

2013 Western Washington Hardwood Assessment (Report Tables in Excel Format)

Extended Executive Summary¹

Hardwood species comprise an important economic component of the timber resource for the forest products industry in western Washington. Since the 1990's, four studies of the hardwood resource in western Washington have been undertaken by the Washington Hardwoods Commission (WHC). This report presents an update for western Washington and addresses the following questions: a) how much hardwood growing stock currently exists in western Washington; b) what is the size class structure and location of the inventory; c) what ownerships currently manage the growing stock; and d) how much volume is under riparian management regulation.

Unlike prior assessments, this study uses the Washington State Biomass Assessment database; a Landsat-based inventory stratification based on the Gradient Nearest Neighbor (GNN) methodology and is used to map the volume of hardwoods by management zone, owner group, diameter class and species². Oregon State University scientists provided forest inventory data to develop the database. They used GNN methods to combine FIA and other plot data to develop an estimate of the forest inventory across Washington State.

The Forest Vegetation Simulator (FVS) is used to provide an estimate of future hardwood inventories³. Combined with future harvests, we project standing inventories on a five-year interval from 2010 – 2030. In addition to a “no harvest alternative,” three possible silvicultural options are modeled across western Washington: only a commercial thinning, only a clear cut final harvest, or a commercial thinning and a clear cut final harvest within this 20-year planning horizon. A 2010 baseline target harvest for all coniferous and hardwood species is set at 2.74 BBF and is maintained over the 20-year planning period. The hardwood component of this harvest is recovered as individual timber types are harvested with a substantial portion coming from mixed species stands.

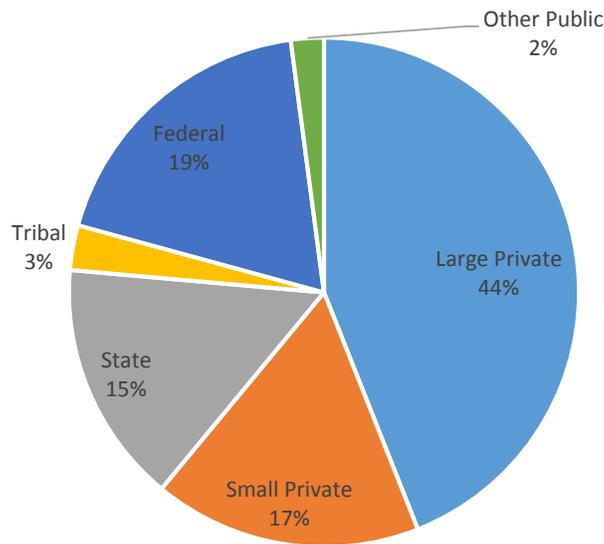
Volume estimates are derived by first identifying the number of unreserved acres capable of sustaining active forest management. We estimate that there are approximately 8.3 million acres of commercial timberland in western Washington that are unreserved and, except for acres in core riparian buffers, are potentially available for forest management.

¹ This is an extended summary of: Rogers, L., Perez-Garcia, J., Bare, B. (2013). 2013 Western Washington Hardwood Assessment, Institute of Forest Resources, School of Environmental and Forest Sciences, University of Washington, Institute Research Report Number 1.

² Perez-Garcia, J., Oneil, E., Hansen, T., Mason, T., McCarter, J., Rogers, L., McLaughlin, M. (2012). Washington Forest Biomass Supply Assessment. University of Washington, School of Environmental and Forest Sciences, Seattle, WA 98195-2100.

³ Crookston, N., Dixon, G. (2005). The Forest Vegetation Simulator: A Review of its Structure, Content, and Applications. *Computers and Electronics in Agriculture* 49, 60-80.

Western Washington Unreserved Timberland Acres Over 10 Acres in Size by Owner Type (8.3 million)



In western Washington, 3.9 million acres (47% of all unreserved timberland acres) are managed by large private and tribal owners, with small private owners and state lands making up an additional 2.7 million acres (32%). The remaining 20% of unreserved timberland acres are managed by federal and other public owners. Across all owner types, there are about 6.1 million acres (74%) of unreserved timberland in uplands across western Washington. The remaining 2.2 million acres (26%) are in riparian buffers, of which about 1.4 million acres are in core riparian buffers.

Unreserved timberland acres by management zone in western Washington

Management Zone	Management Zone Acres
Uplands	6,084,580
Core Buffer	1,394,957
Inner Buffer	678,492
Outer Buffer	102,241
Wetland Buffer	29,352
Grand Total	8,289,622

A breakdown of unreserved timberland acres by ownership shows that private owners (large and small) own about 68% of all uplands timberland acres; and along with other public owners have the highest percentage of their timberlands in the uplands management zone (about 81-84%). This contrasts with federal owners who have about 53% in the uplands zone.

Unreserved timberland acres by ownership and management zone in western Washington

Owner Type / Mgt Zone	Uplands	Core Buffer	Inner Buffer	Outer Buffer	Wetland Buffer	Total (Acres)
Large Private	2,962,389	469,603	136,903	66,358	12,025	3,647,278
Small Private	1,185,371	106,319	68,237	32,537	16,712	1,409,175
State	810,656		466,743			1,277,398
Tribal	164,407	70,812				235,218
Federal	816,861	730,816				1,547,678
Other Public	144,896	17,407	6,610	3,346	615	172,875
Total (Acres)	6,084,580	1,394,957	678,492	102,241	29,352	8,289,622

As of 2010, we estimate a standing inventory of 19.8 BBF (billion board feet) of hardwood inventory on 8.3 million acres of unreserved timberland across all owners and management zones in western Washington.

2010 Hardwood standing inventory by owner type and management zone in western Washington (MBF)

MBF / Mgt Zone & Owner Type	Uplands	Core Buffer	Inner Buffer	Outer Buffer	Wetland Buffer	Total (MBF)
Large Private	4,307,040	1,547,024	461,196	167,312	33,556	6,516,129
Small Private	5,370,358	735,792	430,316	176,020	84,577	6,797,062
State	1,639,089		1,940,549			3,579,638
Tribal	344,208	211,068				555,276
Federal	860,194	1,096,299				1,956,493
Other Public	303,929	55,260	27,522	12,109	2,369	401,189
Total (MBF)	12,824,817	3,645,444	2,859,584	355,441	120,501	19,805,786

The hardwood standing inventory on upland acres, exclusive of federal and other public owners, is estimated at about 11.7 BBF in 2010. Of this volume, about 5.4 BBF occur on small private acres -- the largest volume on uplands among all owner groups -- with the remaining 6.3 BBF occurring on large private, state, and tribal ownerships. The hardwood standing inventory in riparian buffer amounts to about 7.0 BBF, of which 3.6 BBF are located in core riparian buffer areas. Of the remaining 3.4 BBF, about 1.9 BBF, are located on state lands.

A substantial portion of the 2010 hardwood standing inventory is not available for harvest over the 20-year planning horizon of this study. The volume located in the core riparian buffer (3.6 BBF) is considered unavailable for harvest over the 20-year planning horizon due to regulatory restrictions. Also, only about 17% of the volume in the inner riparian buffers on private and other public ownerships; 7% of the volume in the inner riparian buffers on state land; and 61% of the volume on uplands across all owners are available for harvest in 2010 -- largely due to leave tree requirements, volume in age classes that are less than rotation age or too small to be harvested over the 20-year planning horizon, and Habitat Conservation Plan and riparian reserve requirements on state land. In addition, the volume available for harvest in 2010 represents the maximum volume available as we make no attempt to

adjust this standing inventory for operational factors which will likely limit the volume that is economically feasible to harvest.

We estimate that approximately 8.3 BBF of the 19.8 BBF of hardwood standing timber discussed above is available for harvest in 2010. About 94% of this volume occurs on uplands of which about 3.9 BBF occurs on large private and state lands. An additional 3.3 BBF are found on small private uplands.

2010 Hardwood volume available for harvest by owner type and management zone in western Washington (MBF)

MBF / Owner Type & Management Zone	Uplands	Inner Buffer	Outer Buffer	Wetland Buffer	Total (MBF)
Large Private	2,879,273	99,424	74,009	8,307	3,061,013
Small Private	3,305,262	50,714	59,292	10,127	3,425,394
State	1,070,272	142,747			1,213,019
Tribal	109,745				109,745
Federal	367,545				367,545
Other Public	94,015	3,289	2,849	236	100,388
Total (MBF)	7,826,112	296,173	136,149	18,669	8,277,104

About 65% of the hardwood volume available for harvest in 2010 is alder with 28% maple; 75% of the volume on large private ownerships is alder with 20% maple; and 54% on small private ownerships is alder with 37% maple.

2010 Hardwood volume available for harvest by species and owner type in western Washington (MBF)

MBF / Owner Type & Species	Alder	Maple	Cottonwood	Birch	Other	Total (MBF)
Large Private	2,307,961	632,521	87,566	19,490	13,474	3,061,013
Small Private	1,838,697	1,270,194	155,767	146,426	14,310	3,425,394
State	880,610	286,844	31,780	8,878	4,907	1,213,019
Tribal	55,870	32,114	1,318	20,378	65	109,745
Federal	251,378	85,509	27,787	1,153	1,718	367,545
Other Public	72,552	19,217	7,778	292	549	100,388
Total (MBF)	5,407,069	2,326,399	311,996	196,616	35,024	8,277,104

About 60% (4.9 BBF) of the hardwood volume available for harvest in 2010 is between 10-20 inches in diameter and about 68% of this volume is alder. An additional 1.6 BBF in the 5-10 inch diameter class is also available for harvest with about 78% being alder.

2010 Hardwood volume available for harvest by diameter class and species in western Washington (MBF)

MBF / Diameter Class & Species	Alder	Maple	Cottonwood	Birch	Other	Total (MBF)
0"-5"						
5"-10"	1,270,335	299,397	11,906	42,061	14,582	1,638,281
10"-15"	1,974,862	561,343	23,060	123,025	10,561	2,692,851
15"-20"	1,363,066	757,254	34,640	31,530	9,880	2,196,371
20"-25"	643,521	587,360	102,911			1,333,792
25"-30"	155,286	100,550	131,268			387,104
30"-35"		18,844	8,211			27,054
35"-40"		1,651				1,651
Total (MBF)	5,407,069	2,326,399	311,996	196,616	35,024	8,277,104

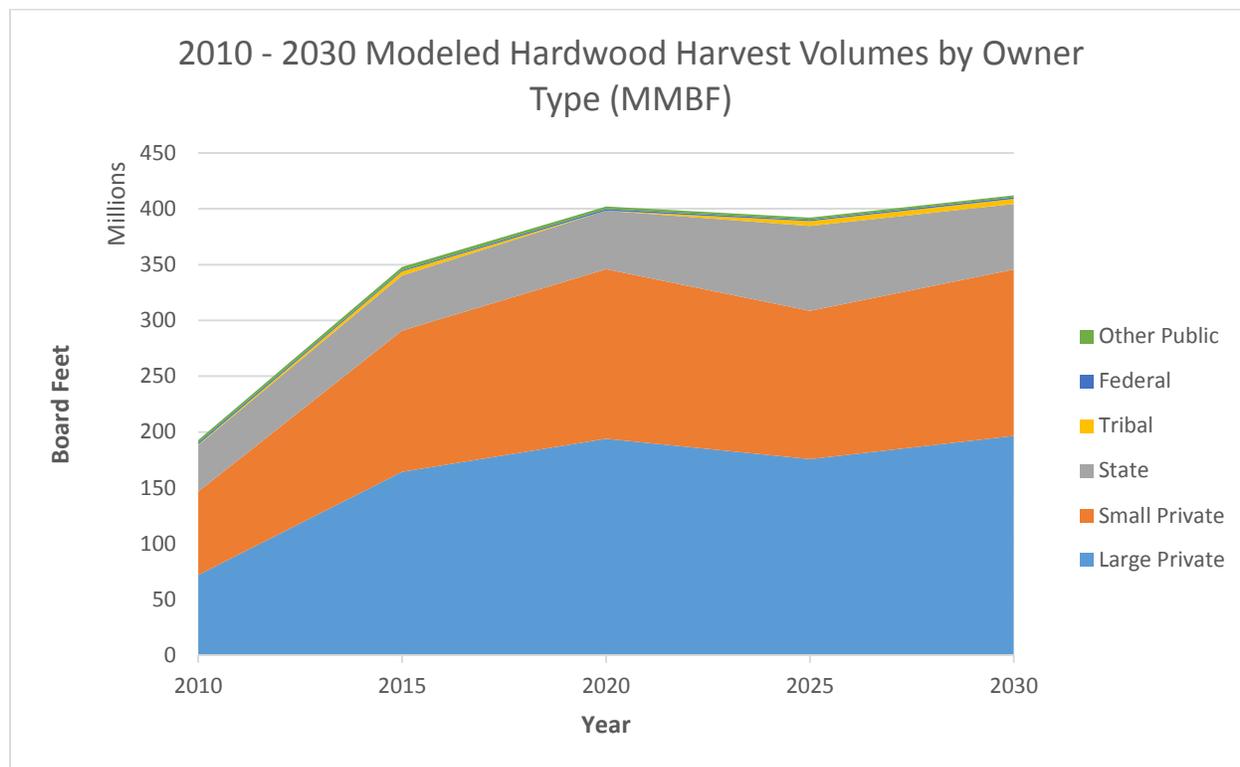
Projecting inventory levels for future years requires that harvest levels be introduced to account for removals. Historical annual harvest volumes for all coniferous and hardwood species in western Washington between 2000 and 2009 averaged 2.74 BBF/year. We use this as our even flow target harvest across all coniferous and hardwood species to project future harvest levels for the years 2010-2030 in five-year increments. About 60% of this volume is allocated to large private owners, 20% to small private owners, and 17% to state lands.

The harvest allocation procedure targets all species volumes -- not hardwood or softwood separately. The hardwood component of the projected harvest is recovered as individual timber types are harvested, with a substantial portion coming from mixed species stands.

Historic and projected harvest volume for all coniferous and hardwood species in western Washington (MBF)

MBF / Year	Large Private	Small Private	Other Public	Tribal	State	Federal
2000	1,971,492	429,955	13,789	26,756	424,453	29,854
2001	1,736,774	378,309	23,242	22,938	380,713	14,973
2002	1,743,343	267,139	23,825	23,109	358,054	17,166
2003	1,322,308	734,549	28,907	24,694	397,386	22,096
2004	1,594,761	740,515	40,511	26,278	444,928	23,251
2005	1,590,826	549,067	24,932	27,863	446,530	25,818
2006	1,701,369	406,188	21,798	29,446	284,387	20,009
2007	1,405,945	593,772	29,813	31,031	316,696	17,612
2008	1,162,914	460,067	63,664	32,615	380,626	28,097
2009	852,542	285,258	46,686	34,200	504,772	33,580
2010	1,138,816	406,112	43,969	32,616	410,952	27,306
2015	1,675,817	538,315	35,250	30,993	437,636	25,829
2020	1,675,814	538,940	35,246	30,993	437,955	25,830
2025	1,675,823	538,320	35,249	30,996	437,649	25,831
2030	1,675,826	538,319	35,245	31,879	437,626	25,831

As shown in the above table, the projected annual harvest for all species comes close to achieving the target volume of 2.74 BBF/year starting around 2015. The projected hardwood harvest component of this total harvest increases to about 0.400 BBF/year by 2020 and remains relatively constant thereafter. From 2015-2030, large private owners account for about 45% of the modeled hardwood harvest, with small private and state owners averaging about 36% and 16%, respectively.



Modeled hardwood harvest volume by owner type 2010-2030 in western Washington (MBF/year)

MBF / Year & Owner Type	Large Private	Small Private	State	Tribal	Federal	Other Public	Total (MBF)
2010	72,010	74,552	41,675	533	1,663	2,435	192,868
2015	164,170	126,683	49,341	3,733	1,031	3,021	347,979
2020	193,840	151,938	52,569	121	1,277	2,403	402,148
2025	175,813	132,631	76,250	4,147	1,347	2,036	392,224
2030	196,535	149,062	58,879	4,425	1,450	1,835	412,186

From 2015-2030, almost 96% of the modeled hardwood harvest is expected to come from upland acres across all owner groups, with the inner and outer riparian buffers making up most of the remaining portion of the estimated harvest.

Modeled hardwood harvest volume by management zone 2010-2030 in western Washington (MBF/year)

MBF / Year & Mgt Zone	Uplands	Inner Buffer	Outer Buffer	Wetland Buffer	Total (MBF)
2010	185,526	4,411	2,654	278	192,868
2015	328,833	11,127	7,053	965	347,979
2020	386,260	8,741	6,291	856	402,148
2025	377,956	8,213	5,101	954	392,224
2030	396,049	8,956	6,064	1,116	412,186

The simulations show an increase in the alder hardwood harvest volume increasing from about 76% of the hardwood harvest in 2010 to about 80% in 2030. For all hardwood species combined, the share of the total harvest volume increases from 9.4% in 2010 to 12.7% in 2015 to 15.0% in 2030.

Modeled hardwood harvest volume by species 2010 - 2030 in western Washington (MBF/year)

MBF / Year & Species	Alder	Maple	Cottonwood	Birch	Other	Total (MBF)
2010	115,623	67,698	8,440	215	893	192,868
2015	263,891	70,747	11,237	528	1,577	347,979
2020	290,765	92,350	16,381	1,051	1,602	402,148
2025	289,458	86,939	11,068	1,931	2,828	392,224
2030	327,640	69,448	7,036	3,263	4,799	412,186

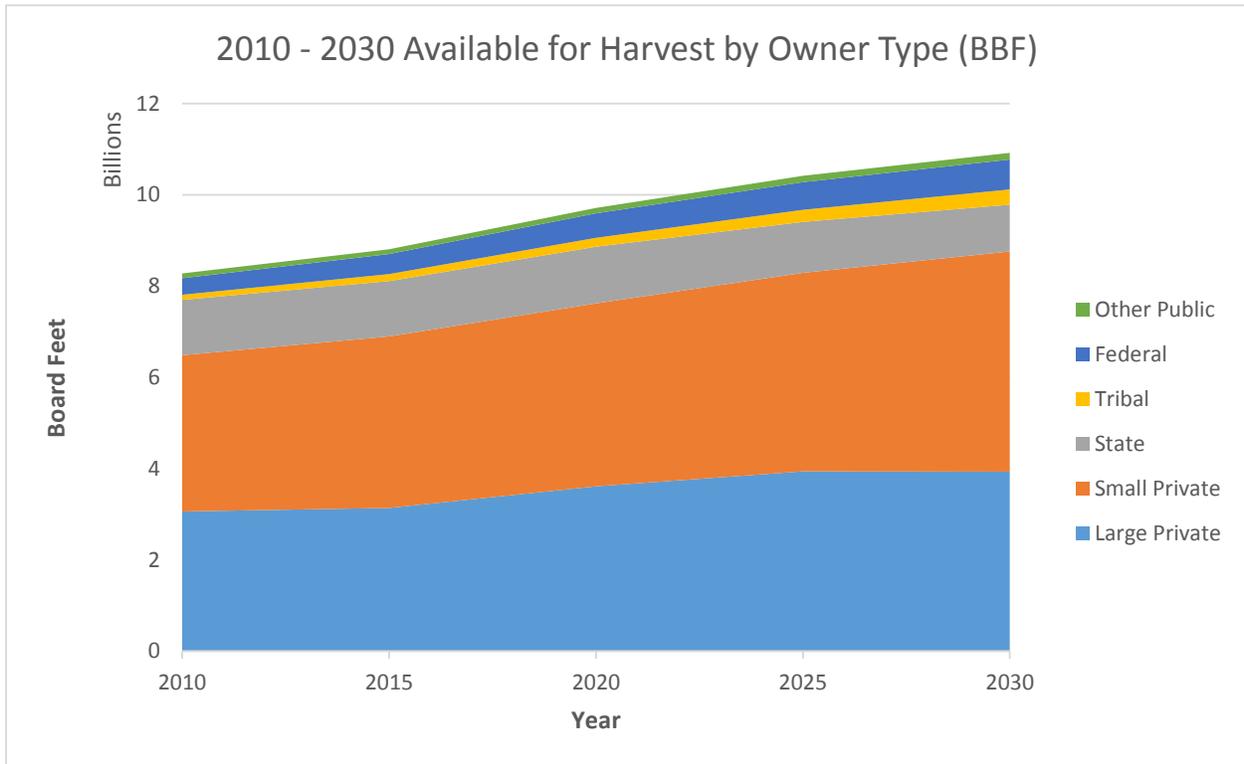
The majority of the modeled hardwood harvest volume occurs in the 10-20 inch diameter class, averaging about 60% between the years 2010-2030. Growth in the harvest volume of the smallest diameter class is also evident - increasing from 14% in 2010 to 15% in 2015 and almost 21% in 2030.

Modeled hardwood harvest volume by diameter class 2010 - 2030 in western Washington (MBF/year)

MBF/Year & DBH	0"-5"	5"-10"	10"-15"	15"-20"	20"-25"	25"-30"	30"-35"	35"-40"	Total (MBF)
2010		27,624	56,599	57,161	35,482	15,005	987	9	192,868
2015		53,350	134,679	81,129	53,953	19,133	5,733	2	347,979
2020		73,498	136,672	94,440	66,466	22,792	8,202	78	402,148
2025		92,497	145,034	77,138	55,471	16,323	5,675	86	392,224
2030		84,578	190,182	75,747	46,647	11,839	2,299	892	412,186

As previously stated, the estimated volume of hardwood inventory on 8.3 million acres of unreserved timberland across all owners and management zones in western Washington that is available for harvest in 2010 is about 8.3 BBF. Given the modeled hardwood harvest levels reported above, we estimate that this available inventory will increase to almost 11 BBF by 2030 – an increase of almost 32%. All (but one) ownership groups are expected to see an increase in available inventory over the 20-year planning

horizon. Similar increases in standing inventory are expected across all management zones. Alder is expected to increase from 65% of the 2010 available harvest volume to about 70% in 2030. Across all species, the available volume in the 25"+ diameter classes increases from about 0.416 BBF to 0.708 BBF from 2010 to 2030.



2010-2030 Hardwood volume available for harvest by owner type in western Washington (MBF)

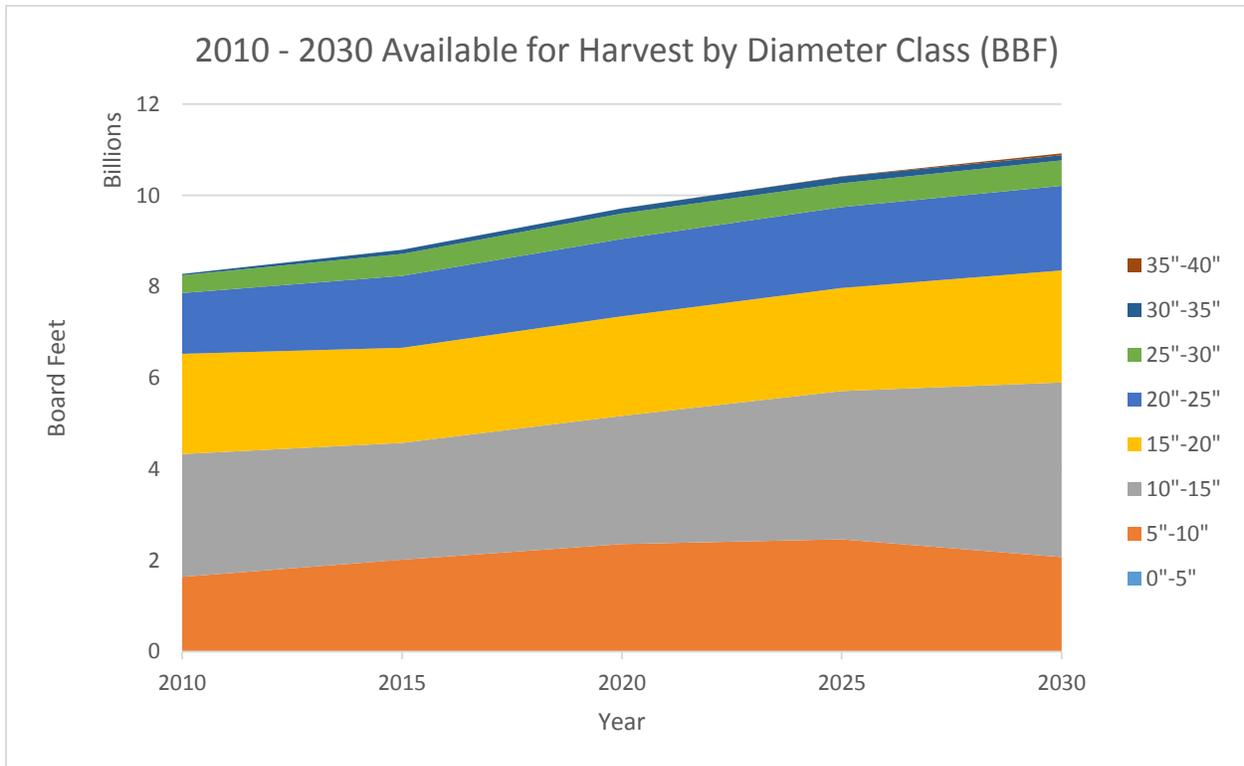
MBF / Year & Owner Type	Large Private	Small Private	State	Tribal	Federal	Other Public	Total (MBF)
2010	3,061,012	3,425,394	1,213,019	109,745	367,545	100,388	8,277,104
2015	3,140,050	3,756,247	1,215,821	149,465	439,240	108,095	8,808,919
2020	3,612,938	4,008,577	1,244,579	195,443	532,436	123,808	9,717,780
2025	3,938,323	4,356,544	1,115,488	264,355	607,822	135,747	10,418,278
2030	3,934,863	4,821,383	1,026,149	336,897	655,735	144,539	10,919,566

2010-2030 Hardwood volume available for harvest by management zone in western Washington (MBF)

MBF / Year & Mgt Zone	Uplands	Inner Buffer	Outer Buffer	Wetland Buffer	Total (MBF)
2010	7,826,112	296,173	136,149	18,669	8,277,104
2015	8,313,952	333,370	142,375	19,222	8,808,919
2020	9,146,340	390,784	159,311	21,345	9,717,780
2025	9,799,141	426,531	169,471	23,136	10,418,278
2030	10,314,126	406,582	174,623	24,235	10,919,566

2010-2030 Hardwood volume available for harvest by species in western Washington (MBF)

MBF / Year & Species	Alder	Maple	Cottonwood	Birch	Other	Total (MBF)
2010	5,407,069	2,326,399	311,996	196,616	35,024	8,277,104
2015	5,824,697	2,419,765	287,518	226,145	50,794	8,808,919
2020	6,643,859	2,496,323	278,504	240,423	58,670	9,717,780
2025	7,252,060	2,536,037	289,859	271,342	68,979	10,418,278
2030	7,657,879	2,573,553	288,857	309,160	90,117	10,919,566



2010-2030 Hardwood volume available for harvest by diameter class in western Washington (MBF)

Year	5"-10"	10"-15"	15"-20"	20"-25"	25"-30"	30"-35"	35"-40"	Total (MBF)
2010	1,638,281	2,692,851	2,196,371	1,333,792	387,104	27,054	1,651	8,277,104
2015	2,017,422	2,559,423	2,086,990	1,572,262	483,326	87,895	1,602	8,808,919
2020	2,357,436	2,813,046	2,177,639	1,696,174	556,227	115,669	1,589	9,717,780
2025	2,461,283	3,250,585	2,261,362	1,772,232	521,313	145,368	6,135	10,418,278
2030	2,075,566	3,824,211	2,456,130	1,855,447	559,058	107,374	41,779	10,919,566

In summary, as of 2010, there exist about 8.3 BBF of hardwood inventory in western Washington that is available for harvest. Of this volume, 7.8 BBF is growing on uplands and 4.1 BBF of the upland volume is owned by large private, state and tribal owners and 3.3 BBF are owned by small private owners. A modeled hardwood harvest volume of about 0.400 BBF/year suggests that about 5% of the available volume on these combined ownerships is being harvested annually. An additional hardwood volume estimated at 3.6 BBF in western Washington is considered completely restricted from commercial harvesting activities due to its location within core riparian buffer areas across all ownerships. State lands contain about 1 BBF of hardwoods on upland acres and 143 MMBF on acres in riparian buffers – both available for harvest in 2010. About 75% of the hardwood volume owned by large private owners is alder with 20% in maple, while small private owners have 54% in alder and 37% in maple. Developing management options for small private landowners presents an opportunity to expand hardwood management, particularly on upland acres. We estimate that harvesting hardwoods at the rate of about 0.400 BBF/year, will allow the available standing inventory to increase to almost 11 BBF by 2030 – an increase of almost 32% from 2010. Thus, the hardwood resource in western Washington can sustain an annual rate of removal in excess of 0.400 BBF/year, but determining the precise level of sustainable management is beyond the scope of this study.