4.2 Standing Tree Contents Notes

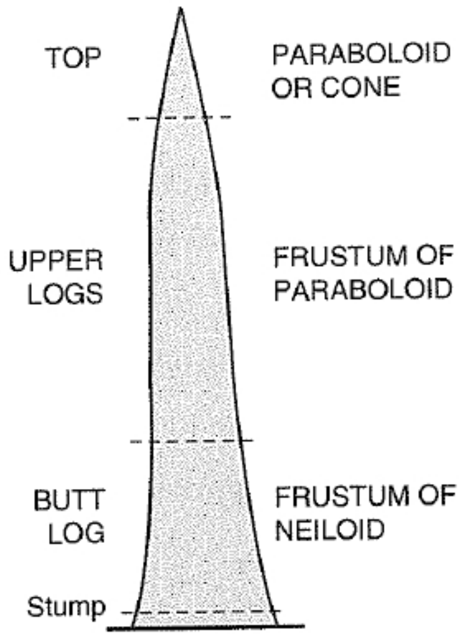

Exhibit.
Geometric shapes assumed by different portions of tree boles.

Geometric Solid(s)	:	Formula for Volume, V	(Formula name)
Paraboloid	:	V = h (A_m)	(Huber's)
	:	$V = h\frac{A_b + A_u}{2}$	(Smalian's)
Conic frustum	:	$V = h\ \frac{1}{3}\left(A_b + \sqrt{A_b \cdot A_u} + A_u\right)$	
Neiloid frustum	:	$V = h\ \frac{1}{4}\left(A_b + \sqrt[3]{A_b^2 \cdot A_u} + \sqrt[3]{A_b \cdot A_u^2} + A_u\right)$	
Cone, Parab., Neil. frustum	:	$V = h\ \frac{A_b + 4(A_m) + A_u}{6}$	(Newton's formula*)

* Newton's formula is closely approximate for all given geometric solids

where,

A_b = cross-sectional area at base, or large end of log or section
A_m = cross-sectional area at log or stem section midpoint
A_u = cross-sectional area at upper, or small end of log or section
h = log or section length

NOTE: trees in cross-section are rarely circular, but always presumed so.

Volume Tables (Equations)

Volume table
- tabulation that provides average stem contents of standing trees of various species and sizes
- objective: obtain estimate of volume (content) of a standing tree that would correspond to volume (content) if the tree were destructively sampled for accurate measurement
- desire estimate of volume & value for inventory and monitoring, potential transactions, or other environmental services such as carbon credits, etc.
- units may be bd.ft, cu.ft, cords, cubic meters
- contents may be:
  - total stem (including top & stump)
  - merchantable stem (up to some minimum top diameter, 4- or 6-inches, excluding stump
  - sawlog + pulp top

Weight tables
- directly analogous to volume tables, except weight (green or dry) will be tabulated
- units are usually pounds, kilograms, Mg, tons

Practically speaking, equations are typically used to predict tree volumes, rather than using table look-up – use of the term "table" has persisted in forestry usage as a generic term for tables or equations that show contents of standing trees

Choosing a volume table

Species - normally apply to a single species

DBH - same everywhere (almost!). Varies from 1.3 m to 1.37 m (4.5 ft.)

Height - may be total, merchantable, height to a minimum top diameter, number of logs (trim allowance in cluded)

Form - table may assume average form or use it directly as an independent variable

Age - second growth, mature (120 + years), etc.

Locality - normally apply to a single geographic area

Units - bd ft, cu. ft, cords, etc.

Log rule - Scribner, Interagency, International, Doyle, etc.

TABLE 2.—STANDARD CUBIC-FOOT VOLUME TABLE FOR COAST MATURE DOUGLAS FIR (OVER 80 YEARS)

British Columbia Forest Service, Forest Surveys and Inventory Division, 1962

D.B.H. (Inches)	TOTAL HEIGHT (FEET)																														Basis (Number of Trees)
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	
	TOTAL VOLUME OF ENTIRE STEM INSIDE BARK (CUBIC FEET)																														
2	0.1	0.2	0.4	0.5	0.7	0.8	1.0																								
4	0.3	0.7	1.1	1.6	2.1	2.6	3.1	3.6	4.2	4.8																					5
6	0.6	1.4	2.2	3.1	4.1	5.1	6.1	7.2	8.2	9.3	10.5	11.6																			26
8	1.0	2.2	3.6	5.0	6.6	8.2	9.8	11.5	13.3	15.0	16.9	18.7	20.6																		46
10			5.2	7.3	9.5	11.8	14.2	16.7	19.2	21.8	24.4	27.1	29.8																		34
12				9.9	12.9	16.0	19.3	22.6	26.0	29.5	33.0	36.7	40.4	44.1	47.9																37
14				12.7	16.6	20.7	24.9	29.2	33.6	38.1	42.7	47.4	52.1	56.9	61.8	66.8															41
16				15.9	20.7	25.8	31.0	36.4	41.9	47.5	53.3	59.1	65.0	71.1	77.2	83.4	89.6														39
18				19.3	25.2	31.4	37.7	44.2	50.9	57.8	64.8	71.9	79.1	86.4	93.8	101	109	117	124												37
20				23.0	30.0	37.4	44.9	52.7	60.7	68.8	77.1	85.6	94.2	103	112	121	130	139	148												41
22				26.9	35.2	43.8	52.6	61.7	71.1	80.6	90.3	100	110	120	131	141	152	163	174	185	196	207	218								47
24				31.1	40.7	50.6	60.8	71.3	82.1	93.1	104	116	127	139	151	163	176	188	201	213	226	239	252								40
26				35.6	46.4	57.7	69.4	81.4	93.8	106	119	132	145	159	173	187	201	215	229	244	258	273	288								29
28				40.2	52.5	65.3	78.5	92.1	106	120	135	150	165	180	195	211	227	243	259	275	292	309	326								26
30				45.1	58.9	73.2	88.0	103	119	135	151	168	184	202	219	236	254	272	290	309	327	346	365								24
32							98.0	115	132	150	168	187	205	224	244	263	283	303	323	344	364	385	406	427	449	470	492	514	536	558	17
34							108	127	146	166	186	206	227	248	269	291	313	335	357	380	403	426	449	473	496	520	544	568	593	617	18
36							119	140	161	182	204	227	250	273	296	320	344	368	393	418	443	468	494	520	546	572	598	625	652	679	15
38							130	153	176	200	224	248	273	298	324	350	376	403	430	457	485	512	540	569	597	626	655	684	713	742	8
40							142	166	192	217	244	270	297	325	353	381	410	439	468	498	528	558	588	619	650	681	713	744	776	808	55
42									208	236	264	293	322	352	383	413	444	476	508	540	572	605	638	671	705	739	773	807	842	876	61
44									224	255	285	317	348	381	413	446	480	514	548	583	618	653	689	725	761	798	835	872	909	947	51
46									242	274	307	341	375	410	445	481	517	553	590	628	665	703	742	781	820	859	899	939	979	1019	29
48									259	294	330	366	402	440	478	516	555	594	634	674	714	755	796	838	880	922	964	1007	1050	1094	34
50									277	315	353	391	431	471	511	552	593	635	678	721	764	808	852	896	941	986	1032	1078	1124	1170	23
52											376	418	460	502	545	589	633	678	723	769	815	862	909	957	1004	1053	1101	1150	1200	1249	20
54											401	445	489	535	581	627	674	722	770	819	868	918	968	1018	1069	1121	1172	1225	1277	1330	29
56											426	472	520	568	617	666	716	767	818	870	922	975	1028	1082	1136	1190	1245	1301	1357	1413	21
58											451	501	551	602	654	706	759	813	867	922	977	1033	1090	1147	1204	1262	1320	1379	1438	1497	11
60											477	530	583	637	691	747	803	860	917	975	1034	1093	1153	1213	1274	1335	1396	1459	1521	1584	20
62														672	730	789	848	908	969	1030	1092	1154	1217	1281	1345	1409	1475	1540	1606	1672	20
64														709	770	831	894	957	1021	1086	1151	1217	1283	1350	1418	1486	1554	1623	1693	1763	8
66														746	810	875	941	1007	1075	1142	1211	1280	1350	1421	1492	1564	1636	1708	1782	1855	14
68														784	851	919	988	1058	1129	1200	1273	1345	1419	1493	1568	1643	1719	1795	1872	1949	10
70														822	893	965	1037	1111	1185	1260	1335	1412	1489	1566	1645	1724	1803	1884	1964	2046	10
72																	1087	1164	1241	1320	1399	1479	1560	1641	1724	1806	1890	1974	2058	2143	9
74																	1137	1218	1299	1381	1464	1548	1633	1718	1804	1890	1978	2065	2154	2243	5
76																	1189	1273	1358	1444	1531	1618	1706	1795	1885	1976	2067	2159	2251	2345	5
78																	1241	1329	1418	1507	1598	1689	1782	1875	1968	2063	2158	2254	2351	2448	5
80																	1294	1386	1479	1572	1666	1762	1858	1955	2053	2151	2251	2351	2451	2553	3
82																				1688	1786	1885	1986	2037	2139	2241	2345	2449	2554	2660	2
84																				1705	1807	1910	2015	2120	2226	2333	2440	2549	2658	2768	
86																				1772	1879	1986	2095	2204	2314	2426	2538	2650	2764	2878	1
88																				1841	1952	2064	2176	2290	2404	2520	2636	2753	2871	2990	
90																				1911	2026	2142	2259	2377	2496	2616	2736	2858	2980	3104	
92																				1982	2101	2222	2343	2465	2588	2713	2838	2964	3091	3219	1
94																				2054	2178	2302	2428	2555	2682	2811	2941	3072	3203	3336	1
96																				2127	2255	2384	2514	2646	2778	2911	3046	3181	3317	3455	
98																				2201	2334	2467	2602	2738	2875	3013	3152	3292	3433	3575	
100																				2276	2413	2551	2690	2831	2972	3115	3259	3404	3550	3697	
																															978

Data collected in the Coastal regions of British Columbia. Bold-face figures indicate extent of basic data.
Table shows total volume of entire stem, inside bark, including stump and top, without allowance for defect, trim, or breakage.
Table volumes obtained by means of logarithmic equation derived by method of least squares: $\log V = -2.712153 + 1.659012 \log D + 1.195715 \log H$.
Standard error of estimated volume for single trees: ±12.1 per cent.
Aggregate difference: 0.57 per cent low.

Types of Volume Tables

I. Multiple Entry –

i) Standard volume tables –

Require both DBH and Height to estimate (predict) tree volume. Assumes all other variables are accounted for by these two variables or are average in value

Examples –

Constant form factor –

$$v = b_1 \left(DBH^2 H \right)$$

where v denotes tree volume; DBH denotes diameter breast height; H denotes total tree height; b_1 is a constant fit by regression

Combined variable model –

$$v = b_0 + b_1 \left(DBH^2 H \right)$$

Logarithmic model –

$$v = aDBH^b H^c$$

where all variables as before; a, b, c are constants fit by regression

Note that if we take logarithms of both sides of the model equation,

$$\log(v) = \log(a) + b\log(DBH) + c\log(H)$$

$$y = b_0 \quad + \quad b_1 X_1 \quad + \quad b_2 X_2$$

ii) Form (class) volume tables –

Tree volume is estimated (predicted) from some measure of tree Form as well as other variables, such as DBH, Height, etc.

Trees having little taper will have more volume in them than trees that taper a lot if DBH and Height are the same – higher the form class, greater the volume

Theory is that for a given total tree height, trees vary most in taper in the first log

Examples –

Combined variable form-class model –

$$v = b_0 + b_1 F + b_2 \left(DBH^2 H \right) + b_3 F \left(DBH^2 H \right)$$

where all variables as before; F denotes Form Class (usually Girard's)

Short-cut form class model –

$$v = b_0 + b_1 F \left(DBH^2 H \right)$$

Types of Volume Tables (continued)

II. Single Entry –

i) Local volume tables –

Use a single variable (DBH) to estimate (predict) tree volume. Assumes all other variables are either accounted for by DBH or are average in value

Presumes that a definitive relationship exists between DBH and Height, i.e. trees of same dbh will have similar height and form – true when trees of given species are growing under fairly uniform conditions in terms of site & density

Example –

$$v = b_0 + b_1 DBH^{b_2}$$

Much research has shown that b_2 coefficient seldom varies far from 2, giving

$$v = b_0 + b_1 DBH^2$$

Often, local volume tables are derived from standard volume tables through development of a relationship between diameter and height

A very robust Height-DBH function that is often used is:

$$\log(H) = c_0 + c_1 \left(DBH^{-1}\right)$$, or,

$$H = e^{\left(c_0 + \frac{c_1}{DBH}\right)}$$

Then, this is substituted in the reliable standard volume equation, say, the constant form factor:

$$v = b_1 DBH^2 \left(e^{\left(c_0 + \frac{c_1}{DBH}\right)} \right)$$

which then completely determines the local volume table.

ii) Tarif volume tables –

Collection of harmonized local volume tables ("tarif" is actually the Arabic word meaning "tabulated information"). Based on the empirical result that volume has a LINEAR relationship with basal area.

III. Composite –

Applies to diverse set of species or species groups, often including conifers and hardwoods. Provision is usually made for estimating tree form or correction factors are developed for the different species.

Douglas-fir, 18-ft and taller (Bruce and DeMars 1974):

$$CVTS = 0.005454154 \times \left(0.480961 + \frac{42.46542}{H^2} - \frac{10.99643 \cdot DBH}{H^2} - \frac{0.107809 \cdot DBH}{H} - 0.00409083 \cdot DBH\right) \times \left[DBH^2 H\right]$$

Browne (1962):

A. CUBIC VOLUME INCLUDING TOP AND STUMP (CVTS)

Four methods are readily available to calculate cubic volume including top and stump.

1. British Columbia Equations

The British Columbia cubic volume equations (1) are presented in the form:

Log CVTS = A + B (Log DBH) + C (Log HT)

This has been changed for the computer to:

CVTS = 10. ** A * DBH ** B * HT ** C

$CVTS = (10^A)(DBH^B)(HT^C)$

Table 1. British Columbia Cubic Volume Equation Coefficients

SPECIES	A	B	C
DOUGLAS FIR:			
Coastal Immature Less Than 140 Years	−2.658025	1.739925	1.133187
Coastal Mature 80 Years +	−2.712153	1.659012	1.195715
Interior	−2.734532	1.739418	1.166033
WESTERN HEMLOCK:			
Coastal Immature Less Than 140 Years	−2.702922	1.842680	1.123661
Coastal Mature 80 Years +	−2.663834	1.790230	1.124873
Interior	−2.571619	1.969710	.977003
WESTERN RED CEDAR:			
Coastal Immature Less Than 140 Years	−2.441193	1.720761	1.049976
Coastal Mature 80 Years+	−2.379642	1.682300	1.039712
Interior	−2.464614	1.701993	1.067038
BALSAM:			
Coastal	−2.575642	1.806775	1.094665
Interior	−2.502332	1.864963	1.004903
SITKA SPRUCE:			
Immature Less Than 140 Years	−2.550299	1.835678	1.042599
Mature 140 Years +	−2.700574	1.754171	1.164531
Interior	−2.539944	1.841226	1.034051
PINE:			
Ponderosa	−2.729937	1.909478	1.085681
Lodgepole	−2.615591	1.847504	1.085772
Western White	−2.480145	1.867286	.994351
WESTERN LARCH:	−2.624325	1.847123	1.044007
YELLOW CEDAR:	−2.454348	1.741044	1.058437
HARDWOODS:			
Alder	−2.672775	1.920617	1.074024
Maple	−2.770324	1.885813	1.119043
Aspen	−2.635360	1.946034	1.024793
Birch	−2.757813	1.911681	1.105403
Cottonwood	−2.945047	1.803973	1.238853

Tarif Volume Tables

- Turnbull, former faculty member in the former CFR, UW developed the “Comprehensive Tree-volume Tarif System” based on principles developed by Hummel in U.K.
- collection of volume tables “harmonized” to be consistent with each other
- gives convenient way to obtain local volume table for a given stand
- works well in homogenous stands and heterogeneous stands provided cohorts within the stand can be found

Theory

When volume (ft^3) to 4” top is plotted over basal area for trees in a stand, a straight line results

When trees from several stands are plotted, the point on the graph where volume is zero will be found at a basal area of 0.087 ft^2 for all such lines

The lines are identified by the volume for a tree of 1.0 ft^2 of basal area – Tarif Number

Note that as tarif number increases, the slope of the line increases also

In practice, a number of sample trees from the stand are chosen and are measured for both height and DBH, and their tarif numbers determined

The arithmetic average of these tarif numbers are found by cohort, then the average tarif number defines the tarif line, which is the local volume equation for that cohort

Harmonization

The Comprehensive Tree-volume Tarif tables can be used to obtain total volume (entire tree stem) or volume to a different top diameter (i.e., merchantable volume)

Start by finding tarif number for 4” top first, then a volume factor is found that is the ratio of the desired volumetric units to the volume up to a 4” top – this produces a set of consistent results, such that no illogical “crossovers” occur

Tarif ‘finding’ choices

1) Fell sample trees, buck them, scale them, plot volumes found over basal area
2) Non-destructively “buck” the tree while standing using optical dendrometer
3) Use a tarif “Access Table”
    - Height – DBH relationship is key to the theory behind the Access table
    - A larger H – DBH ratio always represents more volume for a given DBH
    - A smaller H – DBH ratio may or may not represent more volume when H is fixed

BRITISH COLUMBIA TARIF ACCESS TABLES FOR COAST IMMATURE DOUGLAS FIR

TOTAL HEIGHT (FEET)

DBH	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128
12.0	33.7	34.5	35.4	36.2	37.1	37.9	38.8	39.6	40.5	41.4	42.2	43.1	44.0	44.9	45.7	46.6	47.5	48.4	49.3	50.2
12.1	33.5	34.4	35.2	36.1	36.9	37.8	38.7	39.5	40.4	41.2	42.1	43.0	43.8	44.7	45.6	46.5	47.3	48.2	49.1	50.0
12.2	33.4	34.3	35.1	36.0	36.8	37.7	38.5	39.4	40.2	41.1	42.0	42.8	43.7	44.6	45.4	46.3	47.2	48.1	48.9	49.8
12.3	33.3	34.2	35.0	35.8	36.7	37.5	38.4	39.2	40.1	41.0	41.8	42.7	43.5	44.4	45.3	46.1	47.0	47.9	48.8	49.7
12.4	33.2	34.0	34.9	35.7	36.6	37.4	38.3	39.1	40.0	40.8	41.7	42.5	43.4	44.3	45.1	46.0	46.9	47.7	48.6	49.5
12.5	33.1	33.9	34.8	35.6	36.4	37.3	38.1	39.0	39.8	40.7	41.5	42.4	43.3	44.1	45.0	45.8	46.7	47.6	48.4	49.3
12.6	33.0	33.8	34.6	35.5	36.3	37.2	38.0	38.9	39.7	40.5	41.4	42.3	43.1	44.0	44.8	45.7	46.6	47.4	48.3	49.2
12.7	32.9	33.7	34.5	35.4	36.2	37.0	37.9	38.7	39.6	40.4	41.3	42.1	43.0	43.8	44.7	45.5	46.4	47.3	48.1	49.0
12.8	32.8	33.6	34.4	35.3	36.1	36.9	37.8	38.6	39.4	40.3	41.1	42.0	42.8	43.7	44.5	45.4	46.3	47.1	48.0	48.8
12.9	32.7	33.5	34.3	35.1	36.0	36.8	37.6	38.5	39.3	40.2	41.0	41.9	42.7	43.5	44.4	45.3	46.1	47.0	47.8	48.7
13.0	32.6	33.4	34.2	35.0	35.9	36.7	37.5	38.4	39.2	40.0	40.9	41.7	42.6	43.4	44.3	45.1	46.0	46.8	47.7	48.5
13.1	32.5	33.3	34.1	34.9	35.8	36.6	37.4	38.2	39.1	39.9	40.8	41.6	42.4	43.3	44.1	45.0	45.8	46.7	47.5	48.4
13.2	32.4	33.2	34.0	34.8	35.6	36.5	37.3	38.1	39.0	39.8	40.6	41.5	42.3	43.1	44.0	44.8	45.7	46.5	47.4	48.2
13.3	32.3	33.1	33.9	34.7	35.5	36.4	37.2	38.0	38.8	39.7	40.5	41.3	42.2	43.0	43.9	44.7	45.5	46.4	47.2	48.1
13.4	32.2	33.0	33.8	34.6	35.4	36.2	37.1	37.9	38.7	39.6	40.4	41.2	42.1	42.9	43.7	44.6	45.4	46.3	47.1	47.9
13.5	32.1	32.9	33.7	34.5	35.3	36.1	37.0	37.8	38.6	39.4	40.3	41.1	41.9	42.8	43.6	44.4	45.3	46.1	47.0	47.8
13.6	32.0	32.8	33.6	34.4	35.2	36.0	36.9	37.7	38.5	39.3	40.1	41.0	41.8	42.6	43.5	44.3	45.1	46.0	46.8	47.7
13.7	31.9	32.7	33.5	34.3	35.1	35.9	36.7	37.6	38.4	39.2	40.0	40.9	41.7	42.5	43.3	44.2	45.0	45.8	46.7	47.5
13.8	31.8	32.6	33.4	34.2	35.0	35.8	36.6	37.5	38.3	39.1	39.9	40.7	41.6	42.4	43.2	44.1	44.9	45.7	46.6	47.4
13.9	31.7	32.5	33.3	34.1	34.9	35.7	36.5	37.4	38.2	39.0	39.8	40.6	41.4	42.3	43.1	43.9	44.8	45.6	46.4	47.3
14.0	31.6	32.4	33.2	34.0	34.8	35.6	36.4	37.2	38.1	38.9	39.7	40.5	41.3	42.2	43.0	43.8	44.6	45.5	46.3	47.1
14.1	31.5	32.3	33.1	33.9	34.7	35.5	36.3	37.1	38.0	38.8	39.6	40.4	41.2	42.0	42.9	43.7	44.5	45.3	46.2	47.0
14.2	31.4	32.2	33.0	33.8	34.6	35.4	36.2	37.0	37.8	38.7	39.5	40.3	41.1	41.9	42.7	43.6	44.4	45.2	46.0	46.9
14.3	31.4	32.1	32.9	33.7	34.5	35.3	36.1	36.9	37.7	38.6	39.4	40.2	41.0	41.8	42.6	43.4	44.3	45.1	45.9	46.7
14.4	31.3	32.1	32.9	33.6	34.4	35.2	36.0	36.8	37.6	38.4	39.3	40.1	40.9	41.7	42.5	43.3	44.1	45.0	45.8	46.6
14.5	31.2	32.0	32.8	33.6	34.3	35.1	35.9	36.7	37.5	38.3	39.2	40.0	40.8	41.6	42.4	43.2	44.0	44.8	45.7	46.5
14.6	31.1	31.9	32.7	33.5	34.3	35.1	35.8	36.6	37.4	38.2	39.0	39.9	40.7	41.5	42.3	43.1	43.9	44.7	45.5	46.4
14.7	31.0	31.8	32.6	33.4	34.2	35.0	35.8	36.5	37.3	38.1	38.9	39.8	40.6	41.4	42.2	43.0	43.8	44.6	45.4	46.2
14.8	30.9	31.7	32.5	33.3	34.1	34.9	35.7	36.5	37.3	38.0	38.8	39.6	40.5	41.3	42.1	42.9	43.7	44.5	45.3	46.1
14.9	30.9	31.6	32.4	33.2	34.0	34.8	35.6	36.4	37.2	38.0	38.7	39.5	40.3	41.2	42.0	42.8	43.6	44.4	45.2	46.0
15.0	30.8	31.6	32.3	33.1	33.9	34.7	35.5	36.3	37.1	37.9	38.6	39.4	40.2	41.0	41.9	42.7	43.5	44.3	45.1	45.9
15.1	30.7	31.5	32.3	33.0	33.8	34.6	35.4	36.2	37.0	37.8	38.6	39.3	40.1	40.9	41.7	42.5	43.4	44.2	45.0	45.8
15.2	30.6	31.4	32.2	33.0	33.7	34.5	35.3	36.1	36.9	37.7	38.5	39.3	40.0	40.8	41.6	42.4	43.2	44.0	44.9	45.7
15.3	30.6	31.3	32.1	32.9	33.7	34.4	35.2	36.0	36.8	37.6	38.4	39.2	39.9	40.7	41.5	42.3	43.1	43.9	44.7	45.6
15.4	30.5	31.3	32.0	32.8	33.6	34.4	35.1	35.9	36.7	37.5	38.3	39.1	39.8	40.6	41.4	42.2	43.0	43.8	44.6	45.4
15.5	30.4	31.2	31.9	32.7	33.5	34.3	35.0	35.8	36.6	37.4	38.2	39.0	39.8	40.5	41.3	42.1	42.9	43.7	44.5	45.3
15.6	30.3	31.1	31.9	32.6	33.4	34.2	35.0	35.7	36.5	37.3	38.1	38.9	39.7	40.4	41.2	42.0	42.8	43.6	44.4	45.2
15.7	30.3	31.0	31.8	32.6	33.3	34.1	34.9	35.7	36.4	37.2	38.0	38.8	39.6	40.4	41.1	41.9	42.7	43.5	44.3	45.1
15.8	30.2	31.0	31.7	32.5	33.3	34.0	34.8	35.6	36.3	37.1	37.9	38.7	39.5	40.3	41.0	41.8	42.6	43.4	44.2	45.0
15.9	30.1	30.9	31.6	32.4	33.2	33.9	34.7	35.5	36.3	37.0	37.8	38.6	39.4	40.2	40.9	41.7	42.5	43.3	44.1	44.9
16.0	30.1	30.8	31.6	32.3	33.1	33.9	34.6	35.4	36.2	37.0	37.7	38.5	39.3	40.1	40.9	41.6	42.4	43.2	44.0	44.8
16.1	30.0	30.7	31.5	32.3	33.0	33.8	34.6	35.3	36.1	36.9	37.6	38.4	39.2	40.0	40.8	41.5	42.3	43.1	43.9	44.7
16.2	29.9	30.7	31.4	32.2	33.0	33.7	34.5	35.2	36.0	36.8	37.6	38.3	39.1	39.9	40.7	41.5	42.2	43.0	43.8	44.6
16.3	29.9	30.6	31.4	32.1	32.9	33.6	34.4	35.2	35.9	36.7	37.5	38.2	39.0	39.8	40.6	41.4	42.1	42.9	43.7	44.5
16.4	29.8	30.5	31.3	32.0	32.8	33.6	34.3	35.1	35.9	36.6	37.4	38.2	38.9	39.7	40.5	41.3	42.0	42.8	43.6	44.4
16.5	29.7	30.5	31.2	32.0	32.7	33.5	34.2	35.0	35.8	36.5	37.3	38.1	38.9	39.6	40.4	41.2	42.0	42.7	43.5	44.3
16.6	29.7	30.4	31.2	31.9	32.7	33.4	34.2	34.9	35.7	36.5	37.2	38.0	38.8	39.5	40.3	41.1	41.9	42.6	43.4	44.2
16.7	29.6	30.3	31.1	31.8	32.6	33.3	34.1	34.9	35.6	36.4	37.1	37.9	38.7	39.5	40.2	41.0	41.8	42.5	43.3	44.1
16.8	29.5	30.3	31.0	31.8	32.5	33.3	34.0	34.8	35.5	36.3	37.1	37.8	38.6	39.4	40.1	40.9	41.7	42.5	43.2	44.0
16.9	29.5	30.2	31.0	31.7	32.5	33.2	34.0	34.7	35.5	36.2	37.0	37.8	38.5	39.3	40.1	40.8	41.6	42.4	43.1	43.9
17.0	29.4	30.1	30.9	31.6	32.4	33.1	33.9	34.6	35.4	36.2	36.9	37.7	38.4	39.2	40.0	40.7	41.5	42.3	43.1	43.8
17.1	29.3	30.1	30.8	31.6	32.3	33.1	33.8	34.6	35.3	36.1	36.8	37.6	38.4	39.1	39.9	40.6	41.4	42.2	43.0	43.7
17.2	29.3	30.0	30.8	31.5	32.2	33.0	33.7	34.5	35.2	36.0	36.8	37.5	38.3	39.0	39.8	40.6	41.3	42.1	42.9	43.6
17.3	29.2	30.0	30.7	31.4	32.2	32.9	33.7	34.4	35.2	35.9	36.7	37.4	38.2	39.0	39.7	40.5	41.2	42.0	42.8	43.6
17.4	29.2	29.9	30.6	31.4	32.1	32.9	33.6	34.4	35.1	35.9	36.6	37.4	38.1	38.9	39.6	40.4	41.2	41.9	42.7	43.5
17.5	29.1	29.8	30.6	31.3	32.0	32.8	33.5	34.3	35.0	35.8	36.5	37.3	38.0	38.8	39.6	40.3	41.1	41.8	42.6	43.4
17.6	29.0	29.8	30.5	31.2	32.0	32.7	33.5	34.2	35.0	35.7	36.5	37.2	38.0	38.7	39.5	40.2	41.0	41.8	42.5	43.3
17.7	29.0	29.7	30.4	31.2	31.9	32.7	33.4	34.1	34.9	35.6	36.4	37.1	37.9	38.6	39.4	40.2	40.9	41.7	42.4	43.2
17.8	28.9	29.7	30.4	31.1	31.9	32.6	33.3	34.1	34.8	35.6	36.3	37.1	37.8	38.6	39.3	40.1	40.8	41.6	42.4	43.1
17.9	28.9	29.6	30.3	31.1	31.8	32.5	33.3	34.0	34.8	35.5	36.2	37.0	37.7	38.5	39.2	40.0	40.8	41.5	42.3	43.0
18.0	28.8	29.5	30.3	31.0	31.7	32.5	33.2	33.9	34.7	35.4	36.2	36.9	37.7	38.4	39.2	39.9	40.7	41.4	42.2	43.0
18.1	28.8	29.5	30.2	30.9	31.7	32.4	33.1	33.9	34.6	35.4	36.1	36.8	37.6	38.3	39.1	39.8	40.6	41.4	42.1	42.9
18.2	28.7	29.4	30.2	30.9	31.6	32.3	33.1	33.8	34.6	35.3	36.0	36.8	37.5	38.3	39.0	39.8	40.5	41.3	42.0	42.8
18.3	28.7	29.4	30.1	30.8	31.6	32.3	33.0	33.8	34.5	35.2	36.0	36.7	37.5	38.2	38.9	39.7	40.4	41.2	41.9	42.7
18.4	28.6	29.3	30.0	30.8	31.5	32.2	33.0	33.7	34.4	35.2	35.9	36.6	37.4	38.1	38.9	39.6	40.4	41.1	41.9	42.6
18.5	28.5	29.3	30.0	30.7	31.4	32.2	32.9	33.6	34.4	35.1	35.8	36.6	37.3	38.1	38.8	39.5	40.3	41.0	41.8	42.5
18.6	28.5	29.2	29.9	30.7	31.4	32.1	32.8	33.6	34.3	35.0	35.8	36.5	37.2	38.0	38.7	39.5	40.2	41.0	41.7	42.5
18.7	28.4	29.2	29.9	30.6	31.3	32.0	32.8	33.5	34.2	35.0	35.7	36.4	37.2	37.9	38.7	39.4	40.1	40.9	41.6	42.4
18.8	28.4	29.1	29.8	30.5	31.3	32.0	32.7	33.4	34.2	34.9	35.6	36.4	37.1	37.8	38.6	39.3	40.1	40.8	41.6	42.3
18.9	28.3	29.0	29.8	30.5	31.2	31.9	32.7	33.4	34.1	34.8	35.6	36.3	37.0	37.8	38.5	39.3	40.0	40.7	41.5	42.2
19.0	28.3	29.0	29.7	30.4	31.1	31.9	32.6	33.3	34.0	34.8	35.5	36.2	37.0	37.7	38.4	39.2	39.9	40.7	41.4	42.2
19.1	28.2	28.9	29.7	30.4	31.1	31.8	32.5	33.3	34.0	34.7	35.4	36.2	36.9	37.6	38.4	39.1	39.9	40.6	41.3	42.1
19.2	28.2	28.9	29.6	30.3	31.0	31.8	32.5	33.2	33.9	34.7	35.4	36.1	36.8	37.6	38.3	39.0	39.8	40.5	41.3	42.0
19.3	28.1	28.8	29.6	30.3	31.0	31.7	32.4	33.1	33.9	34.6	35.3	36.0	36.8	37.5	38.2	39.0	39.7	40.5	41.2	41.9
19.4	28.1	28.8	29.5	30.2	30.9	31.6	32.4	33.1	33.8	34.5	35.3	36.0	36.7	37.4	38.2	38.9	39.6	40.4	41.1	41.9
19.5	28.0	28.7	29.5	30.2	30.9	31.6	32.3	33.0	33.7	34.5	35.2	35.9	36.6	37.4	38.1	38.8	39.6	40.3	41.0	41.8
19.6	28.0	28.7	29.4	30.1	30.8	31.5	32.3	33.0	33.7	34.4	35.1	35.9	36.6	37.3	38.0	38.8	39.5	40.2	41.0	41.7
19.7	27.9	28.6	29.4	30.1	30.8	31.5	32.2	32.9	33.6	34.4	35.1	35.8	36.5	37.2	38.0	38.7	39.4	40.2	40.9	41.6
19.8	27.9	28.6	29.3	30.0	30.7	31.4	32.1	32.9	33.6	34.3	35.0	35.7	36.5	37.2	37.9	38.6	39.4	40.1	40.8	41.6
19.9	27.8	28.5	29.3	30.0	30.7	31.4	32.1	32.8	33.5	34.2	35.0	35.7	36.4	37.1	37.8	38.6	39.3	40.0	40.8	41.5

DBH	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158
12.0	51.1	51.9	52.8	53.7	54.6	55.5	56.4	57.3	58.2	59.1	60.0	61.0	61.9	62.8	63.7
12.1	50.9	51.8	52.7	53.5	54.4	55.3	56.2	57.1	58.0	58.9	59.8	60.7	61.6	62.6	63.5
12.2	50.7	51.6	52.5	53.4	54.3	55.1	56.0	56.9	57.8	58.7	59.6	60.5	61.4	62.3	63.2
12.3	50.5	51.4	52.3	53.2	54.1	55.0	55.8	56.7	57.6	58.5	59.4	60.3	61.2	62.1	63.0
12.4	50.4	51.2	52.1	53.0	53.9	54.8	55.7	56.5	57.4	58.3	59.2	60.1	61.0	61.9	62.8
12.5	50.2	51.1	51.9	52.8	53.7	54.6	55.5	56.4	57.3	58.1	59.0	59.9	60.8	61.7	62.6
12.6	50.0	50.9	51.8	52.7	53.5	54.4	55.3	56.2	57.1	57.9	58.8	59.7	60.6	61.5	62.4
12.7	49.9	50.7	51.6	52.5	53.4	54.2	55.1	56.0	56.9	57.8	58.6	59.5	60.4	61.3	62.2
12.8	49.7	50.6	51.4	52.3	53.2	54.1	54.9	55.8	56.7	57.6	58.5	59.3	60.2	61.1	62.0
12.9	49.6	50.4	51.3	52.2	53.0	53.9	54.8	55.6	56.5	57.4	58.3	59.2	60.0	60.9	61.8
13.0	49.4	50.3	51.1	52.0	52.9	53.7	54.6	55.5	56.3	57.2	58.1	59.0	59.9	60.7	61.6
13.1	49.2	50.1	51.0	51.8	52.7	53.6	54.4	55.3	56.2	57.0	57.9	58.8	59.7	60.5	61.4
13.2	49.1	49.9	50.8	51.7	52.5	53.4	54.3	55.1	56.0	56.9	57.7	58.6	59.5	60.4	61.2
13.3	48.9	49.8	50.7	51.5	52.4	53.2	54.1	55.0	55.8	56.7	57.6	58.4	59.3	60.2	61.1
13.4	48.8	49.6	50.5	51.4	52.2	53.1	53.9	54.8	55.7	56.5	57.4	58.3	59.1	60.0	60.9
13.5	48.7	49.5	50.4	51.2	52.1	52.9	53.8	54.6	55.5	56.4	57.2	58.1	59.0	59.8	60.7
13.6	48.5	49.4	50.2	51.1	51.9	52.8	53.6	54.5	55.3	56.2	57.1	57.9	58.8	59.6	60.5
13.7	48.4	49.2	50.1	50.9	51.8	52.6	53.5	54.3	55.2	56.0	56.9	57.7	58.6	59.5	60.3
13.8	48.2	49.1	49.9	50.8	51.6	52.5	53.3	54.2	55.0	55.9	56.7	57.6	58.4	59.3	60.2
13.9	48.1	48.9	49.8	50.6	51.5	52.3	53.2	54.0	54.9	55.7	56.6	57.4	58.3	59.1	60.0
14.0	48.0	48.8	49.6	50.5	51.3	52.2	53.0	53.9	54.7	55.6	56.4	57.3	58.1	59.0	59.8
14.1	47.8	48.7	49.5	50.3	51.2	52.0	52.9	53.7	54.6	55.4	56.2	57.1	58.0	58.8	59.7
14.2	47.7	48.5	49.4	50.2	51.0	51.9	52.7	53.6	54.4	55.2	56.1	56.9	57.8	58.6	59.5
14.3	47.6	48.4	49.2	50.1	50.9	51.7	52.6	53.4	54.3	55.1	55.9	56.8	57.6	58.5	59.3
14.4	47.4	48.3	49.1	49.9	50.8	51.6	52.4	53.3	54.1	54.9	55.8	56.6	57.5	58.3	59.2
14.5	47.3	48.1	49.0	49.8	50.6	51.5	52.3	53.1	54.0	54.8	55.6	56.5	57.3	58.2	59.0
14.6	47.2	48.0	48.8	49.7	50.5	51.3	52.2	53.0	53.8	54.7	55.5	56.3	57.2	58.0	58.9
14.7	47.1	47.9	48.7	49.5	50.4	51.2	52.0	52.8	53.7	54.5	55.4	56.2	57.0	57.9	58.7
14.8	46.9	47.8	48.6	49.4	50.2	51.1	51.9	52.7	53.5	54.4	55.2	56.0	56.9	57.7	58.6
14.9	46.8	47.6	48.5	49.3	50.1	50.9	51.8	52.6	53.4	54.2	55.1	55.9	56.7	57.6	58.4
15.0	46.7	47.5	48.3	49.2	50.0	50.8	51.6	52.4	53.3	54.1	54.9	55.8	56.6	57.4	58.3
15.1	46.6	47.4	48.2	49.0	49.8	50.7	51.5	52.3	53.1	54.0	54.8	55.6	56.4	57.3	58.1
15.2	46.5	47.3	48.1	48.9	49.7	50.5	51.4	52.2	53.0	53.8	54.7	55.5	56.3	57.1	58.0
15.3	46.4	47.2	48.0	48.8	49.6	50.4	51.2	52.1	52.9	53.7	54.5	55.3	56.2	57.0	57.8
15.4	46.2	47.1	47.9	48.7	49.5	50.3	51.1	51.9	52.7	53.6	54.4	55.2	56.0	56.9	57.7
15.5	46.1	46.9	47.7	48.6	49.4	50.2	51.0	51.8	52.6	53.4	54.3	55.1	55.9	56.7	57.5
15.6	46.0	46.8	47.6	48.4	49.2	50.1	50.9	51.7	52.5	53.3	54.1	54.9	55.8	56.6	57.4
15.7	45.9	46.7	47.5	48.3	49.1	49.9	50.7	51.6	52.4	53.2	54.0	54.8	55.6	56.5	57.3
15.8	45.8	46.6	47.4	48.2	49.0	49.8	50.6	51.4	52.2	53.1	53.9	54.7	55.5	56.3	57.1
15.9	45.7	46.5	47.3	48.1	48.9	49.7	50.5	51.3	52.1	52.9	53.7	54.6	55.4	56.2	57.0
16.0	45.6	46.4	47.2	48.0	48.8	49.6	50.4	51.2	52.0	52.8	53.6	54.4	55.2	56.1	56.9
16.1	45.5	46.3	47.1	47.9	48.7	49.5	50.3	51.1	51.9	52.7	53.5	54.3	55.1	55.9	56.7
16.2	45.4	46.2	47.0	47.8	48.6	49.4	50.2	51.0	51.8	52.6	53.4	54.2	55.0	55.8	56.6
16.3	45.3	46.1	46.9	47.7	48.5	49.3	50.1	50.8	51.7	52.5	53.3	54.1	54.9	55.7	56.5
16.4	45.2	46.0	46.8	47.6	48.3	49.1	49.9	50.7	51.5	52.3	53.1	53.9	54.7	55.6	56.4
16.5	45.1	45.9	46.7	47.4	48.2	49.0	49.8	50.6	51.4	52.2	53.0	53.8	54.6	55.4	56.2
16.6	45.0	45.8	46.6	47.3	48.1	48.9	49.7	50.5	51.3	52.1	52.9	53.7	54.5	55.3	56.1
16.7	44.9	45.7	46.5	47.2	48.0	48.8	49.6	50.4	51.2	52.0	52.8	53.6	54.4	55.2	56.0
16.8	44.8	45.6	46.4	47.1	47.9	48.7	49.5	50.3	51.1	51.9	52.7	53.5	54.3	55.1	55.9
16.9	44.7	45.5	46.3	47.0	47.8	48.6	49.4	50.2	51.0	51.8	52.6	53.4	54.2	55.0	55.8
17.0	44.6	45.4	46.2	46.9	47.7	48.5	49.3	50.1	50.9	51.7	52.5	53.2	54.0	54.8	55.6
17.1	44.5	45.3	46.1	46.8	47.6	48.4	49.2	50.0	50.8	51.6	52.3	53.1	53.9	54.7	55.5
17.2	44.4	45.2	46.0	46.7	47.5	48.3	49.1	49.9	50.7	51.4	52.2	53.0	53.8	54.6	55.4
17.3	44.3	45.1	45.9	46.7	47.4	48.2	49.0	49.8	50.6	51.3	52.1	52.9	53.7	54.5	55.3
17.4	44.2	45.0	45.8	46.6	47.3	48.1	48.9	49.7	50.5	51.2	52.0	52.8	53.6	54.4	55.2
17.5	44.1	44.9	45.7	46.5	47.2	48.0	48.8	49.6	50.4	51.1	51.9	52.7	53.5	54.3	55.1
17.6	44.1	44.8	45.6	46.4	47.1	47.9	48.7	49.5	50.3	51.0	51.8	52.6	53.4	54.2	55.0
17.7	44.0	44.7	45.5	46.3	47.0	47.8	48.6	49.4	50.2	50.9	51.7	52.5	53.3	54.1	54.8
17.8	43.9	44.6	45.4	46.2	47.0	47.7	48.5	49.3	50.1	50.8	51.6	52.4	53.2	54.0	54.7
17.9	43.8	44.6	45.3	46.1	46.9	47.6	48.4	49.2	50.0	50.7	51.5	52.3	53.1	53.8	54.6
18.0	43.7	44.5	45.2	46.0	46.8	47.5	48.3	49.1	49.9	50.6	51.4	52.2	53.0	53.7	54.5
18.1	43.6	44.4	45.2	45.9	46.7	47.4	48.2	49.0	49.8	50.5	51.3	52.1	52.9	53.6	54.4
18.2	43.5	44.3	45.1	45.8	46.6	47.4	48.1	48.9	49.7	50.4	51.2	52.0	52.8	53.5	54.3
18.3	43.5	44.2	45.0	45.7	46.5	47.3	48.0	48.8	49.6	50.3	51.1	51.9	52.7	53.4	54.2
18.4	43.4	44.1	44.9	45.7	46.4	47.2	47.9	48.7	49.5	50.2	51.0	51.8	52.6	53.3	54.1
18.5	43.3	44.1	44.8	45.6	46.3	47.1	47.9	48.6	49.4	50.2	50.9	51.7	52.5	53.2	54.0
18.6	43.2	44.0	44.7	45.5	46.2	47.0	47.8	48.5	49.3	50.1	50.8	51.6	52.4	53.1	53.9
18.7	43.1	43.9	44.6	45.4	46.2	46.9	47.7	48.4	49.2	50.0	50.7	51.5	52.3	53.0	53.8
18.8	43.1	43.8	44.6	45.3	46.1	46.8	47.6	48.4	49.1	49.9	50.6	51.4	52.2	52.9	53.7
18.9	43.0	43.7	44.5	45.2	46.0	46.7	47.5	48.3	49.0	49.8	50.5	51.3	52.1	52.8	53.6
19.0	42.9	43.7	44.4	45.2	45.9	46.7	47.4	48.2	48.9	49.7	50.5	51.2	52.0	52.8	53.5
19.1	42.8	43.6	44.3	45.1	45.8	46.6	47.3	48.1	48.9	49.6	50.4	51.1	51.9	52.7	53.4
19.2	42.8	43.5	44.2	45.0	45.7	46.5	47.3	48.0	48.8	49.5	50.3	51.0	51.8	52.6	53.3
19.3	42.7	43.4	44.2	44.9	45.7	46.4	47.2	47.9	48.7	49.4	50.2	50.9	51.7	52.5	53.2
19.4	42.6	43.3	44.1	44.8	45.6	46.3	47.1	47.8	48.6	49.3	50.1	50.9	51.6	52.4	53.1
19.5	42.5	43.3	44.0	44.8	45.5	46.3	47.0	47.8	48.5	49.3	50.0	50.8	51.5	52.3	53.0
19.6	42.5	43.2	43.9	44.7	45.4	46.2	46.9	47.7	48.4	49.2	49.9	50.7	51.4	52.2	53.0
19.7	42.4	43.1	43.9	44.6	45.3	46.1	46.8	47.6	48.3	49.1	49.8	50.6	51.4	52.1	52.9
19.8	42.3	43.0	43.8	44.5	45.3	46.0	46.8	47.5	48.3	49.0	49.8	50.5	51.3	52.0	52.8
19.9	42.2	43.0	43.7	44.5	45.2	45.9	46.7	47.4	48.2	48.9	49.7	50.4	51.2	51.9	52.7

4 DIA 12.0-19.9 HT 90-158

TARIF NUMBER 45.0

DBH	Total Tree Cu.Ft.Vol. Incl. Top and Stump VOL	Incl. Top and Stump V/BA	Incl. Top Only VOL	Incl. Top Only V/BA	Vol to 4 Inch Top Cubic Feet VOL	Vol to 4 Inch Top Cubic Feet V/BA	Volume to 6 Inch Top: Cubic Feet VOL	Cubic Feet V/BA	BD Feet 16 Ft Logs VOL	BD Feet 16 Ft Logs V/BA	Scribner 32 Ft Logs VOL	Scribner 32 Ft Logs V/BA	BD Feet Inter 1/4 16 Ft Logs VOL	BD Feet Inter 1/4 16 Ft Logs V/BA
2	0.4	18.0	0.3	16.0										
3	1.2	24.8	1.1	23.0										
4	2.8	31.5	2.6	29.8										
5	4.9	35.9	4.7	34.3	2.4	17.8								
6	7.6	38.9	7.3	37.4	5.4	27.4								
7	11.0	41.0	10.6	39.5	8.9	33.2	3.4	12.5	12	43.5	12	43.8	17	64.0
8	14.9	42.6	14.3	41.1	12.9	37.0	7.9	22.6	30	85.8	27	76.7	42	121.6
9	19.3	43.8	18.7	42.3	17.5	39.6	13.2	29.9	54	122.4	50	114.2	74	168.0
10	24.4	44.8	23.6	43.3	22.6	41.4	19.1	35.1	83	152.6	76	138.7	111	203.6
11	30.1	45.6	29.1	44.1	28.2	42.8	25.5	38.6	117	177.3	100	151.4	152	230.7
12	36.3	46.3	35.2	44.8	34.4	43.8	32.2	41.0	155	197.5	131	167.2	197	251.3
13	43.2	46.8	41.8	45.3	41.1	44.6	39.4	42.8	197	214.1	168	182.5	246	267.1
14	50.6	47.3	49.0	45.8	48.4	45.3	47.0	44.0	244	228.1	214	200.6	299	279.4
15	58.6	47.7	56.7	46.2	56.2	45.8	55.0	44.9	295	240.1	258	210.5	355	289.1
16	67.1	48.1	65.0	46.5	64.5	46.2	63.5	45.5	350	250.4	307	219.8	415	296.9
17	76.2	48.4	73.8	46.8	73.4	46.6	72.5	46.0	409	259.5	360	228.7	478	303.3
18	85.9	48.6	83.2	47.1	82.8	46.9	82.0	46.4	473	267.5	395	223.4	545	308.5
19	96.2	48.9	93.1	47.3	92.8	47.1	91.9	46.7	541	274.7	455	231.3	616	312.9
20	107.0	49.0	103.6	47.5	103.2	47.3	102.4	46.9	613	281.1	517	237.2	691	316.6
21	118.4	49.2	114.6	47.6	114.3	47.5	113.4	47.1	690	287.0	584	242.8	769	319.7
22	130.3	49.4	126.1	47.8	125.8	47.7	124.9	47.3	772	292.3	655	248.1	851	322.3
23	142.8	49.5	138.2	47.9	137.9	47.8	136.9	47.5	857	297.2	731	253.2	936	324.5
24	155.9	49.6	150.9	48.0	150.6	47.9	149.5	47.6	948	301.7	810	257.7	1025	326.4
25	169.5	49.7	164.0	48.1	163.7	48.0	162.6	47.7	1042	305.7	894	262.4	1118	328.0
26	183.6	49.8	177.7	48.2	177.4	48.1	176.2	47.8	1141	309.5	979	265.4	1214	329.3
27	198.3	49.9	192.0	48.3	191.7	48.2	190.3	47.9	1244	313.0	1070	269.0	1313	330.3
28	213.6	50.0	206.8	48.4	206.5	48.3	205.0	47.9	1352	316.1	1164	272.1	1416	331.2
29	229.5	50.0	222.1	48.4	221.8	48.4	220.2	48.0	1464	319.1	1224	266.8	1522	331.9
30	245.8	50.1	237.9	48.5	237.7	48.4	236.0	48.1	1579	321.8	1323	269.6	1632	332.4
31	262.9	50.1	254.3	48.5	254.1	48.5	252.3	48.1	1700	324.2	1426	272.1	1744	332.8
32	280.3	50.2	271.3	48.6	271.0	48.5	269.1	48.2	1824	326.5	1533	274.5	1860	333.0
33	298.3	50.2	288.8	48.6	288.5	48.6	286.4	48.2	1952	328.6	1643	276.6	1979	333.1
34	316.9	50.3	306.8	48.7	306.5	48.6	304.3	48.3	2084	330.6	1761	279.3	2101	333.2
35	336.1	50.3	325.3	48.7	325.0	48.6	322.7	48.3	2220	332.3	1880	281.4	2225	333.1
36	355.8	50.3	344.4	48.7	344.1	48.7	341.7	48.3	2361	334.0	1999	282.9	2353	332.9
37	376.1	50.4	364.0	48.8	363.7	48.7	361.2	48.4	2505	335.4	2127	284.8	2494	332.7
38	396.9	50.4	384.2	48.8	383.9	48.7	381.2	48.4	2653	336.8	2259	286.8	2617	332.3
39	418.3	50.4	404.9	48.8	404.6	48.8	401.8	48.4	2804	338.1	2394	288.5	2754	332.0
40	440.3	50.5	426.1	48.8	425.8	48.8	422.9	48.5	2960	339.2	2532	290.2	2893	331.5
41	462.8	50.5	447.9	48.9	447.6	48.8	444.5	48.5	3119	340.2	2674	291.7	3035	331.0
42	485.8	50.5	470.2	48.9	469.9	48.9	466.6	48.5	3282	341.1	2820	293.1	3179	330.5
43	509.4	50.5	493.1	48.9	492.8	48.9	489.3	48.5	3449	342.0	2968	294.3	3327	329.9
44	533.6	50.5	516.5	48.9	516.2	48.9	512.5	48.5	3619	342.7	3120	295.5	3476	329.2
45	558.3	50.6	540.4	48.9	540.1	48.9	536.3	48.6	3793	343.4	3276	296.6	3629	328.5
46	583.6	50.6	564.9	48.9	564.5	48.9	560.6	48.6	3970	344.0	3449	298.8	3784	327.8
47	609.4	50.6	589.9	49.0	589.5	48.9	585.4	48.6	4151	344.5	3616	300.1	3941	327.1
48	635.8	50.6	615.4	49.0	615.1	48.9	610.8	48.6	4335	345.0	3780	300.8	4101	326.3
49	662.8	50.6	641.5	49.0	641.2	49.0	636.7	48.6	4523	345.4	3887	296.8	4263	325.5
50	690.3	50.6	668.1	49.0	667.8	49.0	663.1	48.6	4714	345.7	4060	297.8	4428	324.7

DBH	Volume to 8 Inch Top: Cubic Feet VOL	Cubic Feet V/BA	BD Feet 16 Ft Logs VOL	BD Feet 16 Ft Logs V/BA	Scribner 32 Ft Logs VOL	Scribner 32 Ft Logs V/BA	BD Feet Inter 1/4 16 Ft Logs VOL	BD Feet Inter 1/4 16 Ft Logs V/BA
2								
3								
4								
5								
6								
7								
8								
9	2.7	6.2	8	19.1	20	45.3	15	33.6
10	10.1	18.4	49	89.5	49	90.3	67	123.6
11	17.9	27.1	93	140.9	86	131.0	122	185.5
12	26.0	33.1	139	176.8	127	161.5	178	226.1
13	34.4	37.3	186	202.2	167	181.0	233	252.7
14	42.9	40.2	236	220.8	201	188.0	289	270.6
15	51.7	42.2	289	235.1	246	200.2	348	283.2
16	60.8	43.6	344	246.6	297	212.4	408	292.5
17	70.2	44.5	404	256.2	351	222.6	472	299.5
18	80.0	45.3	467	264.5	406	229.6	539	305.1
19	90.1	45.8	535	271.8	474	240.6	610	309.6
20	100.7	46.2	607	278.2	541	247.8	684	313.3
21	111.8	46.5	683	284.1	579	240.7	761	316.5
22	123.3	46.7	764	289.4	647	245.2	842	319.1
23	135.3	46.9	849	294.2	720	249.7	927	321.3
24	147.8	47.0	938	298.6	798	254.1	1015	323.1
25	160.8	47.2	1032	302.7	890	261.0	1107	324.7
26	174.3	47.3	1130	306.4	977	265.0	1202	326.0
27	188.4	47.4	1232	309.8	1066	268.2	1300	327.0
28	202.9	47.5	1338	313.0	1159	271.0	1402	327.9
29	218.0	47.5	1449	315.9	1255	273.7	1507	328.6
30	233.6	47.6	1564	318.5	1356	276.3	1615	329.1
31	249.7	47.6	1683	321.0	1462	278.9	1727	329.5
32	266.4	47.7	1805	323.3	1572	281.5	1841	329.7
33	283.6	47.7	1932	325.3	1537	275.7	1959	329.8
34	301.3	47.8	2063	327.3	1760	279.2	2080	329.8
35	319.5	47.8	2198	329.0	1879	281.2	2203	329.8
36	338.3	47.9	2337	330.6	1997	282.5	2330	329.6
37	357.5	47.9	2480	332.1	2122	284.2	2459	329.3
38	377.4	47.9	2626	333.4	2253	286.0	2591	329.0
39	397.7	47.9	2776	334.7	2386	287.7	2726	328.6
40	418.6	48.0	2930	335.8	2525	289.3	2864	328.2
41	440.0	48.0	3088	336.8	2668	291.0	3004	327.7
42	461.9	48.0	3249	337.7	2816	292.7	3148	327.2
43	484.4	48.0	3414	338.6	2967	294.2	3293	326.6
44	507.4	48.1	3583	339.3	3122	295.6	3442	325.9
45	530.9	48.1	3755	340.0	3279	296.9	3592	325.3
46	554.9	48.1	3930	340.6	3447	298.7	3746	324.6
47	579.5	48.1	4109	341.1	3613	299.9	3902	323.8
48	604.6	48.1	4292	341.5	3777	300.5	4060	323.1
49	630.3	48.1	4478	341.9	3952	301.8	4220	322.3
50	656.4	48.1	4667	342.2	4129	302.8	4383	321.5

Some tarif Equations

Finding tarif

If CVTS is known:

$$\frac{.912733(CVTS)}{1.033\left[1+1.382937\exp\left\{-4.015292\left(\frac{DBH}{10}\right)\right\}\right]\left[BA+.087266\right]-.174533} \qquad \text{tarif}$$

gives tarif for 2+" DBH trees

If CV4 is known:

$$\frac{.912733(CV4)}{BA-.087266} \quad \text{gives tarif} \qquad \text{tarif}$$

Finding various volumes (known tarif)

$$CV4 = \frac{\text{tarif}(BA-.087266)}{.912733} \qquad CV4$$

$$CV6 = CV4\left\{.993-.993\left[.62^{(DBH-6)}\right]\right\} \qquad CV6$$

$$SV6 = CV6\left(10^{X}\right), \text{ where} \qquad SV6$$

$$X = .174439 + .117594(\log_{10} DBH)(\log_{10} T) - 8.210585/DBH^2 + .236693(\log_{10} T) - .00001345(T^2) - .00001937(DBH^2)$$

and $T = \text{tarif}/.912733$

$$SV8 = SV6\left[.990 - .58\left(.484^{\{DBH-9.5\}}\right)\right] \qquad SV8$$

$$SV632 = SV6\left[1.001491 - \frac{.6924097}{\text{tarif}} + .00001351(DBH^2)\right] \qquad SV632$$

Using the Tarif System

1. Measure DBH and Height on tarif sub-sample.

2. Estimate Cubic-foot Volume including Top & Stump (CVTS) for tarif trees using an applicable standard volume equation

3. Use CVTS to derive tarif number for each sample (tarif) tree

4. Average derived tarif numbers from (3) by species

5. Use species average to derive desired vol. units.

Example.

An estimate of Cubic-foot Volume to 4" top (CV4) is desired for a particular Douglas-fir stand. Three tarif trees were measured. An applicable standard CVTS equation is found in Bell & Dilworth appdx. C.II.A.

$$CVTS = 10^{-2.658025} DBH^{1.739925} HT^{1.133187}$$

The following table is then derived (steps circled):

tree	DBH ①	HT ①	CVTS ②	tarif ③	CV4 ⑤
1	15.2	94	43.1	32.2	43.2
2	10.1	86	19.1	34.4	17.3
3	12.5	92	29.9	34.2	28.2

(4) avg. tarif: 33.6

Summary

1. Volume equations / tables typically refer to volume in the main stem or bole, apply to a particular species or species group, a particular age class, and a particular geographic region, and are based on one or more individual tree dimensions, such as DBH or Height
2. Volume units are many: bd.ft., merchantable cubic-ft to a 4” top, etc.
3. There are three main types of volume tables (equations): Multiple Entry, Single Entry, and Composite
4. There are two main sub-types of Multiple Entry volume tables: standard and form class
5. There are two main sub-types of Single Entry tables: local and tarif; tarif equations are used in the PNW quite a lot, particularly among state agencies