Montana Forest Lands Valuation Report

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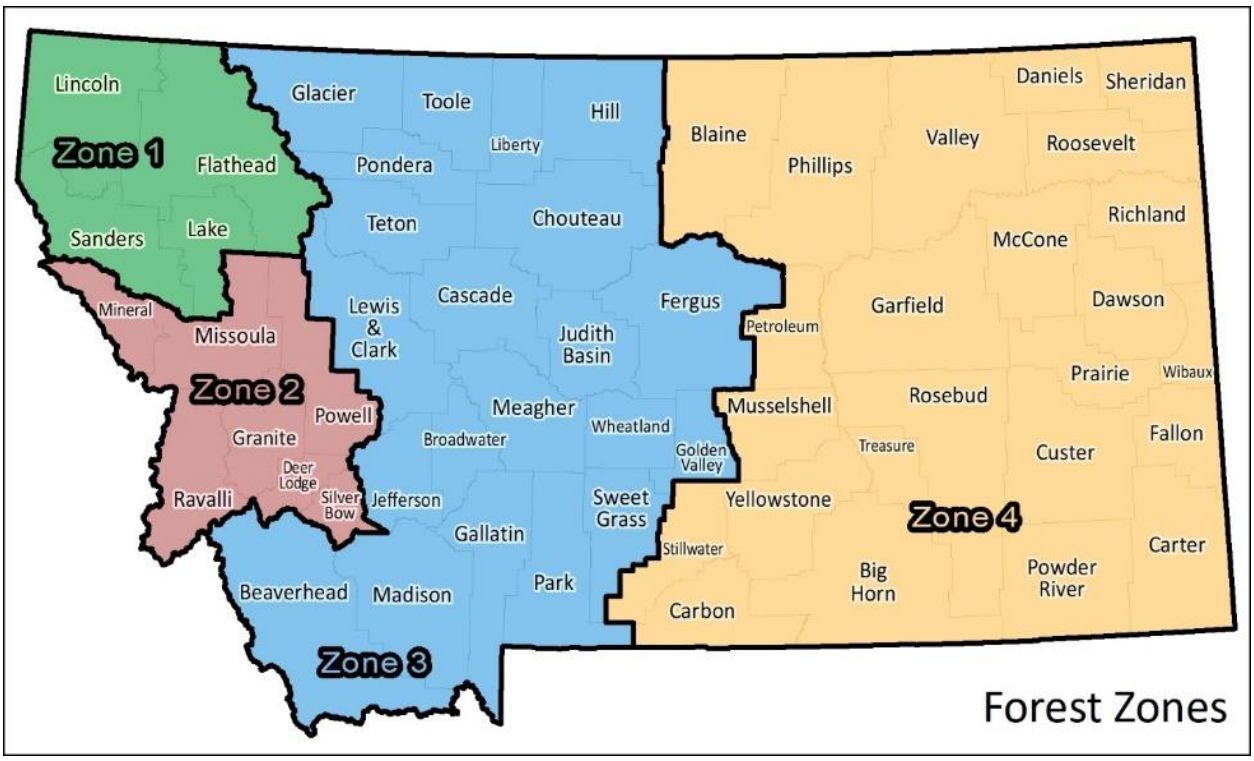
Introduction

This report explains the data and methodology used by the Department of Revenue's Tax Policy and Research Division to estimate stumpage value. Montana values forest land based on the productive value of the land instead of the sale price of the land between a willing buyer and willing seller. In other words, it is the value of the timber on the land rather than the land itself that informs the valuation of forest land property. An average price per board foot is established by region in the state by analyzing public timber sale contracts. An Olympic average of sale prices by region yields the stumpage value "SV" in the statutory formula contained in 15-44-103, MCA. Those stumpage values results are listed by region below.

Northwest: $222.95 Southwest: $184.85 Central: $179.58 East: $42.98

Data

The necessity of performing regression analysis to value forest land arises because of a lack of data for private timber sales. These private sales do not disclose to the Department of Revenue the value of timber sold. Therefore, the best available data for determining forest land value is governmental entities that make timber sales. The Department of Natural Resources and Conservation (DNRC) has a fiduciary responsibility to maximize profit for the support of public schools through the sale of timber on state lands. The DNRC sales data includes information needed to determine bid price per thousand board feet of each sale as well as important determinants of the bid price, such as the location of the sale and the cost of logging and hauling. In recognition that location of forest land influences its value, the state is split into four zones: Northwest, Southwest, Central, and East. There is insufficient evidence to suggest that classification of these zones should be changed from the prior reappraisal. The map on the following page shows how which zone each county belongs to.



Since some DNRC sales are noncompetitive or salvage, these sales are not considered valid for productive value purposes and are excluded from analysis. In fiscal years 2014 through 2023, the DNRC facilitated 187 usable timber sales. Additionally, one sale from the East zone was determined to be an outlier and was dropped from the sample. The geography of Montana means most forest sales take place in the Northwest and Southwest zones. Table 1 sums the total number of sales in each zone for the six-year period that was used. There have been no sales in the eastern zone since 2018.

Table 1. Total Sales by Year and Zone

Year	NW	SW	C	E	Total
2014	9	6	2		17
2015	11	5	2		18
2016	13	6	2		21
2017	7	6	3	3	19
2018	11	3	2	3	19
2019	18	6			24
2020	6	10	3		19
2021	6	2	3		11
2022	10	5	2		17
2023	11	8			19

Methodology

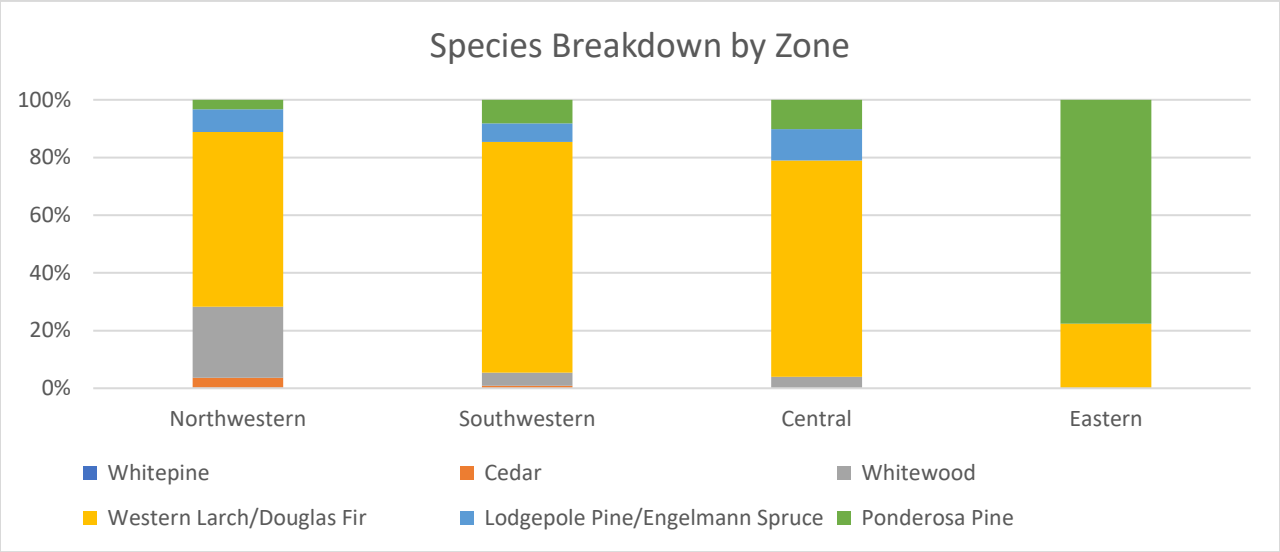
Because some years had no sales in some zones and others had very few, a regression model was created to reach a stumpage value in every zone for every year rather than relying on simple averages. The following formula represents the regression, followed by an explanation of the variables and the reasoning behind them.

$$Bid18\$/MBF_i = \alpha + z_1 NW + z_2 SW + z_3 E + \beta_1 BBER100_i + \beta_2 BBERSQ_i + \beta_3 TotalAcres_i + \beta_4 VolSky\%_i + \beta_5 PavHaul_i + \beta_6 UnPavHaul_i + \beta_7 YardDisSky_i + \beta_8 YardDisGrnd_i + \varepsilon_i$$

The terms α and ε are constant and error terms, respectively. The dependent variable, Bid18$/MBF, is the winning bid of each sale plus the forest improvement fee adjusted to 2018 dollars. The forest improvement fee is known at the time of bid, so it is expected that buyers adjust their willingness to pay accordingly. This information is expressed in $/ton in the DNRC data, so it is converted to $/MBF using the tons/MBF estimated for each sale by the DNRC. It is then converted to 2018 dollars using the U.S. Bureau of Economic Analysis' GDP Price Deflator. This removes inflation from the sales, allowing data points to be compared across years. The Bid18$/MBF variable is calculated for each sale and represents the amount a buyer is willing to pay for each thousand board feet of stumpage adjusted to 2018 dollars.

The explanatory variables are split into three categories: zones, index, and stump-to-mill estimators. The zones (NW, SW, and E) are dummy variables whose coefficients (z_1, z_2, and z_3) only apply to sales when they take place in that respective zone. The Central zone was used as a baseline and therefore has no coefficient. The Bureau of Business and Economic Research (BBER) at the University of Montana publishes a quarterly log price by species and zone, which was used to express lumber value. This data is collected from a survey of mills. The BBER index splits Montana into a West zone and East zone, which match almost exactly with the department's Northwest/Southwest and Central/East zones, respectively. The BBER index breaks down timber prices by region, species type, and quarter, yielding a high level of specificity and generating a unique index value for each sale. That value is also converted to

2018 dollars and then divided by 100 to make it easier to work with, resulting in the variable BBER100. This variable is also squared in the regression to reflect the non-linear relationship between market prices and stumpage value (BBERSQ). The BBER index and its square measure the expected price a logging company will receive for the timber harvested from the sale. Figure 1 displays the average species breakdown of sales in each zone from FY 2014-2023. While western larch and Douglas fir dominate the share of sales outside the East, ponderosa pine is the main species of the East. Therefore, variation in the expected value in the East is sensitive to the price of Ponderosa Pine, while the rest of the zones are sensitive to the value of western larch and Douglas fir.



The final group of explanatory variables estimates the cost of logging and hauling timber, otherwise known as stump-to-mill costs. They include the total acres of the sale, the percent of the land that will be logged by skyline (vs. tractor), the cost of building and maintaining roads to the harvest, hauling distance in miles on paved and unpaved roads, and the average distance in feet of skyline and tractor yarding for each sale.

Results

Table 2. Regression Results

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.820590015					
R Square	0.673367973					
Adjusted R Square	0.64839023					
Standard Error	52.53511388					
Observations	184					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	13	967257.1949	74404.3996	26.95871953	1.0135E-34	
Residual	170	469189.4924	2759.938191			
Total	183	1436446.687				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	415.84	389.61	1.07	0.29	-353.24	1184.93
nw	67.06	14.42	4.65	0.00	38.60	95.52
sw	42.03	15.06	2.79	0.01	12.30	71.75
e	-24.53	30.57	-0.80	0.42	-84.87	35.80
BBER100	-197.81	202.04	-0.98	0.33	-596.64	201.03
BBERSQ	39.81	26.04	1.53	0.13	-11.60	91.22
Road Const $/MBF	-1.28	0.20	-6.28	0.00	-1.68	-0.88
Road Maint $/MBF	-3.37	0.63	-5.35	0.00	-4.62	-2.13
Total Acres	0.02	0.02	1.28	0.20	-0.01	0.06
Vol Sky (%)	-0.62	0.26	-2.40	0.02	-1.13	-0.11
Pav Haul (miles)	-0.31	0.10	-3.22	0.00	-0.50	-0.12
Un Pav Haul (miles)	-1.26	0.32	-3.94	0.00	-1.89	-0.63
Yard Dis Sky (ft)	-0.04	0.02	-1.99	0.05	-0.08	0.00
Yard Dis Grnd (ft)	-0.01	0.02	-0.82	0.41	-0.05	0.02

The regression results reveal important trends in the model and are used to estimate stumpage values. All variables have the expected negative or positive effect on estimated stumpage value. First, the adjusted R-squared of .6484 indicates that the model explains about 65% of the variation in stumpage values. Given the number of factors that contribute to forest land value we consider this is a reasonably good fit. Comparing the dummy variables, stumpage in the Northwest and Southwest zones is more valuable and stumpage in the East zone is less valuable than the Central zone, which was used as a baseline. Regarding the stump-to-mill variables, increasing the acreage of a sale area increases the bid

price, which is expected due to economies of scale and fixed mobilization costs. The other stump-to-mill variables – percent skyline, road construction and maintenance, haul distance, and yard distance – increase the cost of logging and hauling, so they decrease the stumpage value with every increase in percentage point, mile, or foot, respectively. Interpreting the effects of the BBER index is not as straightforward because it is also squared; for the values of the sales in the sample, as the index increases the stumpage value increases as well.

A stumpage value for each zone and year was estimated using the regression coefficients and variable averages for each zone. The estimates were readjusted for inflation from 2018 dollars to their respective years. Table 3 displays the final stumpage value estimates. BBER index data was averaged by fiscal year and species breakdown in each zone. The solid lines in the table indicate reappraisal points. The table highlights the highest and lowest years, which are dropped from the stumpage value average for final value computation.

Table 3. Estimated Annual Stumpage Values

FY2023 Appraisal Olympic Average

Year	NW	SW	Central	East
2023	$211.87	$174.22	$168.41	$50.48
2022	$235.14	$201.06	$193.89	$61.47
2021	$259.86	$234.95	$205.02	$46.23
2020	$194.89	$169.82	$176.30	$9.22
2019	$217.38	$165.27	$185.04	$48.65
2018	$228.43	$175.57	$172.99	$37.35
2017	$200.23	$152.30	$150.99	$32.90
2016	$202.12	$159.91	$152.55	$34.92
2015	$271.01	$259.80	$287.77	$82.46
2014	$228.57	$198.00	$182.45	$31.84
Olympic Average	**$222.95**	**$184.85**	**$179.58**	**$42.98**

The 2022/2023 years saw a decrease in the Northwest, Southwest, and Central zones average price from high values in 2021. This is due to corrections in the market following the disruptive and inflationary shock of the COVID-19 pandemic. Nonetheless, expected price in the East remained relatively constant, in large part due to the consistent value of ponderosa pine over the last few years.