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Taper Equation and Volume Tables for Plantation-Grown Red Alder

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Abstract

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A taper equation and associated tables are presented for red alder (*Alnus rubra* Bong.) trees grown in plantations. The data were gathered from variable-density experimental plantations throughout the Pacific Northwest. Diameter inside bark along the stem was fitted to a variable exponent model form by using generalized nonlinear least squares and a first-order continuous autoregressive process. A number of parameterizations of the exponent were examined in a preliminary analysis, and the most appropriate form was determined. This was achieved by examining alternative models across geographic locations and silvicultural treatments on the basis of their ability to behave well outside the range of the modeling data by using an independent evaluation data set from across the region and a model validation procedure. Incorporating three easily measured tree variables—diameter at breast height, total tree height, and crown ratio—provided the best fit among location and treatment. This taper equation can be used to estimate diameter inside bark anywhere along the stem, inside bark volume of the entire stem to any top height diameter, and merchantable height and volume between any two points along the stem (i.e., individual log volumes). The flexibility of the model allows for accurate volume predictions across a range of operational stand conditions and management activities and is therefore an improvement over previously published red alder volume and taper equations.

Keywords: *Alnus rubra*, red alder, taper equation, bark thickness, stem profile, volume tables.

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Introduction

There is a long history characterizing the stem profile of trees. Mathematically defining stem profile is necessary for the accurate prediction of stem volume. Taper equations do just this and are important to foresters and forest scientists because they provide a flexible alternative to conventional volume equations for evaluating financial worth of individual trees or stands and the various effects of stand management. Unlike volume equations, taper equations provide for (1) predictions of inside bark diameter at any point on the stem, (2) estimates of total stem volume, (3) estimates of merchantable volume and merchantable height to any top diameter and from any stump height, and (4) estimates of individual log volumes (Kozak 1988). In this paper, stem taper is defined as the rate of change in diameter with height along the stem, whereas stem profile reflects the shape of the entire stem (Gray 1956).

It is well understood that differences in stand conditions affect the distribution of diameter growth along the stem (and in some cases height growth), which can affect, in turn, the stem profile and thus stem volume (see Larson 1963 for a review). Likewise, there is a growing body of research that indicates that changes in stand conditions owing to management activities can affect stem profile (Garber and Maguire 2003, Hilt and Dale 1979, Larson 1965, Lennette 1999, Valenti and Cao 1986a), which can have a profound impact on stem volume. Yet most existing volume and taper equations do not include intensively managed stands such as plantations or those that have been pruned or thinned. In addition, these equations use only diameter and height and therefore may not detect subtle changes in stem profile that come from management. Thus, variables representing the effect of various management activities (such as crown size) may improve accuracy of volume equations (Hann et al. 1987, Muhairwe et al. 1994), and ultimately improve yield estimates.

Published red alder (*Alnus rubra* Bong.) volume (Browne 1962, Johnson et al. 1949, Skinner 1959, Snell and Little 1983) and taper (Curtis et al. 1968; Kozak et al. 1969; Kozak 1988, 1997) equations are available to estimate tree volume. However, these equations are based on trees from natural stands in the absence of any knowledge of stand history or silvicultural activity. There are currently no volume/taper equations for managed stands of red alder. The potential differences in stem profile between natural and planted stands (i.e., unmanaged vs. managed) leads to an unknown amount of error in volume estimation. Thus, the primary objective of this project was to develop a taper equation and associated merchantability tables for plantation-grown red alder. The final equation and parameter estimates are presented, the incorporation of crown ratio (CR) is discussed, and five sets of

tables—total stem volume, merchantable volume (0.5-ft stump and 5-in diameter outside bark [DOB] top), merchantable height, volume to crown base, and DOB at crown base—are provided.

Methods

Study Sites

The data in this analysis came from nine plantations of pure red alder in western Oregon, western Washington, and southwestern British Columbia (121.7-125.4°W, 43.1-50.7°N). Five plantations were in the Oregon Coast Range, one in the Oregon Cascade Mountains, two in the Puget Trough of Washington, and one on Vancouver Island, British Columbia. (fig. 1). The climate is maritime and characterized by wet, mild winters, and cool, dry summers (Franklin and Dyrness 1973). Soil types included silty loams, clay loams, gravelly loams, and cobbly loams. Elevation ranged from 300 to 1,225 ft, slopes ranged from 5 to 35 percent, and annual precipitation ranged from 45 to 130 in.

Plantations were established on previously harvested sites of at least 15 ac and reasonably uniform ground conditions. Site preparation methods were the standard operating methods for the region at the time and included normal competition reduction practices. Climatic (annual and growing season precipitation, length of growing season) and soils information was determined and site index was estimated using the soil-site method of Harrington (1986). Mean site index (base age 50 years) was 104 ft and ranged from 90 to 115 ft.

Sites were planted between 1989 and 1993 using operational planting crews. At each site, blocks of local red alder nursery stock (inoculated with *Frankia* spp.) were planted to target densities of 100, 230, 525, and 1,200 trees per acre (tpa). Planting blocks were randomly assigned, and within each planting block, control plots and various thinning and pruning treatment plots were randomly assigned. Treatment plots are 1.28 ac and contain a 0.33-ac measurement plot; the remaining area serves as a buffer. Treatment activities and data collection are administered by the Hardwood Silviculture Cooperative (HSC), Forest Science Department, Oregon State University, Corvallis, Oregon. A full description of site locations, plot layouts, treatments, etc. can be found at www.cof.orst.edu/coops/hsc/.

Site, Treatment, and Tree Selection

The nine sites chosen for this project were a subset of the 26 HSC plantations described above (table 1). Priority was given to the oldest sites because these trees were closer in size to final rotation tree sizes and had more time to respond



Figure 1— Location of modeling and evaluation data study sites used in this analysis.

Table 1—Site and tree characteristics used in taper model development, by site

Characteristics	Pollard	Pioneer	Siletz	Sitkum	Shamu	Humphrey	Clear Lake	Mohun	Thompson
Latitude	45.2	44.62	44.73	43.13	45.93	48.58	48.47	50.67	45.48
Longitude	123.85	123.87	123.9	123.87	122.2	122.18	123.03	122.3	123.78
Elevation (ft)	1,100	350	300	1,000	1,100	400	500	325	1,225
Slope (%)	10	10	5	12	12	5	35	15	7
Site index (50 years) (ft)	100	110	115	110	95	115	105	100	90
Establishment date	1991	1992	1994	1992	1992	1989	1990	1993	1992
Sample size:									
Trees	30	26	22	29	30	20	19	28	30
Stem diameters	420	364	308	406	420	280	266	392	420
Stem diameter outside bark (in):									
Minimum	0.2	0.3	0.2	0.3	0.2	0.3	0.3	0.2	0.2
Mean	4.1	4.5	3.7	4.7	4.4	4.8	4.6	3.6	4.1
Maximum	10.5	13.6	9.3	13.7	12.3	12.3	11.4	9.1	10.3
Tree DBH (in):									
Minimum	3.7	5.1	4.3	3.8	4.1	3.9	4.6	3.9	3.7
Mean	6.7	6.8	5.8	7.1	6.6	7.3	7.2	5.5	6.3
Maximum	9.6	10.4	7.8	10.7	10	10.9	10.7	7	8.9
Tree height (ft):									
Minimum	32.3	40.7	30.2	51.2	33.8	45.6	49.2	32.8	30.4
Mean	45.6	52.5	40.4	59.1	50.2	62	56.4	43.6	46.6
Maximum	58.1	59.9	47.2	66.9	63.7	77.8	63.7	57.4	55.5
Tree crown ratio:									
Minimum	0.28	0.23	0.46	0.22	0.18	0.18	0.21	0.22	0.17
Mean	0.53	0.46	0.66	0.50	0.52	0.37	0.35	0.49	0.51
Maximum	0.80	0.70	0.92	0.83	0.81	0.65	0.61	0.94	0.92

to previously applied silvicultural treatments. In addition, sites were selected to encompass the geographic range of red alder in the Pacific Northwest.

At each site, specific treatments to be sampled were also prioritized based on their likelihood of use in operational management (table 2). The various treatments were included in this analysis to expand the range of tree sizes and stem profiles. Three types of plots were sampled: (1) three control plots, 230 tpa, 525 tpa, and 1,200 tpa; (2) the 230 tpa prune plot; (3) various thinned plots with special emphasis on treatment six. If this treatment was not present on a site, then another thinning treatment was sampled, either treatment five or nine.

All pruned plots have had three 6-ft lifts (the lowermost 6 ft of the crown had all branches removed using a pole saw). The first pruning lift occurred when tree heights were approximately 15 ft (between ages 4 and 6). The third lift was performed in the dormant season just prior to this sampling on five of the six plots. The thinning treatments five and nine occurred when the trees were 5 years

Table 2—Sample tree distribution (number of trees) by treatment and site

Site name	Treatment ^a							Total
	2	3	4	5	6	8	9	
Pollard	6	6	6	—	7 (1)	4	—	29
Pioneer	6	4	6	—	6 (4)	4	—	26
Siletz	6	—	4	4 (5)	—	4	4 (5)	22
Sitkum	7	6	6	—	8 (3)	3	—	30
Shamu	6	6	7	—	6 (4)	5	—	30
Humphrey	8	—	8	—	8 (9)	6	—	30
Clear Lake	7	—	6	—	—	6	—	19
Mohun	4	4	4	4 (7)	—	4	—	20
Thompson	6	6	6	—	6 (4)	4	—	28
Total	56	32	53	8	41	40	4	234

^aThe number of years since thinning is in parentheses.

2 = 230 tpa control—measure only.

3 = 230 tpa pruned to 6-ft. lift, 12-ft lift, 18-ft lift, 24-ft lift.

4 = 525 tpa control—measure only.

5 = 525 tpa thin to 230 tpa in year 3 to 5.

6 = 525 tpa thin to 230 tpa when height to live crown base is 15 to 20 feet.

8 = 1,200 tpa control—measure only.

9 = 1,200 tpa thin to 230 tpa in year 3 to 5.

old (therefore 5 to 7 years before sampling). The timing of treatment six differed depending on stand development, ranging from age 6 through 12 (therefore 1 to 9 years before sampling).

Sample trees were selected across the full range of diameters on each plot. To ensure this objective, diameter at breast height (DBH) histograms were generated for each site/treatment combination. Next, one to three (generally two) trees of good form (no forking, broken tops, excessive sweep, etc.) from each DBH class were selected (see table 3 for the sample distribution by diameter and height class). Sample trees were well distributed throughout the buffer area within the treatment plot, and were at least two tree rows from the edge of the treatment and/or measurement plot.

Sampling Procedure

The sampling procedure used here was the one used for the Inland Northwest Growth and Yield Cooperative Tree Form Equation Project (Hatch and Flewelling 1995). Once the trees were selected, DBH was permanently marked with paint, and DOB and double bark thickness (DBT) were measured at 0.66 ft, 1.6 ft, 2.6 ft and 4.5 ft (DBH) from the base of the tree (uphill side) with a diameter tape. The DOB was measured to the nearest 0.04 in. The DBT was directly measured to the nearest 0.04 in by removing two sections of bark from opposite sides of the bole with a hatchet, held together, and measured with calipers.

Table 3—Modeling data sample distribution by diameter at breast height (DBH) and height class (the shaded region represents every tree present in the Hardwood Silviculture Cooperative research program, n = 48,248)

DBH (inches)	Height (feet)															Total
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
4	—	—	—	—	1	5	4	2	3	3	1	—	—	—	—	19
5	—	—	—	—	3	5	14	11	11	10	3	3	—	—	—	60
6	—	—	—	—	1	1	5	7	9	10	4	1	—	—	—	38
7	—	—	—	—	—	1	4	11	10	7	7	3	3	—	—	46
8	—	—	—	—	—	—	—	9	11	5	9	2	3	—	—	39
9	—	—	—	—	—	—	—	2	2	—	10	2	2	—	1	19
10	—	—	—	—	—	—	—	—	1	3	2	3	1	—	—	10
11	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	3
12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	0	0	0	0	5	12	27	42	47	38	38	15	9	—	1	234

Each sample tree was then felled in a manner that minimized stem breakage. The DBH mark was located and a nail was placed at this point. A tape measure was then stretched along the bole from the nail (at breast height [BH]) to the tree tip and the straight-line distance from BH to the tip of the tree was recorded (to the nearest 0.04 in). Height to live crown base (HLC, to the nearest 0.04 in), defined as the lowest whorl with living branches in at least three quadrants, was recorded. Crown ratio (CR) was defined as the live crown length divided by total tree height (HT). Above BH there were ten target (i.e., measurement) points, one at every 10 percent of the distance from BH to tree tip plus one at 95 percent of this distance. See figure 2 for an example datasheet (note the measurement at 5 percent of the difference was not collected).

Measurement points were permanently marked with paint or crayon. Ideally, these marks were identical to the calculated target points but occasionally the actual measurement point had to be moved above or below a branch whorl. If so, the actual, not the targeted distance from BH was recorded. At each measurement point (at BH, above BH, and below BH), DOB and DBT were measured as explained above. In all, there were 14 DOB and 14 DBT measurements per tree.

Managed Alder Tree Volume Study - 2004

Date: 6/7/04 Data recorder: DAT TREE#16
 Site: 2203 Treatment: 2

Standing DBH: 13.0 (locate, mark and measure before falling tree)

Height to crown base (m): 8.31 (Crown base is where 3 quadrants have branches)

Diameter of largest branch at crown base (cm): 3.4

	Dist. From BH (m)	DOB1 (cm)	Double Bark (cm)	DIB1 (cm)	DIB2 (cm)	(Either double bark or DIB, not both)
H100%	14.56	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX	XXXXXXXX
H95%	13.832	1.1	0.24			
H90%	13.104	2.4	0.23			
H80%	11.648	4.0	0.30			
H70%	10.192	5.8	0.35			
H60%	8.736	7.2	0.34			
H50%	7.28	8.8	0.47			
H40%	5.85	5.824	10.1	0.49		
H30%	4.368	11.5	0.60			
H20%	2.912	12.1	0.48			
H10%	1.456	12.8	0.47			
Breast Height	0	13.0	0.57			
H80cm	-0.6	13.6	0.54			
H50cm	-0.9	14.3	0.57			
H20cm	-1.2	16.2	0.74			

Comments on condition of tree: _____

Comments on environment of tree: _____

Breast height is 1.4 meters above the ground on the up-hill side of the tree
 Precision: 0.1 cm

*H40-moved to 5.85 due to a knot
 whirl at H30*

Figure 2—Example of a field data sheet.

Evaluation Data

Two independent data sets were supplied to the authors to assist in model selection and comparison. They were used to test how well the final model extrapolated to other plantations and to natural stands, both for trees of comparable size and trees beyond the size range of the data collected for this study. The first data set was from 32 trees in planted or managed (i.e., thinned) stands in western Oregon and Washington (provided by David Hibbs, Oregon State University). The second data set was from 29 trees in natural stands on Vancouver Island, British Columbia (provided by George Harper, British Columbia Ministry of Forests Research Branch). Data collection procedures were similar to this study. Number of samples and tree size ranges are given in table 4.

Table 4—Site and tree characteristics for the independent data sets, by site

Characteristics	Apiary	Centralia	Olney	Cowichan and Menzies
Stand type	Planted	Planted	Natural/thinned	Natural
Location	15 km SW of Rainier, OR	30 km SW of Olympia, WA	20 km SW of Astoria, OR	Cowichan Lake and Campbell River, BC
Elevation (ft)	980–1,150	250–450	200	NA
Slope (%)	5–20	NA	0–10	NA
Site index (50 years) (ft)	108	82	98	87–120
Age when sampled	20	13	27	3–70
Range of densities (tpa)	540–5476	112–3923	110–450	NA
Sample size:				
Trees	9	14	9	29
Stem diameters	87	89	88	298
Stem DOB (in)				
Minimum	0.2	0.2	0.6	0.2
Mean	4.3	3.5	6.0	5.8
Maximum	11.0	10.4	14.4	20.2
Tree DBH (in):				
Minimum	5.0	2.5	7.1	0.7
Mean	6.4	5.3	8.9	7.6
Maximum	9.4	7.8	11.6	18.1
Tree height (ft):				
Minimum	57.9	25.4	57.2	13.1
Mean	66.5	37.3	71.6	57.9
Maximum	73.2	53.6	81.4	124.0
Tree crown ratio:				
Minimum	0.18	0.38	0.26	0.20
Mean	0.31	0.70	0.42	0.47
Maximum	0.64	0.99	0.57	0.93

NA = not available.

tpa = trees per acre.

DOB = diameter outside bark.

DBH = diameter at breast height.

Model Development

Several equation forms were screened for modeling stem shape, including several segmented polynomials (Max and Burkhardt 1976, Walters and Hann 1986), trigonometric forms (Thomas and Parresol 1991), a model presented by Zakrzewski (1999), and variable exponent models (Bi and Long 2001, Kozak 1988). The variable exponent model (Kozak 1988) was chosen because it is a single model form for the entire stem, and preliminary analyses indicated it gave an estimated average bias along the stem smaller than the other model forms. The general model form is as follows:

$$\text{dib} = \text{DIBBH} \cdot X^C$$

where dib is diameter inside bark at some height h , DIBBH is the diameter inside bark at reference relative height p , $X = [1-(Z)^{0.5}]/[1-(p)^{0.5}]$, Z is the relative height h/HT , and C is a function of Z and tree variables. The ratio X ranges from zero at the tree tip to 1 at the reference height p . In this case, breast height (4.5 ft) was chosen as the reference point ($p = 4.5/\text{HT}$) so that $X = 1$ at breast height and therefore constrained the dib prediction to equal the bark factor equation at breast height. Since diameter inside bark at breast height is not normally collected in the field, DIBBH was parameterized as a nonlinear function of DBH:

$$\text{DIBBH} = a_1 \text{DBH}^{a_2} X^C \quad (1)$$

where DIBBH, DBH, X , and C are defined above, and a_1 and a_2 are the parameters to be estimated from the data.

The variable exponent C can have numerous mathematical values (parameterizations). Three approaches were taken to efficiently limit the number of candidate parameterizations to be assessed. First, all known existing parameterizations were included (e.g., Garber and Maguire 2003; Kozak 1988, 1997, 2004). Second, the subset approach described by Garber and Maguire (2003) was employed to select up to five additional parameterizations. Third, two model forms were constructed after directly modeling the pattern in C over Z . This approach revealed a slight DBH and HT influence on taper below breast height and a considerable influence of DBH/HT and CR above breast height. Therefore, C was parameterized with two nonlinear additive terms: one representing the section below breast height and the other representing the section above breast height.

An analysis of the error structure revealed the presence of autocorrelation and heterogeneous variance, which had to be addressed to provide unbiased estimates and meaningful tests of parameters. Preliminary model evaluation suggested better dib and volume predictions from generalized least squares than with mixed effects, so directly modeling the autocorrelation was preferred. Variance structure was accounted for by incorporating a power variance function and a first-order continuous autoregressive process on Z , by tree, to account for heterogeneous variance and autocorrelation, respectively. Parameter estimates and the variance function were tested using likelihood ratio tests ($\alpha = 0.01$). Generalized nonlinear models were fit by using maximum likelihood with functions written as part of the nonlinear mixed effects library (Pinheiro and Bates 2000) in S-PLUS 7.0¹ (Insightful Corp., Seattle, WA).

¹The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

Model Selection

Final model selection and validation were based on indices of fit, bias analysis, model behavior, and comparisons to other published equations. Model subsets were compared on the basis of the Bayesian Information Criterion (BIC) (Schwarz 1978):

$$\text{BIC} = -2 \ln(\theta) + k \times \log(n)$$

where $\ln(\theta)$ is the log-likelihood, k is the number of parameters in the model, and n is the number of observations; and the adjusted coefficient of determination (R^2 , Kvålseth 1985):

$$R^2 = 1 - \frac{\frac{\sum_{i=1}^n (Y_i - \hat{Y}_i)^2}{n - k - 1}}{\frac{\sum_{i=1}^n (Y_i - \bar{Y})^2}{n - 1}}$$

where Y_i = is observed dib, $\hat{Y}_i$ = predicted dib, $\bar{Y}$ is the mean dib, and n and k are defined above. Estimated average bias (hereafter referred to as simply “bias”) and standard error of the estimate (SEE) in predicting dib along the stem were assessed against the modeling data set among height classes, sites, and treatments. Similarly, bias and standard error of bias in predicting stem volume were assessed among diameter classes, sites, and treatments. Observed inside-bark stem volume from 0.5-ft stump to tree tip (V_o) was calculated using Smalian’s formula on the observed dib estimates from stump height to tree tip. Predicted volume (V_p) was determined by numerically integrating the taper function between stump and tree tip and assuming sections were frusta of paraboloids. Bias (B) and SEE were calculated as follows:

$$B = \frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)$$

$$\text{SEE} = \sqrt{\frac{\sum_{i=1}^n (Y_i - \hat{Y}_i)^2}{n - k}}$$

where Y_i = is observed dib or V_o , $\hat{Y}_i$ = predicted dib or V_p , and n and k are defined above. Equations were examined across a wide range of DBH (0.1 to 100 in), HT (4.6 to 200 ft), and CR combinations for undesirable behavior (excessively large dib estimates below breast height, decreasing dib estimates below breast height, and dib bulges along the stem).

Model fit was also validated by using the “leave out one observation” cross-validation technique (i.e., a first-order jackknife approach) described by Draper and Smith (1981). In this procedure, one tree was omitted from the data set and the model was fit to the rest of the data and then used to predict dib for the one left out. This was then repeated for all trees in the dataset (234 times) yielding a mean square error of the estimate and biases for each sample height.

Finally, total stem volumes predicted from the final equation and five existing equations (excluding equations developed by Johnson et al. 1949 and Skinner 1959 because of the merchantability limits of these equations) were compared using the modeling and the two evaluation data sets (see table 5 for model, site, and sample tree characteristics for existing red alder models). Observed tree volumes were regressed on predicted tree volumes with the following linear equation:

$$V_o = b_1 V_p \quad (2)$$

where b_1 = the coefficient estimated using weighted least squares and V_o and V_p are defined above. A t-test was performed to determine whether b_1 was significantly different than 1.0 ($\alpha = 0.01$).

Table 5—Existing red alder volume/taper equation site and sample characteristics

Author	Brown 1962	Curtis et al. 1968	Kozak et al. 1969	Snell and Little 1983	Kozak 1988 & 1997 (eq. 2)
Equation type	Volume	Taper	Taper	Volume	Taper
Sample size	599	473	101	53	546
Sample location	SW British Columbia	NW Oregon to SW British Columbia	SW British Columbia	NW Oregon to W Washington	SW British Columbia
Stand type	Natural	Natural	Natural	Natural	Natural
DBH range (in)	2–22	2–24	5–18	1–25	2.5–25
Height range (ft)	30–110	20–120	53–108	NA	27.5–122
Stump height (ft)	0	0.5	0	0	0.66

DBH = diameter at breast height.

Results

The final equation had the parameterization for C as follows.

$$C = a_3 \left[1.364409 \cdot \text{DBH}^{1/3} \cdot e^{a_4 Z} + e^{a_5 \text{CR}^{a_6} \left(\frac{\text{DBH}}{\text{HT}} \right)^{a_7}} \cdot Z \right] \quad (3)$$

Substituting eq. (3) into eq. (1) yields the final equation:

$$\text{dib} = a_1 \text{DBH}^{a_2} X^{a_3} \left[1.364409 \cdot \text{DBH}^{1/3} \cdot e^{a_4 Z} + e^{a_5 \text{CR}^{a_6} \left(\frac{\text{DBH}}{\text{HT}} \right)^{a_7}} \cdot Z \right] \quad (4)$$

Parameter estimates for eq. (4) are presented in table 6.

Table 6—Parameter estimated values and asymptotic standard errors (SE) for eq. (4)

Parameter	Estimated value	SE
a_1	0.9113	0.0279
a_2	1.0160	0.0105
a_3	0.2623	0.0049
a_4	-18.7695	1.7154
a_5	3.1931	0.0894
a_6	0.1631	0.0239
a_7	0.4180	0.0415
$SD(e)$	0.2051	

The R^2 for the model was 0.987 with a root mean square error of 0.21 in. Tests on DBH/HT and CR were also highly significant ($p < 0.0001$). Biases in dib predictions among sample heights (i.e., measurement points), sites, and treatments were very small. Eq. (4) slightly underpredicted dib for 9 of the 14 measurement points (table 7). All but the lowermost measurement point had biases less than 0.05 in, and with the exception of the lowermost measurement point, SEEs were below 0.35 in. Range of dib biases was larger among sites than among measurement points and treatments, (-0.14 to 0.10 in). However, the estimates had a similar degree of precision (table 8). Among treatments, treatment five (early thinning treatment) had a dib bias at least twice as large as the other treatments (-0.10 in), though still quite small.

Table 7—Diameter inside bark bias and standard error of the estimate (SEE) by measurement point (MP) for the modeling data set

MP	N	Bias	SEE	Bias	SEE
		----- Inches -----		----- Percent -----	
0.66 ft	234	0.0604	0.5763	0.3758	6.8035
1.6 ft	234	0.0211	0.3317	0.1455	4.4077
2.6 ft	234	0.0108	0.2317	0.7440	3.3618
4.5 ft	234	0.0171	0.0667	0.2667	1.0291
10%	234	-0.0127	0.2517	-0.3158	4.3568
20%	234	-0.0426	0.2691	-0.9324	4.9411
30%	234	-0.0002	0.2910	-0.3491	5.7809
40%	234	0.0149	0.3448	-0.3376	7.7876
50%	234	0.0022	0.3402	-0.8334	9.3463
60%	234	0.0391	0.3330	-0.2787	11.5385
70%	234	0.0121	0.3018	-1.9896	15.1873
80%	234	-0.0117	0.2214	-3.9077	17.3240
90%	234	-0.0095	0.1465	-4.0839	22.7823
95%	234	0.0124	0.1220	0.5397	31.0768
Total	3,276	0.0082	0.2937	-0.8304	13.0768

Table 8—Diameter inside bark and total stem volume bias and standard error of the estimate (SEE) by site and treatment for the modeling data set

Site/treatment	Diameter inside bark					Total stem volume				
	<i>n</i>	Bias	SEE	Bias	SEE	<i>n</i>	Bias	SEE	Bias	SEE
		---- Inches ----		---- Percent ----			--- Cubic feet ---		--- Percent ---	
Site:										
Pollard	406	-0.1374	0.3291	-4.0596	14.9613	29	-0.2225	0.4449	-4.6443	8.7605
Pioneer	364	0.0963	0.3180	1.2232	11.0261	26	0.2684	0.4767	4.7197	8.0040
Siletz	308	-0.0007	0.2253	1.7781	12.8128	22	0.0071	0.2684	0.0676	7.7846
Sitkum	420	0.0474	0.3186	-0.7638	12.1000	30	0.2472	0.6320	2.5651	7.0885
Shamu	420	0.0741	0.2666	0.9519	11.8599	30	0.3390	0.5720	4.8295	8.7689
Humphrey	420	0.0310	0.3233	-0.0155	12.6047	30	0.0847	0.7662	1.3243	8.8551
Clear Lake	266	-0.0513	0.3100	-3.0415	14.2932	19	-0.0671	0.6815	-2.5354	8.6646
Mohun	280	-0.0224	0.2878	-4.5648	16.0613	20	-0.0212	0.3249	-2.7134	9.6966
Thompson	392	0.0082	0.2577	-0.1289	13.4227	28	0.1130	0.3496	1.5741	7.2601
Treatment:										
2	784	0.0067	0.3089	-0.3442	12.7945	56	0.0847	0.5438	0.0891	7.2627
3	448	-0.0234	0.2846	-2.6427	13.9298	32	0.0459	0.4520	-0.1626	7.5149
4	742	0.0045	0.2793	-2.2074	13.3848	53	0.0883	0.4484	0.8506	7.3023
5	112	-0.1041	0.3413	-2.9530	19.8988	8	-0.2013	0.7945	-7.1440	27.0678
6	574	0.0295	0.3476	1.5339	12.7709	41	0.1306	0.6250	1.4148	8.7845
8	560	0.0365	0.2430	-0.7576	11.5584	40	0.1836	0.4484	3.4561	7.5581
9	56	0.0525	0.1732	4.3884	11.6337	4	0.0671	0.0000	NA NA	
Total	3,276	0.0082	0.2937	-0.8304	13.0768	234	0.0953	0.4661	0.8236	7.2015

NA = not applicable.

Overall, total stem volume bias was small (0.10 ft³ or 0.8 percent). Volume bias patterns across site and treatment were similar to those in dib. Among sites, the largest volume bias was an underestimate of 0.34 ft³ (4.8 percent) per tree on the Shamu site. No patterns of volume bias were observed across sites with respect to latitude, elevation, aspect, slope, or site quality. The dib bias for treatment five translated into a 7.1 percent overestimation of total stem volume. Volume biases for all other treatments were small and ranged from -0.2 to 3.4 percent. Patterns of volume bias by DBH class indicated slight overestimation of volume in all classes except for the smallest trees (table 9). However, these biases were all very small ranging from -1.7 to 1.5 percent.

The jackknife cross-validation showed that the model predicted individual tree dibs extremely well. The root mean square error of the predictions was 0.30 in (table 10) and the correlation coefficient between the observed dibs and the predicted dibs was 0.99 (data not shown). The overall bias (0.01 in) and SEE (0.30 in) were similar to those presented in table 7, but the patterns among sample heights differed.

Table 9—Volume prediction bias and standard error of the estimate (SEE) by diameter class for the modeling data set

Diameter class	Number	Bias	SEE	Bias	SEE
<i>Inches</i>		<i>--- Cubic feet ---</i>		<i>---- Percent ----</i>	
3.0–5.0	34	-0.0141	0.1695	-1.7425	8.5147
5.0–7.0	106	0.0953	0.3390	1.5478	7.7120
7.0–9.0	68	0.0989	0.4979	0.7377	6.3765
9.0–11.0	26	0.2260	1.0805	1.1451	8.7260
Total	234	0.0953	0.4661	0.8236	7.2015

Table 10—Diameter inside bark bias and standard error of the estimate (SEE) by measurement point (MP) using the jackknife validation approach

MP	Number	Bias	SEE	Bias	SEE
		<i>---- Inches ----</i>		<i>---- Percent ----</i>	
0.66 ft	234	0.0165	0.1190	1.7829	30.2212
1.6 ft	234	-0.0047	0.1424	-3.2881	21.9128
2.6 ft	234	-0.0078	0.2220	-3.5835	17.2826
4.5 ft	234	0.0140	0.3065	-1.8635	15.3013
10%	234	0.0392	0.3393	-0.2548	11.7193
20%	234	0.0010	0.3458	-0.8591	9.4823
30%	234	0.0131	0.3493	-0.3876	7.8868
40%	234	-0.0019	0.2943	-0.4042	5.8470
50%	234	-0.0437	0.2712	-0.9794	4.9877
60%	234	-0.0125	0.2528	-0.3443	4.3766
70%	234	0.0181	0.0686	0.2495	1.0430
80%	234	0.0122	0.2337	0.0618	3.3841
90%	234	0.0250	0.3345	0.1478	4.4379
95%	234	0.0670	0.5802	0.4262	6.8264
Total	3,276	0.0097	0.2965	-0.6640	12.8363

An assessment of eq. (4) on the two evaluation data sets indicated the predictions obtained here were less biased than the other published red alder equations (table 11). The equation predicted total stem volume of the plantation trees better than other published equations, with b_1 not significantly different than 1.0 ($p < 0.076$). Eq. (4) also showed a fairly good ability to extrapolate to natural stands with larger tree sizes (b_1 in eq. (2) was significantly different than 1.0, $p = 0.002$). Surprisingly, these predictions for natural stands were superior to the other published equations with the exception of Kozak's (1988) variable exponent equation.

Table 11—Model fit statistics across all existing models for the modeling data set, and independent plantation and natural stand data sets

Model	Modeling data set			Plantation			Natural		
	b_1	SE(b_1)	RMSE	b_1	SE(b_1)	RMSE	b_1	SE(b_1)	RMSE
Browne 1962	0.9605	0.0042	0.0406	0.9621	0.0136	0.0469	0.9514	0.0136	0.0625
Curtis et al. 1968	0.9522	0.0044	0.0424	0.9385	0.0138	0.0478	0.9466	0.0238	0.1090
Kozak et al. 1969	0.9750	0.0047	0.0453	0.9727	0.0143	0.0489	0.9662	0.0153	0.0694
Snell and Little 1983	0.7199	0.0090	0.0930	0.6092	0.0371	0.1443	0.8824	0.0468	0.2212
Kozak 1988	1.0165	0.0051	0.0479	1.0146	0.0155	0.0526	1.0151	0.0164	0.0737
Kozak 1997; equation 2	1.1670	0.0065	0.0594	1.0678	0.0365	0.1222	1.0935	0.0231	0.1019
Equation 4	1.0156	0.0046	0.0433	0.9805	0.0133	0.0455	1.0448	0.0148	0.0663

b_1 = the coefficient obtained for the regression performed in eq. 2.

SE(b_1) = standard error of b_1 .

RMSE = root mean square error.

Tables of estimated stem volume are given in appendixes A, B, and D. Volumes were calculated by numerically integrating eq. (4) and applying Newton's formula between a stump height of 0.5 ft and tree tip (app. A), a 5-in top diameter (app. B), and crown base (app. D). Tables of estimated merchantable height to a 5-in top are given in appendix C. Merchantable heights were calculated by algebraically solving eq. (4) for Z (Kozak 1988) and iteratively solving for the height to a 5-in diameter outside bark. Tables of estimated diameter outside bark at crown base are given in appendix E. Diameters were estimated by eq. (4) where h = height to crown base and applying a locally derived bark factor equation to convert inside bark diameter to outside bark diameter.

Discussion

Overall, biases and standard errors of bias in predicting dib and volume were very small. These values were comparable and oftentimes lower than those reported elsewhere in the literature (Garber and Maguire 2003; Kozak et al. 1969; Kozak 1988, 1997; Muhairwe et al. 1994). Bias patterns among sample heights indicated that the observed stem profiles were slightly more neiloid in shape below DBH than eq. (4) predicted (as indicated by positive values). There were no strong patterns in bias above breast height.

The results presented here show that the shape of the stem profile varied more by site than by treatment. Subtle variations in tree stem profile have been shown among climate variables for jack pine (*Pinus banksiana* Lamb.) (Morris and Forslund 1992). Lester and DeBell (1989) found significant and consistent differences in diameter, height, bole volume, and aboveground biomass across 10 red alder provenances suggesting possible differences in the shape of the stem profile.

Provenances from northern Washington were consistently biggest and provenances from the edges (both northerly and easterly) consistently smallest. However, in this study, no patterns with latitude, elevation, precipitation, etc. were evident. In fact two sites (Pioneer and Pollard) close in geographical location and on similar sites exhibited opposite dib and volume biases. It is likely that differences in stem profile across sites are a combination of genetic, site, and climatic factors. More research is needed to determine the effects of genetics and specific site and environmental features on the stem profile.

Management activities such as initial planting density, pruning, and thinning have a direct effect on stand conditions, and these different conditions have been shown to affect stem shape of many species (Garber and Maguire 2003; Hilt and Dale 1979; Larson 1963, 1965; Lennette 1999; Valenti and Cao 1986a). Although the effect of treatment on stem profile was not explicitly tested, small dib and volume biases among treatments suggest that tree variables, namely DBH/HT and CR, adequately accounted for variation in stem profile among treatments. Most of this variation was the result of changes in diameter and height growth, the distribution of the live crown, and the length of the branch-free bole (Larson 1963). Incorporating DBH/HT and CR into the final model enabled accurate volume predictions across the wide range of management activities and stand conditions found in the modeling and the independent datasets.

As the DBH/HT increased, stem profiles changed from a more parabolic to neiloidic shape, respectively (fig. 3A). This has been well documented in the taper literature, as diameter and height have traditionally been used as shape variables in taper equations (Curtis et al. 1968). These variables represent the accumulation of growth and therefore describe a large portion of stem development over time. In plantation-grown red alder, this effect seems to be primarily manifested in the upper half of the stem. Crown ratio (CR), however, has been a less appealing covariate in stem profile modeling because of its paucity in some databases and its static nature. Moreover, despite marked differences in stem profile observed for trees of a given DBH/HT but different crown lengths (Larson 1963), previous work has demonstrated mixed results when incorporating CR into taper equations. Among several studies of loblolly pine (*Pinus taeda* L.), incorporating CR produced substantial (Valenti and Cao 1986b), slight (Leites and Robinson 2004), or no (Burkhart and Walton 1985) improvement in model performance. In a study of several species in British Columbia, Muhairwe et al. (1994) detected minor improvements in taper estimates but concluded they were minimal and not justifiable. However, substantial improvements in taper estimates by including CR have been reported in Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) in the Pacific

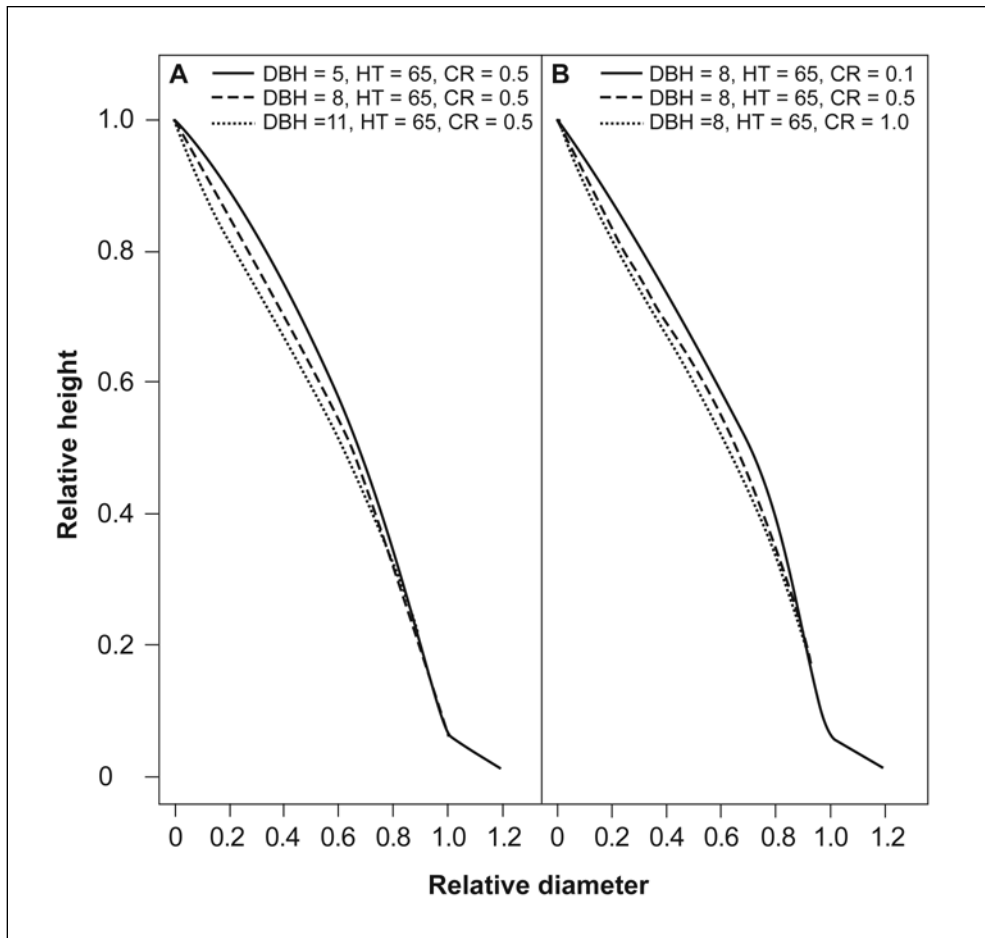


Figure 3— Predicted stem profiles for three trees of (A) identical height (65 ft) and crown ratio (0.5) with diameters of 5.0, 8.0, and 11.0 in, and (B) identical diameter (8.0 in) and height (65 ft) with crown ratios of 0.1, 0.5, and 1.0.

Northwest (Walters and Hann 1986). This ambiguity may be due to the correlation between DBH/HT and CR. In this study, although CR was highly significant, its contribution to the model was fairly subtle. Whereas the effect of DBH/HT was primarily manifested in the upper half of the stem, the slight effect of CR was detected throughout the stem, although primarily in the middle portion (fig. 3B). For a given DBH/HT, smaller and larger crown ratios resulted in a more parabolic and neiloidic stem shape, respectively. The expression of these two covariates may be due to the differences in stand development between the thinned and unthinned stands. The utility of CR as a covariate in taper equations may increase in stands spanning a wide range of silvicultural treatments.

There are implications of eq. (4) on merchantable height and volume. For a given HT and CR, an increase in DBH from 6 to 12 in results in an asymptotic increase in merchantable height to a 5-in top of 20.2 to 42.6 ft (fig. 4). Likewise,

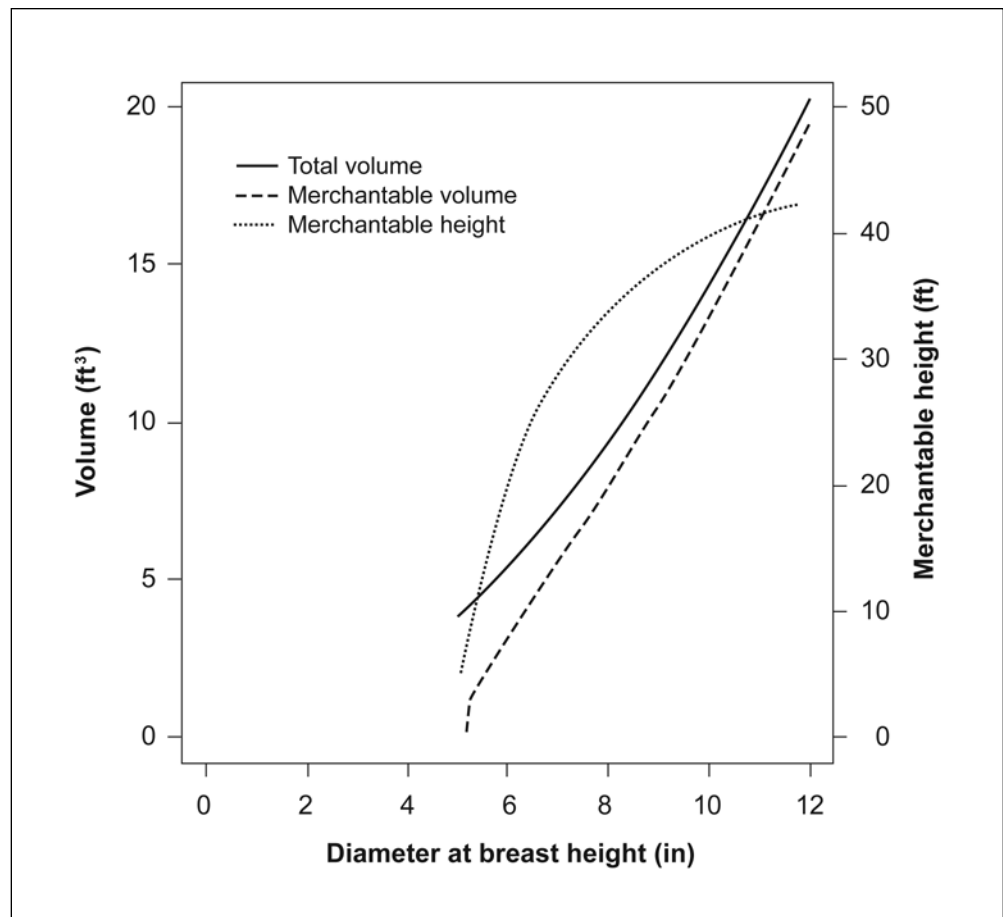


Figure 4— Effect of diameter on total stem volume (ft³), merchantable stem volume (ft³), and merchantable height (ft) for a tree 65 ft tall with a crown ratio of 0.5. Minimum top diameter is 5.0 in outside bark and stump height is 0.5 ft.

total stem volume increases from 5.4 to 20.2 ft³, and merchantable volume (0.5-ft stump to a 5-in top) increases from 3.2 to 19.4 ft³ (59 to 96 percent of total stem volume, respectively). In contrast, for a given DBH/HT, an increase in CR results in less stem volume (fig. 5). For instance, a change in CR of 0.1 to 0.5 results in a reduction in total stem volume and merchantable volume of approximately 7 percent. A change in CR of 0.5 to 0.9 results in a volume reduction of only 3 percent. The same pattern also applies to merchantable height. Using the above example, a change in CR of 0.1 to 0.5 reduces merchantable height 2.7 ft, whereas a change in CR of 0.5 to 0.9 reduces merchantable height 1.0 ft. Therefore, given the discreet log lengths used in log manufacturing, incorporating CR in the model will provide an improved assessment of what products can be obtained from a given tree or stand of trees.

As expected, the previously published red alder equations did not perform well in predicting volume for trees grown in plantations. Four models consistently

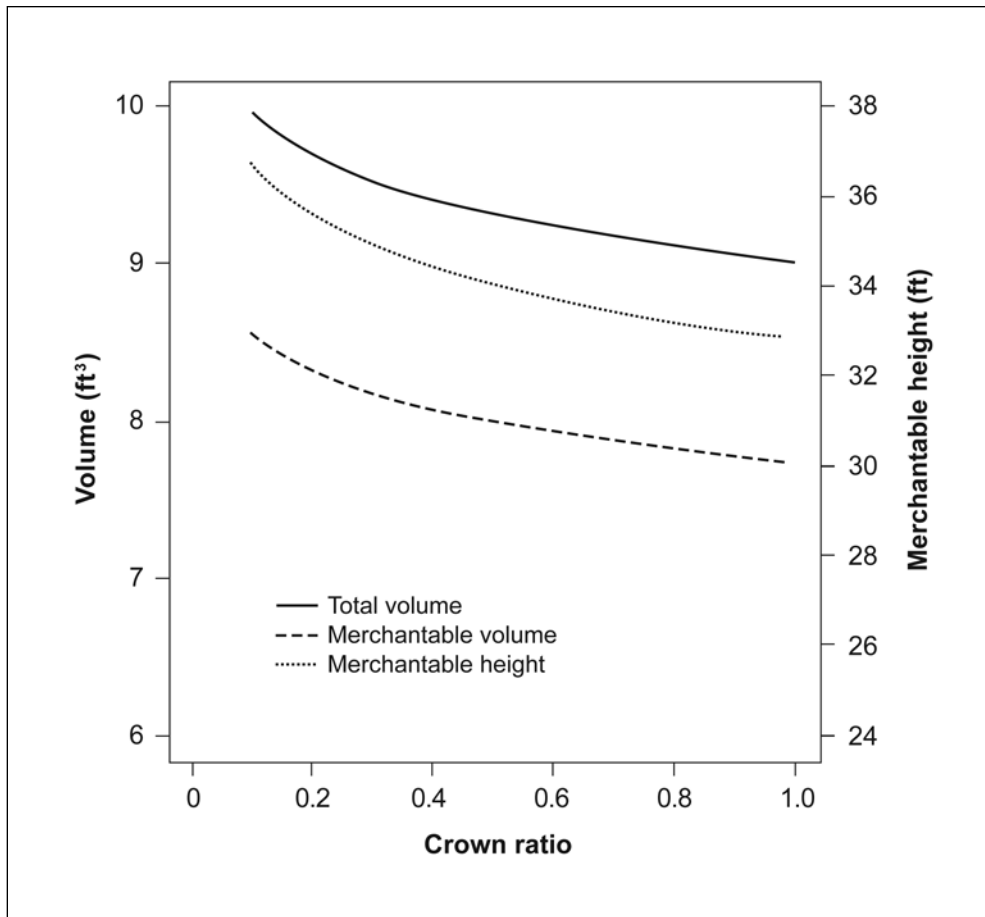


Figure 5— Effect of crown ratio on total stem volume (ft³), merchantable stem volume (ft³), and merchantable height (ft) for a tree 8.0 in diameter at breast height and 65 ft tall. Minimum top diameter is 5.0 in outside bark and stump height is 0.5 ft.

overpredicted tree volume (Browne 1962, Curtis et al. 1968, Kozak et al. 1969, Snell and Little 1983) and two models slightly underpredicted the volume (Kozak 1988 and 1997; eq. 2) of plantation-grown trees in both the modeling and evaluation data sets. This is consistent with the hypothesis that differences in tree growth (DeBell and Harrington 2002) and potentially stem profile shape between natural and planted stands would lead to an error in volume estimation. The consistent overprediction of the existing models can be explained by the early stand conditions of natural red alder and its effect on CR. Natural stands typically regenerate with densities vastly greater than that found in plantations (Harrington 1990). Interspecific competition (and thus crown closure) occurs very early, so, typically, natural trees of the same age as plantation-grown trees have a much lower CR. For a given DBH and HT, trees with a lower CR have more volume, and thus the over-prediction of volume from existing equations based on natural stand data.

The use of both evaluation data sets (plantations and natural stands) provided an assessment of how well eq. (4) predicted total stem volume of (1) plantation trees outside (generally larger than) the range of the modeling data set, and (2) trees grown in natural stands. The final model provided better predictions than existing models in plantations and was surprisingly comparable to Kozak's (1988) for natural stands. Testing the equation on larger trees would have been desirable, but larger plantation-grown tree data do not exist.

Equation Application

Equation 4 can be used to directly predict dib anywhere along the stem. Cursory analysis suggested that the bark factor was similar along the entire stem, so DOB can be predicted anywhere along the stem by solving eq. 4 without coefficients a_1 and a_2 .

Since eq. 4 cannot be integrated analytically, inside bark volume between any two points along the stem must be determined numerically. This is done by dividing the stem into sections (i.e., frustums of a paraboloid about 10 cm or less depending on computing speed desired) and summing the volume of these sections. Volumes of these sections are usually determined by using Huber's, Newton's, or Smalian's formulas (Husch et al. 1982). These formulae can then be used to compute the total volume of a stem, the volume of the merchantable part of the stem from a given stump height to a given top diameter, or the volumes of logs of a given length, etc.

Height to a desired dib must also be determined numerically as a closed form does not exist. This is done by rearranging eq. 4:

$$Z = \left[1 - \left(\frac{\text{dib}}{a_1 \text{DBH}^{a_2}} \right)^{\frac{1}{C}} (1 - \sqrt{p}) \right]^2 \quad (5)$$

where C is defined in eq. 3, a_1 and a_2 are given in table 6, and all other variables are described in the "Model Development" section above. In eq. 5 above, dib is set to the desired top diameter and C is calculated based on a starting value for Z , say Z_0 . A second estimate of Z is then determined via eq. 5, call it Z_1 . The next value of Z used to estimate C is then determined by:

$$Z_2 = Z_0 + \left[\frac{Z_1 - Z_0}{2} \right]$$

The above procedure is repeated until a certain precision is obtained. That is, $|Z_1 - Z_2| < \text{precision criterion}$. A good starting precision criteria could be 1 - dib/DBH. To obtain height to a given DOB, eq. 5 can be reformulated without the coefficients a_1 and a_2 .

If using metric units, the value 1.364409 is omitted from eq. 4 and a new parameter estimate (-1.31631) is substituted for parameter a_5 .

For datasets without CR, the same procedures can be followed using the red alder taper equation presented in Hibbs et al. 2007.

Conclusion

The taper equation used to predict stem volume of plantation-grown red alder developed in this study compares very favorably to existing red alder equations. This equation has several advantages that warrant its use. Unlike volume equations, which only estimate total or merchantable stem volume, taper equations can provide these estimates as well as merchantable height (to any diameter), individual log diameters, and volumes to any length. The merchantability standards (minimum log diameter, log length, etc.) are flexible and can be altered to meet different management needs. The model presented here predicted dib and volumes extremely well; it yielded better estimates of diameters and volumes than existing equations, extrapolated very well to tree sizes outside the range of data (for both managed and unmanaged stands), and is therefore an improvement over previously published equations.

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Metric Equivalents

When you know:	Multiply by:	To find:
Inches (in)	2.540	Centimeters (cm)
Feet (ft)	0.305	Meters (m)
Miles (mi)	1.609	Kilometers (km)
Trees per acre (tpa)	2.471	Trees per hectare (tph)
Acres (ac)	0.405	Hectares (ha)
Cubic feet (ft ³)	0.028	Cubic meters (m ³)

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Appendix A: Total Stem Volume

Table A-1—Total stem volume for red alder with a crown ratio of 0.1

DBH	Total height (feet)																			120
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
<i>Inches</i>																				
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0.15	0.19	0.23	0.28	0.32	0.37	0.42	0.47	0.51	0.56	—	—	—	—	—	—	—	—	—	—
3	0.34	0.42	0.52	0.62	0.72	0.83	0.93	1.04	1.14	1.25	1.36	1.46	1.57	—	—	—	—	—	—	—
4	0.62	0.74	0.91	1.08	1.27	1.45	1.64	1.82	2.01	2.20	2.39	2.58	2.77	2.96	—	—	—	—	—	—
5	—	1.15	1.40	1.68	1.96	2.24	2.53	2.82	3.11	3.40	3.70	3.99	4.28	4.58	4.87	—	—	—	—	—
6	—	—	2.00	2.39	2.79	3.20	3.61	4.02	4.44	4.85	5.27	5.69	6.11	6.54	6.96	7.38	—	—	—	—
7	—	—	—	3.23	3.77	4.31	4.87	5.43	5.99	6.55	7.12	7.69	8.25	8.82	9.40	9.97	10.54	—	—	—
8	—	—	—	—	4.88	5.59	6.31	7.03	7.76	8.49	9.22	9.96	10.70	11.44	12.18	12.93	13.67	14.42	—	—
9	—	—	—	—	—	7.02	7.92	8.83	9.75	10.67	11.59	12.52	13.45	14.38	15.31	16.25	17.19	18.13	—	—
10	—	—	—	—	—	—	9.71	10.82	11.95	13.07	14.21	15.35	16.49	17.63	18.78	19.93	21.09	22.24	23.40	—
11	—	—	—	—	—	—	—	13.01	14.36	15.71	17.08	18.45	19.82	21.20	22.58	23.97	25.36	26.75	28.15	—
12	—	—	—	—	—	—	—	—	16.98	18.58	20.20	21.82	23.44	25.08	26.71	28.36	30.00	31.65	33.31	—
13	—	—	—	—	—	—	—	—	19.80	21.68	23.56	25.45	27.35	29.26	31.17	33.09	35.01	36.94	38.87	—
14	—	—	—	—	—	—	—	—	—	24.99	27.17	29.35	31.54	33.74	35.95	38.17	40.39	42.62	44.85	—
15	—	—	—	—	—	—	—	—	—	28.53	31.02	33.51	36.02	38.53	41.05	43.59	46.12	48.67	51.22	—
16	—	—	—	—	—	—	—	—	—	—	35.10	37.93	40.76	43.61	46.47	49.34	52.22	55.10	58.00	—
17	—	—	—	—	—	—	—	—	—	—	39.43	42.60	45.79	48.99	52.20	55.43	58.66	61.91	65.16	—
18	—	—	—	—	—	—	—	—	—	—	43.98	47.53	51.08	54.66	58.25	61.85	65.46	69.08	72.72	—
19	—	—	—	—	—	—	—	—	—	—	—	52.70	56.65	60.62	64.60	68.59	72.60	76.63	80.66	—
20	—	—	—	—	—	—	—	—	—	—	—	58.13	62.49	66.86	71.26	75.67	80.09	84.53	88.99	—
21	—	—	—	—	—	—	—	—	—	—	—	63.81	68.59	73.39	78.22	83.06	87.93	92.80	97.70	—
22	—	—	—	—	—	—	—	—	—	—	—	—	74.95	80.21	85.48	90.78	96.10	101.43	106.78	—
23	—	—	—	—	—	—	—	—	—	—	—	—	81.58	87.30	93.05	98.82	104.61	110.42	116.25	—
24	—	—	—	—	—	—	—	—	—	—	—	—	88.48	94.68	100.91	107.17	113.45	119.76	126.08	—

DBH = diameter at breast height.

Table A-2—Total stem volume for red alder with a crown ratio of 0.2

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
<i>Inches</i>	<i>Cubic feet</i>																							
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	0.15	0.18	0.23	0.27	0.32	0.36	0.41	0.46	0.51	0.55	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	0.34	0.41	0.50	0.60	0.71	0.81	0.91	1.02	1.12	1.23	1.33	1.44	1.54	—	—	—	—	—	—	—	—	—	—	
4	0.61	0.72	0.89	1.06	1.24	1.42	1.60	1.78	1.97	2.15	2.34	2.52	2.71	2.90	—	—	—	—	—	—	—	—	—	
5	—	1.12	1.37	1.63	1.91	2.19	2.47	2.75	3.04	3.32	3.61	3.90	4.19	4.48	4.77	—	—	—	—	—	—	—	—	
6	—	—	1.95	2.33	2.72	3.11	3.51	3.92	4.33	4.73	5.14	5.56	5.97	6.38	6.80	7.21	—	—	—	—	—	—	—	
7	—	—	—	3.14	3.66	4.19	4.73	5.28	5.83	6.38	6.93	7.49	8.05	8.61	9.17	9.73	10.29	—	—	—	—	—	—	
8	—	—	—	—	4.74	5.43	6.13	6.83	7.54	8.26	8.98	9.70	10.42	11.15	11.87	12.60	13.34	14.07	—	—	—	—	—	
9	—	—	—	—	—	6.81	7.69	8.57	9.46	10.36	11.26	12.17	13.08	13.99	14.91	15.83	16.75	17.67	—	—	—	—	—	
10	—	—	—	—	—	—	9.41	10.50	11.59	12.69	13.80	14.91	16.02	17.14	18.27	19.39	20.52	21.66	22.79	—	—	—	—	
11	—	—	—	—	—	—	—	12.60	13.92	15.24	16.57	17.90	19.24	20.59	21.94	23.30	24.66	26.02	27.39	—	—	—	—	
12	—	—	—	—	—	—	—	—	16.44	18.01	19.58	21.16	22.74	24.34	25.94	27.54	29.15	30.76	32.38	34.00	—	—	—	
13	—	—	—	—	—	—	—	—	19.17	20.99	22.82	24.66	26.51	28.37	30.24	32.11	33.99	35.88	37.77	39.66	—	—	—	
14	—	—	—	—	—	—	—	—	—	24.18	26.30	28.42	30.56	32.70	34.85	37.01	39.18	41.36	43.54	45.73	—	—	—	
15	—	—	—	—	—	—	—	—	—	27.59	30.00	32.43	34.86	37.31	39.77	42.24	44.72	47.20	49.69	52.19	54.70	—	—	
16	—	—	—	—	—	—	—	—	—	—	33.93	36.68	39.44	42.21	44.99	47.79	50.59	53.40	56.23	59.06	61.90	—	—	
17	—	—	—	—	—	—	—	—	—	—	38.09	41.17	44.27	47.38	50.51	53.65	56.80	59.96	63.14	66.32	69.51	—	—	
18	—	—	—	—	—	—	—	—	—	—	42.47	45.91	49.36	52.84	56.32	59.83	63.35	66.88	70.42	73.97	77.53	81.10	—	
19	—	—	—	—	—	—	—	—	—	—	—	50.88	54.71	58.56	62.43	66.32	70.22	74.14	78.07	82.01	85.96	89.93	—	
20	—	—	—	—	—	—	—	—	—	—	—	56.10	60.32	64.57	68.83	73.12	77.42	81.74	86.08	90.43	94.79	99.17	—	
21	—	—	—	—	—	—	—	—	—	—	—	61.54	66.18	70.84	75.52	80.23	84.95	89.70	94.46	99.23	104.03	108.83	113.65	
22	—	—	—	—	—	—	—	—	—	—	—	—	72.29	77.38	82.50	87.64	92.81	97.99	103.19	108.42	113.66	118.91	124.18	
23	—	—	—	—	—	—	—	—	—	—	—	—	78.65	84.19	89.76	95.36	100.98	106.62	112.29	117.97	123.68	129.40	135.14	
24	—	—	—	—	—	—	—	—	—	—	—	—	85.26	91.27	97.31	103.37	109.47	115.59	121.74	127.90	134.09	140.30	146.53	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Table A-3—Total stem volume for red alder with a crown ratio of 0.3

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Inches	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0.15	0.18	0.22	0.27	0.31	0.36	0.41	0.45	0.50	0.55	—	—	—	—	—	—	—	—	—
3	0.34	0.41	0.50	0.60	0.70	0.80	0.90	1.00	1.11	1.21	1.32	1.42	1.52	—	—	—	—	—	—
4	0.61	0.71	0.87	1.04	1.22	1.40	1.58	1.76	1.94	2.12	2.31	2.49	2.67	2.86	—	—	—	—	—
5	—	1.11	1.35	1.61	1.88	2.15	2.43	2.71	2.99	3.27	3.56	3.84	4.13	4.42	4.70	—	—	—	—
6	—	—	1.92	2.29	2.67	3.06	3.46	3.85	4.26	4.66	5.06	5.47	5.88	6.29	6.70	7.11	—	—	—
7	—	—	—	3.08	3.60	4.12	4.65	5.19	5.73	6.27	6.82	7.37	7.92	8.47	9.03	9.58	10.14	—	—
8	—	—	—	—	4.65	5.33	6.02	6.71	7.41	8.11	8.82	9.53	10.25	10.96	11.68	12.40	13.13	13.85	—
9	—	—	—	—	—	6.68	7.54	8.41	9.29	10.18	11.06	11.96	12.85	13.76	14.66	15.57	16.47	17.39	—
10	—	—	—	—	—	—	9.23	10.30	11.37	12.45	13.54	14.64	15.74	16.84	17.95	19.06	20.18	21.29	22.42
11	—	—	—	—	—	—	—	12.36	13.65	14.95	16.26	17.57	18.89	20.22	21.55	22.89	24.23	25.57	26.92
12	—	—	—	—	—	—	—	—	16.12	17.65	19.20	20.75	22.32	23.88	25.46	27.04	28.63	30.22	31.82
13	—	—	—	—	—	—	—	—	18.78	20.57	22.37	24.18	26.00	27.83	29.67	31.52	33.37	35.23	37.09
14	—	—	—	—	—	—	—	—	—	23.69	25.77	27.86	29.95	32.06	34.18	36.31	38.45	40.59	42.74
15	—	—	—	—	—	—	—	—	—	27.02	29.39	31.77	34.16	36.57	38.99	41.42	43.86	46.30	48.76
16	—	—	—	—	—	—	—	—	—	—	33.23	35.92	38.63	41.35	44.09	46.84	49.60	52.37	55.15
17	—	—	—	—	—	—	—	—	—	—	37.29	40.31	43.35	46.41	49.48	52.57	55.67	58.78	61.90
18	—	—	—	—	—	—	—	—	—	—	41.56	44.93	48.32	51.73	55.16	58.60	62.06	65.53	69.02
19	—	—	—	—	—	—	—	—	—	—	—	49.79	53.55	57.32	61.12	64.94	68.78	72.62	76.49
20	—	—	—	—	—	—	—	—	—	—	—	54.87	59.02	63.18	67.37	71.58	75.81	80.05	84.32
21	—	—	—	—	—	—	—	—	—	—	—	60.19	64.73	69.30	73.90	78.52	83.16	87.82	92.49
22	—	—	—	—	—	—	—	—	—	—	—	—	70.69	75.68	80.70	85.75	90.82	95.91	101.02
23	—	—	—	—	—	—	—	—	—	—	—	—	76.89	82.32	87.78	93.27	98.79	104.33	109.89
24	—	—	—	—	—	—	—	—	—	—	—	—	83.33	89.22	95.14	101.09	107.07	113.08	119.11

DBH = diameter at breast height.

Table A-4—Total stem volume for red alder with a crown ratio of 0.4

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
<i>Inches</i>	<i>Cubic feet</i>																							
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	0.15	0.18	0.22	0.27	0.31	0.36	0.40	0.45	0.50	0.54	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	0.34	0.40	0.49	0.59	0.69	0.79	0.89	0.99	1.10	1.20	1.30	1.41	1.51	—	—	—	—	—	—	—	—	—	—	
4	0.60	0.71	0.86	1.03	1.20	1.38	1.56	1.74	1.92	2.10	2.28	2.47	2.65	2.83	—	—	—	—	—	—	—	—	—	
5	—	1.10	1.33	1.59	1.86	2.13	2.40	2.68	2.96	3.24	3.52	3.80	4.09	4.37	4.65	—	—	—	—	—	—	—	—	
6	—	—	1.90	2.26	2.64	3.02	3.41	3.81	4.21	4.60	5.01	5.41	5.81	6.22	6.63	7.03	—	—	—	—	—	—	—	
7	—	—	—	3.04	3.55	4.07	4.59	5.12	5.66	6.20	6.74	7.28	7.83	8.38	8.93	9.48	10.03	—	—	—	—	—	—	
8	—	—	—	—	4.59	5.26	5.94	6.62	7.31	8.01	8.71	9.41	10.12	10.83	11.54	12.26	12.97	13.69	—	—	—	—	—	
9	—	—	—	—	—	6.59	7.44	8.30	9.17	10.04	10.92	11.80	12.69	13.58	14.48	15.37	16.27	17.18	—	—	—	—	—	
10	—	—	—	—	—	—	9.10	10.15	11.22	12.28	13.36	14.44	15.53	16.62	17.72	18.82	19.92	21.03	22.14	—	—	—	—	
11	—	—	—	—	—	—	—	12.18	13.46	14.74	16.03	17.33	18.64	19.95	21.27	22.59	23.92	25.25	26.58	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.89	17.40	18.93	20.46	22.00	23.56	25.11	26.68	28.25	29.82	31.40	32.99	—	—	—	
13	—	—	—	—	—	—	—	—	18.50	20.27	22.05	23.83	25.63	27.44	29.26	31.08	32.91	34.75	36.59	38.44	—	—	—	
14	—	—	—	—	—	—	—	—	—	23.34	25.39	27.45	29.52	31.60	33.70	35.80	37.91	40.03	42.15	44.29	—	—	—	
15	—	—	—	—	—	—	—	—	—	26.61	28.94	31.29	33.66	36.04	38.42	40.82	43.23	45.65	48.08	50.51	52.96	—	—	
16	—	—	—	—	—	—	—	—	—	—	32.72	35.38	38.05	40.74	43.44	46.15	48.88	51.62	54.36	57.12	59.88	—	—	
17	—	—	—	—	—	—	—	—	—	—	36.71	39.69	42.69	45.71	48.74	51.79	54.85	57.92	61.01	64.10	67.21	—	—	
18	—	—	—	—	—	—	—	—	—	—	40.91	44.23	47.57	50.94	54.32	57.72	61.13	64.56	68.00	71.45	74.92	78.40	—	
19	—	—	—	—	—	—	—	—	—	—	—	49.00	52.70	56.43	60.18	63.95	67.73	71.53	75.35	79.18	83.02	86.87	—	
20	—	—	—	—	—	—	—	—	—	—	—	53.99	58.08	62.18	66.31	70.47	74.64	78.83	83.04	87.26	91.50	95.75	—	
21	—	—	—	—	—	—	—	—	—	—	—	59.21	63.69	68.19	72.73	77.28	81.86	86.46	91.07	95.71	100.36	105.03	109.71	
22	—	—	—	—	—	—	—	—	—	—	—	—	69.54	74.46	79.41	84.38	89.38	94.41	99.45	104.51	109.60	114.70	119.82	
23	—	—	—	—	—	—	—	—	—	—	—	—	75.63	80.98	86.36	91.77	97.21	102.68	108.17	113.68	119.21	124.76	130.33	
24	—	—	—	—	—	—	—	—	—	—	—	—	81.95	87.75	93.58	99.45	105.34	111.27	117.22	123.19	129.19	135.21	141.25	

DBH = diameter at breast height.

DBH = diameter at breast height.

Table A-5—Total stem volume for red alder with a crown ratio of 0.5

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Inches	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0.15	0.18	0.22	0.26	0.31	0.36	0.40	0.45	0.49	0.54	—	—	—	—	—	—	—	—	—
3	0.34	0.40	0.49	0.58	0.68	0.78	0.88	0.99	1.09	1.19	1.29	1.40	1.50	—	—	—	—	—	—
4	0.60	0.70	0.86	1.02	1.19	1.37	1.55	1.72	1.90	2.08	2.26	2.45	2.63	2.81	—	—	—	—	—
5	—	1.09	1.32	1.57	1.84	2.11	2.38	2.65	2.93	3.21	3.49	3.77	4.05	4.33	4.62	—	—	—	—
6	—	—	1.88	2.24	2.61	2.99	3.38	3.77	4.17	4.56	4.96	5.36	5.76	6.16	6.57	6.97	—	—	—
7	—	—	—	3.01	3.51	4.03	4.55	5.07	5.60	6.14	6.67	7.21	7.75	8.30	8.84	9.39	9.94	—	—
8	—	—	—	—	4.54	5.20	5.87	6.55	7.24	7.93	8.62	9.32	10.02	10.73	11.43	12.14	12.85	13.57	—
9	—	—	—	—	—	6.52	7.36	8.21	9.07	9.93	10.80	11.68	12.56	13.44	14.33	15.22	16.12	17.01	—
10	—	—	—	—	—	—	9.00	10.04	11.09	12.15	13.22	14.29	15.37	16.45	17.54	18.63	19.72	20.82	21.92
11	—	—	—	—	—	—	—	12.04	13.30	14.57	15.85	17.14	18.43	19.73	21.04	22.35	23.67	24.99	26.31
12	—	—	—	—	—	—	—	—	15.70	17.20	18.71	20.23	21.76	23.30	24.84	26.39	27.95	29.51	31.07
13	—	—	—	—	—	—	—	—	18.29	20.03	21.79	23.56	25.34	27.13	28.93	30.74	32.55	34.37	36.20
14	—	—	—	—	—	—	—	—	—	23.06	25.09	27.12	29.18	31.24	33.31	35.40	37.49	39.59	41.69
15	—	—	—	—	—	—	—	—	—	26.29	28.60	30.92	33.26	35.61	37.98	40.35	42.74	45.14	47.54
16	—	—	—	—	—	—	—	—	—	—	32.32	34.95	37.59	40.25	42.93	45.61	48.31	51.02	53.75
17	—	—	—	—	—	—	—	—	—	—	36.25	39.20	42.17	45.15	48.15	51.17	54.20	57.24	60.30
18	—	—	—	—	—	—	—	—	—	—	40.40	43.68	46.99	50.31	53.66	57.02	60.40	63.79	67.20
19	—	—	—	—	—	—	—	—	—	—	—	48.38	52.04	55.73	59.44	63.16	66.91	70.67	74.45
20	—	—	—	—	—	—	—	—	—	—	—	53.31	57.34	61.40	65.49	69.59	73.72	77.87	82.03
21	—	—	—	—	—	—	—	—	—	—	—	58.45	62.87	67.33	71.81	76.31	80.84	85.39	89.96
22	—	—	—	—	—	—	—	—	—	—	—	—	68.64	73.50	78.39	83.31	88.26	93.23	98.22
23	—	—	—	—	—	—	—	—	—	—	—	—	74.64	79.93	85.25	90.60	95.97	101.38	106.81
24	—	—	—	—	—	—	—	—	—	—	—	—	80.87	86.60	92.36	98.16	103.99	109.85	115.73

DBH = diameter at breast height.

Table A-6—Total stem volume for red alder with a crown ratio of 0.6

DBH	Total height (feet)																				120		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115
<i>Inches</i>	<i>Cubic feet</i>																						
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0.15	0.18	0.22	0.26	0.31	0.35	0.40	0.44	0.49	0.54	—	—	—	—	—	—	—	—	—	—	—	—	—
3	0.34	0.40	0.49	0.58	0.68	0.78	0.88	0.98	1.08	1.18	1.29	1.39	1.49	—	—	—	—	—	—	—	—	—	—
4	0.60	0.70	0.85	1.01	1.18	1.36	1.53	1.71	1.89	2.07	2.25	2.43	2.61	2.79	—	—	—	—	—	—	—	—	—
5	—	1.08	1.31	1.56	1.82	2.09	2.36	2.63	2.91	3.19	3.46	3.74	4.02	4.30	4.58	—	—	—	—	—	—	—	—
6	—	—	1.87	2.22	2.59	2.97	3.35	3.74	4.13	4.53	4.92	5.32	5.72	6.12	6.52	6.92	—	—	—	—	—	—	—
7	—	—	—	2.99	3.48	3.99	4.51	5.03	5.56	6.09	6.62	7.15	7.69	8.23	8.77	9.32	9.86	—	—	—	—	—	—
8	—	—	—	—	4.50	5.16	5.82	6.50	7.18	7.86	8.55	9.24	9.94	10.64	11.34	12.04	12.75	13.46	—	—	—	—	—
9	—	—	—	—	—	6.46	7.29	8.14	8.99	9.85	10.71	11.58	12.45	13.33	14.21	15.10	15.98	16.87	—	—	—	—	—
10	—	—	—	—	—	—	8.92	9.95	10.99	12.04	13.10	14.16	15.23	16.30	17.38	18.47	19.56	20.65	21.74	—	—	—	—
11	—	—	—	—	—	—	—	11.93	13.18	14.44	15.71	16.98	18.27	19.56	20.85	22.15	23.46	24.77	26.09	—	—	—	—
12	—	—	—	—	—	—	—	—	15.55	17.04	18.53	20.04	21.56	23.08	24.61	26.15	27.70	29.25	30.80	32.36	—	—	—
13	—	—	—	—	—	—	—	—	18.11	19.84	21.58	23.33	25.10	26.88	28.66	30.46	32.26	34.06	35.88	37.70	—	—	—
14	—	—	—	—	—	—	—	—	—	22.83	24.84	26.86	28.89	30.94	33.00	35.06	37.14	39.22	41.31	43.41	—	—	—
15	—	—	—	—	—	—	—	—	—	26.02	28.31	30.61	32.93	35.27	37.61	39.97	42.33	44.71	47.10	49.49	51.89	—	—
16	—	—	—	—	—	—	—	—	—	—	31.99	34.59	37.22	39.85	42.50	45.17	47.85	50.53	53.23	55.94	58.66	—	—
17	—	—	—	—	—	—	—	—	—	—	35.88	38.80	41.74	44.70	47.67	50.66	53.67	56.69	59.72	62.76	65.81	—	—
18	—	—	—	—	—	—	—	—	—	—	39.97	43.23	46.50	49.80	53.11	56.45	59.80	63.16	66.54	69.93	73.34	76.75	—
19	—	—	—	—	—	—	—	—	—	—	—	47.87	51.50	55.15	58.83	62.52	66.23	69.96	73.70	77.46	81.24	85.03	—
20	—	—	—	—	—	—	—	—	—	—	—	52.74	56.74	60.76	64.81	68.88	72.97	77.08	81.20	85.35	89.51	93.69	—
21	—	—	—	—	—	—	—	—	—	—	—	57.82	62.20	66.61	71.05	75.51	80.00	84.51	89.04	93.58	98.15	102.73	107.33
22	—	—	—	—	—	—	—	—	—	—	—	—	67.90	72.72	77.56	82.43	87.33	92.25	97.20	102.17	107.15	112.16	117.18
23	—	—	—	—	—	—	—	—	—	—	—	—	73.83	79.06	84.33	89.63	94.96	100.31	105.69	111.09	116.52	121.97	127.43
24	—	—	—	—	—	—	—	—	—	—	—	—	79.99	85.65	91.36	97.10	102.87	108.68	114.51	120.36	126.24	132.15	138.08

DBH = diameter at breast height.

Table A-7—Total stem volume for red alder with a crown ratio of 0.7

Total height (feet)																								
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Cubic feet																							
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	0.15	0.18	0.22	0.26	0.31	0.35	0.40	0.44	0.49	0.53	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	0.34	0.40	0.48	0.58	0.67	0.77	0.87	0.97	1.08	1.18	1.28	1.38	1.48	—	—	—	—	—	—	—	—	—	—	
4	0.60	0.69	0.84	1.01	1.18	1.35	1.52	1.70	1.88	2.06	2.24	2.42	2.60	2.78	—	—	—	—	—	—	—	—	—	
5	—	1.08	1.30	1.55	1.81	2.08	2.34	2.62	2.89	3.16	3.44	3.72	4.00	4.28	4.56	—	—	—	—	—	—	—	—	
6	—	—	1.85	2.20	2.57	2.95	3.33	3.71	4.10	4.49	4.89	5.28	5.68	6.08	6.48	6.88	—	—	—	—	—	—	—	
7	—	—	—	2.97	3.46	3.96	4.47	4.99	5.52	6.04	6.57	7.10	7.64	8.18	8.72	9.26	9.80	—	—	—	—	—	—	
8	—	—	—	—	4.47	5.12	5.78	6.45	7.12	7.80	8.49	9.18	9.87	10.56	11.26	11.96	12.66	13.37	—	—	—	—	—	
9	—	—	—	—	—	6.41	7.24	8.07	8.92	9.77	10.63	11.49	12.36	13.23	14.11	14.99	15.87	16.76	—	—	—	—	—	
10	—	—	—	—	—	—	8.85	9.87	10.90	11.94	12.99	14.05	15.11	16.18	17.25	18.33	19.41	20.50	21.59	—	—	—	—	
11	—	—	—	—	—	—	—	11.83	13.07	14.32	15.58	16.85	18.12	19.40	20.69	21.99	23.29	24.59	25.90	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.42	16.90	18.38	19.88	21.38	22.90	24.42	25.95	27.48	29.02	30.57	32.12	—	—	—	
13	—	—	—	—	—	—	—	—	17.95	19.67	21.40	23.14	24.90	26.66	28.43	30.21	32.00	33.80	35.60	37.41	—	—	—	
14	—	—	—	—	—	—	—	—	—	22.64	24.63	26.63	28.65	30.68	32.73	34.78	36.84	38.91	40.98	43.07	—	—	—	
15	—	—	—	—	—	—	—	—	—	25.80	28.07	30.35	32.65	34.97	37.30	39.64	41.99	44.35	46.72	49.10	51.48	—	—	
16	—	—	—	—	—	—	—	—	—	—	31.71	34.29	36.89	39.51	42.14	44.79	47.45	50.12	52.80	55.49	58.19	—	—	
17	—	—	—	—	—	—	—	—	—	—	35.56	38.46	41.37	44.31	47.26	50.23	53.21	56.21	59.22	62.24	65.27	—	—	
18	—	—	—	—	—	—	—	—	—	—	39.62	42.84	46.09	49.36	52.65	55.96	59.28	62.62	65.98	69.35	72.73	76.12	—	
19	—	—	—	—	—	—	—	—	—	—	—	47.44	51.04	54.66	58.31	61.97	65.65	69.35	73.07	76.80	80.55	84.31	—	
20	—	—	—	—	—	—	—	—	—	—	—	52.26	56.22	60.21	64.23	68.26	72.32	76.40	80.50	84.61	88.74	92.89	—	
21	—	—	—	—	—	—	—	—	—	—	—	57.29	61.63	66.01	70.41	74.84	79.29	83.76	88.25	92.77	97.30	101.85	106.41	
22	—	—	—	—	—	—	—	—	—	—	—	—	67.27	72.05	76.85	81.68	86.54	91.43	96.33	101.26	106.21	111.18	116.17	
23	—	—	—	—	—	—	—	—	—	—	—	—	73.14	78.33	83.55	88.81	94.09	99.40	104.74	110.10	115.49	120.89	126.32	
24	—	—	—	—	—	—	—	—	—	—	—	—	79.23	84.85	90.51	96.20	101.93	107.68	113.47	119.28	125.11	130.97	136.85	

DBH = diameter at breast height.

Table A-8—Total stem volume for red alder with a crown ratio of 0.8

Total height (feet)																								
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
<i>Inches</i>																								
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	0.15	0.18	0.22	0.26	0.30	0.35	0.39	0.44	0.49	0.53	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	0.34	0.39	0.48	0.57	0.67	0.77	0.87	0.97	1.07	1.17	1.27	1.38	1.48	—	—	—	—	—	—	—	—	—	—	
4	0.60	0.69	0.84	1.00	1.17	1.34	1.52	1.69	1.87	2.05	2.22	2.40	2.58	2.76	—	—	—	—	—	—	—	—	—	
5	—	1.07	1.29	1.54	1.80	2.06	2.33	2.60	2.87	3.15	3.42	3.70	3.98	4.25	4.53	—	—	—	—	—	—	—	—	
6	—	—	1.84	2.19	2.56	2.93	3.31	3.69	4.08	4.47	4.86	5.25	5.65	6.04	6.44	6.84	—	—	—	—	—	—	—	
7	—	—	—	2.95	3.44	3.94	4.45	4.96	5.48	6.00	6.53	7.06	7.59	8.13	8.66	9.20	9.74	—	—	—	—	—	—	
8	—	—	—	—	4.44	5.08	5.74	6.40	7.07	7.75	8.43	9.12	9.81	10.50	11.19	11.89	12.59	13.29	—	—	—	—	—	
9	—	—	—	—	—	6.37	7.19	8.02	8.86	9.70	10.56	11.42	12.28	13.15	14.02	14.89	15.77	16.65	—	—	—	—	—	
10	—	—	—	—	—	—	8.78	9.80	10.83	11.86	12.91	13.96	15.01	16.07	17.14	18.21	19.29	20.37	21.45	—	—	—	—	
11	—	—	—	—	—	—	—	11.75	12.98	14.22	15.47	16.73	18.00	19.27	20.55	21.84	23.13	24.43	25.73	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.31	16.77	18.25	19.74	21.23	22.74	24.25	25.77	27.30	28.83	30.37	31.91	—	—	—	
13	—	—	—	—	—	—	—	—	17.82	19.52	21.24	22.97	24.72	26.47	28.23	30.00	31.78	33.57	35.36	37.16	—	—	—	
14	—	—	—	—	—	—	—	—	—	22.47	24.45	26.44	28.44	30.46	32.49	34.53	36.58	38.63	40.70	42.77	—	—	—	
15	—	—	—	—	—	—	—	—	—	25.60	27.85	30.12	32.41	34.71	37.02	39.35	41.68	44.03	46.39	48.75	51.13	—	—	
16	—	—	—	—	—	—	—	—	—	—	31.47	34.03	36.62	39.21	41.83	44.46	47.10	49.75	52.42	55.09	57.78	—	—	
17	—	—	—	—	—	—	—	—	—	—	35.29	38.16	41.06	43.97	46.90	49.85	52.82	55.79	58.78	61.79	64.80	—	—	
18	—	—	—	—	—	—	—	—	—	—	39.31	42.51	45.73	48.98	52.25	55.53	58.83	62.15	65.49	68.83	72.19	75.57	—	
19	—	—	—	—	—	—	—	—	—	—	—	47.07	50.64	54.23	57.85	61.49	65.15	68.83	72.52	76.23	79.95	83.69	—	
20	—	—	—	—	—	—	—	—	—	—	—	51.84	55.78	59.74	63.72	67.73	71.76	75.81	79.88	83.97	88.07	92.19	—	
21	—	—	—	—	—	—	—	—	—	—	—	56.83	61.14	65.48	69.85	74.24	78.66	83.11	87.57	92.05	96.56	101.08	105.61	
22	—	—	—	—	—	—	—	—	—	—	—	—	66.73	71.47	76.24	81.03	85.86	90.71	95.58	100.48	105.39	110.33	115.28	
23	—	—	—	—	—	—	—	—	—	—	—	—	72.54	77.69	82.88	88.09	93.34	98.61	103.91	109.24	114.58	119.95	125.34	
24	—	—	—	—	—	—	—	—	—	—	—	—	78.58	84.16	89.77	95.42	101.10	106.82	112.56	118.33	124.13	129.94	135.79	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Table A-9—Total stem volume for red alder with a crown ratio of 0.9

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
<i>Inches</i>	<i>Cubic feet</i>																						
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0.15	0.18	0.22	0.26	0.30	0.35	0.39	0.44	0.48	0.53	—	—	—	—	—	—	—	—	—	—	—	—	—
3	0.34	0.39	0.48	0.57	0.67	0.77	0.87	0.97	1.07	1.17	1.27	1.37	1.47	—	—	—	—	—	—	—	—	—	—
4	0.60	0.69	0.84	1.00	1.16	1.34	1.51	1.68	1.86	2.04	2.21	2.39	2.57	2.75	—	—	—	—	—	—	—	—	—
5	—	1.07	1.29	1.53	1.79	2.05	2.32	2.59	2.86	3.13	3.40	3.68	3.96	4.23	4.51	—	—	—	—	—	—	—	—
6	—	—	1.83	2.18	2.54	2.91	3.29	3.67	4.06	4.44	4.83	5.23	5.62	6.01	6.41	6.81	—	—	—	—	—	—	—
7	—	—	—	2.93	3.42	3.91	4.42	4.93	5.45	5.97	6.49	7.02	7.55	8.08	8.62	9.16	9.69	—	—	—	—	—	—
8	—	—	—	—	4.41	5.05	5.70	6.37	7.03	7.71	8.38	9.07	9.75	10.44	11.13	11.82	12.52	13.22	—	—	—	—	—
9	—	—	—	—	—	6.33	7.14	7.97	8.80	9.65	10.50	11.35	12.21	13.07	13.94	14.81	15.68	16.56	—	—	—	—	—
10	—	—	—	—	—	—	8.73	9.74	10.76	11.79	12.83	13.87	14.92	15.98	17.04	18.11	19.18	20.25	21.33	—	—	—	—
11	—	—	—	—	—	—	—	11.67	12.90	14.13	15.37	16.63	17.89	19.15	20.43	21.71	22.99	24.28	25.58	—	—	—	—
12	—	—	—	—	—	—	—	—	15.21	16.67	18.13	19.61	21.10	22.60	24.10	25.61	27.13	28.65	30.18	31.72	—	—	—
13	—	—	—	—	—	—	—	—	17.70	19.40	21.10	22.83	24.56	26.30	28.05	29.81	31.58	33.36	35.14	36.93	—	—	—
14	—	—	—	—	—	—	—	—	—	22.32	24.28	26.26	28.26	30.26	32.28	34.31	36.35	38.39	40.45	42.51	—	—	—
15	—	—	—	—	—	—	—	—	—	25.43	27.67	29.92	32.19	34.48	36.78	39.09	41.42	43.75	46.09	48.45	50.81	—	—
16	—	—	—	—	—	—	—	—	—	—	31.25	33.80	36.37	38.95	41.55	44.16	46.79	49.43	52.08	54.74	57.41	—	—
17	—	—	—	—	—	—	—	—	—	—	35.04	37.90	40.78	43.67	46.59	49.52	52.47	55.43	58.40	61.38	64.38	—	—
18	—	—	—	—	—	—	—	—	—	—	39.03	42.21	45.42	48.64	51.89	55.15	58.44	61.74	65.05	68.38	71.72	75.07	—
19	—	—	—	—	—	—	—	—	—	—	—	46.74	50.28	53.86	57.45	61.07	64.71	68.36	72.03	75.72	79.42	83.14	—
20	—	—	—	—	—	—	—	—	—	—	—	51.47	55.38	59.31	63.28	67.26	71.27	75.29	79.34	83.40	87.48	91.58	—
21	—	—	—	—	—	—	—	—	—	—	—	56.42	60.70	65.01	69.35	73.72	78.11	82.53	86.97	91.42	95.90	100.39	104.90
22	—	—	—	—	—	—	—	—	—	—	—	—	66.25	70.95	75.69	80.46	85.25	90.07	94.91	99.78	104.67	109.57	114.50
23	—	—	—	—	—	—	—	—	—	—	—	—	72.02	77.13	82.28	87.46	92.67	97.91	103.18	108.47	113.79	119.12	124.48
24	—	—	—	—	—	—	—	—	—	—	—	—	78.00	83.54	89.12	94.73	100.38	106.05	111.76	117.49	123.25	129.04	134.84

DBH = diameter at breast height.

Table A-10—Total stem volume for red alder with a crown ratio of 1.0

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
<i>Inches</i>	<i>Cubic feet</i>																							
1	0.04	0.05	0.06	0.07	0.08	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	0.15	0.18	0.22	0.26	0.30	0.35	0.39	0.44	0.48	0.53	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	0.34	0.39	0.48	0.57	0.66	0.76	0.86	0.96	1.06	1.16	1.26	1.36	1.47	—	—	—	—	—	—	—	—	—	—	
4	0.60	0.69	0.83	0.99	1.16	1.33	1.50	1.68	1.85	2.03	2.20	2.38	2.56	2.74	—	—	—	—	—	—	—	—	—	
5	—	1.06	1.28	1.53	1.78	2.04	2.31	2.57	2.84	3.12	3.39	3.66	3.94	4.22	4.49	—	—	—	—	—	—	—	—	
6	—	—	1.82	2.17	2.53	2.90	3.27	3.65	4.04	4.42	4.81	5.20	5.59	5.99	6.38	6.78	—	—	—	—	—	—	—	
7	—	—	—	2.92	3.40	3.89	4.40	4.91	5.42	5.94	6.46	6.99	7.52	8.05	8.58	9.11	9.65	—	—	—	—	—	—	
8	—	—	—	—	4.39	5.03	5.67	6.33	7.00	7.66	8.34	9.02	9.70	10.39	11.07	11.77	12.46	13.16	—	—	—	—	—	
9	—	—	—	—	—	6.29	7.10	7.92	8.76	9.59	10.44	11.29	12.14	13.00	13.87	14.73	15.60	16.48	—	—	—	—	—	
10	—	—	—	—	—	—	8.68	9.68	10.70	11.72	12.76	13.79	14.84	15.89	16.95	18.01	19.08	20.15	21.22	—	—	—	—	
11	—	—	—	—	—	—	—	11.61	12.82	14.05	15.29	16.53	17.79	19.05	20.32	21.59	22.87	24.15	25.44	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.12	16.57	18.03	19.50	20.98	22.47	23.97	25.47	26.98	28.50	30.02	31.55	—	—	—	
13	—	—	—	—	—	—	—	—	17.60	19.28	20.98	22.69	24.41	26.15	27.89	29.64	31.40	33.17	34.95	36.73	—	—	—	
14	—	—	—	—	—	—	—	—	—	22.18	24.14	26.11	28.09	30.09	32.09	34.11	36.14	38.17	40.22	42.27	—	—	—	
15	—	—	—	—	—	—	—	—	—	25.27	27.50	29.74	32.00	34.28	36.56	38.86	41.17	43.50	45.83	48.17	50.52	—	—	
16	—	—	—	—	—	—	—	—	—	—	31.06	33.59	36.15	38.72	41.30	43.90	46.51	49.14	51.77	54.42	57.08	—	—	
17	—	—	—	—	—	—	—	—	—	—	34.82	37.66	40.52	43.40	46.30	49.22	52.15	55.09	58.05	61.02	64.01	—	—	
18	—	—	—	—	—	—	—	—	—	—	38.78	41.95	45.13	48.34	51.57	54.82	58.08	61.36	64.66	67.97	71.29	74.63	—	
19	—	—	—	—	—	—	—	—	—	—	—	46.44	49.97	53.52	57.09	60.69	64.31	67.94	71.59	75.26	78.94	82.64	—	
20	—	—	—	—	—	—	—	—	—	—	—	51.14	55.03	58.94	62.87	66.84	70.82	74.82	78.85	82.89	86.95	91.02	—	
21	—	—	—	—	—	—	—	—	—	—	—	56.06	60.31	64.60	68.91	73.25	77.62	82.01	86.42	90.85	95.31	99.78	104.26	
22	—	—	—	—	—	—	—	—	—	—	—	—	65.82	70.49	75.20	79.94	84.71	89.50	94.31	99.15	104.01	108.89	113.80	
23	—	—	—	—	—	—	—	—	—	—	—	—	71.54	76.62	81.74	86.89	92.07	97.28	102.52	107.78	113.07	118.38	123.71	
24	—	—	—	—	—	—	—	—	—	—	—	—	77.49	82.99	88.53	94.11	99.72	105.37	111.04	116.74	122.47	128.22	133.99	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Appendix B: Merchantable Stem Volume

Table B-1—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.1

DBH	Total height (feet)																				120		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115
Inches																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.69	1.89	2.10	2.30	2.50	2.71	2.91	3.11	3.31	3.50	3.70	3.89	4.09	—	—	—	—	—	—	—
7	—	—	—	2.70	3.09	3.49	3.90	4.30	4.71	5.11	5.52	5.93	6.33	6.74	7.15	7.56	7.96	—	—	—	—	—	
8	—	—	—	—	4.34	4.93	5.53	6.13	6.73	7.34	7.95	8.56	9.18	9.79	10.41	11.02	11.64	12.26	—	—	—	—	
9	—	—	—	—	—	6.46	7.26	8.07	8.88	9.70	10.52	11.35	12.18	13.01	13.84	14.67	15.51	16.35	—	—	—	—	
10	—	—	—	—	—	—	9.13	10.16	11.20	12.24	13.29	14.34	15.39	16.45	17.52	18.58	19.65	20.72	21.79	—	—	—	
11	—	—	—	—	—	—	—	12.42	13.69	14.97	16.26	17.56	18.86	20.16	21.47	22.78	24.10	25.42	26.74	—	—	—	
12	—	—	—	—	—	—	—	—	16.38	17.91	19.46	21.01	22.58	24.14	25.71	27.29	28.87	30.46	32.05	33.64	—	—	
13	—	—	—	—	—	—	—	—	19.25	21.06	22.89	24.72	26.56	28.41	30.26	32.12	33.99	35.86	37.74	39.62	—	—	
14	—	—	—	—	—	—	—	—	—	24.43	26.54	28.67	30.81	32.96	35.11	37.28	39.44	41.62	43.80	45.99	—	—	
15	—	—	—	—	—	—	—	—	—	28.00	30.43	32.87	35.33	37.80	40.27	42.75	45.25	47.75	50.25	52.76	55.28	—	
16	—	—	—	—	—	—	—	—	—	—	34.55	37.33	40.12	42.92	45.74	48.56	51.39	54.24	57.09	59.94	62.81	—	
17	—	—	—	—	—	—	—	—	—	—	38.90	42.03	45.18	48.34	51.51	54.69	57.89	61.09	64.30	67.53	70.76	—	
18	—	—	—	—	—	—	—	—	—	—	43.49	46.99	50.50	54.04	57.58	61.15	64.72	68.31	71.90	75.51	79.13	82.75	
19	—	—	—	—	—	—	—	—	—	—	—	52.19	56.09	60.02	63.97	67.92	71.90	75.89	79.89	83.90	87.92	91.95	
20	—	—	—	—	—	—	—	—	—	—	—	57.63	61.95	66.29	70.65	75.03	79.42	83.82	88.24	92.68	97.13	101.58	
21	—	—	—	—	—	—	—	—	—	—	—	63.33	68.07	72.84	77.63	82.45	87.27	92.12	96.98	101.86	106.75	111.65	
22	—	—	—	—	—	—	—	—	—	—	—	—	74.46	79.68	84.92	90.18	95.47	100.77	106.09	111.43	116.79	122.15	
23	—	—	—	—	—	—	—	—	—	—	—	—	81.10	86.79	92.50	98.24	104.00	109.78	115.58	121.40	127.23	133.09	
24	—	—	—	—	—	—	—	—	—	—	—	—	88.01	94.18	100.38	106.61	112.86	119.14	125.44	131.76	138.09	144.45	

DBH = diameter at breast height.

Table B-2—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.2

DBH	Total height (feet)																						
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
<i>Inches</i>	<i>Cubic feet</i>																						
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.66	1.86	2.06	2.26	2.46	2.65	2.85	3.05	3.24	3.44	3.63	3.82	4.01	—	—	—	—	—	—	—
7	—	—	—	2.63	3.02	3.40	3.80	4.19	4.58	4.98	5.38	5.78	6.17	6.57	6.97	7.37	7.77	—	—	—	—	—	—
8	—	—	—	—	4.21	4.79	5.37	5.95	6.54	7.13	7.73	8.33	8.92	9.52	10.13	10.73	11.33	11.94	—	—	—	—	—
9	—	—	—	—	—	6.27	7.04	7.83	8.62	9.42	10.22	11.02	11.83	12.64	13.45	14.26	15.08	15.90	—	—	—	—	—
10	—	—	—	—	—	—	8.85	9.85	10.85	11.87	12.88	13.91	14.94	15.97	17.00	18.04	19.09	20.13	21.18	—	—	—	—
11	—	—	—	—	—	—	—	12.02	13.26	14.50	15.76	17.01	18.28	19.55	20.83	22.11	23.39	24.68	25.97	—	—	—	—
12	—	—	—	—	—	—	—	—	15.85	17.34	18.84	20.35	21.87	23.40	24.93	26.46	28.01	29.55	31.11	32.66	—	—	—
13	—	—	—	—	—	—	—	—	18.62	20.37	22.14	23.92	25.71	27.51	29.32	31.13	32.95	34.77	36.60	38.44	—	—	—
14	—	—	—	—	—	—	—	—	—	23.61	25.67	27.73	29.81	31.90	34.00	36.10	38.22	40.34	42.46	44.60	—	—	—
15	—	—	—	—	—	—	—	—	—	27.06	29.41	31.78	34.17	36.56	38.97	41.39	43.81	46.25	48.69	51.14	53.60	—	—
16	—	—	—	—	—	—	—	—	—	—	33.38	36.07	38.78	41.50	44.24	46.98	49.74	52.51	55.29	58.07	60.86	—	—
17	—	—	—	—	—	—	—	—	—	—	37.56	40.60	43.65	46.71	49.79	52.89	56.00	59.12	62.25	65.38	68.53	—	—
18	—	—	—	—	—	—	—	—	—	—	41.97	45.36	48.77	52.20	55.64	59.10	62.58	66.07	69.57	73.08	76.60	80.14	—
19	—	—	—	—	—	—	—	—	—	—	—	50.36	54.14	57.95	61.78	65.63	69.49	73.36	77.26	81.16	85.07	89.00	—
20	—	—	—	—	—	—	—	—	—	—	—	55.59	59.77	63.98	68.21	72.45	76.72	81.00	85.30	89.62	93.94	98.28	—
21	—	—	—	—	—	—	—	—	—	—	—	61.06	65.65	70.27	74.92	79.59	84.27	88.98	93.71	98.45	103.21	107.98	112.77
22	—	—	—	—	—	—	—	—	—	—	—	—	71.78	76.83	81.91	87.02	92.15	97.30	102.47	107.66	112.86	118.09	123.33
23	—	—	—	—	—	—	—	—	—	—	—	—	78.16	83.66	89.19	94.76	100.34	105.95	111.59	117.24	122.91	128.60	134.31
24	—	—	—	—	—	—	—	—	—	—	—	—	84.78	90.75	96.75	102.79	108.85	114.94	121.06	127.19	133.35	139.53	145.72

DBH = diameter at breast height.

Table B-3—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.3

DBH	Total height (feet)																				120		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115
Inches																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.64	1.83	2.03	2.23	2.42	2.62	2.82	3.01	3.20	3.40	3.59	3.78	3.97	—	—	—	—	—	—	—
7	—	—	—	2.59	2.97	3.35	3.73	4.12	4.51	4.90	5.29	5.69	6.08	6.47	6.87	7.26	7.66	—	—	—	—	—	—
8	—	—	—	—	4.14	4.70	5.27	5.85	6.43	7.01	7.60	8.18	8.77	9.36	9.96	10.55	11.15	11.74	—	—	—	—	—
9	—	—	—	—	—	6.15	6.91	7.68	8.46	9.24	10.03	10.82	11.61	12.41	13.21	14.01	14.82	15.63	—	—	—	—	—
10	—	—	—	—	—	—	8.68	9.66	10.65	11.64	12.64	13.65	14.66	15.67	16.69	17.72	18.74	19.77	20.81	—	—	—	—
11	—	—	—	—	—	—	—	11.79	13.00	14.22	15.45	16.69	17.93	19.18	20.44	21.70	22.96	24.23	25.50	—	—	—	—
12	—	—	—	—	—	—	—	—	15.53	16.99	18.47	19.95	21.45	22.94	24.45	25.96	27.48	29.00	30.53	32.07	—	—	—
13	—	—	—	—	—	—	—	—	18.24	19.96	21.70	23.45	25.20	26.97	28.75	30.53	32.32	34.11	35.92	37.72	—	—	—
14	—	—	—	—	—	—	—	—	—	23.13	25.14	27.17	29.21	31.26	33.32	35.39	37.47	39.56	41.65	43.75	—	—	—
15	—	—	—	—	—	—	—	—	—	26.49	28.80	31.13	33.47	35.82	38.19	40.56	42.95	45.34	47.75	50.16	52.57	—	—
16	—	—	—	—	—	—	—	—	—	—	32.67	35.31	37.97	40.65	43.33	46.03	48.74	51.46	54.19	56.93	59.68	—	—
17	—	—	—	—	—	—	—	—	—	—	36.76	39.73	42.73	45.74	48.76	51.80	54.85	57.92	61.00	64.09	67.18	—	—
18	—	—	—	—	—	—	—	—	—	—	41.06	44.38	47.73	51.09	54.47	57.87	61.29	64.71	68.15	71.61	75.07	78.55	—
19	—	—	—	—	—	—	—	—	—	—	—	49.26	52.97	56.71	60.47	64.24	68.03	71.84	75.66	79.50	83.35	87.21	—
20	—	—	—	—	—	—	—	—	—	—	—	54.37	58.47	62.59	66.74	70.91	75.09	79.30	83.52	87.76	92.02	96.28	—
21	—	—	—	—	—	—	—	—	—	—	—	59.70	64.20	68.73	73.29	77.87	82.47	87.09	91.73	96.39	101.06	105.75	110.46
22	—	—	—	—	—	—	—	—	—	—	—	—	70.18	75.13	80.11	85.12	90.15	95.21	100.28	105.38	110.49	115.62	120.77
23	—	—	—	—	—	—	—	—	—	—	—	—	76.39	81.79	87.21	92.66	98.14	103.65	109.18	114.73	120.30	125.89	131.50
24	—	—	—	—	—	—	—	—	—	—	—	—	82.85	88.70	94.58	100.50	106.44	112.42	118.42	124.44	130.49	136.55	142.64

DBH = diameter at breast height.

Table B-4—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.4

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
<i>Inches</i>	<i>Cubic feet</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.62	1.82	2.01	2.21	2.40	2.60	2.79	2.98	3.18	3.37	3.56	3.75	3.93	—	—	—	—	—	—	—	
7	—	—	—	2.56	2.93	3.31	3.69	4.07	4.46	4.85	5.23	5.62	6.01	6.40	6.79	7.18	7.57	—	—	—	—	—	—	
8	—	—	—	—	4.09	4.64	5.20	5.77	6.34	6.92	7.50	8.08	8.66	9.25	9.83	10.42	11.01	11.60	—	—	—	—	—	
9	—	—	—	—	—	6.07	6.82	7.58	8.35	9.12	9.90	10.68	11.46	12.25	13.04	13.83	14.63	15.43	—	—	—	—	—	
10	—	—	—	—	—	—	8.56	9.52	10.50	11.48	12.47	13.46	14.46	15.46	16.47	17.48	18.50	19.52	20.54	—	—	—	—	
11	—	—	—	—	—	—	—	11.62	12.81	14.02	15.23	16.45	17.68	18.92	20.15	21.40	22.65	23.90	25.16	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.30	16.74	18.20	19.66	21.14	22.62	24.11	25.60	27.10	28.61	30.12	31.63	—	—	—	
13	—	—	—	—	—	—	—	—	17.96	19.66	21.38	23.10	24.84	26.58	28.33	30.09	31.86	33.64	35.42	37.20	—	—	—	
14	—	—	—	—	—	—	—	—	—	22.78	24.76	26.76	28.78	30.80	32.84	34.88	36.93	39.00	41.06	43.14	—	—	—	
15	—	—	—	—	—	—	—	—	—	26.08	28.36	30.65	32.96	35.29	37.62	39.96	42.32	44.69	47.06	49.44	51.83	—	—	
16	—	—	—	—	—	—	—	—	—	—	32.17	34.77	37.39	40.03	42.68	45.34	48.02	50.71	53.40	56.11	58.83	—	—	
17	—	—	—	—	—	—	—	—	—	—	36.18	39.11	42.06	45.03	48.02	51.02	54.03	57.06	60.09	63.14	66.20	—	—	
18	—	—	—	—	—	—	—	—	—	—	40.41	43.68	46.98	50.30	53.63	56.98	60.35	63.74	67.13	70.54	73.96	77.40	—	
19	—	—	—	—	—	—	—	—	—	—	—	48.47	52.13	55.82	59.52	63.24	66.98	70.74	74.51	78.30	82.10	85.92	—	
20	—	—	—	—	—	—	—	—	—	—	—	53.49	57.53	61.59	65.68	69.79	73.92	78.07	82.24	86.42	90.62	94.83	—	
21	—	—	—	—	—	—	—	—	—	—	—	58.72	63.16	67.62	72.11	76.63	81.17	85.72	90.30	94.90	99.51	104.14	108.79	
22	—	—	—	—	—	—	—	—	—	—	—	—	69.03	73.91	78.82	83.75	88.71	93.70	98.70	103.73	108.78	113.84	118.93	
23	—	—	—	—	—	—	—	—	—	—	—	—	—	75.13	80.44	85.79	91.16	96.56	101.99	107.44	112.92	118.41	123.93	
24	—	—	—	—	—	—	—	—	—	—	—	—	—	81.47	87.23	93.02	98.85	104.71	110.60	116.51	122.45	128.42	134.41	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Table B-5—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.5

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Cubic feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.61	1.80	2.00	2.19	2.39	2.58	2.77	2.96	3.15	3.34	3.53	3.72	3.91	—	—	—	—	—	—	—	
7	—	—	—	2.54	2.91	3.28	3.66	4.04	4.42	4.80	5.18	5.57	5.96	6.34	6.73	7.12	7.50	—	—	—	—	—	—	
8	—	—	—	—	4.05	4.60	5.15	5.71	6.28	6.85	7.42	8.00	8.58	9.16	9.74	10.32	10.91	11.49	—	—	—	—	—	
9	—	—	—	—	—	6.00	6.75	7.50	8.26	9.02	9.79	10.56	11.34	12.12	12.90	13.69	14.48	15.27	—	—	—	—	—	
10	—	—	—	—	—	—	8.46	9.42	10.38	11.35	12.33	13.31	14.30	15.30	16.29	17.30	18.30	19.31	20.32	—	—	—	—	
11	—	—	—	—	—	—	—	11.48	12.67	13.86	15.06	16.27	17.48	18.71	19.93	21.17	22.40	23.65	24.89	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.12	16.55	17.99	19.44	20.90	22.36	23.84	25.32	26.80	28.29	29.79	31.29	—	—	—	
13	—	—	—	—	—	—	—	—	17.75	19.43	21.13	22.83	24.55	26.27	28.01	29.75	31.50	33.26	35.02	36.79	—	—	—	
14	—	—	—	—	—	—	—	—	—	22.50	24.47	26.45	28.44	30.44	32.45	34.48	36.51	38.55	40.60	42.66	—	—	—	
15	—	—	—	—	—	—	—	—	—	25.76	28.02	30.28	32.57	34.86	37.17	39.50	41.83	44.17	46.52	48.88	51.25	—	—	
16	—	—	—	—	—	—	—	—	—	—	31.77	34.34	36.94	39.55	42.17	44.80	47.45	50.11	52.78	55.46	58.15	—	—	
17	—	—	—	—	—	—	—	—	—	—	35.73	38.63	41.55	44.48	47.43	50.40	53.38	56.38	59.39	62.40	65.43	—	—	
18	—	—	—	—	—	—	—	—	—	—	39.90	43.13	46.39	49.67	52.97	56.29	59.62	62.97	66.33	69.70	73.09	76.49	—	
19	—	—	—	—	—	—	—	—	—	—	—	47.86	51.47	55.12	58.78	62.46	66.16	69.88	73.61	77.36	81.12	84.90	—	
20	—	—	—	—	—	—	—	—	—	—	—	52.80	56.79	60.81	64.85	68.92	73.00	77.11	81.23	85.37	89.53	93.70	—	
21	—	—	—	—	—	—	—	—	—	—	—	57.96	62.35	66.76	71.19	75.66	80.15	84.65	89.18	93.73	98.30	102.88	107.48	
22	—	—	—	—	—	—	—	—	—	—	—	—	68.13	72.95	77.80	82.68	87.59	92.52	97.47	102.44	107.43	112.45	117.48	
23	—	—	—	—	—	—	—	—	—	—	—	—	74.15	79.39	84.67	89.98	95.32	100.69	106.08	111.50	116.94	122.39	127.87	
24	—	—	—	—	—	—	—	—	—	—	—	—	80.39	86.08	91.80	97.56	103.36	109.18	115.03	120.90	126.80	132.72	138.67	

DBH = diameter at breast height.

Table B-6—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.6

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
<i>Inches</i>	<i>Cubic feet</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.60	1.79	1.99	2.18	2.37	2.56	2.75	2.94	3.13	3.32	3.51	3.70	3.89	—	—	—	—	—	—	—	
7	—	—	—	2.52	2.88	3.25	3.63	4.00	4.38	4.76	5.14	5.53	5.91	6.29	6.68	7.06	7.45	—	—	—	—	—	—	
8	—	—	—	—	4.01	4.56	5.11	5.66	6.23	6.79	7.36	7.93	8.50	9.08	9.66	10.24	10.82	11.40	—	—	—	—	—	
9	—	—	—	—	—	5.95	6.68	7.43	8.18	8.94	9.70	10.47	11.24	12.02	12.79	13.57	14.36	15.14	—	—	—	—	—	
10	—	—	—	—	—	—	8.38	9.33	10.28	11.25	12.22	13.19	14.17	15.16	16.15	17.14	18.14	19.14	20.15	—	—	—	—	
11	—	—	—	—	—	—	—	11.37	12.55	13.73	14.92	16.12	17.32	18.53	19.75	20.97	22.20	23.43	24.67	—	—	—	—	
12	—	—	—	—	—	—	—	—	14.97	16.39	17.82	19.25	20.70	22.15	23.61	25.08	26.55	28.03	29.52	31.01	—	—	—	
13	—	—	—	—	—	—	—	—	17.57	19.24	20.92	22.61	24.31	26.02	27.74	29.47	31.21	32.95	34.70	36.46	—	—	—	
14	—	—	—	—	—	—	—	—	—	22.28	24.22	26.18	28.16	30.14	32.14	34.15	36.16	38.19	40.22	42.26	—	—	—	
15	—	—	—	—	—	—	—	—	—	25.50	27.73	29.98	32.24	34.52	36.81	39.11	41.42	43.74	46.07	48.42	50.76	—	—	
16	—	—	—	—	—	—	—	—	—	—	31.44	33.99	36.56	39.15	41.75	44.36	46.98	49.62	52.27	54.93	57.60	—	—	
17	—	—	—	—	—	—	—	—	—	—	35.36	38.23	41.12	44.03	46.95	49.89	52.85	55.82	58.80	61.79	64.80	—	—	
18	—	—	—	—	—	—	—	—	—	—	39.48	42.68	45.91	49.16	52.43	55.71	59.02	62.33	65.67	69.01	72.37	75.74	—	
19	—	—	—	—	—	—	—	—	—	—	—	47.35	50.93	54.54	58.17	61.81	65.48	69.17	72.87	76.58	80.31	84.06	—	
20	—	—	—	—	—	—	—	—	—	—	—	52.24	56.19	60.17	64.17	68.20	72.25	76.31	80.40	84.50	88.62	92.76	—	
21	—	—	—	—	—	—	—	—	—	—	—	57.34	61.68	66.04	70.44	74.86	79.31	83.77	88.26	92.77	97.29	101.84	106.40	
22	—	—	—	—	—	—	—	—	—	—	—	—	67.39	72.17	76.97	81.80	86.66	91.54	96.45	101.38	106.33	111.29	116.28	
23	—	—	—	—	—	—	—	—	—	—	—	—	73.34	78.53	83.76	89.02	94.31	99.62	104.96	110.33	115.72	121.13	126.56	
24	—	—	—	—	—	—	—	—	—	—	—	—	79.51	85.14	90.80	96.51	102.24	108.01	113.80	119.62	125.46	131.33	137.22	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Table B-7—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.7

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Inches																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.60	1.78	1.98	2.17	2.36	2.55	2.74	2.93	3.12	3.31	3.49	3.68	3.87	—	—	—	—	—	—	—
7	—	—	—	2.51	2.87	3.23	3.60	3.98	4.35	4.73	5.11	5.49	5.87	6.25	6.64	7.02	7.40	—	—	—	—	—	—
8	—	—	—	—	3.98	4.52	5.07	5.62	6.18	6.74	7.31	7.87	8.44	9.02	9.59	10.17	10.74	11.32	—	—	—	—	—
9	—	—	—	—	—	5.90	6.63	7.37	8.12	8.87	9.63	10.39	11.16	11.93	12.70	13.47	14.25	15.03	—	—	—	—	—
10	—	—	—	—	—	—	8.32	9.25	10.20	11.16	12.12	13.09	14.06	15.04	16.02	17.01	18.00	19.00	20.00	—	—	—	—
11	—	—	—	—	—	—	—	11.28	12.44	13.62	14.80	15.99	17.18	18.39	19.60	20.81	22.03	23.25	24.48	—	—	—	—
12	—	—	—	—	—	—	—	—	14.85	16.25	17.67	19.10	20.53	21.97	23.42	24.88	26.34	27.81	29.29	30.77	—	—	—
13	—	—	—	—	—	—	—	—	17.43	19.08	20.74	22.42	24.11	25.81	27.51	29.23	30.95	32.69	34.42	36.17	—	—	—
14	—	—	—	—	—	—	—	—	—	22.09	24.02	25.96	27.92	29.89	31.87	33.86	35.86	37.87	39.89	41.92	—	—	—
15	—	—	—	—	—	—	—	—	—	25.28	27.49	29.72	31.97	34.22	36.50	38.78	41.08	43.38	45.70	48.02	50.35	—	—
16	—	—	—	—	—	—	—	—	—	—	31.17	33.70	36.24	38.81	41.39	43.98	46.59	49.20	51.83	54.47	57.12	—	—
17	—	—	—	—	—	—	—	—	—	—	35.05	37.89	40.76	43.64	46.54	49.46	52.40	55.34	58.30	61.27	64.26	—	—
18	—	—	—	—	—	—	—	—	—	—	39.12	42.30	45.50	48.72	51.96	55.22	58.50	61.80	65.10	68.43	71.76	75.11	—
19	—	—	—	—	—	—	—	—	—	—	—	46.92	50.47	54.05	57.65	61.27	64.91	68.56	72.23	75.92	79.63	83.34	—
20	—	—	—	—	—	—	—	—	—	—	—	51.76	55.68	59.62	63.59	67.59	71.60	75.64	79.69	83.76	87.85	91.96	—
21	—	—	—	—	—	—	—	—	—	—	—	56.81	61.11	65.44	69.80	74.18	78.59	83.02	87.48	91.95	96.44	100.95	105.48
22	—	—	—	—	—	—	—	—	—	—	—	—	66.77	71.50	76.26	81.05	85.87	90.72	95.58	100.47	105.38	110.31	115.26
23	—	—	—	—	—	—	—	—	—	—	—	—	72.65	77.80	82.98	88.20	93.44	98.71	104.01	109.33	114.68	120.05	125.44
24	—	—	—	—	—	—	—	—	—	—	—	—	78.76	84.34	89.95	95.61	101.30	107.01	112.76	118.53	124.33	130.15	136.00
DBH = diameter at breast height.																							

Table B-8—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.8

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Cubic feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.59	1.78	1.97	2.16	2.35	2.54	2.73	2.92	3.11	3.29	3.48	3.67	3.85	—	—	—	—	—	—	—	
7	—	—	—	2.49	2.85	3.21	3.58	3.95	4.33	4.70	5.08	5.46	5.84	6.22	6.60	6.98	7.36	—	—	—	—	—	—	
8	—	—	—	—	3.96	4.49	5.04	5.59	6.14	6.70	7.26	7.82	8.39	8.96	9.53	10.10	10.68	11.25	—	—	—	—	—	
9	—	—	—	—	—	5.86	6.59	7.32	8.06	8.81	9.56	10.32	11.08	11.85	12.62	13.39	14.16	14.94	—	—	—	—	—	
10	—	—	—	—	—	—	8.26	9.19	10.13	11.08	12.04	13.00	13.97	14.94	15.92	16.90	17.88	18.87	19.87	—	—	—	—	
11	—	—	—	—	—	—	—	11.20	12.35	13.52	14.69	15.87	17.06	18.26	19.46	20.67	21.88	23.10	24.32	—	—	—	—	
12	—	—	—	—	—	—	—	—	14.74	16.14	17.54	18.96	20.38	21.82	23.26	24.71	26.16	27.62	29.09	30.56	—	—	—	
13	—	—	—	—	—	—	—	—	17.30	18.94	20.59	22.26	23.93	25.62	27.32	29.02	30.74	32.46	34.18	35.92	—	—	—	
14	—	—	—	—	—	—	—	—	—	21.92	23.84	25.77	27.71	29.67	31.64	33.62	35.61	37.60	39.61	41.62	—	—	—	
15	—	—	—	—	—	—	—	—	—	25.09	27.28	29.50	31.72	33.97	36.22	38.49	40.77	43.06	45.36	47.67	49.99	—	—	
16	—	—	—	—	—	—	—	—	—	—	30.93	33.44	35.97	38.51	41.07	43.65	46.24	48.84	51.45	54.07	56.71	—	—	
17	—	—	—	—	—	—	—	—	—	—	34.77	37.60	40.44	43.31	46.19	49.09	52.00	54.93	57.87	60.82	63.79	—	—	
18	—	—	—	—	—	—	—	—	—	—	38.81	41.97	45.14	48.34	51.56	54.80	58.06	61.33	64.61	67.91	71.23	74.55	—	
19	—	—	—	—	—	—	—	—	—	—	—	46.55	50.08	53.63	57.20	60.79	64.40	68.03	71.68	75.35	79.03	82.72	—	
20	—	—	—	—	—	—	—	—	—	—	—	51.35	55.23	59.15	63.09	67.06	71.04	75.05	79.08	83.12	87.18	91.26	—	
21	—	—	—	—	—	—	—	—	—	—	—	56.35	60.62	64.91	69.24	73.59	77.97	82.37	86.79	91.24	95.70	100.18	104.67	
22	—	—	—	—	—	—	—	—	—	—	—	—	66.22	70.92	75.65	80.40	85.19	90.00	94.83	99.69	104.56	109.46	114.38	
23	—	—	—	—	—	—	—	—	—	—	—	—	72.05	77.16	82.31	87.48	92.69	97.92	103.18	108.47	113.78	119.11	124.46	
24	—	—	—	—	—	—	—	—	—	—	—	—	78.10	83.64	89.22	94.83	100.47	106.15	111.85	117.58	123.34	129.12	134.93	

DBH = diameter at breast height.

Table B-9—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 0.9

DBH	Total height (feet)																			120
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
<i>Inches</i>																				
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.58	1.77	1.96	2.15	2.34	2.53	2.72	2.91	3.09	3.28	3.47	3.65	3.84	—	—	—	—
7	—	—	—	2.48	2.84	3.20	3.56	3.93	4.31	4.68	5.06	5.43	5.81	6.19	6.57	6.95	7.33	—	—	—
8	—	—	—	—	3.94	4.47	5.01	5.56	6.11	6.66	7.22	7.78	8.34	8.91	9.48	10.05	10.62	11.19	—	—
9	—	—	—	—	—	5.83	6.55	7.28	8.02	8.76	9.51	10.26	11.02	11.78	12.54	13.31	14.08	14.85	—	—
10	—	—	—	—	—	—	8.21	9.13	10.07	11.01	11.96	12.92	13.88	14.85	15.82	16.80	17.78	18.76	19.75	—
11	—	—	—	—	—	—	—	11.13	12.28	13.43	14.60	15.77	16.96	18.14	19.34	20.54	21.75	22.96	24.17	—
12	—	—	—	—	—	—	—	—	14.65	16.03	17.43	18.84	20.25	21.68	23.11	24.55	26.00	27.45	28.91	—
13	—	—	—	—	—	—	—	—	17.18	18.81	20.45	22.11	23.78	25.45	27.14	28.84	30.54	32.25	33.97	—
14	—	—	—	—	—	—	—	—	—	21.77	23.68	25.60	27.53	29.47	31.43	33.40	35.38	37.36	39.36	—
15	—	—	—	—	—	—	—	—	—	24.92	27.10	29.30	31.51	33.74	35.98	38.24	40.51	42.78	45.07	—
16	—	—	—	—	—	—	—	—	—	—	30.72	33.21	35.72	38.25	40.80	43.36	45.93	48.52	51.11	—
17	—	—	—	—	—	—	—	—	—	—	34.53	37.34	40.16	43.01	45.87	48.75	51.65	54.56	57.48	—
18	—	—	—	—	—	—	—	—	—	—	38.54	41.67	44.83	48.01	51.21	54.42	57.66	60.91	64.18	—
19	—	—	—	—	—	—	—	—	—	—	—	46.22	49.72	53.25	56.80	60.37	63.96	67.57	71.19	—
20	—	—	—	—	—	—	—	—	—	—	—	50.98	54.84	58.73	62.65	66.59	70.55	74.53	78.53	—
21	—	—	—	—	—	—	—	—	—	—	—	55.94	60.18	64.45	68.75	73.07	77.42	81.79	86.19	—
22	—	—	—	—	—	—	—	—	—	—	—	—	65.74	70.41	75.10	79.83	84.58	89.36	94.16	—
23	—	—	—	—	—	—	—	—	—	—	—	—	71.53	76.60	81.71	86.85	92.02	97.22	102.45	—
24	—	—	—	—	—	—	—	—	—	—	—	—	77.53	83.03	88.57	94.14	99.75	105.38	111.05	—

DBH = diameter at breast height.

Table B-10—Merchantable stem volume (0.5-ft stump and 5-in diameter outside bark top) for red alder with a crown ratio of 1.0

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
Inches	Cubic feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.58	1.76	1.95	2.14	2.33	2.52	2.71	2.90	3.08	3.27	3.45	3.64	3.82	—	—	—	—	—	—	—	
7	—	—	—	2.47	2.82	3.18	3.55	3.92	4.29	4.66	5.03	5.41	5.79	6.16	6.54	6.92	7.30	—	—	—	—	—	—	
8	—	—	—	—	3.92	4.45	4.99	5.53	6.08	6.63	7.19	7.74	8.31	8.87	9.43	10.00	10.57	11.14	—	—	—	—	—	
9	—	—	—	—	—	5.80	6.52	7.24	7.98	8.72	9.46	10.21	10.97	11.72	12.48	13.25	14.01	14.78	—	—	—	—	—	
10	—	—	—	—	—	—	8.17	9.09	10.02	10.96	11.90	12.85	13.81	14.78	15.74	16.72	17.69	18.67	19.66	—	—	—	—	
11	—	—	—	—	—	—	—	11.07	12.21	13.36	14.52	15.69	16.87	18.05	19.24	20.44	21.64	22.84	24.05	—	—	—	—	
12	—	—	—	—	—	—	—	—	14.57	15.95	17.34	18.74	20.15	21.57	22.99	24.43	25.87	27.31	28.76	30.22	—	—	—	
13	—	—	—	—	—	—	—	—	17.09	18.71	20.34	21.99	23.65	25.32	27.00	28.69	30.38	32.09	33.80	35.51	—	—	—	
14	—	—	—	—	—	—	—	—	—	21.65	23.55	25.46	27.38	29.32	31.26	33.22	35.19	37.17	39.15	41.15	—	—	—	
15	—	—	—	—	—	—	—	—	—	24.78	26.95	29.13	31.34	33.56	35.79	38.03	40.29	42.56	44.83	47.12	49.42	—	—	
16	—	—	—	—	—	—	—	—	—	—	30.54	33.02	35.52	38.04	40.57	43.12	45.68	48.26	50.84	53.44	56.04	—	—	
17	—	—	—	—	—	—	—	—	—	—	34.34	37.13	39.94	42.77	45.62	48.48	51.37	54.26	57.17	60.09	63.03	—	—	
18	—	—	—	—	—	—	—	—	—	—	38.32	41.44	44.57	47.74	50.92	54.12	57.34	60.57	63.82	67.09	70.37	73.66	—	
19	—	—	—	—	—	—	—	—	—	—	—	45.96	49.44	52.94	56.47	60.03	63.60	67.19	70.80	74.42	78.06	81.72	—	
20	—	—	—	—	—	—	—	—	—	—	—	—	50.68	54.52	58.39	62.29	66.20	70.15	74.11	78.09	82.09	86.11	90.14	
21	—	—	—	—	—	—	—	—	—	—	—	—	55.62	59.83	64.07	68.35	72.65	76.98	81.33	85.70	90.09	94.50	98.93	
22	—	—	—	—	—	—	—	—	—	—	—	—	—	65.36	69.99	74.66	79.36	84.09	88.84	93.62	98.42	103.24	108.09	
23	—	—	—	—	—	—	—	—	—	—	—	—	—	71.10	76.15	81.23	86.34	91.48	96.66	101.86	107.08	112.33	117.60	
24	—	—	—	—	—	—	—	—	—	—	—	—	—	77.06	82.53	88.04	93.58	99.16	104.76	110.40	116.07	121.76	127.48	

DBH = diameter at breast height.

Appendix C: Merchantable Height

Table C-1—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.1

Total height (feet)																								
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	8.49	9.94	11.39	12.82	14.25	15.67	17.08	18.48	19.87	21.26	22.65	24.02	25.40	26.77	—	—	—	—	—	—	—	
7	—	—	—	12.62	14.87	17.14	19.42	21.71	24.02	26.33	28.65	30.97	33.31	35.65	37.99	40.34	42.69	—	—	—	—	—	—	
8	—	—	—	—	16.91	19.68	22.47	25.29	28.13	30.99	33.87	36.77	39.67	42.59	45.53	48.47	51.43	54.39	—	—	—	—	—	
9	—	—	—	—	—	21.33	24.46	27.62	30.82	34.04	37.28	40.55	43.84	47.14	50.46	53.79	57.14	60.50	—	—	—	—	—	
10	—	—	—	—	—	—	25.83	29.24	32.68	36.16	39.66	43.18	46.73	50.30	53.89	57.49	61.11	64.75	68.40	—	—	—	—	
11	—	—	—	—	—	—	—	30.41	34.03	37.69	41.38	45.09	48.84	52.60	56.38	60.19	64.01	67.84	71.70	75.56	79.42	83.28	87.14	
12	—	—	—	—	—	—	—	—	35.05	38.84	42.67	46.53	50.42	54.33	58.26	62.21	66.18	70.17	74.18	78.20	82.23	86.26	90.29	
13	—	—	—	—	—	—	—	—	35.82	39.73	43.67	47.64	51.63	55.66	59.71	63.78	67.86	71.97	76.09	80.23	84.38	88.52	92.66	
14	—	—	—	—	—	—	—	—	—	40.42	44.44	48.50	52.59	56.71	60.85	65.01	69.19	73.39	77.60	81.84	86.09	90.33	94.57	
15	—	—	—	—	—	—	—	—	—	40.97	45.06	49.20	53.36	57.54	61.76	65.99	70.25	74.52	78.82	83.12	87.45	91.79	96.13	
16	—	—	—	—	—	—	—	—	—	—	45.56	49.75	53.97	58.22	62.50	66.79	71.11	75.45	79.80	84.17	88.56	92.95	97.34	
17	—	—	—	—	—	—	—	—	—	—	45.97	50.21	54.48	58.78	63.10	67.45	71.82	76.21	80.61	85.03	89.47	93.90	98.33	
18	—	—	—	—	—	—	—	—	—	—	46.30	50.58	54.89	59.23	63.60	67.99	72.40	76.83	81.28	85.75	90.23	94.73	99.23	
19	—	—	—	—	—	—	—	—	—	—	—	50.88	55.23	59.61	64.01	68.44	72.89	77.35	81.84	86.35	90.87	95.40	100.00	
20	—	—	—	—	—	—	—	—	—	—	—	51.13	55.51	59.92	64.36	68.81	73.29	77.79	82.31	86.85	91.40	95.97	100.55	
21	—	—	—	—	—	—	—	—	—	—	—	51.34	55.75	60.18	64.64	69.13	73.64	78.16	82.71	87.27	91.85	96.45	101.05	
22	—	—	—	—	—	—	—	—	—	—	—	—	55.94	60.40	64.88	69.39	73.92	78.47	83.04	87.63	92.23	96.85	101.49	
23	—	—	—	—	—	—	—	—	—	—	—	—	56.10	60.58	65.08	69.61	74.16	78.74	83.33	87.94	92.56	97.20	101.85	
24	—	—	—	—	—	—	—	—	—	—	—	—	56.23	60.72	65.25	69.80	74.37	78.96	83.57	88.19	92.84	97.49	102.17	

DBH = diameter at breast height.

Table C-2—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.2

DBH	Total height (feet)																				110	115	120
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105			
<i>Inches</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	8.30	9.72	11.13	12.54	13.93	15.32	16.71	18.08	19.46	20.82	22.18	23.54	24.89	26.24	27.59	28.94	30.29	31.64	32.99	34.34	35.69	37.04
7	—	—	12.24	14.42	16.62	18.84	21.07	23.32	25.57	27.84	30.11	32.39	34.67	36.96	39.26	41.57	43.88	46.19	48.50	50.81	53.12	55.43	57.74
8	—	—	—	16.34	19.01	21.72	24.46	27.22	30.00	32.80	35.62	38.45	41.30	44.16	47.03	49.91	52.81	55.71	58.61	61.51	64.41	67.31	70.21
9	—	—	—	—	20.56	23.59	26.66	29.76	32.89	36.04	39.22	42.41	45.63	48.86	52.11	55.38	58.65	61.92	65.19	68.46	71.73	75.00	78.27
10	—	—	—	—	—	24.88	28.18	31.52	34.89	38.29	41.71	45.16	48.64	52.13	55.64	59.18	62.72	66.28	69.84	73.40	76.96	80.52	84.08
11	—	—	—	—	—	—	29.28	32.79	36.33	39.91	43.52	47.16	50.82	54.51	58.21	61.94	65.68	69.44	73.19	76.94	80.69	84.44	88.19
12	—	—	—	—	—	—	—	33.73	37.41	41.13	44.88	48.66	52.46	56.29	60.14	64.01	67.91	71.82	75.74	79.67	83.60	87.53	91.46
13	—	—	—	—	—	—	—	34.46	38.24	42.06	45.92	49.81	53.72	57.66	61.63	65.61	69.62	73.64	77.69	81.74	85.79	89.84	93.89
14	—	—	—	—	—	—	—	—	38.88	42.79	46.73	50.71	54.71	58.74	62.80	66.87	70.97	75.09	79.22	83.35	87.48	91.61	95.74
15	—	—	—	—	—	—	—	—	39.39	43.36	47.38	51.42	55.50	59.60	63.73	67.88	72.05	76.24	80.45	84.68	88.91	93.14	97.37
16	—	—	—	—	—	—	—	—	—	43.82	47.89	52.00	56.13	60.29	64.48	68.69	72.92	77.17	81.45	85.74	89.97	94.20	98.43
17	—	—	—	—	—	—	—	—	—	44.19	48.31	52.46	56.64	60.85	65.09	69.35	73.63	77.94	82.26	86.60	90.93	95.26	99.59
18	—	—	—	—	—	—	—	—	—	44.49	48.64	52.83	57.06	61.31	65.59	69.89	74.22	78.57	82.93	87.32	91.72	96.11	100.50
19	—	—	—	—	—	—	—	—	—	—	48.92	53.14	57.40	61.68	66.00	70.34	74.70	79.09	83.49	87.91	92.35	96.79	101.23
20	—	—	—	—	—	—	—	—	—	—	49.14	53.39	57.68	61.99	66.34	70.71	75.10	79.52	83.95	88.41	92.88	97.34	101.80
21	—	—	—	—	—	—	—	—	—	—	49.32	53.59	57.91	62.25	66.62	71.02	75.44	79.88	84.34	88.82	93.32	97.84	102.35
22	—	—	—	—	—	—	—	—	—	—	—	53.76	58.09	62.46	66.85	71.27	75.71	80.18	84.67	89.17	93.69	98.23	102.76
23	—	—	—	—	—	—	—	—	—	—	—	53.89	58.24	62.63	67.04	71.48	75.94	80.43	84.94	89.46	94.01	98.57	103.12
24	—	—	—	—	—	—	—	—	—	—	—	53.99	58.36	62.76	67.19	71.65	76.13	80.64	85.16	89.71	94.27	98.85	103.42

DBH = diameter at breast height.

Table C-3—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.3

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Inches	Feet																						
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	8.19	9.58	10.97	12.36	13.74	15.12	16.48	17.84	19.20	20.55	21.90	23.24	24.58	25.92	—	—	—	—	—	—	—
7	—	—	—	12.01	14.15	16.31	18.49	20.69	22.90	25.12	27.35	29.58	31.83	34.08	36.34	38.61	40.88	—	—	—	—	—	—
8	—	—	—	—	16.00	18.62	21.28	23.96	26.67	29.40	32.16	34.93	37.72	40.52	43.33	46.16	49.00	51.85	—	—	—	—	—
9	—	—	—	—	—	20.11	23.08	26.08	29.12	32.19	35.29	38.41	41.55	44.71	47.89	51.09	54.31	57.53	—	—	—	—	—
10	—	—	—	—	—	—	24.31	27.54	30.82	34.12	37.46	40.82	44.21	47.63	51.06	54.52	57.99	61.48	64.99	—	—	—	—
11	—	—	—	—	—	—	—	28.60	32.04	35.51	39.03	42.57	46.14	49.74	53.36	57.01	60.67	64.36	68.06	—	—	—	—
12	—	—	—	—	—	—	—	—	32.94	36.55	40.20	43.88	47.59	51.33	55.09	58.88	62.69	66.52	70.36	74.23	—	—	—
13	—	—	—	—	—	—	—	—	33.63	37.34	41.09	44.88	48.69	52.54	56.42	60.31	64.24	68.18	72.14	76.12	—	—	—
14	—	—	—	—	—	—	—	—	—	37.96	41.79	45.65	49.56	53.49	57.45	61.44	65.45	69.48	73.54	77.61	—	—	—
15	—	—	—	—	—	—	—	—	—	38.44	42.33	46.27	50.24	54.24	58.27	62.33	66.42	70.52	74.65	78.80	82.96	—	—
16	—	—	—	—	—	—	—	—	—	—	42.77	46.76	50.78	54.84	58.93	63.05	67.19	71.36	75.55	79.76	83.98	—	—
17	—	—	—	—	—	—	—	—	—	—	43.11	47.15	51.22	55.33	59.47	63.63	67.82	72.04	76.28	80.54	84.81	—	—
18	—	—	—	—	—	—	—	—	—	—	43.39	47.46	51.57	55.72	59.90	64.11	68.34	72.60	76.88	81.18	85.50	89.84	—
19	—	—	—	—	—	—	—	—	—	—	—	47.71	51.86	56.04	60.25	64.49	68.76	73.05	77.37	81.71	86.07	90.44	—
20	—	—	—	—	—	—	—	—	—	—	—	47.91	52.09	56.30	60.54	64.81	69.11	73.43	77.78	82.14	86.54	90.94	—
21	—	—	—	—	—	—	—	—	—	—	—	48.08	52.27	56.51	60.77	65.07	69.39	73.74	78.11	82.51	86.92	91.36	95.81
22	—	—	—	—	—	—	—	—	—	—	—	—	52.42	56.67	60.96	65.28	69.62	73.99	78.39	82.81	87.25	91.70	96.18
23	—	—	—	—	—	—	—	—	—	—	—	—	52.53	56.81	61.11	65.45	69.81	74.20	78.62	83.06	87.52	91.99	96.49
24	—	—	—	—	—	—	—	—	—	—	—	—	52.62	56.91	61.23	65.58	69.96	4.37	78.80	83.26	87.74	92.23	96.75
DBH = diameter at breast height.																							

DBH = diameter at breast height.

Table C-4—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.4

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
Inches	Feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	8.10	9.48	10.86	12.23	13.60	14.96	16.32	17.67	19.02	20.36	21.69	23.03	24.36	25.68	—	—	—	—	—	—	—	—	
7	—	—	11.85	13.96	16.09	18.24	20.41	22.60	24.79	26.99	29.21	31.43	33.66	35.89	38.14	40.39	—	—	—	—	—	—	—	
8	—	—	—	15.75	18.33	20.95	23.60	26.28	28.98	31.69	34.43	37.18	39.95	42.74	45.53	48.34	51.16	—	—	—	—	—	—	
9	—	—	—	—	19.78	22.70	25.67	28.66	31.69	34.75	37.83	40.93	44.05	47.19	50.35	53.53	56.72	—	—	—	—	—	—	
10	—	—	—	—	—	23.90	27.09	30.31	33.57	36.86	40.18	43.53	46.90	50.29	53.70	57.14	60.59	64.05	67.06	—	—	—	—	
11	—	—	—	—	—	—	28.11	31.50	34.92	38.39	41.88	45.41	48.96	52.54	56.14	59.76	63.40	67.06	—	—	—	—	—	
12	—	—	—	—	—	—	—	32.37	35.93	39.52	43.15	46.81	50.50	54.22	57.96	61.72	65.51	69.31	73.13	—	—	—	—	
13	—	—	—	—	—	—	—	33.04	36.69	40.39	44.12	47.89	51.68	55.51	59.36	63.23	67.13	71.04	74.98	—	—	—	—	
14	—	—	—	—	—	—	—	—	37.28	41.06	44.87	48.72	52.60	56.51	60.45	64.41	68.40	72.40	76.43	—	—	—	—	
15	—	—	—	—	—	—	—	—	37.75	41.59	45.47	49.38	53.33	57.31	61.32	65.35	69.41	73.49	77.58	81.70	—	—	—	
16	—	—	—	—	—	—	—	—	—	42.00	45.93	49.90	53.91	57.95	62.01	66.10	70.22	74.36	78.52	82.69	—	—	—	
17	—	—	—	—	—	—	—	—	—	42.33	46.31	50.32	54.37	58.46	62.57	66.71	70.87	75.06	79.27	83.50	—	—	—	
18	—	—	—	—	—	—	—	—	—	42.59	46.60	50.66	54.75	58.87	63.02	67.20	71.41	75.64	79.89	84.16	88.45	—	—	
19	—	—	—	—	—	—	—	—	—	—	46.84	50.93	55.05	59.21	63.39	67.61	71.85	76.11	80.40	84.70	89.03	—	—	
20	—	—	—	—	—	—	—	—	—	—	47.03	51.14	55.29	59.48	63.69	67.93	72.20	76.50	80.82	85.15	89.51	—	—	
21	—	—	—	—	—	—	—	—	—	—	47.18	51.31	55.49	59.69	63.93	68.20	72.50	76.82	81.16	85.52	89.91	94.31	—	
22	—	—	—	—	—	—	—	—	—	—	—	51.45	55.64	59.87	64.13	68.42	72.73	77.08	81.44	85.83	90.24	94.67	—	
23	—	—	—	—	—	—	—	—	—	—	—	51.55	55.76	60.00	64.28	68.59	72.93	77.29	81.67	86.08	90.51	94.96	—	
24	—	—	—	—	—	—	—	—	—	—	—	51.63	55.85	60.11	64.40	68.73	73.08	77.46	81.86	86.29	90.73	95.20	—	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Table C-5—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.5

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	8.04	9.41	10.77	12.13	13.49	14.84	16.19	17.53	18.87	20.20	21.53	22.86	24.18	25.50	—	—	—	—	—	—	—
7	—	—	—	11.72	13.80	15.92	18.05	20.20	22.36	24.53	26.72	28.91	31.11	33.32	35.54	37.77	40.00	—	—	—	—	—	—
8	—	—	—	—	15.56	18.11	20.70	23.32	25.97	28.64	31.33	34.04	36.77	39.51	42.27	45.04	47.82	50.61	—	—	—	—	—
9	—	—	—	—	—	19.52	22.41	25.34	28.31	31.30	34.32	37.37	40.44	43.53	46.65	49.77	52.92	56.08	—	—	—	—	—
10	—	—	—	—	—	—	23.58	26.73	29.92	33.14	36.39	39.68	42.99	46.33	49.68	53.06	56.46	59.88	63.31	—	—	—	—
11	—	—	—	—	—	—	—	27.72	31.07	34.46	37.88	41.34	44.83	48.35	51.89	55.45	59.03	62.64	66.26	—	—	—	—
12	—	—	—	—	—	—	—	—	31.93	35.44	38.99	42.58	46.20	49.85	53.53	57.23	60.96	64.71	68.47	72.26	—	—	—
13	—	—	—	—	—	—	—	—	32.58	36.19	39.84	43.53	47.25	51.01	54.79	58.60	62.44	66.30	70.17	74.07	—	—	—
14	—	—	—	—	—	—	—	—	—	36.76	40.49	44.26	48.07	51.90	55.77	59.67	63.59	67.54	71.51	75.49	—	—	—
15	—	—	—	—	—	—	—	—	—	37.20	41.00	44.83	48.71	52.61	56.55	60.51	64.51	68.52	72.56	76.62	80.71	—	—
16	—	—	—	—	—	—	—	—	—	—	41.40	45.29	49.21	53.17	57.17	61.19	65.24	69.31	73.41	77.53	81.67	—	—
17	—	—	—	—	—	—	—	—	—	—	41.71	45.64	49.61	53.62	57.66	61.73	65.83	69.95	74.10	78.27	82.46	—	—
18	—	—	—	—	—	—	—	—	—	—	41.96	45.93	49.94	53.98	58.06	62.17	66.30	70.47	74.66	78.87	83.10	87.35	—
19	—	—	—	—	—	—	—	—	—	—	—	46.16	50.19	54.27	58.38	62.52	66.69	70.89	75.11	79.36	83.63	87.91	—
20	—	—	—	—	—	—	—	—	—	—	—	46.33	50.40	54.50	58.64	62.81	67.01	71.23	75.48	79.76	84.06	88.38	—
21	—	—	—	—	—	—	—	—	—	—	—	46.47	50.56	54.68	58.84	63.04	67.26	71.51	75.79	80.09	84.41	88.76	93.12
22	—	—	—	—	—	—	—	—	—	—	—	—	50.68	54.83	59.01	63.22	67.46	71.73	76.03	80.36	84.70	89.07	93.46
23	—	—	—	—	—	—	—	—	—	—	—	—	50.77	54.94	59.13	63.36	67.62	71.91	76.23	80.57	84.94	89.33	93.74
24	—	—	—	—	—	—	—	—	—	—	—	—	50.84	55.02	59.23	63.47	67.75	72.06	76.39	80.75	85.13	89.54	93.96

DBH = diameter at breast height.

Table C-6—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.6

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Inches	Feet																						
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	7.99	9.34	10.70	12.05	13.40	14.75	16.08	17.42	18.75	20.08	21.40	22.71	24.03	25.34	—	—	—	—	—	—	—
7	—	—	—	11.61	13.68	15.77	17.89	20.02	22.16	24.32	26.49	28.67	30.85	33.05	35.25	37.46	39.68	—	—	—	—	—	—
8	—	—	—	—	15.40	17.93	20.50	23.09	25.72	28.36	31.03	33.72	36.42	39.14	41.88	44.62	47.39	50.16	—	—	—	—	—
9	—	—	—	—	—	19.31	22.17	25.07	28.01	30.98	33.98	37.00	40.04	43.11	46.19	49.30	52.42	55.55	—	—	—	—	—
10	—	—	—	—	—	—	23.32	26.44	29.59	32.78	36.01	39.26	42.55	45.85	49.18	52.53	55.91	59.30	62.70	—	—	—	—
11	—	—	—	—	—	—	—	27.41	30.72	34.08	37.47	40.90	44.35	47.84	51.35	54.88	58.44	62.01	65.61	—	—	—	—
12	—	—	—	—	—	—	—	—	31.56	35.04	38.56	42.11	45.70	49.32	52.96	56.63	60.33	64.05	67.78	71.54	—	—	—
13	—	—	—	—	—	—	—	—	32.19	35.77	39.38	43.04	46.73	50.45	54.20	57.98	61.78	65.61	69.46	73.32	—	—	—
14	—	—	—	—	—	—	—	—	—	36.32	40.02	43.75	47.52	51.33	55.16	59.02	62.91	66.83	70.76	74.72	—	—	—
15	—	—	—	—	—	—	—	—	—	36.76	40.51	44.31	48.15	52.02	55.92	59.85	63.81	67.79	71.80	75.83	79.87	—	—
16	—	—	—	—	—	—	—	—	—	—	40.90	44.75	48.64	52.56	56.52	60.51	64.52	68.56	72.63	76.71	80.82	—	—
17	—	—	—	—	—	—	—	—	—	—	41.21	45.10	49.03	53.00	57.00	61.04	65.10	69.19	73.30	77.43	81.59	—	—
18	—	—	—	—	—	—	—	—	—	—	41.45	45.37	49.34	53.35	57.39	61.46	65.56	69.69	73.84	78.02	82.22	86.44	—
19	—	—	—	—	—	—	—	—	—	—	—	45.59	49.59	53.62	57.70	61.80	65.93	70.10	74.28	78.49	82.73	86.98	—
20	—	—	—	—	—	—	—	—	—	—	—	45.76	49.78	53.84	57.94	62.07	66.24	70.42	74.64	78.88	83.15	87.43	—
21	—	—	—	—	—	—	—	—	—	—	—	45.89	49.93	54.02	58.14	62.29	66.48	70.69	74.93	79.20	83.49	87.80	92.13
22	—	—	—	—	—	—	—	—	—	—	—	—	50.05	54.15	58.29	62.47	66.67	70.91	75.17	79.45	83.77	88.10	92.45
23	—	—	—	—	—	—	—	—	—	—	—	—	50.14	54.25	58.41	62.60	66.82	71.08	75.36	79.66	83.99	88.34	92.72
24	—	—	—	—	—	—	—	—	—	—	—	—	50.20	54.33	58.50	62.70	66.94	71.21	75.50	79.83	84.17	88.54	92.93

DBH = diameter at breast height.

Table C-7—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.7

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches																								
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	7.94	9.29	10.64	11.98	13.33	14.66	15.99	17.32	18.65	19.97	21.28	22.59	23.90	25.21	—	—	—	—	—	—	—	
7	—	—	—	11.52	13.58	15.65	17.75	19.87	22.00	24.14	26.29	28.46	30.63	32.81	35.00	37.20	39.40	—	—	—	—	—	—	
8	—	—	—	—	15.27	17.78	20.32	22.90	25.50	28.13	30.78	33.44	36.13	38.83	41.55	44.28	47.02	49.78	—	—	—	—	—	
9	—	—	—	—	—	19.14	21.97	24.85	27.76	30.71	33.68	36.68	39.70	42.74	45.81	48.89	51.99	55.10	—	—	—	—	—	
10	—	—	—	—	—	—	23.10	26.19	29.31	32.48	35.68	38.91	42.17	45.45	48.76	52.08	55.43	58.80	62.18	—	—	—	—	
11	—	—	—	—	—	—	—	27.14	30.43	33.76	37.12	40.52	43.95	47.40	50.89	54.40	57.93	61.48	65.05	—	—	—	—	
12	—	—	—	—	—	—	—	—	31.25	34.70	38.19	41.71	45.27	48.86	52.48	56.12	59.79	63.48	67.19	70.93	—	—	—	
13	—	—	—	—	—	—	—	—	31.87	35.41	39.00	42.62	46.28	49.97	53.70	57.45	61.22	65.02	68.84	72.68	—	—	—	
14	—	—	—	—	—	—	—	—	—	35.96	39.62	43.32	47.06	50.84	54.64	58.47	62.33	66.22	70.13	74.05	—	—	—	
15	—	—	—	—	—	—	—	—	—	36.38	40.10	43.87	47.67	51.51	55.38	59.28	63.21	67.17	71.14	75.14	79.17	—	—	
16	—	—	—	—	—	—	—	—	—	—	40.48	44.30	48.15	52.04	55.97	59.93	63.91	67.92	71.96	76.02	80.10	—	—	
17	—	—	—	—	—	—	—	—	—	—	40.78	44.63	48.53	52.47	56.44	60.44	64.47	68.53	72.61	76.72	80.85	—	—	
18	—	—	—	—	—	—	—	—	—	—	41.01	44.90	48.83	52.81	56.81	60.85	64.92	69.02	73.14	77.29	81.46	85.65	—	
19	—	—	—	—	—	—	—	—	—	—	—	45.11	49.07	53.07	57.11	61.18	65.29	69.42	73.57	77.76	81.96	86.19	—	
20	—	—	—	—	—	—	—	—	—	—	—	45.27	49.26	53.29	57.35	61.45	65.58	69.74	73.92	78.13	82.37	86.62	—	
21	—	—	—	—	—	—	—	—	—	—	—	45.39	49.40	53.45	57.54	61.66	65.81	69.99	74.20	78.44	82.69	86.98	91.28	
22	—	—	—	—	—	—	—	—	—	—	—	—	49.51	53.58	57.68	61.82	66.00	70.20	74.43	78.68	82.96	87.27	91.59	
23	—	—	—	—	—	—	—	—	—	—	—	—	49.59	53.67	57.79	61.95	66.14	70.36	74.61	78.88	83.18	87.50	91.84	
24	—	—	—	—	—	—	—	—	—	—	—	—	49.65	53.74	57.88	62.05	66.25	70.48	74.75	79.03	83.35	87.69	92.05	
DBH = diameter at breast height.																								

DBH = diameter at breast height.

Table C-8—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.8

DBH	Total height (feet)																				110	115	120
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105			
<i>Inches</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	7.90	9.24	10.58	11.92	13.26	14.59	15.91	17.24	18.56	19.87	21.18	22.49	23.79	25.09	—	—	—	—	—	—	—
7	—	—	—	11.45	13.48	15.55	17.63	19.74	21.85	23.98	26.12	28.28	30.44	32.61	34.79	36.97	39.16	—	—	—	—	—	—
8	—	—	—	—	15.15	17.64	20.17	22.73	25.31	27.92	30.55	33.20	35.87	38.56	41.26	43.97	46.70	49.44	—	—	—	—	—
9	—	—	—	—	—	18.98	21.79	24.65	27.54	30.47	33.42	36.40	39.40	42.42	45.47	48.53	51.61	54.71	—	—	—	—	—
10	—	—	—	—	—	—	22.91	25.97	29.07	32.22	35.39	38.60	41.84	45.10	48.38	51.69	55.02	58.36	61.73	—	—	—	—
11	—	—	—	—	—	—	—	26.91	30.17	33.47	36.81	40.19	43.59	47.03	50.49	53.97	57.48	61.01	64.56	—	—	—	—
12	—	—	—	—	—	—	—	—	30.98	34.40	37.87	41.37	44.90	48.47	52.06	55.68	59.32	62.99	66.68	70.39	—	—	—
13	—	—	—	—	—	—	—	—	31.58	35.10	38.66	42.26	45.89	49.56	53.26	56.98	60.73	64.51	68.30	72.12	—	—	—
14	—	—	—	—	—	—	—	—	—	35.64	39.27	42.95	46.66	50.41	54.19	57.99	61.83	65.69	69.57	73.48	—	—	—
15	—	—	—	—	—	—	—	—	—	36.05	39.74	43.48	47.26	51.07	54.91	58.79	62.69	66.62	70.57	74.55	78.54	—	—
16	—	—	—	—	—	—	—	—	—	—	40.11	43.90	47.73	51.59	55.49	59.42	63.38	67.36	71.37	75.41	79.46	—	—
17	—	—	—	—	—	—	—	—	—	—	40.40	44.23	48.10	52.01	55.95	59.92	63.93	67.96	72.02	76.10	80.20	—	—
18	—	—	—	—	—	—	—	—	—	—	40.62	44.49	48.39	52.34	56.31	60.33	64.37	68.44	72.53	76.66	80.80	84.96	—
19	—	—	—	—	—	—	—	—	—	—	—	44.69	48.62	52.60	56.60	60.65	64.72	68.82	72.95	77.11	81.29	85.49	—
20	—	—	—	—	—	—	—	—	—	—	—	44.84	48.80	52.80	56.83	60.90	65.00	69.13	73.29	77.47	81.68	85.91	—
21	—	—	—	—	—	—	—	—	—	—	—	44.96	48.94	52.96	57.01	61.11	65.23	69.38	73.56	77.77	82.00	86.26	90.53
22	—	—	—	—	—	—	—	—	—	—	—	—	49.04	53.08	57.15	61.26	65.41	69.58	73.78	78.01	82.26	86.54	90.83
23	—	—	—	—	—	—	—	—	—	—	—	—	49.12	53.17	57.26	61.38	65.54	69.73	73.95	78.20	82.47	86.76	91.08
24	—	—	—	—	—	—	—	—	—	—	—	—	49.17	53.23	57.33	61.47	65.64	69.85	74.08	78.34	82.63	86.94	91.27

DBH = diameter at breast height.

Table C-9—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 0.9

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Inches	Feet																						
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	7.87	9.20	10.54	11.87	13.20	14.52	15.84	17.16	18.47	19.79	21.09	22.39	23.69	24.99	—	—	—	—	—	—	—
7	—	—	—	11.38	13.40	15.45	17.53	19.62	21.73	23.84	25.97	28.12	30.27	32.43	34.59	36.77	38.95	—	—	—	—	—	—
8	—	—	—	—	15.05	17.52	20.03	22.58	25.15	27.74	30.36	32.99	35.65	38.32	41.00	43.70	46.42	49.15	—	—	—	—	—
9	—	—	—	—	—	18.84	21.64	24.48	27.35	30.25	33.19	36.15	39.14	42.14	45.17	48.22	51.28	54.36	—	—	—	—	—
10	—	—	—	—	—	—	22.74	25.78	28.86	31.98	35.14	38.33	41.54	44.79	48.05	51.34	54.65	57.98	61.32	—	—	—	—
11	—	—	—	—	—	—	—	26.70	29.94	33.22	36.54	39.90	43.28	46.69	50.13	53.60	57.09	60.60	64.13	—	—	—	—
12	—	—	—	—	—	—	—	—	30.74	34.14	37.58	41.06	44.57	48.11	51.69	55.28	58.91	62.55	66.22	69.91	—	—	—
13	—	—	—	—	—	—	—	—	31.33	34.83	38.36	41.94	45.55	49.19	52.87	56.57	60.30	64.05	67.83	71.62	—	—	—
14	—	—	—	—	—	—	—	—	—	35.35	38.96	42.61	46.30	50.03	53.78	57.57	61.38	65.22	69.08	72.96	—	—	—
15	—	—	—	—	—	—	—	—	—	35.76	39.43	43.14	46.89	50.68	54.50	58.35	62.23	66.13	70.06	74.02	77.99	—	—
16	—	—	—	—	—	—	—	—	—	—	39.79	43.55	47.35	51.19	55.06	58.97	62.90	66.87	70.85	74.86	78.90	—	—
17	—	—	—	—	—	—	—	—	—	—	40.07	43.87	47.71	51.60	55.51	59.46	63.44	67.45	71.48	75.54	79.62	—	—
18	—	—	—	—	—	—	—	—	—	—	40.29	44.12	48.00	51.92	55.87	59.86	63.87	67.92	71.99	76.09	80.21	84.35	—
19	—	—	—	—	—	—	—	—	—	—	—	44.32	48.22	52.17	56.15	60.17	64.22	68.30	72.40	76.53	80.69	84.86	—
20	—	—	—	—	—	—	—	—	—	—	—	44.47	48.40	52.37	56.38	60.42	64.49	68.60	72.73	76.89	81.07	85.28	—
21	—	—	—	—	—	—	—	—	—	—	—	44.58	48.53	52.52	56.55	60.61	64.71	68.84	73.00	77.18	81.38	85.61	89.87
22	—	—	—	—	—	—	—	—	—	—	—	—	48.63	52.63	56.68	60.76	64.88	69.03	73.20	77.41	81.63	85.89	90.16
23	—	—	—	—	—	—	—	—	—	—	—	—	48.70	52.72	56.78	60.88	65.01	69.17	73.37	77.59	81.83	86.10	90.39
24	—	—	—	—	—	—	—	—	—	—	—	—	48.74	52.78	56.85	60.96	65.11	69.28	73.49	77.73	81.99	86.27	90.58

DBH = diameter at breast height.

Table C-10—Merchantable height (5-in diameter outside bark top) for red alder with a crown ratio of 1.0

DBH	Total height (feet)																				110	115	120
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105			
<i>Inches</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	7.84	9.17	10.50	11.82	13.15	14.47	15.79	17.10	18.41	19.72	21.02	22.32	23.61	24.91	—	—	—	—	—	—	—	—
7	—	—	11.32	13.34	15.38	17.44	19.52	21.62	23.73	25.85	27.99	30.13	32.28	34.44	36.60	38.78	—	—	—	—	—	—	—
8	—	—	—	14.97	17.43	19.92	22.45	25.01	27.59	30.20	32.82	35.46	38.12	40.80	43.49	46.19	48.90	—	—	—	—	—	—
9	—	—	—	—	18.73	21.51	24.33	27.19	30.08	33.00	35.95	38.92	41.92	44.93	47.96	51.01	54.08	—	—	—	—	—	—
10	—	—	—	—	—	22.60	25.62	28.69	31.80	34.94	38.11	41.31	44.53	47.78	51.06	54.35	57.66	61.00	—	—	—	—	—
11	—	—	—	—	—	—	26.54	29.76	33.02	36.32	39.66	43.03	46.42	49.85	53.29	56.77	60.26	63.77	—	—	—	—	—
12	—	—	—	—	—	—	—	30.54	33.92	37.35	40.81	44.30	47.83	51.38	54.96	58.57	62.20	65.85	69.52	—	—	—	—
13	—	—	—	—	—	—	—	31.13	34.60	38.12	41.68	45.27	48.89	52.55	56.23	59.94	63.68	67.44	71.22	—	—	—	—
14	—	—	—	—	—	—	—	—	35.12	38.71	42.34	46.01	49.72	53.45	57.22	61.01	64.83	68.68	72.54	—	—	—	—
15	—	—	—	—	—	—	—	—	35.52	39.17	42.86	46.59	50.36	54.16	57.99	61.85	65.74	69.65	73.59	77.54	—	—	—
16	—	—	—	—	—	—	—	—	—	39.52	43.26	47.05	50.86	54.72	58.60	62.52	66.46	70.43	74.42	78.43	—	—	—
17	—	—	—	—	—	—	—	—	—	—	43.58	47.40	51.26	55.16	59.09	63.05	67.04	71.05	75.09	79.15	—	—	—
18	—	—	—	—	—	—	—	—	—	40.01	43.83	47.68	51.58	55.51	59.48	63.47	67.50	71.55	75.63	79.73	83.85	—	—
19	—	—	—	—	—	—	—	—	—	—	44.02	47.90	51.82	55.79	59.78	63.81	67.87	71.95	76.06	80.20	84.35	—	—
20	—	—	—	—	—	—	—	—	—	—	44.16	48.07	52.02	56.00	60.03	64.08	68.16	72.28	76.41	80.58	84.76	—	—
21	—	—	—	—	—	—	—	—	—	—	44.27	48.20	52.16	56.17	60.21	64.29	68.40	72.53	76.69	80.88	85.09	89.32	—
22	—	—	—	—	—	—	—	—	—	—	—	48.29	52.27	56.30	60.36	64.45	68.58	72.74	76.92	81.13	85.36	89.61	—
23	—	—	—	—	—	—	—	—	—	—	—	48.36	52.35	56.39	60.47	64.58	68.72	72.89	77.09	81.32	85.57	89.84	—
24	—	—	—	—	—	—	—	—	—	—	—	48.40	52.41	56.46	60.55	64.67	68.83	73.01	77.23	81.47	85.73	90.02	—

DBH = diameter at breast height.

Appendix D: Stem Volume to Live Crown Base

Table D-1—Stem volume to live crown base for red alder with a crown ratio of 0.1

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Inches	Cubic feet																						
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.69	1.89	2.10	2.30	2.50	2.71	2.91	3.11	3.31	3.50	3.70	3.89	4.09	—	—	—	—	—	—	—
7	—	—	—	2.70	3.09	3.49	3.90	4.30	4.71	5.11	5.52	5.93	6.33	6.74	7.15	7.56	7.96	—	—	—	—	—	—
8	—	—	—	—	4.34	4.93	5.53	6.13	6.73	7.34	7.95	8.56	9.18	9.79	10.41	11.02	11.64	12.26	—	—	—	—	—
9	—	—	—	—	—	6.46	7.26	8.07	8.88	9.70	10.52	11.35	12.18	13.01	13.84	14.67	15.51	16.35	—	—	—	—	—
10	—	—	—	—	—	—	9.13	10.16	11.20	12.24	13.29	14.34	15.39	16.45	17.52	18.58	19.65	20.72	21.79	—	—	—	—
11	—	—	—	—	—	—	—	12.42	13.69	14.97	16.26	17.56	18.86	20.16	21.47	22.78	24.10	25.42	26.74	—	—	—	—
12	—	—	—	—	—	—	—	—	16.38	17.91	19.46	21.01	22.58	24.14	25.71	27.29	28.87	30.46	32.05	33.64	—	—	—
13	—	—	—	—	—	—	—	—	19.25	21.06	22.89	24.72	26.56	28.41	30.26	32.12	33.99	35.86	37.74	39.62	—	—	—
14	—	—	—	—	—	—	—	—	—	24.43	26.54	28.67	30.81	32.96	35.11	37.28	39.44	41.62	43.80	45.99	—	—	—
15	—	—	—	—	—	—	—	—	—	28.00	30.43	32.87	35.33	37.80	40.27	42.75	45.25	47.75	50.25	52.76	55.28	—	—
16	—	—	—	—	—	—	—	—	—	—	34.55	37.33	40.12	42.92	45.74	48.56	51.39	54.24	57.09	59.94	62.81	—	—
17	—	—	—	—	—	—	—	—	—	—	38.90	42.03	45.18	48.34	51.51	54.69	57.89	61.09	64.30	67.53	70.76	—	—
18	—	—	—	—	—	—	—	—	—	—	43.49	46.99	50.50	54.04	57.58	61.15	64.72	68.31	71.90	75.51	79.13	82.75	—
19	—	—	—	—	—	—	—	—	—	—	—	52.19	56.09	60.02	63.97	67.92	71.90	75.89	79.89	83.90	87.92	91.95	—
20	—	—	—	—	—	—	—	—	—	—	—	57.63	61.95	66.29	70.65	75.03	79.42	83.82	88.24	92.68	97.13	101.58	—
21	—	—	—	—	—	—	—	—	—	—	—	63.33	68.07	72.84	77.63	82.45	87.27	92.12	96.98	101.86	106.75	111.65	116.57
22	—	—	—	—	—	—	—	—	—	—	—	—	74.46	79.68	84.92	90.18	95.47	100.77	106.09	111.43	116.79	122.15	127.54
23	—	—	—	—	—	—	—	—	—	—	—	—	81.10	86.79	92.50	98.24	104.00	109.78	115.58	121.40	127.23	133.09	138.95
24	—	—	—	—	—	—	—	—	—	—	—	—	88.01	94.18	100.38	106.61	112.86	119.14	125.44	131.76	138.09	144.45	150.82

DBH = diameter at breast height.

Table D-2—Stem volume to live crown base for red alder with a crown ratio of 0.2

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
<i>Inches</i>	<i>Cubic feet</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.66	1.86	2.06	2.26	2.46	2.65	2.85	3.05	3.24	3.44	3.63	3.82	4.01	—	—	—	—	—	—	—	
7	—	—	—	2.63	3.02	3.40	3.80	4.19	4.58	4.98	5.38	5.78	6.17	6.57	6.97	7.37	7.77	—	—	—	—	—	—	
8	—	—	—	—	4.21	4.79	5.37	5.95	6.54	7.13	7.73	8.33	8.92	9.52	10.13	10.73	11.33	11.94	—	—	—	—	—	
9	—	—	—	—	—	6.27	7.04	7.83	8.62	9.42	10.22	11.02	11.83	12.64	13.45	14.26	15.08	15.90	—	—	—	—	—	
10	—	—	—	—	—	—	8.85	9.85	10.85	11.87	12.88	13.91	14.94	15.97	17.00	18.04	19.09	20.13	21.18	—	—	—	—	
11	—	—	—	—	—	—	—	12.02	13.26	14.50	15.76	17.01	18.28	19.55	20.83	22.11	23.39	24.68	25.97	—	—	—	—	
12	—	—	—	—	—	—	—	—	15.85	17.34	18.84	20.35	21.87	23.40	24.93	26.46	28.01	29.55	31.11	32.66	—	—	—	
13	—	—	—	—	—	—	—	—	18.62	20.37	22.14	23.92	25.71	27.51	29.32	31.13	32.95	34.77	36.60	38.44	—	—	—	
14	—	—	—	—	—	—	—	—	—	23.61	25.67	27.73	29.81	31.90	34.00	36.10	38.22	40.34	42.46	44.60	—	—	—	
15	—	—	—	—	—	—	—	—	—	27.06	29.41	31.78	34.17	36.56	38.97	41.39	43.81	46.25	48.69	51.14	53.60	—	—	
16	—	—	—	—	—	—	—	—	—	—	33.38	36.07	38.78	41.50	44.24	46.98	49.74	52.51	55.29	58.07	60.86	—	—	
17	—	—	—	—	—	—	—	—	—	—	37.56	40.60	43.65	46.71	49.79	52.89	56.00	59.12	62.25	65.38	68.53	—	—	
18	—	—	—	—	—	—	—	—	—	—	41.97	45.36	48.77	52.20	55.64	59.10	62.58	66.07	69.57	73.08	76.60	80.14	—	
19	—	—	—	—	—	—	—	—	—	—	—	50.36	54.14	57.95	61.78	65.63	69.49	73.36	77.26	81.16	85.06	88.93	—	
20	—	—	—	—	—	—	—	—	—	—	—	55.59	59.77	63.98	68.21	72.45	76.72	81.00	85.30	89.60	93.87	98.14	—	
21	—	—	—	—	—	—	—	—	—	—	—	61.06	65.65	70.27	74.92	79.59	84.27	88.98	93.70	98.39	103.08	107.78	112.49	
22	—	—	—	—	—	—	—	—	—	—	—	—	71.78	76.83	81.91	87.02	92.15	97.30	102.43	107.55	112.69	117.83	122.99	
23	—	—	—	—	—	—	—	—	—	—	—	—	78.16	83.66	89.19	94.76	100.34	105.94	111.51	117.10	122.69	128.30	133.92	
24	—	—	—	—	—	—	—	—	—	—	—	—	84.78	90.75	96.75	102.79	108.85	114.91	120.95	127.02	133.09	139.18	145.29	

DBH = diameter at breast height.

Table D-3—Stem volume to live crown base for red alder with a crown ratio of 0.3

Total height (feet)																							
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
Inches	Cubic feet																						
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.64	1.83	2.03	2.23	2.42	2.62	2.82	3.01	3.20	3.40	3.59	3.78	3.97	—	—	—	—	—	—	—
7	—	—	—	2.59	2.97	3.35	3.73	4.12	4.51	4.90	5.29	5.69	6.08	6.47	6.87	7.26	7.66	—	—	—	—	—	
8	—	—	—	—	4.14	4.70	5.27	5.85	6.43	7.01	7.60	8.18	8.77	9.36	9.96	10.55	11.15	11.74	—	—	—	—	
9	—	—	—	—	—	6.15	6.91	7.68	8.46	9.24	10.03	10.82	11.61	12.41	13.21	14.01	14.82	15.63	—	—	—	—	
10	—	—	—	—	—	—	8.68	9.66	10.65	11.64	12.64	13.65	14.66	15.67	16.69	17.72	18.74	19.77	20.81	—	—	—	
11	—	—	—	—	—	—	—	11.79	13.00	14.22	15.45	16.69	17.93	19.18	20.44	21.70	22.96	24.23	25.50	—	—	—	
12	—	—	—	—	—	—	—	—	15.53	16.99	18.47	19.95	21.45	22.94	24.45	25.96	27.48	28.97	30.45	31.93	—	—	
13	—	—	—	—	—	—	—	—	18.24	19.96	21.70	23.45	25.20	26.94	28.67	30.39	32.12	33.86	35.59	37.33	—	—	
14	—	—	—	—	—	—	—	—	—	23.13	25.14	27.13	29.12	31.11	33.10	35.10	37.10	39.11	41.11	43.12	—	—	
15	—	—	—	—	—	—	—	—	—	26.48	28.74	31.01	33.28	35.56	37.84	40.13	42.42	44.71	47.01	49.31	51.61	—	
16	—	—	—	—	—	—	—	—	—	—	32.56	35.13	37.70	40.29	42.88	45.47	48.07	50.68	53.28	55.89	58.51	—	
17	—	—	—	—	—	—	—	—	—	—	36.59	39.48	42.38	45.29	48.21	51.13	54.06	56.99	59.92	62.87	65.81	—	
18	—	—	—	—	—	—	—	—	—	—	40.85	44.08	47.32	50.57	53.83	57.10	60.37	63.65	66.93	70.22	73.52	76.81	
19	—	—	—	—	—	—	—	—	—	—	—	48.91	52.51	56.12	59.74	63.37	67.01	70.65	74.30	77.96	81.62	85.29	
20	—	—	—	—	—	—	—	—	—	—	—	53.98	57.95	61.94	65.94	69.95	73.97	78.00	82.04	86.08	90.12	94.18	
21	—	—	—	—	—	—	—	—	—	—	—	59.27	63.65	68.03	72.43	76.84	81.26	85.69	90.12	94.57	99.02	103.48	
22	—	—	—	—	—	—	—	—	—	—	—	—	69.58	74.38	79.20	84.02	88.86	93.71	98.57	103.44	108.31	113.19	
23	—	—	—	—	—	—	—	—	—	—	—	—	75.77	81.00	86.25	91.51	96.78	102.07	107.37	112.67	117.99	123.32	
24	—	—	—	—	—	—	—	—	—	—	—	—	82.20	87.88	93.57	99.29	105.01	110.76	116.51	122.28	128.05	133.84	

DBH = diameter at breast height.

Table D-4—Stem volume to live crown base for red alder with a crown ratio of 0.4

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
Inches	Cubic feet																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.62	1.82	2.01	2.21	2.40	2.60	2.79	2.98	3.18	3.37	3.56	3.75	3.93	—	—	—	—	—	—	—	
7	—	—	—	2.56	2.93	3.31	3.69	4.07	4.46	4.85	5.23	5.62	6.01	6.40	6.79	7.18	7.57	—	—	—	—	—		
8	—	—	—	—	4.09	4.64	5.20	5.77	6.34	6.92	7.50	8.08	8.66	9.25	9.83	10.42	11.01	11.60	—	—	—	—		
9	—	—	—	—	—	6.07	6.82	7.58	8.35	9.12	9.90	10.68	11.46	12.25	13.04	13.83	14.63	15.41	—	—	—	—		
10	—	—	—	—	—	—	8.56	9.49	10.44	11.38	12.33	13.28	14.22	15.17	16.12	17.07	18.02	18.97	19.92	—	—	—		
11	—	—	—	—	—	—	—	11.45	12.59	13.73	14.87	16.01	17.16	18.30	19.45	20.60	21.75	22.90	24.04	—	—	—		
12	—	—	—	—	—	—	—	—	14.93	16.28	17.64	19.00	20.36	21.72	23.08	24.44	25.81	27.17	28.54	29.90	—	—		
13	—	—	—	—	—	—	—	—	17.47	19.05	20.64	22.23	23.82	25.41	27.01	28.61	30.20	31.80	33.40	35.00	—	—		
14	—	—	—	—	—	—	—	—	—	22.02	23.86	25.70	27.54	29.39	31.23	33.08	34.93	36.78	38.64	40.49	—	—		
15	—	—	—	—	—	—	—	—	—	25.20	27.30	29.41	31.52	33.63	35.75	37.87	39.99	42.11	44.23	46.36	48.48	—		
16	—	—	—	—	—	—	—	—	—	—	30.97	33.36	35.76	38.16	40.56	42.97	45.37	47.78	50.20	52.61	55.02	—		
17	—	—	—	—	—	—	—	—	—	—	34.85	37.55	40.25	42.95	45.66	48.37	51.08	53.80	56.52	59.24	61.96	—		
18	—	—	—	—	—	—	—	—	—	—	38.96	41.97	44.99	48.01	51.04	54.08	57.11	60.15	63.20	66.24	69.29	72.34		
19	—	—	—	—	—	—	—	—	—	—	—	46.62	49.98	53.34	56.71	60.09	63.46	66.85	70.23	73.62	77.01	80.40		
20	—	—	—	—	—	—	—	—	—	—	—	51.51	55.22	58.94	62.67	66.40	70.13	73.87	77.62	81.36	85.11	88.86		
21	—	—	—	—	—	—	—	—	—	—	—	56.62	60.71	64.80	68.90	73.01	77.12	81.23	85.35	89.48	93.61	97.74		
22	—	—	—	—	—	—	—	—	—	—	—	—	66.44	70.92	75.41	79.91	84.41	88.92	93.44	97.96	102.48	107.01		
23	—	—	—	—	—	—	—	—	—	—	—	—	72.41	77.30	82.20	87.11	92.02	96.94	101.87	106.80	111.74	116.68		
24	—	—	—	—	—	—	—	—	—	—	—	—	78.63	83.94	89.27	94.60	99.94	105.29	110.64	116.01	121.37	126.74		

DBH = diameter at breast height.

Table D-5—Stem volume to live crown base for red alder with a crown ratio of 0.5

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Inches	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1.61	1.80	2.00	2.19	2.39	2.58	2.77	2.96	3.15	3.34	3.53	3.72	3.91	—	—	—
7	—	—	—	2.54	2.91	3.28	3.66	4.04	4.42	4.80	5.18	5.57	5.96	6.34	6.73	7.12	7.50	—	—
8	—	—	—	—	3.96	4.50	5.04	5.58	6.12	6.67	7.21	7.75	8.30	8.84	9.38	9.92	10.47	11.01	—
9	—	—	—	—	—	5.69	6.37	7.06	7.74	8.43	9.12	9.81	10.49	11.18	11.86	12.55	13.24	13.92	—
10	—	—	—	—	—	—	7.86	8.71	9.55	10.40	11.25	12.09	12.94	13.79	14.63	15.48	16.33	17.17	18.02
11	—	—	—	—	—	—	—	10.52	11.55	12.57	13.59	14.62	15.64	16.67	17.69	18.71	19.74	20.76	21.78
12	—	—	—	—	—	—	—	—	13.73	14.94	16.16	17.38	18.59	19.81	21.03	22.24	23.46	24.68	25.89
13	—	—	—	—	—	—	—	—	16.09	17.51	18.94	20.37	21.79	23.22	24.65	26.07	27.50	28.93	30.35
14	—	—	—	—	—	—	—	—	—	20.29	21.94	23.59	25.24	26.90	28.55	30.20	31.85	33.51	35.16
15	—	—	—	—	—	—	—	—	—	23.26	25.15	27.04	28.94	30.83	32.73	34.63	36.52	38.42	40.31
16	—	—	—	—	—	—	—	—	—	—	28.57	30.73	32.88	35.03	37.19	39.34	41.50	43.65	45.81
17	—	—	—	—	—	—	—	—	—	—	32.21	34.64	37.06	39.49	41.92	44.35	46.78	49.21	51.64
18	—	—	—	—	—	—	—	—	—	—	36.06	38.77	41.49	44.21	46.93	49.66	52.38	55.10	57.82
19	—	—	—	—	—	—	—	—	—	—	—	43.14	46.16	49.19	52.22	55.25	58.28	61.31	64.34
20	—	—	—	—	—	—	—	—	—	—	—	47.73	51.08	54.43	57.78	61.13	64.48	67.84	71.19
21	—	—	—	—	—	—	—	—	—	—	—	52.54	56.23	59.91	63.61	67.30	70.99	74.68	78.38
22	—	—	—	—	—	—	—	—	—	—	—	—	61.62	65.66	69.70	73.75	77.80	81.85	85.90
23	—	—	—	—	—	—	—	—	—	—	—	—	67.24	71.66	76.07	80.49	84.91	89.34	93.76
24	—	—	—	—	—	—	—	—	—	—	—	—	73.11	77.90	82.71	87.52	92.32	97.13	101.95

DBH = diameter at breast height.

Table D-6—Stem volume to live crown base for red alder with a crown ratio of 0.6

DBH	Total height (feet)																				120			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105		110	115	
<i>Inches</i>	<i>Cubic feet</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	1.60	1.79	1.99	2.18	2.37	2.56	2.75	2.94	3.13	3.32	3.51	3.70	3.89	—	—	—	—	—	—	—	
7	—	—	—	2.28	2.63	2.98	3.34	3.70	4.05	4.41	4.76	5.11	5.47	5.82	6.17	6.53	6.88	—	—	—	—	—	—	
8	—	—	—	—	3.45	3.91	4.37	4.84	5.30	5.77	6.23	6.69	7.15	7.61	8.07	8.53	8.99	9.45	—	—	—	—	—	
9	—	—	—	—	—	4.96	5.55	6.14	6.72	7.31	7.89	8.48	9.06	9.65	10.23	10.81	11.39	11.97	—	—	—	—	—	
10	—	—	—	—	—	—	6.86	7.59	8.31	9.03	9.76	10.48	11.20	11.92	12.64	13.36	14.08	14.79	15.51	—	—	—	—	
11	—	—	—	—	—	—	—	9.19	10.07	10.94	11.82	12.69	13.56	14.43	15.30	16.17	17.04	17.91	18.78	—	—	—	—	
12	—	—	—	—	—	—	—	—	11.99	13.03	14.07	15.11	16.15	17.19	18.22	19.26	20.29	21.32	22.35	23.38	—	—	—	
13	—	—	—	—	—	—	—	—	14.09	15.31	16.53	17.75	18.96	20.18	21.39	22.61	23.82	25.03	26.24	27.45	—	—	—	
14	—	—	—	—	—	—	—	—	—	17.76	19.18	20.59	22.00	23.41	24.82	26.23	27.63	29.04	30.44	31.84	—	—	—	
15	—	—	—	—	—	—	—	—	—	20.40	22.02	23.64	25.26	26.88	28.50	30.11	31.72	33.33	34.95	36.56	38.16	—	—	
16	—	—	—	—	—	—	—	—	—	—	25.06	26.91	28.75	30.59	32.43	34.26	36.10	37.93	39.76	41.59	43.42	—	—	
17	—	—	—	—	—	—	—	—	—	—	28.30	30.38	32.46	34.53	36.61	38.68	40.75	42.82	44.89	46.95	49.01	—	—	
18	—	—	—	—	—	—	—	—	—	—	31.73	34.06	36.39	38.72	41.04	43.36	45.68	48.00	50.32	52.63	54.94	57.25	—	
19	—	—	—	—	—	—	—	—	—	—	—	37.95	40.55	43.14	45.72	48.31	50.89	53.48	56.06	58.63	61.21	63.78	—	
20	—	—	—	—	—	—	—	—	—	—	—	42.05	44.92	47.79	50.66	53.52	56.38	59.24	62.10	64.96	67.81	70.66	—	
21	—	—	—	—	—	—	—	—	—	—	—	46.36	49.52	52.68	55.84	59.00	62.15	65.30	68.45	71.60	74.74	77.88	81.02	
22	—	—	—	—	—	—	—	—	—	—	—	—	54.34	57.81	61.27	64.74	68.20	71.65	75.11	78.56	82.01	85.46	88.90	
23	—	—	—	—	—	—	—	—	—	—	—	—	59.38	63.17	66.95	70.74	74.52	78.29	82.07	85.84	89.61	93.37	97.14	
24	—	—	—	—	—	—	—	—	—	—	—	—	64.65	68.77	72.88	77.00	81.11	85.22	89.33	93.44	97.54	101.64	105.74	

DBH = diameter at breast height.

Table D-7—Stem volume to live crown base for red alder with a crown ratio of 0.7

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Cubic feet																								
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	—	1.53	1.74	1.95	2.16	2.36	2.57	2.78	2.98	3.19	3.39	3.59	3.80	—	—	—	—	—	—	—	
7	—	—	—	—	2.10	2.38	2.67	2.95	3.23	3.51	3.79	4.07	4.35	4.63	4.91	5.18	5.46	—	—	—	—	—	—	
8	—	—	—	—	2.76	3.13	3.50	3.87	4.24	4.61	4.97	5.34	5.70	6.06	6.43	6.79	7.15	7.51	—	—	—	—	—	
9	—	—	—	—	—	3.98	4.45	4.92	5.38	5.85	6.31	6.77	7.24	7.69	8.15	8.61	9.07	9.52	—	—	—	—	—	
10	—	—	—	—	—	—	5.52	6.09	6.67	7.24	7.81	8.38	8.95	9.52	10.09	10.65	11.22	11.78	12.34	—	—	—	—	
11	—	—	—	—	—	—	—	7.40	8.09	8.79	9.48	10.17	10.86	11.54	12.23	12.91	13.59	14.28	14.96	—	—	—	—	
12	—	—	—	—	—	—	—	—	9.66	10.48	11.31	12.13	12.95	13.77	14.58	15.39	16.21	17.02	17.82	18.63	—	—	—	
13	—	—	—	—	—	—	—	—	11.36	12.33	13.30	14.26	15.22	16.18	17.14	18.10	19.05	20.00	20.95	21.90	—	—	—	
14	—	—	—	—	—	—	—	—	—	14.33	15.45	16.57	17.69	18.80	19.91	21.02	22.12	23.23	24.33	25.43	—	—	—	
15	—	—	—	—	—	—	—	—	—	16.49	17.77	19.06	20.34	21.61	22.89	24.16	25.43	26.69	27.96	29.22	30.48	—	—	
16	—	—	—	—	—	—	—	—	—	—	20.26	21.72	23.17	24.63	26.08	27.52	28.97	30.41	31.84	33.28	34.71	—	—	
17	—	—	—	—	—	—	—	—	—	—	22.90	24.55	26.20	27.84	29.47	31.11	32.74	34.36	35.99	37.61	39.22	—	—	
18	—	—	—	—	—	—	—	—	—	—	25.72	27.56	29.41	31.25	33.08	34.91	36.74	38.56	40.38	42.20	44.01	45.82	—	
19	—	—	—	—	—	—	—	—	—	—	—	30.75	32.81	34.85	36.90	38.94	40.97	43.00	45.03	47.05	49.08	51.09	—	
20	—	—	—	—	—	—	—	—	—	—	—	34.12	36.39	38.66	40.93	43.18	45.44	47.69	49.94	52.18	54.42	56.65	—	
21	—	—	—	—	—	—	—	—	—	—	—	37.66	40.16	42.66	45.16	47.65	50.14	52.62	55.10	57.57	60.04	62.50	64.96	
22	—	—	—	—	—	—	—	—	—	—	—	—	44.12	46.87	49.61	52.34	55.07	57.79	60.51	63.22	65.93	68.64	71.34	
23	—	—	—	—	—	—	—	—	—	—	—	—	48.27	51.27	54.27	57.25	60.23	63.21	66.18	69.14	72.10	75.06	78.01	
24	—	—	—	—	—	—	—	—	—	—	—	—	52.61	55.88	59.13	62.38	65.63	68.87	72.10	75.33	78.56	81.77	84.99	

DBH = diameter at breast height.

Table D-8—Stem volume to live crown base for red alder with a crown ratio of 0.8

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
<i>Inches</i>	<i>Cubic feet</i>																							
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	—	—	—	—	—	1.63	1.77	1.92	2.06	2.20	2.34	2.47	2.61	—	—	—	—	—	—	—	
7	—	—	—	—	—	—	—	—	2.23	2.43	2.62	2.81	3.00	3.19	3.38	3.57	3.75	—	—	—	—	—	—	
8	—	—	—	—	—	—	—	—	2.93	3.18	3.43	3.68	3.93	4.18	4.43	4.67	4.92	5.16	—	—	—	—	—	
9	—	—	—	—	—	—	—	—	3.73	4.05	4.36	4.68	4.99	5.31	5.62	5.93	6.24	6.55	—	—	—	—	—	
10	—	—	—	—	—	—	—	—	4.62	5.02	5.41	5.80	6.18	6.57	6.96	7.34	7.72	8.10	8.48	—	—	—	—	
11	—	—	—	—	—	—	—	—	5.61	6.09	6.56	7.04	7.50	7.97	8.44	8.90	9.36	9.82	10.28	—	—	—	—	
12	—	—	—	—	—	—	—	—	6.71	7.27	7.84	8.40	8.96	9.51	10.06	10.61	11.16	11.71	12.25	12.80	—	—	—	
13	—	—	—	—	—	—	—	—	7.90	8.56	9.23	9.88	10.54	11.19	11.84	12.48	13.13	13.77	14.41	15.04	—	—	—	
14	—	—	—	—	—	—	—	—	—	9.96	10.73	11.49	12.25	13.01	13.76	14.51	15.25	16.00	16.74	17.47	—	—	—	
15	—	—	—	—	—	—	—	—	—	11.47	12.35	13.23	14.10	14.96	15.83	16.69	17.54	18.39	19.24	20.09	20.93	—	—	
16	—	—	—	—	—	—	—	—	—	—	14.09	15.09	16.08	17.06	18.04	19.02	19.99	20.96	21.93	22.89	23.85	—	—	
17	—	—	—	—	—	—	—	—	—	—	15.95	17.07	18.19	19.30	20.40	21.51	22.61	23.70	24.79	25.87	26.96	—	—	
18	—	—	—	—	—	—	—	—	—	—	17.92	19.18	20.43	21.68	22.92	24.16	25.39	26.61	27.83	29.05	30.26	31.47	—	
19	—	—	—	—	—	—	—	—	—	—	—	21.42	22.81	24.20	25.58	26.96	28.33	29.69	31.05	32.40	33.75	35.10	—	
20	—	—	—	—	—	—	—	—	—	—	—	23.78	25.32	26.86	28.39	29.92	31.44	32.95	34.45	35.95	37.44	38.93	—	
21	—	—	—	—	—	—	—	—	—	—	—	26.27	27.97	29.67	31.35	33.04	34.71	36.37	38.03	39.68	41.33	42.97	44.61	
22	—	—	—	—	—	—	—	—	—	—	—	—	30.76	32.61	34.46	36.31	38.15	39.97	41.79	43.60	45.41	47.21	49.00	
23	—	—	—	—	—	—	—	—	—	—	—	—	33.67	35.71	37.73	39.74	41.75	43.74	45.73	47.71	49.68	51.65	53.61	
24	—	—	—	—	—	—	—	—	—	—	—	—	36.73	38.94	41.14	43.33	45.52	47.69	49.85	52.01	54.15	56.29	58.43	

DBH = diameter at breast height.

Table D-9—Stem volume to live crown base for red alder with a crown ratio of 0.9

DBH	Total height (feet)															
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
Inches	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

DBH = diameter at breast height.

Appendix E: Diameter Outside Bark at Crown Base

Table E-1—Diameter outside bark at crown base for red alder with a crown ratio of 0.1

DBH	Total height (feet)																							
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches																								
1	0.37	0.35	0.35	0.35	0.36	0.36	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	0.55	0.54	0.56	0.58	0.60	0.62	0.63	0.64	0.65	0.66	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	0.63	0.65	0.70	0.74	0.77	0.80	0.83	0.85	0.87	0.89	0.91	0.92	0.93	—	—	—	—	—	—	—	—	—	—	
4	0.65	0.70	0.78	0.85	0.90	0.95	0.99	1.02	1.05	1.08	1.11	1.13	1.15	1.17	—	—	—	—	—	—	—	—	—	
5	—	0.72	0.82	0.91	0.99	1.05	1.11	1.16	1.20	1.24	1.27	1.30	1.33	1.36	1.38	—	—	—	—	—	—	—	—	
6	—	—	0.84	0.95	1.05	1.13	1.20	1.26	1.32	1.37	1.41	1.45	1.49	1.52	1.55	1.58	—	—	—	—	—	—	—	
7	—	—	—	0.97	1.08	1.18	1.27	1.35	1.41	1.47	1.53	1.58	1.62	1.66	1.70	1.74	1.77	—	—	—	—	—	—	
8	—	—	—	—	1.10	1.22	1.32	1.41	1.49	1.56	1.63	1.68	1.74	1.79	1.83	1.88	1.91	1.95	—	—	—	—	—	
9	—	—	—	—	—	1.23	1.35	1.45	1.55	1.63	1.71	1.77	1.84	1.89	1.95	2.00	2.04	2.09	—	—	—	—	—	
10	—	—	—	—	—	—	1.37	1.49	1.59	1.68	1.77	1.85	1.92	1.99	2.05	2.10	2.16	2.21	2.25	—	—	—	—	
11	—	—	—	—	—	—	—	1.50	1.62	1.72	1.82	1.91	1.99	2.06	2.13	2.20	2.26	2.31	2.36	—	—	—	—	
12	—	—	—	—	—	—	—	—	1.64	1.75	1.86	1.96	2.05	2.13	2.21	2.28	2.34	2.41	2.47	2.52	—	—	—	
13	—	—	—	—	—	—	—	—	1.65	1.77	1.89	1.99	2.09	2.18	2.27	2.35	2.42	2.49	2.55	2.62	—	—	—	
14	—	—	—	—	—	—	—	—	—	1.78	1.91	2.02	2.13	2.23	2.32	2.41	2.49	2.56	2.63	2.70	—	—	—	
15	—	—	—	—	—	—	—	—	—	1.78	1.92	2.04	2.15	2.26	2.36	2.45	2.54	2.62	2.70	2.78	2.84	—	—	
16	—	—	—	—	—	—	—	—	—	—	1.92	2.05	2.17	2.29	2.39	2.50	2.59	2.68	2.76	2.84	2.92	—	—	
17	—	—	—	—	—	—	—	—	—	—	1.91	2.05	2.18	2.31	2.42	2.53	2.63	2.72	2.81	2.90	2.98	—	—	
18	—	—	—	—	—	—	—	—	—	—	1.90	2.05	2.19	2.32	2.44	2.55	2.66	2.76	2.86	2.95	3.04	3.12	—	
19	—	—	—	—	—	—	—	—	—	—	—	2.04	2.19	2.32	2.45	2.57	2.69	2.79	2.90	2.99	3.08	3.17	—	
20	—	—	—	—	—	—	—	—	—	—	—	2.03	2.18	2.32	2.46	2.58	2.71	2.82	2.93	3.03	3.13	3.22	—	
21	—	—	—	—	—	—	—	—	—	—	—	2.01	2.17	2.32	2.46	2.59	2.72	2.84	2.95	3.06	3.16	3.26	3.35	
22	—	—	—	—	—	—	—	—	—	—	—	—	2.15	2.31	2.45	2.59	2.73	2.85	2.97	3.08	3.19	3.29	3.39	
23	—	—	—	—	—	—	—	—	—	—	—	—	2.13	2.29	2.45	2.59	2.73	2.86	2.98	3.10	3.22	3.32	3.43	
24	—	—	—	—	—	—	—	—	—	—	—	—	2.11	2.27	2.43	2.58	2.73	2.86	2.99	3.12	3.23	3.35	3.46	

DBH = diameter at breast height.

Table E-2—Diameter outside bark at crown base for red alder with a crown ratio of 0.2

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
<i>Inches</i>																			
1	0.54	0.50	0.49	0.48	0.48	0.49	—	—	—	—	—	—	—	—	—	—	—	—	—
2	0.92	0.84	0.84	0.85	0.86	0.87	0.87	0.88	0.89	0.90	—	—	—	—	—	—	—	—	—
3	1.17	1.09	1.11	1.13	1.16	1.18	1.20	1.22	1.23	1.25	1.26	1.27	1.28	—	—	—	—	—	—
4	1.34	1.27	1.31	1.36	1.40	1.44	1.47	1.50	1.53	1.56	1.58	1.60	1.61	1.63	—	—	—	—	—
5	—	1.39	1.46	1.53	1.60	1.66	1.71	1.75	1.79	1.83	1.86	1.89	1.91	1.94	1.96	—	—	—	—
6	—	—	1.56	1.67	1.76	1.84	1.91	1.97	2.02	2.07	2.11	2.15	2.18	2.21	2.24	2.27	—	—	—
7	—	—	—	1.77	1.89	1.99	2.07	2.15	2.22	2.28	2.33	2.38	2.42	2.46	2.50	2.53	2.56	—	—
8	—	—	—	—	1.98	2.11	2.21	2.31	2.39	2.46	2.53	2.59	2.64	2.69	2.74	2.78	2.82	2.85	—
9	—	—	—	—	—	2.20	2.33	2.44	2.54	2.63	2.71	2.78	2.84	2.90	2.95	3.00	3.05	3.09	—
10	—	—	—	—	—	—	2.42	2.55	2.67	2.77	2.86	2.95	3.02	3.09	3.15	3.21	3.27	3.32	3.36
11	—	—	—	—	—	—	—	2.65	2.78	2.90	3.00	3.10	3.18	3.26	3.33	3.40	3.46	3.52	3.58
12	—	—	—	—	—	—	—	—	2.87	3.00	3.12	3.23	3.33	3.42	3.50	3.58	3.65	3.71	3.77
13	—	—	—	—	—	—	—	—	2.95	3.09	3.23	3.35	3.46	3.56	3.65	3.74	3.81	3.89	3.96
14	—	—	—	—	—	—	—	—	—	3.17	3.32	3.45	3.57	3.68	3.79	3.88	3.97	4.05	4.13
15	—	—	—	—	—	—	—	—	—	3.23	3.39	3.54	3.67	3.80	3.91	4.01	4.11	4.20	4.29
16	—	—	—	—	—	—	—	—	—	—	3.46	3.62	3.76	3.90	4.02	4.13	4.24	4.34	4.43
17	—	—	—	—	—	—	—	—	—	—	3.51	3.68	3.84	3.99	4.12	4.24	4.36	4.47	4.57
18	—	—	—	—	—	—	—	—	—	—	3.56	3.74	3.91	4.06	4.21	4.34	4.47	4.58	4.69
19	—	—	—	—	—	—	—	—	—	—	—	3.79	3.97	4.13	4.29	4.43	4.57	4.69	4.81
20	—	—	—	—	—	—	—	—	—	—	—	3.82	4.01	4.19	4.36	4.51	4.65	4.79	4.91
21	—	—	—	—	—	—	—	—	—	—	—	3.85	4.05	4.24	4.42	4.58	4.73	4.88	5.01
22	—	—	—	—	—	—	—	—	—	—	—	—	4.08	4.28	4.47	4.64	4.80	4.95	5.10
23	—	—	—	—	—	—	—	—	—	—	—	—	4.11	4.32	4.51	4.69	4.87	5.03	5.18
24	—	—	—	—	—	—	—	—	—	—	—	—	4.12	4.34	4.55	4.74	4.92	5.09	5.25

DBH = diameter at breast height.

Table E-3—Diameter outside bark at crown base for red alder with a crown ratio of 0.3

Total height (feet)																								
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Inches																							
1	0.70	0.63	0.60	0.60	0.59	0.59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	1.28	1.13	1.10	1.09	1.09	1.09	1.09	1.09	1.10	1.10	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	1.77	1.55	1.52	1.51	1.52	1.53	1.54	1.55	1.56	1.57	1.58	1.58	1.59	—	—	—	—	—	—	—	—	—	—	
4	2.18	1.91	1.87	1.88	1.90	1.92	1.94	1.96	1.98	2.00	2.01	2.02	2.04	2.05	—	—	—	—	—	—	—	—	—	
5	—	2.20	2.18	2.20	2.24	2.28	2.31	2.34	2.36	2.39	2.41	2.43	2.45	2.47	2.48	—	—	—	—	—	—	—	—	
6	—	—	2.43	2.48	2.54	2.59	2.64	2.68	2.72	2.75	2.78	2.81	2.84	2.86	2.88	2.90	—	—	—	—	—	—	—	
7	—	—	—	2.72	2.80	2.87	2.94	2.99	3.04	3.09	3.13	3.17	3.20	3.23	3.26	3.29	3.31	—	—	—	—	—	—	
8	—	—	—	—	3.03	3.12	3.21	3.28	3.34	3.40	3.45	3.50	3.54	3.58	3.62	3.65	3.68	3.71	—	—	—	—	—	
9	—	—	—	—	—	3.35	3.45	3.54	3.62	3.69	3.76	3.81	3.87	3.91	3.96	4.00	4.04	4.07	—	—	—	—	—	
10	—	—	—	—	—	—	3.67	3.78	3.87	3.96	4.04	4.10	4.17	4.22	4.28	4.33	4.37	4.41	4.45	—	—	—	—	
11	—	—	—	—	—	—	—	3.99	4.11	4.21	4.30	4.38	4.45	4.52	4.58	4.64	4.69	4.74	4.78	—	—	—	—	
12	—	—	—	—	—	—	—	—	4.32	4.44	4.54	4.63	4.72	4.79	4.86	4.93	4.99	5.05	5.10	5.15	—	—	—	
13	—	—	—	—	—	—	—	—	4.51	4.65	4.76	4.87	4.97	5.05	5.13	5.21	5.28	5.34	5.40	5.46	—	—	—	
14	—	—	—	—	—	—	—	—	—	4.84	4.97	5.09	5.20	5.30	5.39	5.47	5.55	5.62	5.69	5.75	—	—	—	
15	—	—	—	—	—	—	—	—	—	5.02	5.17	5.30	5.42	5.53	5.63	5.72	5.81	5.89	5.97	6.04	6.10	—	—	
16	—	—	—	—	—	—	—	—	—	—	5.34	5.49	5.62	5.75	5.86	5.96	6.06	6.15	6.23	6.31	6.38	—	—	
17	—	—	—	—	—	—	—	—	—	—	5.51	5.67	5.82	5.95	6.07	6.19	6.29	6.39	6.48	6.57	6.65	—	—	
18	—	—	—	—	—	—	—	—	—	—	5.66	5.84	6.00	6.14	6.28	6.40	6.52	6.62	6.72	6.82	6.90	6.99	—	
19	—	—	—	—	—	—	—	—	—	—	—	5.99	6.16	6.32	6.47	6.60	6.73	6.84	6.95	7.05	7.15	7.24	—	
20	—	—	—	—	—	—	—	—	—	—	—	6.13	6.32	6.49	6.65	6.79	6.93	7.05	7.17	7.28	7.38	7.48	—	
21	—	—	—	—	—	—	—	—	—	—	—	6.26	6.46	6.65	6.82	6.97	7.12	7.25	7.38	7.50	7.61	7.71	7.81	
22	—	—	—	—	—	—	—	—	—	—	—	—	6.59	6.79	6.97	7.14	7.30	7.44	7.58	7.71	7.83	7.94	8.04	
23	—	—	—	—	—	—	—	—	—	—	—	—	6.72	6.93	7.12	7.30	7.47	7.62	7.77	7.90	8.03	8.15	8.27	
24	—	—	—	—	—	—	—	—	—	—	—	—	6.83	7.05	7.26	7.45	7.63	7.79	7.95	8.09	8.23	8.36	8.48	

DBH = diameter at breast height.

Table E-4—Diameter outside bark at crown base for red alder with a crown ratio of 0.4

DBH	Total height (feet)																			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
<i>Inches</i>																				
1	0.84	0.74	0.71	0.69	0.68	0.68	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	1.62	1.40	1.34	1.31	1.30	1.29	1.29	1.29	1.28	1.28	—	—	—	—	—	—	—	—	—	—
3	2.35	2.00	1.91	1.88	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.87	1.87	—	—	—	—	—	—	—
4	3.03	2.55	2.44	2.40	2.39	2.39	2.39	2.39	2.40	2.41	2.41	2.42	2.42	2.43	—	—	—	—	—	—
5	—	3.05	2.92	2.88	2.88	2.88	2.89	2.90	2.91	2.92	2.94	2.95	2.96	2.96	2.97	—	—	—	—	—
6	—	—	3.36	3.33	3.33	3.35	3.36	3.38	3.40	3.42	3.44	3.45	3.47	3.48	3.49	3.50	—	—	—	—
7	—	—	—	3.75	3.76	3.78	3.81	3.84	3.87	3.89	3.91	3.94	3.96	3.97	3.99	4.01	4.02	—	—	—
8	—	—	—	—	4.16	4.19	4.23	4.27	4.31	4.34	4.37	4.40	4.43	4.45	4.47	4.50	4.52	4.53	—	—
9	—	—	—	—	—	4.58	4.63	4.68	4.73	4.77	4.81	4.85	4.88	4.91	4.94	4.97	4.99	5.01	—	—
10	—	—	—	—	—	—	5.01	5.07	5.13	5.18	5.23	5.28	5.32	5.35	5.39	5.42	5.45	5.48	5.51	—
11	—	—	—	—	—	—	—	5.44	5.51	5.58	5.63	5.69	5.74	5.78	5.82	5.86	5.90	5.93	5.97	—
12	—	—	—	—	—	—	—	—	5.88	5.95	6.02	6.09	6.14	6.20	6.25	6.29	6.33	6.37	6.41	6.45
13	—	—	—	—	—	—	—	—	6.22	6.31	6.39	6.47	6.53	6.60	6.65	6.71	6.75	6.80	6.84	6.88
14	—	—	—	—	—	—	—	—	—	6.66	6.75	6.84	6.91	6.98	7.05	7.11	7.16	7.22	7.26	7.31
15	—	—	—	—	—	—	—	—	—	6.99	7.09	7.19	7.28	7.36	7.43	7.50	7.56	7.62	7.67	7.73
16	—	—	—	—	—	—	—	—	—	—	7.42	7.53	7.63	7.72	7.80	7.87	7.95	8.01	8.07	8.13
17	—	—	—	—	—	—	—	—	—	—	7.74	7.86	7.96	8.06	8.16	8.24	8.32	8.39	8.46	8.52
18	—	—	—	—	—	—	—	—	—	—	8.04	8.17	8.29	8.40	8.50	8.60	8.68	8.76	8.84	8.91
19	—	—	—	—	—	—	—	—	—	—	—	8.47	8.61	8.73	8.84	8.94	9.04	9.12	9.21	9.28
20	—	—	—	—	—	—	—	—	—	—	—	8.76	8.91	9.04	9.16	9.27	9.38	9.47	9.56	9.65
21	—	—	—	—	—	—	—	—	—	—	—	9.04	9.20	9.34	9.48	9.60	9.71	9.82	9.91	10.00
22	—	—	—	—	—	—	—	—	—	—	—	—	9.48	9.64	9.78	9.91	10.03	10.15	10.25	10.35
23	—	—	—	—	—	—	—	—	—	—	—	—	9.75	9.92	10.07	10.21	10.35	10.47	10.58	10.69
24	—	—	—	—	—	—	—	—	—	—	—	—	10.01	10.19	10.36	10.51	10.65	10.78	10.90	11.02

DBH = diameter at breast height.

Table E-5—Diameter outside bark at crown base for red alder with a crown ratio of 0.5

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
<i>Inches</i>												<i>Inches</i>							
1	0.96	0.84	0.80	0.78	0.77	0.76	—	—	—	—	—	—	—	—	—	—	—	—	—
2	1.91	1.64	1.56	1.51	1.49	1.48	1.47	1.46	1.45	1.45	—	—	—	—	—	—	—	—	—
3	2.85	2.41	2.27	2.21	2.18	2.16	2.15	2.14	2.13	2.13	2.13	2.12	2.12	—	—	—	—	—	—
4	3.78	3.15	2.96	2.88	2.84	2.82	2.80	2.79	2.79	2.79	2.78	2.78	2.78	2.78	—	—	—	—	—
5	—	3.85	3.62	3.53	3.48	3.45	3.44	3.43	3.43	3.42	3.42	3.42	3.42	3.43	3.43	—	—	—	—
6	—	—	4.26	4.14	4.09	4.07	4.05	4.05	4.04	4.04	4.04	4.05	4.05	4.05	4.06	4.06	—	—	—
7	—	—	—	4.74	4.68	4.66	4.65	4.64	4.64	4.65	4.65	4.66	4.66	4.67	4.67	4.68	4.69	—	—
8	—	—	—	—	5.25	5.23	5.22	5.22	5.23	5.23	5.24	5.25	5.26	5.27	5.28	5.29	5.30	5.30	—
9	—	—	—	—	—	5.79	5.78	5.79	5.80	5.81	5.82	5.83	5.85	5.86	5.87	5.88	5.89	5.90	—
10	—	—	—	—	—	—	6.33	6.34	6.35	6.37	6.38	6.40	6.42	6.43	6.45	6.47	6.48	6.49	6.51
11	—	—	—	—	—	—	—	6.87	6.89	6.91	6.94	6.96	6.98	7.00	7.02	7.04	7.06	7.07	7.09
12	—	—	—	—	—	—	—	—	7.42	7.45	7.47	7.50	7.53	7.55	7.58	7.60	7.62	7.64	7.66
13	—	—	—	—	—	—	—	—	7.93	7.97	8.00	8.03	8.07	8.10	8.13	8.15	8.18	8.20	8.23
14	—	—	—	—	—	—	—	—	—	8.48	8.52	8.56	8.59	8.63	8.66	8.69	8.72	8.75	8.78
15	—	—	—	—	—	—	—	—	—	8.97	9.02	9.07	9.11	9.15	9.19	9.23	9.26	9.30	9.33
16	—	—	—	—	—	—	—	—	—	—	9.51	9.57	9.62	9.67	9.71	9.75	9.79	9.83	9.86
17	—	—	—	—	—	—	—	—	—	—	10.00	10.06	10.12	10.17	10.22	10.27	10.31	10.35	10.39
18	—	—	—	—	—	—	—	—	—	—	10.47	10.54	10.60	10.66	10.72	10.77	10.82	10.87	10.91
19	—	—	—	—	—	—	—	—	—	—	—	11.01	11.08	11.15	11.21	11.27	11.33	11.38	11.43
20	—	—	—	—	—	—	—	—	—	—	—	11.47	11.55	11.63	11.70	11.76	11.82	11.88	11.93
21	—	—	—	—	—	—	—	—	—	—	—	11.92	12.01	12.09	12.17	12.24	12.31	12.37	12.43
22	—	—	—	—	—	—	—	—	—	—	—	—	12.46	12.55	12.64	12.72	12.79	12.86	12.92
23	—	—	—	—	—	—	—	—	—	—	—	—	12.91	13.00	13.10	13.18	13.26	13.34	13.41
24	—	—	—	—	—	—	—	—	—	—	—	—	13.34	13.45	13.55	13.64	13.73	13.81	13.89

DBH = diameter at breast height.

Table E-6—Diameter outside bark at crown base for red alder with a crown ratio of 0.6

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
<i>Inches</i>																			
1	1.06	0.93	0.89	0.86	0.84	0.83	—	—	—	—	—	—	—	—	—	—	—	—	—
2	2.14	1.85	1.75	1.69	1.66	1.64	1.63	1.62	1.61	1.60	—	—	—	—	—	—	—	—	—
3	3.24	2.76	2.59	2.51	2.46	2.43	2.41	2.39	2.38	2.37	2.36	2.36	2.35	—	—	—	—	—	—
4	4.35	3.65	3.42	3.31	3.25	3.21	3.18	3.16	3.14	3.13	3.12	3.11	3.11	3.10	—	—	—	—	—
5	—	4.54	4.24	4.10	4.02	3.97	3.93	3.91	3.89	3.88	3.87	3.86	3.85	3.85	3.84	—	—	—	—
6	—	—	5.04	4.87	4.77	4.71	4.67	4.65	4.63	4.61	4.60	4.59	4.58	4.58	4.57	4.57	—	—	—
7	—	—	—	5.63	5.52	5.45	5.41	5.37	5.35	5.34	5.33	5.32	5.31	5.30	5.30	5.30	5.29	—	—
8	—	—	—	—	6.25	6.17	6.13	6.09	6.07	6.05	6.04	6.03	6.02	6.02	6.02	6.01	6.01	6.01	—
9	—	—	—	—	—	6.89	6.83	6.80	6.78	6.76	6.75	6.74	6.73	6.73	6.72	6.72	6.72	6.72	—
10	—	—	—	—	—	—	7.53	7.50	7.47	7.46	7.44	7.44	7.43	7.43	7.43	7.42	7.42	7.42	7.42
11	—	—	—	—	—	—	—	8.19	8.16	8.14	8.13	8.13	8.12	8.12	8.12	8.12	8.12	8.12	8.12
12	—	—	—	—	—	—	—	—	8.84	8.83	8.82	8.81	8.81	8.81	8.81	8.81	8.81	8.81	8.82
13	—	—	—	—	—	—	—	—	9.51	9.50	9.49	9.49	9.48	9.48	9.49	9.49	9.49	9.50	9.50
14	—	—	—	—	—	—	—	—	—	10.16	10.16	10.15	10.15	10.16	10.16	10.16	10.17	10.18	10.18
15	—	—	—	—	—	—	—	—	—	10.82	10.82	10.82	10.82	10.82	10.83	10.83	10.84	10.85	10.86
16	—	—	—	—	—	—	—	—	—	—	11.47	11.47	11.47	11.48	11.49	11.50	11.51	11.52	11.53
17	—	—	—	—	—	—	—	—	—	—	12.11	12.12	12.13	12.13	12.14	12.16	12.17	12.18	12.19
18	—	—	—	—	—	—	—	—	—	—	12.75	12.76	12.77	12.78	12.79	12.81	12.82	12.83	12.85
19	—	—	—	—	—	—	—	—	—	—	—	13.39	13.41	13.42	13.44	13.45	13.47	13.49	13.50
20	—	—	—	—	—	—	—	—	—	—	—	14.02	14.04	14.06	14.08	14.09	14.11	14.13	14.15
21	—	—	—	—	—	—	—	—	—	—	—	14.65	14.67	14.69	14.71	14.73	14.75	14.77	14.79
22	—	—	—	—	—	—	—	—	—	—	—	—	15.29	15.31	15.34	15.36	15.38	15.41	15.43
23	—	—	—	—	—	—	—	—	—	—	—	—	15.90	15.93	15.96	15.99	16.01	16.04	16.07
24	—	—	—	—	—	—	—	—	—	—	—	—	16.51	16.54	16.57	16.60	16.64	16.67	16.69

DBH = diameter at breast height.

Table E-7—Diameter outside bark at crown base for red alder with a crown ratio of 0.7

Total height (feet)																								
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Inches																							
1	1.14	1.01	0.96	0.93	0.91	0.90	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	2.31	2.02	1.91	1.85	1.81	1.79	1.77	1.76	1.75	1.74	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	3.52	3.04	2.86	2.77	2.71	2.67	2.64	2.62	2.60	2.59	2.58	2.57	2.56	—	—	—	—	—	—	—	—	—	—	
4	4.75	4.05	3.80	3.68	3.60	3.54	3.51	3.48	3.46	3.44	3.42	3.41	3.40	3.39	—	—	—	—	—	—	—	—	—	
5	—	5.07	4.75	4.58	4.48	4.41	4.37	4.33	4.30	4.28	4.26	4.25	4.23	4.22	4.21	—	—	—	—	—	—	—	—	
6	—	—	5.68	5.48	5.36	5.28	5.22	5.18	5.14	5.12	5.09	5.08	5.06	5.05	5.04	5.03	—	—	—	—	—	—	—	
7	—	—	—	6.37	6.23	6.13	6.07	6.02	5.98	5.95	5.92	5.90	5.89	5.87	5.86	5.85	5.84	—	—	—	—	—	—	
8	—	—	—	—	7.09	6.98	6.91	6.85	6.81	6.77	6.75	6.72	6.70	6.69	6.67	6.66	6.65	6.64	—	—	—	—	—	
9	—	—	—	—	—	7.83	7.74	7.68	7.63	7.59	7.56	7.54	7.52	7.50	7.49	7.47	7.46	7.45	—	—	—	—	—	
10	—	—	—	—	—	—	8.58	8.51	8.45	8.41	8.38	8.35	8.33	8.31	8.29	8.28	8.27	8.26	8.25	—	—	—	—	
11	—	—	—	—	—	—	—	9.33	9.27	9.22	9.19	9.16	9.13	9.11	9.10	9.08	9.07	9.06	9.05	—	—	—	—	
12	—	—	—	—	—	—	—	—	10.08	10.03	9.99	9.96	9.94	9.91	9.90	9.88	9.87	9.86	9.85	9.84	—	—	—	
13	—	—	—	—	—	—	—	—	10.89	10.84	10.80	10.76	10.73	10.71	10.69	10.68	10.66	10.65	10.64	10.63	—	—	—	
14	—	—	—	—	—	—	—	—	—	11.64	11.59	11.56	11.53	11.51	11.49	11.47	11.45	11.44	11.43	11.42	—	—	—	
15	—	—	—	—	—	—	—	—	—	12.43	12.39	12.35	12.32	12.30	12.27	12.26	12.24	12.23	12.22	12.21	12.20	—	—	
16	—	—	—	—	—	—	—	—	—	—	13.18	13.14	13.11	13.08	13.06	13.04	13.03	13.01	13.00	12.99	12.99	—	—	
17	—	—	—	—	—	—	—	—	—	—	13.97	13.93	13.89	13.87	13.84	13.83	13.81	13.80	13.79	13.78	13.77	—	—	
18	—	—	—	—	—	—	—	—	—	—	14.75	14.71	14.67	14.65	14.62	14.60	14.59	14.58	14.56	14.55	14.55	14.54	—	
19	—	—	—	—	—	—	—	—	—	—	—	15.49	15.45	15.42	15.40	15.38	15.37	15.35	15.34	15.33	15.32	15.32	—	
20	—	—	—	—	—	—	—	—	—	—	—	16.26	16.23	16.20	16.17	16.15	16.14	16.13	16.11	16.10	16.10	16.09	—	
21	—	—	—	—	—	—	—	—	—	—	—	17.03	17.00	16.97	16.95	16.93	16.91	16.90	16.89	16.88	16.87	16.86	16.86	
22	—	—	—	—	—	—	—	—	—	—	—	—	17.77	17.74	17.71	17.69	17.68	17.66	17.65	17.64	17.64	17.63	17.63	
23	—	—	—	—	—	—	—	—	—	—	—	—	18.53	18.50	18.48	18.46	18.44	18.43	18.42	18.41	18.40	18.40	18.39	
24	—	—	—	—	—	—	—	—	—	—	—	—	19.29	19.26	19.24	19.22	19.21	19.19	19.18	19.17	19.17	19.16	19.16	

DBH = diameter at breast height.

Table E-8—Diameter outside bark at crown base for red alder with a crown ratio of 0.8

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
<i>Inches</i>																			
1	1.20	1.08	1.02	0.99	0.97	0.96	—	—	—	—	—	—	—	—	—	—	—	—	—
2	2.45	2.17	2.05	1.99	1.95	1.92	1.90	1.88	1.87	1.86	—	—	—	—	—	—	—	—	—
3	3.72	3.27	3.09	2.99	2.92	2.88	2.85	2.82	2.80	2.79	2.77	2.76	2.75	—	—	—	—	—	—
4	5.02	4.37	4.12	3.99	3.90	3.84	3.79	3.76	3.73	3.71	3.69	3.68	3.66	3.65	—	—	—	—	—
5	—	5.49	5.16	4.98	4.87	4.79	4.74	4.69	4.66	4.63	4.61	4.59	4.57	4.56	4.54	—	—	—	—
6	—	—	6.20	5.98	5.84	5.75	5.68	5.63	5.59	5.55	5.52	5.50	5.48	5.46	5.44	5.43	—	—	—
7	—	—	—	6.98	6.82	6.70	6.62	6.56	6.51	6.47	6.44	6.41	6.38	6.36	6.34	6.33	6.31	—	—
8	—	—	—	—	7.79	7.66	7.56	7.49	7.43	7.39	7.35	7.31	7.29	7.26	7.24	7.22	7.21	7.19	—
9	—	—	—	—	—	8.61	8.50	8.42	8.35	8.30	8.26	8.22	8.19	8.16	8.14	8.12	8.10	8.08	—
10	—	—	—	—	—	—	9.44	9.34	9.27	9.21	9.16	9.12	9.09	9.06	9.03	9.01	8.99	8.97	8.95
11	—	—	—	—	—	—	—	10.27	10.19	10.12	10.07	10.03	9.99	9.95	9.92	9.90	9.88	9.86	9.84
12	—	—	—	—	—	—	—	—	11.11	11.03	10.98	10.93	10.88	10.85	10.82	10.79	10.76	10.74	10.72
13	—	—	—	—	—	—	—	—	12.02	11.94	11.88	11.83	11.78	11.74	11.71	11.67	11.65	11.62	11.60
14	—	—	—	—	—	—	—	—	—	12.85	12.78	12.72	12.67	12.63	12.59	12.56	12.53	12.51	12.48
15	—	—	—	—	—	—	—	—	—	13.76	13.68	13.62	13.57	13.52	13.48	13.45	13.41	13.39	13.36
16	—	—	—	—	—	—	—	—	—	—	14.58	14.51	14.46	14.41	14.37	14.33	14.30	14.27	14.24
17	—	—	—	—	—	—	—	—	—	—	15.48	15.41	15.35	15.30	15.25	15.21	15.18	15.15	15.12
18	—	—	—	—	—	—	—	—	—	—	16.38	16.30	16.24	16.18	16.13	16.09	16.06	16.02	15.99
19	—	—	—	—	—	—	—	—	—	—	—	17.19	17.13	17.07	17.02	16.97	16.93	16.90	16.87
20	—	—	—	—	—	—	—	—	—	—	—	18.08	18.01	17.95	17.90	17.85	17.81	17.77	17.74
21	—	—	—	—	—	—	—	—	—	—	—	18.97	18.90	18.83	18.78	18.73	18.69	18.65	18.61
22	—	—	—	—	—	—	—	—	—	—	—	—	19.78	19.71	19.66	19.60	19.56	19.52	19.48
23	—	—	—	—	—	—	—	—	—	—	—	—	20.66	20.59	20.53	20.48	20.43	20.39	20.35
24	—	—	—	—	—	—	—	—	—	—	—	—	21.55	21.47	21.41	21.35	21.30	21.26	21.22

DBH = diameter at breast height.

Table E-9—Diameter outside bark at crown base for red alder with a crown ratio of 0.9

DBH	Total height (feet)																		
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
<i>Inches</i>												<i>Inches</i>							
1	1.30	1.16	1.10	1.07	1.04	1.03	—	—	—	—	—	—	—	—	—	—	—	—	—
2	2.66	2.35	2.22	2.15	2.10	2.06	2.04	2.02	2.00	1.99	—	—	—	—	—	—	—	—	—
3	4.06	3.56	3.35	3.23	3.15	3.10	3.06	3.03	3.00	2.98	2.96	2.95	2.93	—	—	—	—	—	—
4	5.47	4.77	4.48	4.32	4.22	4.14	4.08	4.04	4.00	3.97	3.95	3.93	3.91	3.89	—	—	—	—	—
5	—	6.00	5.63	5.42	5.28	5.18	5.11	5.05	5.01	4.97	4.94	4.91	4.89	4.86	4.85	—	—	—	—
6	—	—	6.77	6.51	6.35	6.23	6.14	6.07	6.01	5.96	5.92	5.89	5.86	5.84	5.81	5.79	—	—	—
7	—	—	—	7.61	7.41	7.27	7.16	7.08	7.01	6.96	6.91	6.87	6.84	6.81	6.78	6.75	6.73	—	—
8	—	—	—	—	8.48	8.32	8.19	8.10	8.02	7.95	7.90	7.85	7.81	7.78	7.74	7.72	7.69	7.67	—
9	—	—	—	—	—	9.37	9.22	9.11	9.02	8.95	8.89	8.83	8.79	8.75	8.71	8.68	8.65	8.62	—
10	—	—	—	—	—	—	10.25	10.13	10.03	9.94	9.87	9.81	9.76	9.72	9.67	9.64	9.61	9.58	9.55
11	—	—	—	—	—	—	—	11.14	11.03	10.94	10.86	10.79	10.74	10.68	10.64	10.60	10.56	10.53	10.50
12	—	—	—	—	—	—	—	—	12.04	11.93	11.85	11.77	11.71	11.65	11.60	11.56	11.52	11.48	11.45
13	—	—	—	—	—	—	—	—	13.04	12.93	12.83	12.75	12.68	12.62	12.57	12.52	12.47	12.43	12.40
14	—	—	—	—	—	—	—	—	—	13.92	13.82	13.73	13.66	13.59	13.53	13.48	13.43	13.39	13.35
15	—	—	—	—	—	—	—	—	—	14.92	14.81	14.71	14.63	14.56	14.49	14.43	14.38	14.34	14.29
16	—	—	—	—	—	—	—	—	—	—	15.79	15.69	15.60	15.52	15.45	15.39	15.34	15.29	15.24
17	—	—	—	—	—	—	—	—	—	—	16.78	16.67	16.57	16.49	16.42	16.35	16.29	16.24	16.19
18	—	—	—	—	—	—	—	—	—	—	17.76	17.65	17.54	17.46	17.38	17.31	17.24	17.19	17.13
19	—	—	—	—	—	—	—	—	—	—	—	18.62	18.52	18.42	18.34	18.26	18.20	18.14	18.08
20	—	—	—	—	—	—	—	—	—	—	—	19.60	19.49	19.39	19.30	19.22	19.15	19.08	19.03
21	—	—	—	—	—	—	—	—	—	—	—	20.58	20.46	20.35	20.26	20.17	20.10	20.03	19.97
22	—	—	—	—	—	—	—	—	—	—	—	—	21.43	21.32	21.22	21.13	21.05	20.98	20.91
23	—	—	—	—	—	—	—	—	—	—	—	—	22.40	22.28	22.18	22.08	22.00	21.93	21.86
24	—	—	—	—	—	—	—	—	—	—	—	—	23.37	23.25	23.14	23.04	22.95	22.87	22.80

DBH = diameter at breast height.

Table E-10—Diameter outside bark at crown base for red alder with a crown ratio of 1.0

Total height (feet)																								
DBH	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	
Inches	Inches																							
1	2.01	1.64	1.50	1.41	1.36	1.32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
2	4.47	3.55	3.19	2.98	2.85	2.76	2.69	2.64	2.59	2.56	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	7.21	5.61	4.99	4.65	4.43	4.27	4.15	4.06	3.99	3.93	3.88	3.83	3.79	—	—	—	—	—	—	—	—	—	—	
4	10.20	7.81	6.88	6.38	6.06	5.83	5.66	5.53	5.42	5.33	5.26	5.19	5.14	5.09	—	—	—	—	—	—	—	—	—	
5	—	10.11	8.86	8.18	7.74	7.44	7.21	7.03	6.89	6.77	6.67	6.58	6.51	6.45	6.39	—	—	—	—	—	—	—	—	
6	—	—	10.90	10.03	9.47	9.08	8.79	8.56	8.38	8.23	8.11	8.00	7.91	7.82	7.75	7.69	—	—	—	—	—	—	—	
7	—	—	—	11.93	11.24	10.76	10.41	10.13	9.91	9.72	9.57	9.43	9.32	9.22	9.13	9.05	8.98	—	—	—	—	—	—	
8	—	—	—	—	13.05	12.47	12.05	11.72	11.45	11.23	11.05	10.89	10.75	10.63	10.53	10.43	10.35	10.27	—	—	—	—	—	
9	—	—	—	—	—	14.22	13.72	13.33	13.02	12.76	12.55	12.36	12.20	12.06	11.94	11.83	11.73	11.64	—	—	—	—	—	
10	—	—	—	—	—	—	15.41	14.97	14.61	14.31	14.06	13.85	13.67	13.51	13.36	13.24	13.12	13.02	12.93	—	—	—	—	
11	—	—	—	—	—	—	—	16.62	16.22	15.88	15.60	15.36	15.15	14.97	14.80	14.66	14.53	14.41	14.31	—	—	—	—	
12	—	—	—	—	—	—	—	—	17.84	17.46	17.15	16.88	16.64	16.44	16.26	16.10	15.95	15.82	15.70	15.59	—	—	—	
13	—	—	—	—	—	—	—	—	19.49	19.07	18.71	18.41	18.15	17.92	17.72	17.54	17.38	17.23	17.10	16.98	—	—	—	
14	—	—	—	—	—	—	—	—	—	20.68	20.29	19.96	19.67	19.42	19.20	19.00	18.82	18.66	18.51	18.38	—	—	—	
15	—	—	—	—	—	—	—	—	—	22.32	21.89	21.52	21.21	20.93	20.68	20.47	20.27	20.09	19.93	19.79	19.65	—	—	
16	—	—	—	—	—	—	—	—	—	—	23.49	23.10	22.75	22.45	22.18	21.95	21.73	21.54	21.36	21.20	21.06	—	—	
17	—	—	—	—	—	—	—	—	—	—	25.11	24.68	24.31	23.98	23.69	23.43	23.20	22.99	22.80	22.63	22.47	—	—	
18	—	—	—	—	—	—	—	—	—	—	26.75	26.28	25.87	25.52	25.21	24.93	24.68	24.46	24.25	24.06	23.89	23.73	—	
19	—	—	—	—	—	—	—	—	—	—	—	27.89	27.45	27.07	26.74	26.44	26.17	25.93	25.71	25.50	25.32	25.15	—	
20	—	—	—	—	—	—	—	—	—	—	—	29.51	29.04	28.63	28.27	27.95	27.67	27.41	27.17	26.95	26.75	26.57	—	
21	—	—	—	—	—	—	—	—	—	—	—	31.14	30.64	30.20	29.82	29.48	29.17	28.89	28.64	28.41	28.20	28.00	27.82	
22	—	—	—	—	—	—	—	—	—	—	—	—	32.25	31.78	31.37	31.01	30.68	30.39	30.12	29.87	29.65	29.44	29.25	
23	—	—	—	—	—	—	—	—	—	—	—	—	33.87	33.37	32.94	32.55	32.20	31.89	31.60	31.34	31.10	30.88	30.68	
24	—	—	—	—	—	—	—	—	—	—	—	—	35.49	34.97	34.51	34.10	33.73	33.40	33.10	32.82	32.57	32.33	32.12	

DBH = diameter at breast height.

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