

DDS	is the square of the diameter growth increment
EL	is stand elevation in hundreds of feet
SI	is species site index
ASP	is stand aspect
SL	is stand slope
CR	is crown ratio expressed as a proportion
ICR	is crown ratio expressed as a percent
DBH	is tree diameter at breast height
PBAL	is point basal area in trees larger than the subject tree
BAL	is total basal area in trees larger than the subject tree
CCF	is stand crown competition factor
PCCF	is crown competition factor on the inventory point where the tree is established
BA	is total stand basal area
PBA	is basal area on the inventory point where the tree is established
RELHT	is tree height divided by average height of the 40 largest diameter trees in the stand
b_1 - b_{17}	are species-specific coefficients shown in table 4.7.1.1 or table 4.7.1.2

Table 4.7.1.1 Coefficients ($b_1 – b_{17}$) for equations {4.7.1.1} and {4.7.1.3} in the NC variant.

	Species Code					
Coefficient	**OS**	**SP**	**DF**	**WF**	**MA**	**IC**
b_1	**	-0.4297	**	**	**	0.0540
b_2	0	0	0	0	0	0
b_3	0.47932	0.01401	0.56356	0.4736	0.20189	0.012
b_4	-0.02884	0	-0.040708	-0.0156	-0.10656	0
b_5	-0.14319	0	-0.16836	-0.1563	-0.19174	0
b_6	0.635	1.26883	0.46468	0.58937	-1.29627	1.41389
b_7	-1.094	-0.35325	-0.87145	-1.05045	0.87335	-0.48938
b_8	0.88425	0.27986	0.8699	1.01718	1.14082	0.32660
b_9	2.83271	-0.79922	2.9604	3.01884	2.82796	-0.16000
b_{10}	-0.84141	0	-1.08219	-1.12464	-2.14739	-0.25287
b_{11}	-0.000328*		-0.000313	-0.000356*	-0.000875	
b_{12}	-0.00358		-0.00443	-0.00257	-0.00126	
b_{13}	0		0	0	0	
b_{14}	0		0	0	0.56348	
b_{15}	-0.06784		0	0	0	
b_{16}	0		-0.01744	-0.16596	0	
b_{17}	0		0	-0.15032	0	

	Species Code				
Coefficient	**BO**	**TO**	**RF**	**PP**	**OH**
b_1	**	**	0.1434	**	**
b_2	0	0	-0.007	0	0
b_3	0.32093	0.00659	0.00734	1.10842	0.00659
b_4	-0.11954	-0.03587	0	0	-0.03587
b_5	0.08632	-0.19935	-0.834	0	-0.19935
b_6	0.85815	0.7353	1.53339	0	0.7353
b_7	-1.17209	-0.99561	-0.47442	0	-0.99561
b_8	1.23911	0.99531	0.35739	0.96865	0.99531
b_9	-1.20841	2.08524	-0.44256	1.5466	2.08524
b_{10}	2.31782	-0.98396	-0.12359	0.07152	-0.98396
*b_{11}	-0.000338	-0.000373		-0.000728	-0.000373
b_{12}	-0.00199	-0.00147		-0.00408	-0.00147
b_{13}	0	-0.00018		-0.00002	-0.00018
b_{14}	0	0.50155		0	0.50155
b_{15}	0	0		0	0
b_{16}	0	0		0	0
b_{17}	0	0		0	0

*If the location code is 705 (Hoopa Indian Reservation) or 800 (Simpson Timber), the β_{11} value is –0.000248 for OS and –0.000268 for WF.
**See tables 4.7.1.2 and 4.7.1.3 for these values

Table 4.7.1.2 b_1 values by location class for equation {4.7.1.3} in the NC variant.

Location Class	Species Code							
	OS	DF	WF	MA	BO	TO	PP	OH
1	-2.00201	-2.54402	-1.88042	-1.6995	-2.68349	-0.94563	-4.6744	-0.94563
2	-2.19449	-2.41928	-2.06853	0	0	0	0	0
3	-1.84083	-2.75656	-1.69815	0	0	0	0	0

Table 4.7.1.3 Location class by species and location code in the NC variant.

Location Code	Species Code							
	OS	DF	WF	MA	BO	TO	PP	OH
505 – Klamath	1	1	1	1	1	1	1	1
510 – Six Rivers	1	1	1	1	1	1	1	1
514 – Shasta-Trinity	1	1	1	1	1	1	1	1
611 – Siskiyou	2	2	2	1	1	1	1	1
705 – Hoopa Indian Reservation	3	3	3	1	1	1	1	1
712 – BLM Coos Bay	2	2	2	1	1	1	1	1
800 – Simpson Timber	3	3	3	1	1	1	1	1

4.7.2 Large Tree Height Growth

The height growth equations used in the NC variant are based on site index curves. Species differences in height growth are accounted for by entering the appropriate curve with the species specific site index value (see section 3.4). Equations {4.7.2.1} – {4.7.2.6} are used to calculate estimated height growth.

{4.7.2.1} Used for other softwoods and Douglas-fir

$$H5 = [A_5\text{^}2 / (X + (Y * A_5) + (Z * A_5\text{^}2))] + 4.5$$
$$X = b_1 + (b_2 * b0) / (SI - 4.5)$$
$$Y = b_3 + (b_4 * b0) / (SI - 4.5)$$
$$Z = b_5 + (b_6 * b0) / (SI - 4.5)$$

{4.7.2.2} Used for white fir, incense-cedar, and California red fir

$$H5 = [(SI - b_0 + (X_1 * X_2)) / X_1] + 4.5$$
$$X_1 = b_1 * A_5\text{^}b_2 * \exp(b_3 * A_5)$$
$$X_2 = b_4 * (1.0 - \exp(b_5 * A_5\text{^}b_6)$$

{4.7.2.3} Used for Pacific madrone

$$H5 = SI / [b_0 + (b_1 / A_5)]$$

{4.7.2.4} Used for black oak

$H5 = [SI * (1 + (b_2 * TERM)) – (b_1 * TERM)] * 0.80$
$TERM = (A_5)^{0.5} – 7.0711$

{4.7.2.5} Used for tanoak and other hardwoods

$H5 = [SI / (b_0 + (b_1 / A_5))] * 0.85$

{4.7.2.6} Used for ponderosa pine and sugar pine

$H5 = ((b_1 * SI) – b_2) * [(1 – \exp(b_3 * A_5))^{(0.001 * SI + b_4)}]$

where:

H5	is estimated height of the tree in five years
SI	is species site index
A_5	is estimated age of the tree in five years
b_0– b_6	are species-specific coefficients shown in table 4.7.2.1

Table 4.7.2.1 Coefficients (b_0 - b_6) for height-growth equations in the NC variant.

	Species Code					
Coefficient	**OS**	**SP**	**DF**	**WF**	**MA**	**IC**
b_0	2500	0	2500	69.91	0.375	69.91
b_1	-0.954038	1.88	-0.954038	38.0202	31.233	38.0202
b_2	0.109757	7.178	0.109757	-1.05213	0	-1.05213
b_3	0.0558178	-0.025	0.055818	0.009557	0	0.009557
b_4	0.0079224	1.64	0.0079224	101.84289	0	101.84289
b_5	-0.0007338	0	-0.0007338	-0.001442	0	-0.001442
b_6	0.0001977	0	0.0001977	1.679259	0	1.679259

	Species Code				
Coefficient	**BO**	**TO**	**RF**	**PP**	**OH**
b_0	0	0.204	69.91	0	0.204
b_1	6.413	39.787	38.0202	1.88	39.787
b_2	0.322	0	-1.05213	7.178	0
b_3	0	0	0.009557	-0.025	0
b_4	0	0	101.84289	1.64	0
b_5	0	0	-0.001442	0	0
b_6	0	0	1.679259	0	0

Potential 5-year height growth (*POTHTG*) is calculated by using equation {4.7.2.7}. If the initial height of the tree is greater than or equal to 300 feet, or the initial age of the tree is greater than or equal to 200 years, then potential height growth is set to 0.1 foot. Modifiers are applied to the height growth based upon a tree's crown ratio and relative height (using equation {4.7.2.8}). Final height growth is calculated using equation {4.7.2.9} as a product of the modifier and potential height growth. The final height growth is then adjusted to the length of the cycle.

{4.7.2.7} $POTHTG = H5 – HT$

{4.7.2.8} $HTGMOD = -0.02647 + 0.71338 * RELHT^2 + 0.06851 * CR$

{4.7.2.9} $HTG = POTHTG * HTGMOD$

where:

POTHTG	is potential height growth
H5	is estimated height of the tree in five years
HT	is tree height at the beginning of the cycle
HTG	is estimated height growth for the cycle
HTGMOD	is a weighted height growth modifier
CR	is a tree's live crown ratio (compacted) expressed as a percent divided by 10
RELHT	is tree height divided by average height of the 40 largest diameter trees in the stand

5.0 Mortality Model

The NC variant uses an SDI-based mortality model as described in Section 7.3.2 of Essential FVS: A User's Guide to the Forest Vegetation Simulator (Dixon 2002, referred to as EFVS). This SDI-based mortality model is comprised of two steps: 1) determining the amount of stand mortality (section 7.3.2.1 of EFVS) and 2) dispersing stand mortality to individual tree records (section7.3.2.2 of EFVS). In determining the amount of stand mortality, the summation of individual tree background mortality rates is used when stand density is below the minimum level for density dependent mortality (default is 55% of maximum SDI), while stand level density-related mortality rates are used when stands are above this minimum level.

The equation used to calculate individual tree background mortality rates for all species is shown in equation {5.0.1}, and this is then adjusted to the length of the cycle by using a compound interest formula as shown in equation {5.0.2}. Species mapping and coefficients for these equations are shown in tables 5.0.1 and 5.0.2. The overall amount of mortality calculated for the stand is the summation of the final mortality rate (*RIP*) across all live tree records.

{5.0.1} $RI = [1 / (1 + \exp(p_0 + p_1 * DBH))] * 0.5$

{5.0.2} $RIP = 1 - (1 - RI)^{\wedge}Y$

where:

RI	is the proportion of the tree record attributed to mortality
RIP	is the final mortality rate adjusted to the length of the cycle
DBH	is tree diameter at breast height
Y	is length of the current projection cycle in years
p_0 and p_1	are species-specific coefficients shown in table 5.0.1

Table 5.1.1 Coefficients used in the background mortality equation {5.0.1} in the NC variant.

Species Code	p_0	p_1
OS	6.5112	-0.00525
SP	6.5112	-0.00525
DF	7.2985	-0.01291
WF	5.1677	-0.00777
MA	9.6943	-0.01273
IC	5.1677	-0.00777
BO	5.9617	-0.03401
TO	9.6943	-0.01273
RF	5.1677	-0.00777
PP	5.5877	-0.00535
OH	5.1677	-0.00777

When stand density-related mortality is in effect, the total amount of stand mortality is determined based on the trajectory developed from the relationship between stand SDI and the maximum SDI for the stand. This is explained in section 7.3.2.1 of EFVS.

Once the amount of stand mortality is determined based on either the summation of background mortality rates or density-related mortality rates, mortality is dispersed to individual tree records in relation to a tree's percentile in the basal area distribution (*PCT*) using equation {5.0.3}. This value is then adjusted by a species-specific mortality modifier (representing the species' tolerance) to obtain a final mortality rate as shown in equation {5.0.4}.

The mortality model makes multiple passes through the tree records multiplying a record's trees-per-acre value times the final mortality rate (*MORT*), accumulating the results, and reducing the trees-per-acre representation until the desired mortality level has been reached. If the stand still exceeds the basal area maximum sustainable on the site the mortality rates are proportionally adjusted to reduce the stand to the specified basal area maximum.

{5.0.3} $MR = 0.84525 - (0.01074 * PCT) + (0.0000002 * PCT^3)$

{5.0.4} $MORT = MR * MWT * 0.1$

where:

MR	is the proportion of the tree record attributed to mortality (bounded: $0.01 \leq MR \leq 1$)
PCT	is the subject tree's percentile in the basal area distribution of the stand
MORT	is the final mortality rate of the tree record
MWT	is a mortality weight value based on a species' tolerance shown in table 5.0.3

Table 5.0.3 *MWT* values for the mortality equation {5.0.4} in the NC variant.

Species Code	*MWT*
OS	0.65
SP	0.7
DF	0.65
WF	0.55
MA	0.8
IC	0.6
BO	1.0
TO	0.55
RF	0.5
PP	0.85
OH	0.55

6.0 Regeneration

The NC variant contains a partial establishment model which may be used to input regeneration and ingrowth into simulations. A more detailed description of how the partial establishment model works can be found in section 5.4.5 of the Essential FVS Guide (Dixon 2002).

The regeneration model is used to simulate stand establishment from bare ground, or to bring seedlings and sprouts into a simulation with existing trees. Sprouts are automatically added to the simulation following harvest or burning of known sprouting species (see table 6.0.1 for sprouting species).

Table 6.0.1 Regeneration parameters by species in the NC variant.

Species Code	Sprouting Species	Minimum Bud Width (in)	Minimum Tree Height (ft)	Maximum Tree Height (ft)
OS	No	0.3	1	27
SP	No	0.4	1	31
DF	No	0.3	1	25
WF	No	0.3	0.5	25
MA	Yes	0.2	1	26
IC	No	0.2	0.5	24
BO	Yes	0.2	0.5	28
TO	Yes	0.2	1	20
RF	No	0.3	0.5	20
PP	No	0.5	1	18
OH	No	0.2	1	26

For more prolific stump sprouting hardwood species, logic rule {6.0.1} is used to determine the number of sprout records, with logic rule {6.0.2} being used for root suckering species. The trees-per-acre represented by each sprout record is determined using the general sprouting probability equation {6.0.2}. See table 6.0.2 for species-specific sprouting probabilities, number of sprout records created, and reference information.

Users wanting to modify or turn off automatic sprouting can do so with the SPROUT or NOSPROUT keywords, respectively. Sprouts are not subject to maximum and minimum tree heights found in table 6.0.1 and do not need to be grown to the end of the cycle because estimated heights and diameters are end of cycle values.

{6.0.1} For stump sprouting hardwood species

$DSTMP_i \leq 5$: $NUMSPRC = 1$
$5 < DSTMP_i \leq 10$: $NUMSPRC = \text{NINT}(0.2 * DSTMP_i)$
$DSTMP_i > 10$: $NUMSPRC = 2$

{6.0.2} For root suckering hardwood species

$DSTMP_i \leq 5$: $NUMSPRC = 1$
$5 < DSTMP_i \leq 10$: $NUMSPRC = \text{NINT}(-1.0 + 0.4 * DSTMP_i)$

$DSTMP_i$ > 10: $NUMSPRC$ = 3

{6.0.3} $TPA_s = TPA_i * PS$

where:

$DSTMP_i$	is the diameter at breast height of the parent tree
$NUMSPRC$	is the number of sprout tree records
NINT	rounds the value to the nearest integer
TPA_s	is the trees per acre represented by each sprout record
TPA_i	is the trees per acre removed/killed represented by the parent tree
PS	is a sprouting probability (see table 6.0.2)

Table 6.0.2 Sprouting algorithm parameters for sprouting species in the NC variant.

Species Code	Sprouting Probability	Number of Sprout Records	Source
MA	0.9	{6.0.2}	McDonald et al. 1983 McDonald and Tappenier 1990
BO	0.9	{6.0.1}	McDonald 1978 McDonald 1990
TO	0.9	{6.0.2}	Harrington et al. 1992 Wilkinson et al. 1997 Fryer 2008

Regeneration of seedlings must be specified by the user with the partial establishment model by using the PLANT or NATURAL keywords. Height of the seedlings is estimated in two steps. First, the height is estimated when a tree is 5 years old (or the end of the cycle – whichever comes first) by using the small-tree height growth equations found in section 4.6.1. Users may override this value by entering a height in field 6 of the PLANT or NATURAL keyword; however the height entered in field 6 is not subject to minimum height restrictions and seedlings as small as 0.05 feet may be established. The second step also uses the equations in section 4.6.1, which grow the trees in height from the point five years after establishment to the end of the cycle.

Seedlings and sprouts are passed to the main FVS model at the end of the growth cycle in which regeneration is established. Unless noted above, seedlings being passed are subject to minimum and maximum height constraints and a minimum budwidth constraint shown in table 6.0.1. After seedling height is estimated, diameter growth is estimated using equations described in section 4.6.2. Crown ratios on newly established trees are estimated as described in section 4.3.1.

Regenerated trees and sprouts can be identified in the treelist output file with tree identification numbers beginning with the letters “ES”.

7.0 Volume

In the NC variant, volume is calculated for three merchantability standards: total stem cubic feet, merchantable stem cubic feet, and merchantable stem board feet (Scribner Decimal C (R5) and Scribner (R6)). Volume estimation is based on methods contained in the National Volume Estimator Library maintained by the Forest Products Measurements group in the Forest Management Service Center (Volume Estimator Library Equations 2009). The default volume merchantability standards and equation numbers for the NC variant are shown in tables 7.0.1-7.0.3.

Table 7.0.1 Volume merchantability standards for the NC variant.

Merchantable Cubic Foot Volume Specifications:		
Minimum DBH / Top Diameter	Hardwoods	Softwoods
705 & 712	9.0 / 5.0 inches	9.0 / 5.0 inches
Region 5	9.0 / 6.0 inches	9.0 / 6.0 inches
Region 6	9.0 / 4.5 inches	9.0 / 4.5 inches
Stump Height	1.0 foot	1.0 foot
Merchantable Board Foot Volume Specifications:		
Minimum DBH / Top Diameter	Hardwoods	Softwoods
705 & 712	9.0 / 5.0 inches	9.0 / 5.0 inches
Region 5	9.0 / 6.0 inches	9.0 / 6.0 inches
Region 6	9.0 / 4.5 inches	9.0 / 4.5 inches
Stump Height	1.0 foot	1.0 foot

Table 7.0.2 Volume equation defaults for each species, at specific location codes, with model name.

Common Name	Location Code	Equation Number	Model Type
other softwoods	505, 510, 514, 800	500WO2W108	Wensel and Olsen Profile Model
other softwoods	611	616BEHW298	Behre's Hyperbola
other softwoods	705, 712	B00BEHW999	Behre's Hyperbola
sugar pine	505, 510, 514, 800	500WO2W117	Wensel and Olsen Profile Model
sugar pine	611	616BEHW117	Behre's Hyperbola
sugar pine	705, 712	B00BEHW117	Behre's Hyperbola
Douglas-fir	505, 510, 514, 800	500WO2W202	Wensel and Olsen Profile Model
Douglas-fir	611	F06FW2W202	Behre's Hyperbola
Douglas-fir	705, 712	B02BEHW202	Behre's Hyperbola
white fir	505, 510, 514, 800	500WO2W015	Wensel and Olsen Profile Model
white fir	611	I00FW2W093	Behre's Hyperbola
white fir	705, 712	B00BEHW015	Behre's Hyperbola
Pacific madrone	505, 510, 514, 800	500DVEW361	Pillsbury and Kirkley Equations
Pacific madrone	611	616BEHW361	Behre's Hyperbola
Pacific madrone	705, 712	B00BEHW361	Behre's Hyperbola
incense-cedar	505, 510, 514, 800	500WO2W081	Wensel and Olsen Profile Model
incense-cedar	611	616BEHW081	Behre's Hyperbola

Common Name	Location Code	Equation Number	Model Type
incense-cedar	705, 712	B00BEHW081	Behre's Hyperbola
California black oak	505, 510, 514, 800	500DVEW818	Pillsbury and Kirkley Equations
California black oak	611	616BEHW818	Behre's Hyperbola
California black oak	705, 712	B00BEHW800	Behre's Hyperbola
tanoak	505, 510, 514, 800	500DVEW631	Pillsbury and Kirkley Equations
tanoak	611	616BEHW631	Behre's Hyperbola
tanoak	705, 712	B00BEHW631	Behre's Hyperbola
California red fir	505, 510, 514, 800	500WO2W020	Wensel and Olsen Profile Model
California red fir	611	616BEHW020	Behre's Hyperbola
California red fir	705, 712	B00BEHW021	Behre's Hyperbola
ponderosa pine	505, 510, 514, 800	500WO2W122	Wensel and Olsen Profile Model
ponderosa pine	611	I00FW2W073	Behre's Hyperbola
ponderosa pine	705, 712	B00BEHW122	Behre's Hyperbola
other hardwoods	505, 510, 514, 800	500DVEW981	Pillsbury and Kirkley Equations
other hardwoods	611	616BEHW998	Behre's Hyperbola
other hardwoods	705, 712	B00BEHW999	Behre's Hyperbola

Table 7.0.3 Citations by Volume Model

Model Name	Citation
Behre's Hyperbola	USFS-R6 Sale Preparation and Valuation Section of Diameter and Volume Procedures - R6 Timber Cruise System. 1978.
Pillsbury and Kirkley Equations	Norman H Pillsbury and Michael L Kirkley 1984 Equations for Total, Wood, and saw-Log Volume for Thirteen California Hardwoods. Pacific Northwest Forest and Range Experiment Station Research Note PNW-414.
Wensel and Olsen Profile Model	Wensel, L. C. and C. M. Olson. 1993. Tree Taper Models for Major Commercial California Conifers. Research Note No. 33. Northern Calif. Forest Yield Cooperative. Dept. of Forstry and Mgmt., Univ. of Calif., Berkeley. 28 pp.

8.0 Fire and Fuels Extension (FFE-FVS)

The Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS) (Reinhardt and Crookston 2003) integrates FVS with models of fire behavior, fire effects, and fuel and snag dynamics. This allows users to simulate various management scenarios and compare their effect on potential fire hazard, surface fuel loading, snag levels, and stored carbon over time. Users can also simulate prescribed burns and wildfires and get estimates of the associated fire effects such as tree mortality, fuel consumption, and smoke production, as well as see their effect on future stand characteristics. FFE-FVS, like FVS, is run on individual stands, but it can be used to provide estimates of stand characteristics such as canopy base height and canopy bulk density when needed for landscape-level fire models.

For more information on FFE-FVS and how it is calibrated for the NC variant, refer to the updated FFE-FVS model documentation (Rebain, comp. 2010) available on the FVS website.

9.0 Insect and Disease Extensions

The FVS Insect and Pathogen model for dwarf mistletoe has been developed for the CA variant through the participation and contribution of various organizations led by Forest Health Protection. This model is currently maintained by the Forest Management Service Center and regional Forest Health Protection specialists. Additional details regarding this model may be found in chapter 8 of the Essential FVS Users Guide (Dixon 2002).

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11.0 Appendices

11.1 Appendix A. Distribution of Data Samples

The following tables contain distribution information of data used to fit species relationships in this variant's geographic region (information from original variant overview).

Table 11.1.1. Distribution of samples by National Forest, expressed in whole percent of total observations for each species.

Species	National Forest				Hoopa Indian Reservation	Simpson Timber Company	Total Number of Observations
	Klamath	Six Rivers	Trinity	Siskiyou			
Douglas-fir	5	24	1	26	31	13	6502
white fir	6	18	2	29	45	0	297
Pacific madrone	1	1	0	1	92	6	467
California black oak	0	2	0	0	98	0	198
tanoak	0	1	0	1	63	35	2376

ponderosa pine	21	60	1	13	5	0	389

Table 11.1.2. Distribution of samples for diameter breast high, expressed in whole percent of total observations for each species.

Species	DBH Range					
	0-5	5-10	10-15	15-20	20-25	25+
Douglas-fir	30	23	13	10	6	18
white fir	17	34	10	11	6	20
Pacific madrone	1	47	24	15	6	7
California black oak	0	49	30	9	6	7
tanoak	2	56	23	12	4	3
ponderosa pine	33	50	9	3	2	3

Table 11.1.3. Distribution of samples by Crown Ratio group, expressed in whole percent of total observations for each species.

Species	Crown Code (1=1-10,2=11-20,…,9=81-100)								
	1	2	3	4	5	6	7	8	9
Douglas-fir	1	6	11	15	12	10	9	10	26
white fir	2	9	16	17	12	10	11	10	12
Pacific madrone	10	24	27	17	11	7	3	1	1
California black oak	10	12	24	31	11	8	2	2	0
tanoak	3	11	24	20	14	12	9	4	2
ponderosa pine	1	5	10	9	9	19	22	16	8

Table 11.1.4. Distribution of samples by Aspect Code, expressed in percent of total observations for each species.

Species	Aspect Code								
	North	North-east	East	South-east	South	South-west	West	North-west	Level
Douglas-fir	20	13	13	9	11	10	11	12	1
white fir	8	11	6	4	13	24	14	19	1
Pacific madrone	6	6	12	6	21	14	24	10	1
California black oak	2	8	2	10	20	20	24	14	0
tanoak	19	10	16	11	12	10	11	9	1
ponderosa pine	19	18	11	14	15	9	6	7	0

Table 11.1.5. Distribution of samples by total stand basal area per acre, expressed in percent of total for each species.

Species	Basal Area								
	0-50	50-100	100-150	150-200	200-250	250-300	300-350	350-400	≥ 400
Douglas-fir	40	5	5	8	8	5	6	5	17
white fir	21	8	9	1	4	20	16	7	12
Pacific madrone	2	1	3	7	12	5	10	15	46
California black oak	1	1	1	10	1	20	3	27	35
tanoak	5	6	6	13	10	4	9	7	40
ponderosa pine	68	18	4	2	1	1	1	0	5

Table 11.1.6. Distribution of samples by diameter growth, expressed in percent for each species.

Species	Diameter Growth (inches/5 years)							
	< 0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	≥ 3.5
Douglas-fir	24	24	19	17	9	4	2	1
white fir	38	32	19	6	4	1	0	1
Pacific madrone	68	26	5	1	0	0	0	0
California black oak	87	12	1	0	0	0	0	0
tanoak	50	36	11	2	1	1	1	1
ponderosa pine	8	19	30	22	12	5	2	1

Table 11.1.7. Distribution of samples by elevation, expressed in percent for each species.

Species	Elevation				
	< 1000	1000-2000	2000-3000	3000-4000	> 4000
Douglas-fir	22	23	28	21	6
white fir	0	0	1	12	84
Pacific madrone	15	25	44	16	1
California black oak	44	41	12	2	2
tanoak	40	22	32	5	1
ponderosa pine	1	2	30	39	27

11.2 Appendix B. Plant Association Codes

Table 11.2.1 Region 5 Plant association codes recognized in the NC variant.

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
1 = 2TE/BEOC2 Conifer/water birch	43014	501 – Manning & Padgett
2 =2TE/ROWO Conifer/wood's rose	43015	501 – Manning & Padget
3 = 2TE/2FORB Conifer/tall forb	43016	501 – Manning & Padgett
4 = 2TE/2FORB Conifer/mesic forb	43017	501 – Manning & Padget
5 = PICO/CASC12 Lodgepole pine/mountain sedge	43031	501 – Manning & Padgett
6 = POTR5/BEOC2 Quaking aspen/water birch	43061	501 – Manning & Padget
7 = POTR5/COSE16 Quaking aspen/redosier dogwood	43062	501 – Manning & Padgett
8 = POTR5/SALIX Quaking aspen/willow	43063	501 – Manning & Padget
9 = POTR5/ROWO Quaking aspen/woods' rose	43064	501 – Manning & Padgett
10 = POTR5/BRCA5 Quaking aspen/California brome	43065	501 – Manning & Padget
11 = POTR5/POPR Quaking aspen/Kentucky bluegrass	43066	501 – Manning & Padgett
12 = POTR5/2FORB Quaking aspen/mesic forb	43067	501 – Manning & Padget
13 = POPUL/BEOC2 Cottonwood/water birch	43071	501 – Manning & Padgett
14 = POPUL/COSE16 Cottonwood/redosier dogwood	43072	501 – Manning & Padget
15 = POPUL/SALIX Cottonwood/willow	43073	501 – Manning & Padgett
16 = POPUL/ROWO Cottonwood/woods' rose	43074	501 – Manning & Padget

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
17 = POPUL/RHAR4 Cottonwood/fragrant sumac	43075	501 – Manning & Padgett
18 = POPUL Cottonwood (stream bar)	43076	501 – Manning & Padget
19 = ALIN2 Gray alder (bench)	43106	501 – Manning & Padgett
20 = BEOC2/2GRAM Water birch/mesic graminoid	43153	501 – Manning & Padget
21 = BEOC2/EQAR Water birch/field horsetail	43154	501 – Manning & Padgett
22 = BEOC2 Water birch (bench)	43156	501 – Manning & Padget
23 = SAEX/ROWO Narrowleaf willow/woods' rose	43246	501 – Manning & Padgett
24 = SAEX Narrowleaf willow (bench)	43267	501 – Manning & Padget
25 = SALE/CASC12 Lemmons willow/mountain sedge	43261	501 – Manning & Padgett
26 = SALE/2GRAM Lemmons willow/mesic graminoid	43262	501 – Manning & Padget
27 = SALE/2FORB Lemmons willow/mesic forb	43263	501 – Manning & Padgett
28 = SALE/2FORB Lemons willow/tall forb	43264	501 – Manning & Padget
29 = SALE Lemmons willow (seep)	43265	501 – Manning & Padgett
30 = SALE Lemmons willow (bench)	43266	501 – Manning & Padget
31 = SALU2/2GRAM Yellow willow/ mesic graminoid	43272	501 – Manning & Padgett
32 = SALU2/2FORB Yellow willow/mesic forb	43273	501 – Manning & Padget
33 = SALU2/ROWO Yellow willow/woods' rose	43274	501 – Manning & Padgett
34 = SALU2/POPR Yellow willow/Kentucky bluegrass	43275	501 – Manning & Padget
35 = SALU2 Yellow willow (bench)	43276	501 – Manning & Padgett
36 = SADR Drummond's willow	43282	501 – Manning & Padget
37 = SALUL/2FORB Pacific willow/mesic forb	43284	501 – Manning & Padgett
38 = SALUL Pacific willow (bench)	43285	501 – Manning & Padget
39 = SALA6/ROWO Arroyo willow/woods' rose	43287	501 – Manning & Padgett
40 = SALA6 Arroyo willow (bench)	43288	501 – Manning & Padget

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
41 = SALIX/CARO6 Willow/beaked sedge	43289	501 – Manning & Padgett
42 = SALIX/2GRAM Willow/mesic graminoid	43290	501 – Manning & Padget
43 = SALIX/2FORB Willow/mesic forb	43291	501 – Manning & Padgett
44 = SALIX/2FORB Willow/tall forb	43292	501 – Manning & Padget
45 = SALIX/ROWO Willow/woods' rose	43293	501 – Manning & Padgett
46 = SALIX/POPR Willow/Kentucky bluegrass	43294	501 – Manning & Padget
47 = SAWO/CASC12 Wolf's willow/mountain sedge	43304	501 – Manning & Padgett
48 = SAPL2/CASC12 Diamondleaf willow/mountain sedge	43325	501 – Manning & Padget
49 = SAEA/CASC12 Mountain willow/mountain sedge	43327	501 – Manning & Padgett
50 = SAOR/2FORB Sierra willow/tall forb	43328	501 – Manning & Padget
51 = SALIX/2FORB Willow/mesic forb	43329	501 – Manning & Padgett
52 = COSE16 Redosier dogwood	43351	501 – Manning & Padget
53 = COSE16/SALIX Redosier dogwood-willow	43352	501 – Manning & Padgett
54 = PRVI/ROWO Chokecherry/woods' rose	43451	501 – Manning & Padget
55 = ROWO Woods' rose	43500	501 – Manning & Padgett
56 = DAFL3/LIGR Shrubby cinquefoil/gray's licorice-root	43554	501 – Manning & Padget
57 = ARCA13/2GRAM Silver sagebrush/graminoid (dry)	43605	501 – Manning & Padgett
58 = ARCA13/2GRAM Silver sagebrush/graminoid (mesic)	43606	501 – Manning & Padget
59 = ARTRT/ROWO Basin big sagebrush/woods' rose	43651	501 – Manning & Padgett
60 = CADO2 Douglas' sedge	43803	501 – Manning & Padget
61 = CASC12 Mountain sedge	43811	501 – Manning & Padgett
62 = DECA18-CANE2 Tufted hairgrass-Nebraska sedge	43872	501 – Manning & Padget
63 = POSE Sandberg bluegrass	43883	501 – Manning & Padgett
64 = DOJE Sierra shootingstar	43905	501 – Manning & Padget

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
65 = LUPO2-SETR Bigleaf lupine-arrowleaf ragwort	43911	501 – Manning & Padgett
66 = IRMI/2GRAM Western iris/dry graminoid	43915	501 – Manning & Padget
67 = IRMI/2GRAM Western iris/ mesic graminoid	43916	501 – Manning & Padgett
68 = AGST2 Creping bentgrass	43991	501 – Manning & Padget
69 = HOBR2 Meadow barley	43995	501 – Manning & Padgett
70 = CHLA Port Orford cedar	CCOCCO00	510 – Jimerson, 1994
71 = Port Orford cedar/salal (1)	CCOCCO11	510 – Jimerson, 1994
72 = Port Orford cedar/pacific rhododendron-salal(1)	CCOCCO12	510 – Jimerson, 1994
73 = Port Orford cedar/western azalea (1)	CCOCCO13	510 – Jimerson, 1994
74 = Port Orford cedar-western white pine/huckleberry oak (1)	CCOCCO14	510 – Jimerson, 1994
75 = CHLA-ABCO Port Orford cedar-white fir	CCOCFW00	510 – Jimerson, 1994
76 = CHLA-ABCO/QUVA Port Orford cedar-white fir/huckleberry oak	CCOCFW11	510 – Jimerson, 1994
77 = CHLA-ABCO-PIMO3/QUVA Port Orford cedar-white fir-western white pine/huckleberry oak	CCOCFW12	510 – Jimerson, 1994
78 = CHLA-ABCO/RHOB Port Orford cedar-white fir/western azalea	CCOCFW13	510 – Jimerson, 1994
79 = CHLA-ABCO/2FORB Port Orford cedar-white fir/forbs	CCOCFW14	510 – Jimerson, 1994
80 = CHLA-ABCO/QUSA2 Port Orford cedar-white fir/deer oak	CCOCFW15	510 – Jimerson, 1994
81 = CHLA-ABSH/QUSA2-VAME Port Orford cedar-Shasta red fir/deer oak-thinleaf huckleberry	CCOCFW16	510 – Jimerson, 1994
82 = CHLA-PSME/QUVA Port Orford cedar-Douglas-fir/huckleberry oak	CCOCFW17	510 – Jimerson, 1994
83 = CHLA-CADE27-ALRH2 Port Orford cedar-incense cedar-white alder	CCOCFW18	510 – Jimerson, 1994
84 = PSME Douglas-fir	CD000000	513 – Jimerson et al, 1996
85 = PSME-CADE27 Douglas-fir-incense cedar	CD0CCI00	513 – Jimerson et al, 1996
86 = PSME-CADE27/FECA Douglas-fir-incense cedar/California fescue	CD0CCI11	513 – Jimerson et al, 1996
87 = PSME-PIJE Douglas-fir-Jeffrey Pine	CD0CPJ00	513 – Jimerson et al, 1996

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
88 = PSME-PIJE/FECA Douglas-fir-Jeffrey pine/California fescue	CD0CPJ11	513 – Jimerson et al, 1996
89 = PSME-ALRU2 Douglas-fir-red alder	CD0HAR00	513 – Jimerson et al, 1996
90 = PSME-ALRU2/ACCI/CLSIS Douglas-fir-red alder/vine maple/Siberian springbeauty	CD0HAR11	513 – Jimerson et al, 1996
91 = PSME-UMCA Douglas-fir-California laurel	CD0HBC00	513 – Jimerson et al, 1996
92 = PSME-UMCA/TODI Douglas-fir-California laurel/Pacific poison oak	CD0HBC11	513 – Jimerson et al, 1996
93 = PSME-UMCA/HODI Douglas-fir-California laurel/ocean spray	CD0HBC12	513 – Jimerson et al, 1996
94 = PSME-CHCHC4 Douglas-fir-giant chinquapin	CD0HGC00	513 – Jimerson et al, 1996
95 = PSME-CHCHC4-LIDE3 Douglas-fir-giant chinquapin-tanoak	CD0HGC11	513 – Jimerson et al, 1996
96 = PSME-CHCHC4/XETE Douglas-fir-giant chinquapin/common beargrass	CD0HGC12	513 – Jimerson et al, 1996
97 = PSME-CHCHC4/RHMA3-GASH Douglas-fir-giant chinquapin/Pacific rhododendron-salal	CD0HGC13	513 – Jimerson et al, 1996
98 = PSME-CHCHC4/RHMA3-MANE2 Douglas-fir-giant chinquapin/pacific rhododendron-Cascade barberry	CD0HGC14	513 – Jimerson et al, 1996
99 = PSME-CHCHC4/RHMA3-QUSA2/XETE Douglas-fir-giant chinquapin/pacific rhododendron-deer oak/common beargrass	CD0HGC15	513 – Jimerson et al, 1996
100 = PSME-CHCHC4-LIDE3/MANE2 Douglas-fir-giant chinquapin-tanoak/cascade barberry	CD0HGC16	513 – Jimerson et al, 1996
101 = PSME-CHCHC4/RHA3-QUSA-GASH Douglas-fir-giant chinquapin/pacific rhododendron-deer oak-salal	CD0HGC17	513 – Jimerson et al, 1996
102 = PSME-ACER Douglas-fir-maple	CD0HMA00	513 – Jimerson et al, 1996
103 = PSME-ACMA3/POMU Douglas-fir-bigleaf maple/western swordfern	CD0HMA11	513 – Jimerson et al, 1996
104 = PSME-ACMA3/PHLE4 Douglas-fir-bigleaf maple/Lewis' mock orange	CD0HMA12	513 – Jimerson et al, 1996
105 = PSME/ACCI-MARE11 Douglas-fir/vine maple-Cascade barberry	CD0HMA13	513 – Jimerson et al, 1996
106 = PSME-QUKE Douglas-fir-California black oak	CD0HOB00	513 – Jimerson et al, 1996
107 = PSME-QUKE Douglas-fir-California black oak (metamorphic)	CD0HOB11	513 – Jimerson et al, 1996
108 = PSME-QUKE Douglas-fir-California black oak (sandstone)	CD0HOB12	513 – Jimerson et al, 1996
109 = PSME-QUKE-QUGA4/2GRAM Douglas-fir-California black oak-Oregon white oak/grass	CD0HOB13	513 – Jimerson et al, 1996

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
110 = PSME-QUCH2 Douglas-fir-canyon live oak	CD0HOL00	513 – Jimerson et al, 1996
111 = PSME-QUCH2 Douglas-fir-canyon live oak (rockpile)	CD0HOL11	513 – Jimerson et al, 1996
112 = PSME-QUCH2-ARME/TODI Douglas-fir-canyon live oak-Pacific madrone/pacific poison oak	CD0HOL12	513 – Jimerson et al, 1996
113 = PSME-QUCH2-LIDE3 Douglas-fir-canyon live oak-tanoak	CD0HOL13	513 – Jimerson et al, 1996
114 = PSME-QUGA4 Douglas-fir-Oregon white oak	CD0HOO00	513 – Jimerson et al, 1996
115 = PSME-QUGA4/2GRAM Douglas-fir-Oregon white oak/grass	CD0HOO11	513 – Jimerson et al, 1996
116 = PSME-QUGA4/HODI Douglas-fir-Oregon white oak/oceanspray	CD0HOO12	513 – Jimerson et al, 1996
117 = PSME-LIDE3 Douglas-fir-tanoak	CD0HT000	513 – Jimerson et al, 1996
118 = PSME-LIDE3/WHMO Douglas-fir-tanoak/common whipplea	CD0HT011	513 – Jimerson et al, 1996
119 = PSME-LIDE3/QUVA-HODI Douglas-fir-tanoak/huckleberry oak-oceanspray	CD0HT012	513 – Jimerson et al, 1996
120 = PSME/2SHRUB Douglas-fir/shrub (moist)	CD0SM000	513 – Jimerson et al, 1996
121 = PSME/COCOC Douglas-fir/California hazelnut	CD0SM011	513 – Jimerson et al, 1996
122 = PSME/QUVA Douglas-fir/huckleberry oak	CD0SOH00	513 – Jimerson et al, 1996
123 = PSME/QUVA/LIDEE Douglas-fir/huckleberry oak-tanoak	CD0SOH12	513 – Jimerson et al, 1996
124 = PSME/QUVA-RHMA3 Douglas-fir/huckleberry oak-Pacific rhododendron	CD0SOH13	513 – Jimerson et al, 1996
125 = PIJE Jeffrey pine	CPJ00000	512 – Jimerson et al, 1995
126 = PIJE-CADE27 Jeffrey Pine – Incense cedar	CPJCCI00	512 – Jimerson et al, 1995
127 = PIJE-CADE27-ABCO/QUVA Jeffrey Pine-Incense cedar-white fir/huckleberry oak	CPJCCI11	512 – Jimerson et al, 1995
128 = PIJE-CADE27/QUVA/XETE Jeffrey Pine-Incense cedar/huckleberry oak/common beargrass	CPJCCI12	512 – Jimerson et al, 1995
129 = PIJE-CADE27/CEPU Jeffrey Pine-incense cedar/dwarf ceanothus	CPJCCI13	512 – Jimerson et al, 1995
130 = PIJE-CADE27/CECU Jeffrey Pine-incense cedar/buckbrush	CPJCCI14	512 – Jimerson et al, 1995
131 = PIJE-ABCO/IRIS Jeffrey Pine-white fir/iris	CPJCFW11	512 – Jimerson et al, 1995
132 = PIJE-ABCO/QUSA2/XETE Jeffrey pine-white fir/deer oak/common beargrass	CPJCFW12	512 – Jimerson et al, 1995
133 = PIJE/FEID Jeffrey pine/Idaho fescue	CPJGFI00	512 – Jimerson et al, 1995

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
134 = PIJE/FEID Jeffrey pine/Idaho fescue	CPJGFI11	512 – Jimerson et al, 1995
135 = PIJE/QUVA-ARNE/FEID Jeffrey pine/huckleberry oak-pinemat manzanita/Idaho fescue	CPJGFI12	512 – Jimerson et al, 1995
136 = PIJE/QUSA2-ARNE/FEID Jeffrey pine/deer oak-pinemat manzanita/Idaho fescue	CPJSOD11	512 – Jimerson et al, 1995
137 = PICO Lodgepole pine	CPL00000	512 – Jimerson et al, 1995
138 = PICO/QUVA Lodgepole pine/huckleberry oak	CPLSOH00	512 – Jimerson et al, 1995
139 = PICO/QUVA-FRCAO4 Lodgepole pine/huckleberry oak-California buckthorn	CPLSOH11	512 – Jimerson et al, 1995
140 = PICO/QUVA/LIDE3 Lodgepole pine/huckleberry oak-tanoak	CPLSOH12	512 – Jimerson et al, 1995
141 = PICO/LIDE3 Lodgepole pine/shrub tanoak	CPLST000	512 – Jimerson et al, 1995
142 = PICO/LIDE3-RHMA3 Lodgepole pine/tanoak-Pacific rhododendron	CPLST011	512 – Jimerson et al, 1995
143 = PILA Sugar pine	CPS00000	512 – Jimerson et al, 1995
144 = PILA-PICO Sugar pine-lodgepole pine	CPSCPL00	512 – Jimerson et al, 1995
145 = PILA-PICO/QUVA-LIDEE Sugar pine-lodgepole pine/huckleberry oak-tanoak	CPSCPL11	512 – Jimerson et al, 1995
146 = PILA-PICO/LIDEE-RHMA3 Sugar pine-lodgepole pine/tanoak-Pacific rhododendron	CPSCPL12	512 – Jimerson et al, 1995
147 = PILA-PIMO3 Sugar pine-western white pine	CPSCPW00	512 – Jimerson et al, 1995
148 = PILA-PIMO3/QUVA-GABU2 Sugar pine-western white pine/huckleberry oak-dwarf silktassel	CPSCPW11	512 – Jimerson et al, 1995
149 = PILA-CHCHC4 Sugar pine-giant chinquapin	CPSHGC00	512 – Jimerson et al, 1995
150 = PILA-CHCHC4/Quva-QUSA2 Sugar pine-giant chinquapin/huckleberry oak-deer oak	CPSHGC11	512 – Jimerson et al, 1995
151 = PIMO3 Western white pine	CPW00000	512 – Jimerson et al, 1995
152 = PIMO3-PSME Western white pine-Douglas-fir	CPWCD000	512 – Jimerson et al, 1995
153 = PIMO3-PSME/QUVA-LIDEE Western white pine-Douglas-fir/huckleberry oak-tanoak	CPWCD011	512 – Jimerson et al, 1995
154 = PIMO3/PIMO3 Western white pine/white pine	CPWCFW00	512 – Jimerson et al, 1995

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
155 = PIMO3-ABCO/QUVA/ANEMO Western white pine-white fir/huckleberry oak/western anemone	CPWCFW11	512 – Jimerson et al, 1995
156 = PIMO3-PICO Western white pine-lodgepole pine	CPWCPL00	512 – Jimerson et al, 1995
157 = PIMO3-PICO/LIDEE-RHMA3 Western white pine-lodglepole pine/tanoak-Pacific rhododendron	CPWCPL11	512 – Jimerson et al, 1995
158 = PIMO3-PILA Western white pine-sugar pine	CPWCPS00	512 – Jimerson et al, 1995
159 = PIMO3-PILA/QUVA-LIDEE Western white pine-sugar pine/huckleberry oak-tanoak	CPWCPS11	512 – Jimerson et al, 1995
160 = LIDE3 Tanoak	HT000000	513 – Jimerson et al, 1996
161 = LIDE3/CADE27 Tanoak-incense cedar	HT0CCI00	513 – Jimerson et al, 1996
162 = LIDE3-CADE27/FECA Tanoak-incense cedar/California fescue	HT0CCI11	513 – Jimerson et al, 1996
163 = LIDE3-CHLA Tanoak-Port Orford cedar	HT0CCO00	513 – Jimerson et al, 1996
164 = LIDE3-CHLA-UMCA/VAOV2 Tanoak-Port Orford cedar-California laurel/California huckleberry	HT0CCO11	513 – Jimerson et al, 1996
165 = LIDE3-CHLA/VAOV2-RHOC Tanoak-Port Orford cedar/California huckleberry-western azalea	HT0CCO12	513 – Jimerson et al, 1996
166 = LIDE3-CHLA/VAOV2 Tanoak-Port Orford cedar/California huckleberry	HT0CCO13	513 – Jimerson et al, 1996
167 = LIDE3-CHLA/MANE2/LIBOL2 Tanoak-Port Orford cedar/Cascade barberry/longtube twinflower	HT0CCO14	513 – Jimerson et al, 1996
168 = LIDE3-CHLA-ALRH2 Tanoak-Port Orford cedar-white alder (riparian)	HT0CCO15	513 – Jimerson et al, 1996
169 = LIDE3-CHLA/ACCI Tanoak-Port Orford cedar/vine maple	HT0CCO16	513 – Jimerson et al, 1996
170 = LIDE3-CHLA/VAPA Tanoak-Port Orford cedar/red huckleberry	HT0CCO17	513 – Jimerson et al, 1996
171 = LIDE3-CHLA/GASH Tanoak-Port Orford cedar/salal	HT0CCO18	513 – Jimerson et al, 1996
172 = LIDE3-CHLA-TSHE/VAOV2 Tanoak-Port Orford cedar-western hemlock/California huckleberry	HT0CCO19	513 – Jimerson et al, 1996
173 = LIDE3-UMCA Tanoak-California laurel	HT0HBC00	513 – Jimerson et al, 1996
174 = LIDE3-UMCA/TODI Tanoak-California laurel/Pacific poison oak	HT0HBC11	513 – Jimerson et al, 1996
175 = LIDE3-UMCA/VAOV2 Tanoak-California laurel/California huckleberry	HT0HBC12	513 – Jimerson et al, 1996

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
176 = LIDE3-CHCHC4 Tanoak-giant chinquapin	HT0HGC00	513 – Jimerson et al, 1996
177 = LIDE3-CHCHC4/GASH Tanoak-giant chinquapin/salal	HT0HGC11	513 – Jimerson et al, 1996
178 = LIDE3-CHCHC4/GASH-RHMA3 Tanoak-giant chinquapin/salal-Pacific rhododendron	HT0HGC12	513 – Jimerson et al, 1996
179 = LIDE3-CHCHC4/RHMA3/XETE Tanoak-giant chinquapin/Pacific rhododendron/common beargrass	HT0HGC13	513 – Jimerson et al, 1996
180 = LIDE3-CHCHC4/PTAQL Tanoak-giant chinquapin/western brackenfern	HT0HGC14	513 – Jimerson et al, 1996
181 = LIDE3-CHCHC4/MANE2 Tanoak-giant chinquapin/Cascade barberry	HT0HGC15	513 – Jimerson et al, 1996
182 = LIDE3CHCHC4/VAOV2-GASH Tanoak-giant chinquapin/California huckleberry-salal	HT0HGC16	513 – Jimerson et al, 1996
183 = LIDE3/ACER Tanoak-maple	HT0HM000	513 – Jimerson et al, 1996
184 = LIDE3-ACMA3/POMU Tanoak-bigleaf maple/swordfern	HT0HM011	513 – Jimerson et al, 1996
185 = LIDE3/ACCI-GASH Tanoak/vine maple-salal	HT0HM012	513 – Jimerson et al, 1996
186 = LIDE3/ACCI Tanoak/vine maple	HT0HM013	513 – Jimerson et al, 1996
187 = LIDE3/QUKE Tanoak-California black oak	HT0HOB00	513 – Jimerson et al, 1996
188 = LIDE3/QUKE Tanoak-California black oak	HT0HOB11	513 – Jimerson et al, 1996
189 = LIDE3-QUCH2 Tanoak-canyon live oak	HT0HOL00	513 – Jimerson et al, 1996
190 = LIDE3-QUCH2 Tanoak-canyon live oak (rockpile)	HT0HOL11	513 – Jimerson et al, 1996
191 = LIDE3-QUCH2/VAOV2 Tanoak-canyon live oak/California huckleberry	HT0HOL12	513 – Jimerson et al, 1996
192 = LIDE3-QUCH2/GASH-MANE2 Tanoak-canyon live oak/salal-Cascade barberry	HT0HOL13	513 – Jimerson et al, 1996
193 = LIDE-QUCH2-QUKE/TODI Tanoak-canyon live oak-California black oak/Pacific poison oak	HT0HOL14	513 – Jimerson et al, 1996
194 = LIDE3-QUCH2/TODI Tanoak-canyon live oak/Pacific poison oak	HT0HOL15	513 – Jimerson et al, 1996
195 = LIDE3-QUCH2/MANE2 Tanoak-canyon live oak/Cascade barberry	HT0HOL16	513 – Jimerson et al, 1996
196 = LIDE3/2SHRUB Tanoak/shrub (dry)	HT0SD000	513 – Jimerson et al, 1996
197 = LIDE3/TODI/LOHIV Tanoak/Pacific poison oak/pink honeysuckle	HT0SD011	513 – Jimerson et al, 1996
198 = LIDE3/MANE2 Tanoak/Cascade barberry	HT0SD012	513 – Jimerson et al, 1996
199 = LIDE3/VAOV2-GASH Tanoak/California huckleberry-salal	HT0SEH12	513 – Jimerson et al, 1996

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
200 = LIDE3/VAOV2-RHMA3 Tanoak/California huckleberry-Pacific rhododendron	HT0SEH13	513 – Jimerson et al, 1996
201 = LIDE3/2SHRUB Tanoak/shrub (moist0	HT0SM000	513 – Jimerson et al, 1996
202 = LIDE2/COCOC Tanoak/California hazelnut	HT0SM011	513 – Jimerson et al, 1996
203 = LIDE3/QUVA Tanoak/huckleberry oak	HT0SOH00	513 – Jimerson et al, 1996
204 = LIDE3/QUVA-RHMA3 Tanoak/huckleberry oak-Pacific rhododendron	HT0SOH11	513 – Jimerson et al, 1996
205 = LIDE3/GASH-RHMA3 Tanoak/salal-Pacific rhododendron	HT0SSG12	513 – Jimerson et al, 1996
206 = LIDE3/GASH-MANE2 Tanoak/salal-Cascade barberry	HT0SSG13	513 – Jimerson et al, 1996
207 = LIDE3/VAOV2 Tanoak/California huckleberry	HT0SEH00	513 – Jimerson et al, 1996
208 = LIDE3/VAOV2 Tanoak/California huckleberry	HT0SEH11	513 – Jimerson et al, 1996
209 = LIDE3/GASH Tanoak/salal	HT0SSG00	513 – Jimerson et al, 1996
210 = LIDE3/GASH Tanoak/salal	HT0SSG11	513 – Jimerson et al, 1996
211 = CADE27-PIPO-PSME/CHFO Incense cedar-ponderosa pine-Douglas-fir/mountain misery	CC0311	502 – Benson (1988)
212 = PIJE-ABCO/POA Jeffrey pine-white fir/bluegrass (granite)	CPJGBW11	502 – Benson (1988)
213 = PIPO-PIJE-ABCO/ACOCO Ponderosa pine-Jeffrey pine-white fir/western needlegrass (ash)	CPJGNG11	502 – Benson (1988)
214 = PIPO-PIJE-QUKE/AMPA2 Ponderosa pine-Jeffrey pine-California black oak/pale serviceberry	CPJSAM11	502 – Benson (1988)
215 = PIPO-PIJE-ABCO/AMPA2-MARE11 Ponderosa pine-Jeffrey pine-white fir/pale serviceberry-creeping barberry	CPJSAM12	502 – Benson (1988)
216 = PIJE-QUKE/RHTRQ Jeffrey pine-California black oak/skunkbush sumac	CPJSBB11	502 – Benson (1988)
217 = PIJE/PUTR2-CELE3/ACOCO Jeffrey pine/antelope bitterbrush-curl-leaf mountain mahogany/western needlegrass	CPJSBB12	502 – Benson (1988)
218 = PIJE/PUTR2-SYORU/POA Jeffrey pine/antelope bitterbrush-Utah snowberry/bluegrass	CPJSBB13	502 – Benson (1988)
219 = PIJE/PUTR2/WYMO Jeffrey pine/antelope bitterbrush/woolly mule-ears	CPJSBB14	502 – Benson (1988)
220 = PIPO-PIJE-PSME/PUTR2/WYMO Ponderosa pine-Jeffrey pine-Douglas-fir/antelope bitterbrush/woolly mule-ears	CPJSBB15	502 – Benson (1988)

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
221 = PIPO-PIJE-QUKE/POA Ponderosa pine-Jeffrey pine-California black oak/bluegrass (granite)	CPJSBB16	502 – Benson (1988)
222 = PIPO-PIJE/ARTRV-PUTR2 Ponderosa pine-Jeffrey pine/mountain big sagebrush-antelope bitterbrush	CPJSBB17	502 – Benson (1988)
223 = PIPO-PIJE/PUTR2/FEID Ponderosa pine-Jeffrey pine/antelope bitterbrush/Idaho fescue	CPJSBB18	502 – Benson (1988)
224 = PIPO-PIJE/PUTR2/FEID Ponderosa pine-Jeffrey pine/antelope bitterbrush/Idaho fescue (granite)	CPJSBB19	502 – Benson (1988)
225 = PIPO-PIJE/PUTR2/SEINM Ponderosa pine-Jeffrey pine/antelope bitterbrush/lambstongue ragwort (granite)	CPJSBB20	502 – Benson (1988)
226 = PIPO-PIJE/FRRUM/POSE Ponderosa pine-Jeffrey pine/Modoc buckthorn/Sandberg bluegrass	CPJSBB21	502 – Benson (1988)
227 = PIPO-PIJE-ABCO/QUW12 Ponderosa pine-Jeffrey pine-white fir/interior live oak	CPJSBB23	502 – Benson (1988)
228 = PIJE/CELE3 Jeffrey pine/curl-leaf mountain mahogany	CPJSMC11	502 – Benson (1988)
229 = PIPO-PIJE/CELE3/PSSPS Ponderosa pine-Jeffrey pine/curl-leaf mountain mahogany/ bluebunch balsamroot	CPJSMC12	502 – Benson (1988)
230 = PIPO-PIJE/CELE3/BASA3 Ponderosa pine-Jeffrey pine/curl-leaf mountain mahogany/ arrowleaf balsamroot	CPJSMC13	502 – Benson (1988)
231 = PIPO-PIJE-ABCO/QUVA/WYMO Ponderosa pine-Jeffrey pine-white fir/huckleberry oak/woolly mule-ears	CPJSOH11	502 – Benson (1988)
232 = PIJE/ARTRV/FEID Jeffrey pine/mountain big sagebrush/Idaho fescue	CPJSSB11	502 – Benson (1988)
233 = PIPO-PIJE-ABCO/SYAC/WYMO Ponderosa pine-Jeffrey pine-white fir/sharpleaf snowberry/ woolly mule-ears	CPJSSS12	502 – Benson (1988)
234 = PIJE-ABCO/SYORU/PONE2 Jeffrey pine-white fur/Utah snowberry/Wheeler bluegrass	CPJSSY11	502 – Benson (1988)
235 = PIWA/ARNE Washoe pine/pinemat manzanita	CPOSMP11	502 – Benson (1988)
236 = PIWA-ABCO/SYORU/PSJA2 Washoe pine-white fir/Utah snowberry/tuber starwort	CPOSSY11	502 – Benson (1988)
237 = PIPO/AMPA2-MARE11/ARCO9 Ponderosa pine/pale serviceberry-creeping barberry/ heartleaf arnica	CPPSAM11	502 – Benson (1988)
238 = PIPO/AMPA2-PRUNU Ponderosa pine/pale serviceberry-prunus	CPPSAM12	502 – Benson (1988)

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
239 = PIPO-ABCO-PICO/AMPA2 Ponderosa pine-white fir-lodgepole pine/pale serviceberry	CPPSAM13	502 – Benson (1988)
240 = PIPO-ABCO-QUVA/AMPA2 Ponderosa pine-white fir-black oak/pale serviceberry	CPPSAM14	502 – Benson (1988)
241 = PIPO-ABCO/AMPA2-MARE11 Ponderosa pine-white fir/pale serviceberry-creeping barberry	CPPSAM15	502 – Benson (1988)
242 = PIPO-ABCO/AMPA2-CEVE/BROR2 Ponderosa pine-white fir/pale serviceberry-snowbrush ceonothus/Orcutt's brome	CPPSAM16	502 – Benson (1988)
243 = PIPO-CADE27/PUTR2/BASA3 Ponderosa pine-incense cedar/antelope bitterbrush/ arrowleaf balsamroot	CPPSBB11	502 – Benson (1988)
244 = PIPO-QUKE/PUTR2/ACOCO Ponderosa pine-California black oak/antelope bitterbrush/ western needlegrass	CPPSBB12	502 – Benson (1988)
245 = PIPO/CELE3-PUTR2/FEID Ponderosa pine/curl-leaf mountain mahogany-antelope bitterbrush/Idaho fescue	CPPSBB13	502 – Benson (1988)
246 = PIPO/PURT2-CEVE-ARPA6/BROR2 Ponderosa pine/antelope bitterbrush-snowbrush ceanothus-greenleaf manzanita/Orcutt's brome	CPPSBB14	502 – Benson (1988)
247 = PIPO/PURT2-PRUNU/BROR2 Ponderosa pine/antelope bitterbrush-prunus/Orcutt's brome	CPPSBB15	502 – Benson (1988)
248 = PIPO/PUTR2-PRUNU/PSSPS Ponderosa pine/antelope bitterbrush-prunus/bluebunch wheatgrass	CPPSBB16	502 – Benson (1988)
249 = PIPO/PUTR2-RICE/BROR2 Ponderosa pine/antelope bitterbrush-wax current/Orcutt's brome	CPPSBB17	502 – Benson (1988)
250 = PIPO/PUTR2/BASA3 Ponderosa pine/antelope bitterbrush/arrowleaf balsamroot	CPPSBB18	502 – Benson (1988)
251 = PIPO/PUTR2/FEID Ponderosa pine/antelope bitterbrush/Idaho fescue	CPPSBB19	502 – Benson (1988)
252 = PIPO/PUTR2/ACOCO Ponderosa pine/antelope bitterbrush/western needlegrass (pumice)	CPPSBB20	502 – Benson (1988)
253 = PIPO-ABCO/CEVE/ACOCO Ponderosa pine-white fir/snowbrush ceonothus/western needlegrass	CPPSBB21	502 – Benson (1988)
254 = PIPO-ABCO/PUTR2-ARPA6/ACOCO Ponderosa pine-white fir/antelope bitterbrush-greenleaf manzanita/western needlegrass	CPPSBB22	502 – Benson (1988)
255 = PIPO/ARTRV/FEID Ponderosa pine/mountain big sagebrush/Idaho fescue	CPPSSB11	502 – Benson (1988)

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
256 = PSME-PIPO/TODI Douglas-fir-ponderosa pine/Pacific poison oak	DC0811	502 – Benson (1988)
257 = PSME-PIPO/CHFO/POCOC Douglas-fir-ponderosa pine/mountain misery/Sierra milk wort	DC0812	502 – Benson (1988)
258 = PSME-PINUS-QUCH2/CEIN3 Douglas-fir-pine-canyon live oak/deerbrush	DC0813	502 – Benson (1988)
259 = PSME-ABCO-LIDE3/PTAQL Douglas-fir-white fir-tanoak/western brackenfern	DC0911	502 – Benson (1988)
260 = PSME-CONU2-LIDE3/COCOC/GAAP2 Douglas-fir-mountain dogwood-tanoak/California hazelnut/ stickywilly	DH0711	502 – Benson (1988)
261 = PIPO-ABCO/CEVE3-CEPR Ponderosa pine-white fir/tobaccobrush-squawcarpet	PC0611	502 – Benson (1988)
262 = PILE-PIMO3/QUVA-ARNE2 Sugar pine-western white pine/huckleberry oak-pinemat manzanita	QS0111	502 – Benson (1988)
263 = ABCO-PSME-LIDE3/COCOC White fir-Douglas-fir-tanoak/California hazelnut	WC0911	502 – Benson (1988)
264 = ABCO-PSME/????/???? White fir-Douglas-fir-mountain dogwood/bush chinquapin	WC0912	502 – Benson (1988)
265 = ABCO-PSME/SYACC-????/???? White fir-Douglas-fir/sharpleaf snowberry/thimbleberry	WC0913	502 – Benson (1988)
266 = ABCO-PILA/SYAC/CARO5 White-fir-sugar pine/sharpleaf snowberry/Ross' sedge	WC0914	502 – Benson (1988)
267 = ABCO-PSME/CHME2 White fir-Douglas-fir/prince's pine	WC0915	502 – Benson (1988)
268 = ABCO-PSME-CADE27/AMPA2 White fir-Douglas-fir-incense cedar/pallid serviceberry	WC0916	502 – Benson (1988)
269 = ABCO-PSME-PIJE/???? White fir-Douglas-fir-Jeffrey pine/rosy everlasting	WC0917	502 – Benson (1988)
270 = PSME-PINUS-CADE27/ASDE6 Douglas-fir-pine-incense cedar/Indian dream	CC0411	
271 = PSME-PILA/LIDEE/PTAQL Douglas-fir-sugar pine/tanoak/western brackenfern	DC1011	
272 = PSME-PILA/LIDEE/TRIEN Douglas-fir-sugar pine/tanoak/broadleaf starflower	DC1012	
273 = PSME-PIPO/FRCAO4/PTAQL Douglas-fir-ponderosa pine/California buckthorn/western brackenfern	DC1013	
274 = PSME-PIPO/CEIN3/COHE2 Douglas-fir-ponderosa pine/deerbrush/variableleaf collomia	DC1014	
275 = PSME-PIPO/FECA Douglas-fir-ponderosa pine/California fescue	DC1015	

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
276 = PSME-PIPO/QUVA/POMU Douglas-fir-ponderosa pine/huckleberry oak/western swordfern	DC1016	
277 = PSME-PINUS-CADE27/TRBR3 Douglas-fir-pine-incense cedar/forest clover	DC1017	
278 = PSME-PINUS-CADE27/CECU/TRBR3-FECA Douglas-fir-pine-incense cedar/buckbrush/forest clover-California fescue	DC1018	
279 = PSME-PINUS-CADE27/XETE Douglas-fir-pine-incense cedar/common beargrass	DC1019	
280 = PSME/COCOC/POMU Douglas-fir/California hazelnut/western swordfern	DS0911	
281 = PIJE-CADE27/CECU/HECAS2 Jeffrey pine-incense cedar/buckbrush/Shasta heliathella	PG0611	
282 = PIJE-CADE27/MAAQ2/FEID Jeffrey pine-incense cedar/hollyleaved barberry/Idaho fescue	PG0612	
283 = PIJE/CELE3/PSSPS Jeffrey pine/curl-leaf mountain mahogany/bluebench wheatgrass	PG0613	
284 = PIJE/ERPAA2/PHDI3 Jeffrey pine/Parry's rabbitbrush/spreading phlox	PG0614	
285 = PIJE-CADE27/QUVA/ASDE6 Jeffrey pine-incense cedar/huckleberry oak/Indian's dream	PS0911	
286 = ABCO-PSME-PILA/CONU4 White fir-Douglas-fir-sugar pine/Pacific dogwood	WC1011	
287 = PSME-ABCO/RHOC Douglas-fir-white fir/western azalea	WC1012	
288 = PSME-ABCO-PIPO/ARNE/CHUMO2 Douglas-fir-white fir-ponderosa pine/pinemat manzanita/ pipsisseqa	WC1013	
289 = 2TE Mixed conifer series	CX000000	
290 = Mixed conifer dry group	CX0D0000	
291 = Ponderosa pine-mixed conifer/Bolander's bedstraw-milkwort	CX0FBB11	
292 = White fir-mixed conifer/false Solomon's seal-Hooker's fairybells	CX0FFS11	
293 = Ponderosa pine-mixed conifer/rosy everlasting-naked stemmed	CX0FRE11	
294 = White fir-mixed conifer/troul plant	CX0FTP11	
295 = Douglas-fir-mixed conifer/starflower	CX0FWS11	

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
296 = White fir-mixed conifer/Ross' sedge	CX0GCR11	
297 = Douglas-fir-mixed conifer-white alder/Indian rhubarb	CX0HAW11	
298 = Mountain dogwood group	CX0HDP00	
299 = Douglas-fir-mixed conifer-mountain dogwood/California hazel buckwheat	CX0HDP13	
300 = Douglas-fir-mixed conifer-mountain dogwood/trail plant	CX0HDP14	
301 = Douglas-fir-mixed conifer-bigleaf maple/trail plant	CX0HMB12	
302 = QUCH2 Canyon live oak	CX0H0L00	
303 = Ponderosa pine-mixed conifer-canyon live oak/bearclover	CX0H0L15	
304 = Ponderosa pine-mixed conifer/Bolander's bedstraw	CX0H0L16	
305 = Douglas-fir-mixed conifer-canyon live oak/sword fern	CX0H0L17	
306 = LIDE3 Tanoak	CX0HT000	
307 = PSME-2TE-LIDE3/CONU4 Douglas-fir-mixed conifer-tanoak/Pacific dogwood	CX0HT012	
308 = PSME-2TE-LIDE3/CHFO Douglas-fir-mixed conifer-tanoak/mountain misery	CX0HT013	
309 = PSME-2TE-LIDE3/COCOC Douglas-fir-mixed conifer-tanoak/California hazelnut	CX0HT011	
310 = PSME-2TE-LIDE3/IRIS Douglas-fir-mixed conifer-tanoak/iris	CX0HT014	
311 = Mixed conifer moderate group	CX0M0000	
312 = Mixed conifer riparian group	CX0R0000	
313 = Douglas-fir-mixed conifer/serviceberry	CX0SAM12	
314 = Evergreen shrub group	CX0SE000	
315 = White fir-mixed conifer/vine maple-bush chinquapin	CX0SE011	
316 = White fir-mixed conifer/bush chinquapin	CX0SE012	
317 = Ponderosa pine-mixed conifer/shrub canyon live oak, huckleberry oak	CX0SE013	

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
318 = Ponderosa pine-mixed conifer/huckleberry oak (serpentine)	CX0SE014	
319 = Douglas-fir-mixed conifer/California hazelnut	CX0SHN12	
320 = Douglas-fir-mixed conifer/Sierra laurel	CX0SLS11	
321 = White fir-mixed conifer/mountain alder/sedge	CX0SMA11	
322 = White fir-mixed conifer/mountain alder/monkshood	CX0SMA12	
323 = Bearclover group	CX0SMM00	
324 = Ponderosa pine-mixed conifer/manzanita bearclover	CX0SMM11	
325 = Ponderosa pine-mixed conifer/bearclover/Bolander's bedstraw	CX0SMM12	
326 = White fir-mixed conifer/creeping snowberry/kelloggia	CX0SSS13	
327 = Mixed conifer moist group	CX0W0000	
328 = Douglas-fir-mixed conifer/American dogwood	CX0SDA11	
329 = ABMAS/RHMA Red fir/Pacific rhododendron	RS0511	
330 = ABCO-PILA-ABMAS/PTAQL White fir-sugar pine-red fir/bracken	WC0413	
331 = JUOC/WYMO Western juniper/woolly mule-ears	JC0111	
332 = JUOC Western juniper	JC0112	
333 = TSME Mountain hemlock (steep)	MC0211	
334 = PIJE/QUVA Jeffrey pine/huckleberry oak	PS0811	
335 = PIJE/ARPA6-CEVE Jeffrey pine/greenleaf manzanita-snowbrush ceonothus	PS0812	
336 = PIJE/CECO-ARTR2 Jeffrey pine/whitethorn ceanothus-big sagebrush	PS0813	
337 = POTR5 Quaking aspen (flats)	QC0211	
338 = POTR5 Quaking aspen (uplands)	QC0212	
339 = ABMA California red fir	RC0011	
340 = ABMA/ABCO California red fir/white fir	RC0331	

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
341 = ABMA-TSME California red fir-mountain hemlock	RC0421	
342 = PIMO3/ARNE Western white pine/pinemat manzanita	RC0511	
343 = PIMO3-PICO Western white pine-lodgepole pine	RC0512	
344 = PIMO3 Western white pine	RC0513	
345 = PICO/HIAL2 Lodgepole pine/white hawkweed	RC0611	
346 = PICO/LIGR Lodgepole pine/Gray's licorice-root	RC0612	
347 = PICO Lodgepole pine	RC0613	
348 = ABMA/ASBO2 California red fir/Bolander's locoweed	RF0411	
349 = ABMA/WYMO California red fir/wooly mule-ears	RF0412	
350 = ABMA/ARNE California red fir/pinemat manzanita	RS0114	
351 = ABCO-PIJE White fir-Jeffrey pine	WC0711	
352 = ABCO-ABMA White fir-California red fir (mixed conifer)	WC0712	
353 = PSME/QUVA Douglas-fir/huckleberry oak	CD0SOH11	507-513 – Jimerson et al, 1996
354 = SESE3 Redwood	CN00000	507-514 – Borchert, Segotta, & Purser
355 = SESE3 Redwood (Gamboa-Sur)	CN00011	507-514 – Borchert, Segotta, & Purser
356 = SESE3/PTAQ-WOFI Redwood/western brackenfern-giant chainfern (steamsides)	CNF0111	507-514 – Borchert, Segotta, & Purser
357 = SESE3/POMU-TROV2 Redwood/western swordfern-Pacific trillium (Gamboa-Sur)	CNF0211	507-514 – Borchert, Segotta, & Purser
358 = SESE3/MAFA3-VISAN2 Redwood/California manroot-garden vetch (Gamboa-Sur)	CNF0311	507-514 – Borchert, Segotta, & Purser
359 = SESE3-ACMA3/POCA12 Redwood-bigleaf maple/California polypody (Gamboa)	CNHB011	507-514 – Borchert, Segotta, & Purser
360 = SESE3-LIDE3/CAGL7-IRDO Redwood-tanoak/roundfruit sedge-Douglas iris (Gamboa)	CNHT011	507-504 – Smith
361 = PIPO-ABCO/SYAC Ponderosa pine-white fir/sharpleaf snowberry	CPPSSS11	507-515 – Borchert, Cunha, Krosse, & Lawrence
362 = QUDO Blue oak	HOD00000	507-515 – Borchert, Cunha, Krosse, & Lawrence

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
363 = QUDO/2GRAM Blue oak/annual grass	HODGA000	507-515 – Borchert, Cunha, Krosse, & Lawrence
364 = QUDO/HOMUL-VIPE3 Blue oak/leporinum barley-Johnny-jump-up	HODGA011	507-515 – Borchert, Cunha, Krosse, & Lawrence
365 = QUDO/LOWR2-NAPU4 Blue oak/Chilean bird's foot trefoil-purple tussockgrass	HODGA012	507-515 – Borchert, Cunha, Krosse, & Lawrence
366 = QUDO/EUSP-PETR7 Blue oak/warty spurge-goldback fern	HODGA013	507-515 – Borchert, Cunha, Krosse, & Lawrence
367 = QUDO/GAAN-LUCO Blue oak/phloxleaf bedstraw-scarlet lupine	HODGA014	507-515 – Borchert, Cunha, Krosse, & Lawrence
368 = QUDO/ERMO7-HOMUL Blue oak/musky stork's bill-leporinum barley	HODGA015	507-515 – Borchert, Cunha, Krosse, & Lawrence
369 = QUDO/DEPA2-PHIM Blue oak/San Bernardino larkspur-imbricate phacelia	HODGA016	507-515 – Borchert, Cunha, Krosse, & Lawrence
370 = QUDO/LUCO-MEAL12 Blue oak/scarlet lupine-foothill clover	HODGA017	507-515 – Borchert, Cunha, Krosse, & Lawrence
371 = QUDO/AMME12-PLNO Blue oak/common fiddleneck-rusty popcornflower	HODGA018	507-515 – Borchert, Cunha, Krosse, & Lawrence
372 = QUDO/EREL6/LOWR2-PLER3 Blue oak/longstem buckwheat/Chilean bird's-foot trefoil-dotseed plantain	HODGA019	507-515 – Borchert, Cunha, Krosse, & Lawrence
373 = QUDO/COSP-RILE2 Blue oak/spinster's blue eyed Mary-wireweed	HODGA020	507-515 – Borchert, Cunha, Krosse, & Lawrence
374 = QUDO/CEMOG/BOIN3-LIAF Blue oak/birchleaf mountain mahogany/hoary bowlesia-San Francisco woodland-star	HODGA021	507-515 – Borchert, Cunha, Krosse, & Lawrence
375 = QUDO/RICA/BRDI3 Blue oak/hillside gooseberry/ripgut brome	HODGA022	507-515 – Borchert, Cunha, Krosse, & Lawrence
376 = QUDO-QUWI2/2GRAM Blue oak-interior live oak/grass	HODHOI00	507-515 – Borchert, Cunha, Krosse, & Lawrence
377 = QUDO-QUWI2/LICY3 Blue oak-interior live oak/mission woodland-star	HODHOI11	507-515 – Borchert, Cunha, Krosse, & Lawrence
378 = ADFA Chamise	SA000000	511 – Gordon & White, 1994
379 = ADFA/ERFA2-SAAP2 Chamise/Eastern Mojave buckwheat-white sage	SA0SB000	511 – Gordon & White, 1994
380 = ADFA/SAME3 Chamise/black sage	SA0SBS00	511 – Gordon & White, 1994
381 = ADFA-CEGRP Chamise-desert ceanothus	SA0SCC00	511 – Gordon & White, 1994
382 = ADFA-CECR Chamise-hoaryleam ceanothus	SA0SCH00	511 – Gordon & White, 1994
383 = ADFA-CETO-CYBI Chamise-woolyleaf ceanothus-mission manzanita	SA0SCT00	511 – Gordon & White, 1994
384 = ADFA-CECU Chamise-buckbrush	SA0SCW00	511 – Gordon & White, 1994
385 = ADFA-ARGL4 Chamise-bigberry manzanita	SA0SMB00	511 – Gordon & White, 1994

FVS Sequence Number = Plant Association Species Type	Alpha Code	Reference
386 = ADFA-ARGL3 Chamise-Eastwood's manzanita	SA0SME00	511 – Gordon & White, 1994
387 = ERFA2-SAAP2 Eastern Majove buckwheat-white sage	SB0SSW00	511 – Gordon & White, 1994
388 = CEMOG Birchleaf mountain mahogany	SBM00000	511 – Gordon & White, 1994
389 = CECR Hoaryleaf ceanothus	SCH00000	511 – Gordon & White, 1994
390 = ARGL4 Bigberry manzanita	SMB00000	511 – Gordon & White, 1994
391 = ARGL3 Eastwood's manzanita	SME00000	511 – Gordon & White, 1994
392 = QUCH2 Canyon live oak	SOC00000	511 – Gordon & White, 1994
393 = QUW12 Interior live oak	SOI00000	511 – Gordon & White, 1994
394 = QUW12-CELE2 Interior live oak-chaparral whitethorn	SOISCL00	511 – Gordon & White, 1994
395 = QUW12-QUCH2 Interior live oak-canyon live oak	SOISOC00	511 – Gordon & White, 1994
396 = QUW12-QUBE5 Interior live oak-scrub oak	SOISOS00	511 – Gordon & White, 1994
397 = QUBE5 Scrub oak	SOS00000	511 – Gordon & White, 1994
398 = QUBE5-ADFA Scrub oak-chamise	SOSSA000	511 – Gordon & White, 1994
399 = QUBE5-CEMOG Scrub oak-birchleaf mountain mahogany	SOSSBM00	511 – Gordon & White, 1994
400 = QUBE5-CEOL-HEAR5 Scrub oak-hairy ceanothus-toyon	SOSSCH00	511 – Gordon & White, 1994
401 = QUBE5-CELE2 Scrub oak-chaparral whitethorn	SOSSCL00	511 – Gordon & White, 1994
402 = ADSP Redshank	SR000000	511 – Gordon & White, 1994
403 = ADSP-ADFA Redshank-chamise	SR0SA000	511 – Gordon & White, 1994
404 = ARCA11 Coastal sagebrush	SSC00000	511 – Gordon & White, 1994
405 = ARCA11-ERFA2 Coastal sagebrush-Eastern Majave buchwheat	SSCSB000	511 – Gordon & White, 1994
406 = ARCA11-SAME3 Coastal sagebrush-black sage	SSCSSB00	511 – Gordon & White, 1994

Table 11.2.2 Region 6 Plant association codes recognized in the NC variant.

FVS Sequence Number = Plant Association Species Type	Alpha Code	Site Species	Site Index*	SDI Max*	Source*	Reference
407 = PSME-ABCO-PIJE Douglas-fir-white fir-Jeffrey pine	CDC411	DF	85	899	H	Aztet and Wheeler (1984)

FVS Sequence Number = Plant Association Species Type	Alpha Code	Site Species	Site Index*	SDI Max*	Source*	Reference
408 = PSME-ABCO-PIPO Douglas-fir-white fir-ponderosa pine	CDC412	DF	87	1155	H	Aztet and Wheeler (1984)
409 = PSME-ABCO Douglas-fir-white fir	CDC421	DF	72	720	C	Aztet and Wheeler (1984)
410 = PSME-ABCO/HODI Douglas-fir-white fir/creambush oceanspray	CDC431	DF	96	765	C	Aztet and Wheeler (1984)
411 = PSME-ABCO/BENE Douglas-fir-white fir/dwarf Oregongrape	CDC432	DF	93	1193	H	Aztet and Wheeler (1984)
412 = PSME-PIPO Douglas-fir-ponderosa pine	CDC511	DF	101	735	C	Aztet and Wheeler (1984)
413 = PSME-PIJE Douglas-fir-Jeffrey pin	CDC521	DF	71	595	C	Aztet and Wheeler (1984)
414 = PSME/DEPAUPERATE Douglas-fir/depauperate	CDF911	DF	70	670	C	Aztet and Wheeler (1984)
415 = PSME-LIDE3/GASH Douglas-fir-tanoak/salal	CDH111	DF	86	845	H	Aztet and Wheeler (1984)
416 = PSME/RHMA Douglas-fir/Pacific rhododendron	CDH112	DF	92	800	C	Aztet and Wheeler (1984)
417 = PSME-LIDE3-PILA Douglas-fir-tanoak-sugar pine	CDH121	DF	97	720	C	Aztet and Wheeler (1984)
418 = PSME-LIDE3 Douglas-fir-tanoak	CDH131	DF	81	1098	H	Aztet and Wheeler (1984)
419 = PSME-LIDE3-QUCH Douglas-fir-tanoak-canyon live oak	CDH141	DF	86	780	C	Aztet and Wheeler (1984)
420 = PSME-LIDE3/RHDI Douglas-fir-tanoak/poison oak	CDH142	DF	82	1050	C	Aztet and Wheeler (1984)
421 = PSME-QUSA Douglas-fir-Sadler oak	CDH511	DF	95	1087	H	Aztet and Wheeler (1984)
422 = PSME/RHDI-BEPI Douglas-fir/poison oak-Piper's Oregongrape	CDS111	DF	77	655	C	Aztet and Wheeler (1984)
423 = PSME/RHDI Douglas-fir/poison oak	CDS112	DF	67	630	C	Aztet and Wheeler (1984)
424 = PSME/BENE Douglas-fir/dwarf Oregongrape	CDS511	DF	93	635	C	Aztet and Wheeler (1984)
425 = PSME/BERE Douglas-fir/creeping Oregongrape	CDS521	DF	85	670	C	Aztet and Wheeler (1984)
426 = TSHE-CHLA Western hemlock-Port-Orford-cedar	CHC111	DF	117	1215	C	Aztet and Wheeler (1984)
427 = TSHE-THPL/HIGH ELEV Western hemlock-western redcedar/high elevation	CHC412	DF	108	945	C	Aztet and Wheeler (1984)
428 = TSHE-THPL Western hemlock-western redcedar	CHC461	DF	146	1105	C	Aztet and Wheeler (1984)
429 = TSHE-ABCO Western hemlock-white fir	CHC611	DF	119	890	C	Aztet and Wheeler (1984)
430 = TSHE-UMCA Western hemlock-California laurel	CHH111	DF	106	650	C	Aztet and Wheeler (1984)

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431 = TSHE-QUSA Western hemlock-Sadler oak	CHH511	DF	108	1152	H	Aztet and Wheeler (1984)
432 = TSHE/GASH Western hemlock/salal	CHS131	DF	61	1050	C	Aztet and Wheeler (1984)
433 = TSHE/RHMA Western hemlock/Pacific rhododendron	CHS331	DF	102	1145	C	Aztet and Wheeler (1984)
434 = TSME/POPU Mountain hemlock/skunkleaf polemonium	CMF211	RF	74	555	C	Aztet and Wheeler (1984)
435 = PIPO-PSME Ponderosa pine-Douglas-fir	CPC411	DF	76	720	H	Aztet and Wheeler (1984)
436 = PIJE-PIMO Jeffrey pine-western white pine	CPC511	PP	52	420	C	Aztet and Wheeler (1984)
437 = PIJE/FEID Jeffrey pine/Idaho fescue	CPG141	PP	57	200	C	Aztet and Wheeler (1984)
438 = PIJE-QUVA Jeffrey pine-huckleberry oak	CPH411	PP	60	470	C	Aztet and Wheeler (1984)
439 = PIJE/CEPU Jeffrey pine/dwarf ceanothus	CPS321	PP	58	364	H	Aztet and Wheeler (1984)
440 = PIJE/GRASS Jeffrey pine/grass	CPS611	PP	57	340	H	Aztet and Wheeler (1984)
441 = PIMO/XETE Western white pine/beargrass	CQF111	WF	33	436	H	Aztet and Wheeler (1984)
442 = ABMAS/POPU Shasta red fir/skunkleaf polemonium	CRF211	RF	57	675	C	Aztet and Wheeler (1984)
443 = ABMAS/SHEEP Shasta red fir/sheep(grazing destroyed understory plants)	CRF311	RF	50	319	H	Aztet and Wheeler (1984)
444 = ABMAS-QUSA Shasta red fir-Sadler oak	CRH111	RF	81	470	C	Aztet and Wheeler (1984)
445 = ABMAS/SYMO Shasta red fir/creeping snowberry	CRS211	RF	91	755	C	Aztet and Wheeler (1984)
446 = CHLA-QUVA Port-Orford-cedar-huckleberry oak	CTH111	DF	87	1309	H	Aztet and Wheeler (1984)
447 = CHLA-ACMA Port-Orford-cedar-bigleaf maple	CTH211	DF	87	760	C	Aztet and Wheeler (1984)
448 = CHLA/BENE/ACTR Port-Orford-cedar/dwarf Oregongrape/vanillaleaf	CTS111	DF	85	1348	H	Aztet and Wheeler (1984)
449 = CHLA/BENE/LIBOL Port-Orford-cedar/dwarf Oregongrape/western twinflower	CTS112	DF	92	370	C	Aztet and Wheeler (1984)
450 = CHLA/GASH Port-Orford-cedar/salal	CTS211	DF	83	990	C	Aztet and Wheeler (1984)
451 = CHLA/GABU Port-Orford-cedar/box-leaved silktassle	CTS311	DF	87	660	C	Aztet and Wheeler (1984)
452 = ABCO-PSME White fir-Douglas-fir	CWC221	DF	92	815	C	Aztet and Wheeler (1984)

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453 = ABCO-PSME/BENE White fir-Douglas-fir/dwarf Oregongrape	CWC231	DF	95	785	C	Aztet and Wheeler (1984)
454 = ABCO-PSME/HODI White fir-Douglas-fir/creambush oceanspray	CWC232	DF	89	675	C	Aztet and Wheeler (1984)
455 = ABCO-PSME/DEPAUPERATE White fir-Douglas-fir/depauperate	CWC233	DF	78	988	H	Aztet and Wheeler (1984)
456 = ABCO-PIPO White fir-ponderosa pine	CWC241	DF	84	930	C	Aztet and Wheeler (1984)
457 = ABCO-PIBR/VAME White fir-Brewer spruce/thin-leaved huckleberry	CWC521	DF	57	899	H	Aztet and Wheeler (1984)
458 = ABCO-PIBR/GAOV White fir-Brewer spruce/slender salal	CWC522	DF	95	874	H	Aztet and Wheeler (1984)
459 = ABCO-PIBR/CHUM White fir-Brewer spruce/western prince's-pine	CWC523	DF	69	335	C	Aztet and Wheeler (1984)
460 = ABCO-CHLA White fir-Port-Orford-cedar	CWC611	DF	99	1399	H	Aztet and Wheeler (1984)
461 = ABCO-CHLA/DEPAUPERATE White fir-Port-Orford-cedar/depauperate	CWC612	DF	99	1399	H	Aztet and Wheeler (1984)
462 = ABCO-ABMAS/RIBES White fir-Shasta red fir/currant	CWC721	WF	77	660	C	Aztet and Wheeler (1984)
463 = ABCO-ABMAS/ROGY White fir-Shasta red fir/baldhip rose	CWC722	DF	89	1349	H	Aztet and Wheeler (1984)
464 = ABCO-ABMAS/SYMO White fir-Shasta red fir/creeping snowberry	CWC723	DF	81	945	C	Aztet and Wheeler (1984)
465 = ABCO-TABR White fir-Pacific yew	CWC811	DF	96	695	C	Aztet and Wheeler (1984)
466 = ABCO-CHNO White fir-Alaska cedar	CWC911	WF	65	1641	H	Aztet and Wheeler (1984)
467 = ABCO/HERB White fir/herb	CWF911	DF	89	670	C	Aztet and Wheeler (1984)
468 = ABCO-LIDE3 White fir-tanoak	CWH312	DF	93	815	C	Aztet and Wheeler (1984)
469 = ABCO-ACGL White fir-Rocky Mountain maple	CWH413	DF	108	654	H	Aztet and Wheeler (1984)
470 = ABCO-QUSA/CHUM White fir-Sadler oak/western prince's-pine	CWH511	DF	93	1337	H	Aztet and Wheeler (1984)
471 = ABCO-QUSA/BENE-PAMY White-fir Sadler oak/dwarf Oregongrape-Oregon boxwood	CWH521	DF	96	470	C	Aztet and Wheeler (1984)
472 = ABCO-QUSA/BENE White fir-Sadler oak/dwarf Oregongrape	CWH522	DF	105	560	C	Aztet and Wheeler (1984)

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473 = ABCO-QUSA-CACH White fir-Sadler oak-golden chinquapin	CWH531	DF	94	810	C	Aztet and Wheeler (1984)
474 = ABCO/SYMO White fir/creeping snowberry	CWS331	DF	92	695	C	Aztet and Wheeler (1984)
475 = ABCO/BENE White fir/dwarf Oregongrape	CWS523	DF	101	900	C	Aztet and Wheeler (1984)
476 = LIDE3-SESE2 Tanoak-coast redwood	HTC111	DF	125	820	C	Aztet and Wheeler (1984)
477 = LIDE3-TSHE Tanoak-western hemlock	HTC211	DF	103	870	C	Aztet and Wheeler (1984)
478 = LIDE3-CHLA Tanoak-Port-Orford-cedar	HTC311	DF	98	890	C	Aztet and Wheeler (1984)
479 = LIDE3-ABCO-ACCI Tanoak-white fir-vine maple	HTC411	DF	90	865	C	Aztet and Wheeler (1984)
480 = LIDE3-ABCO Tanoak-white fir	HTC412	DF	99	970	C	Aztet and Wheeler (1984)
481 = LIDE3-QUCH Tanoak-canyon live oak	HTH111	DF	96	735	C	Aztet and Wheeler (1984)
482 = LIDE3-QUCH/BENE Tanoak-canyon live oak/dwarf Oregongrape	HTH112	DF	83	650	C	Aztet and Wheeler (1984)
483 = LIDE3-UMCA Tanoak-California laurel	HTH211	DF	110	810	C	Aztet and Wheeler (1984)
484 = LIDE3-ACCI Tanoak-vine maple	HTH311	DF	104	595	C	Aztet and Wheeler (1984)
485 = LIDE3/VAOV2-GASH Tanoak/evergreen huckleberry-salal	HTS111	DF	107	910	C	Aztet and Wheeler (1984)
486 = LIDE3/VAOV2 Tanoak/evergreen huckleberry	HTS112	DF	116	915	C	Aztet and Wheeler (1984)
487 = LIDE3/RHMA Tanoak/Pacific rhododendron	HTS221	DF	111	830	C	Aztet and Wheeler (1984)
488 = LIDE3/RHMA-VAOV2 Tanoak/Pacific rhododendron-evergreen huckleberry	HTS222	DF	93	815	C	Aztet and Wheeler (1984)
489 = LIDE3/RHMA-GASH Tanoak/Pacific rhododendron-salal	HTS223	DF	68	840	C	Aztet and Wheeler (1984)
490 = LIDE3/BENE Tanoak/dwarf Oregongrape	HTS311	DF	95	805	C	Aztet and Wheeler (1984)
491 = LIDE3/BENE-RHDI Tanoak/dwarf Oregongrape-poison oak	HTS312	DF	96	785	C	Aztet and Wheeler (1984)
492 = LIDE3/GASH Tanoak/salal	HTS321	DF	102	970	C	Aztet and Wheeler (1984)
493 = LIDE3/GASH-RHMA Tanoak/salal-Pacific rhododendron	HTS331	DF	90	610	C	Aztet and Wheeler (1984)
494 = LIDE3/GASH-BENE Tanoak/salal-dwarf Oregongrape	HTS341	DF	109	935	C	Aztet and Wheeler (1984)
495 = LIDE3/RHDI-LOHI Tanoak/poison oak-hairy honeysuckle	HTS411	DF	79	730	C	Aztet and Wheeler (1984)

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496 = LIDE3/RHCA Tanoak/California coffeeberry	HTS511	DF	50	450	C	Aztet and Wheeler (1984)

*Site index estimates are from GBA analysis. SDI maximums are set by GBA analysis (Source=H) or CVS plot analysis (Source=C).

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