



Interior MARKET PRICING SYSTEM

Update – 2018

July 1, 2018

Timber Pricing
Branch

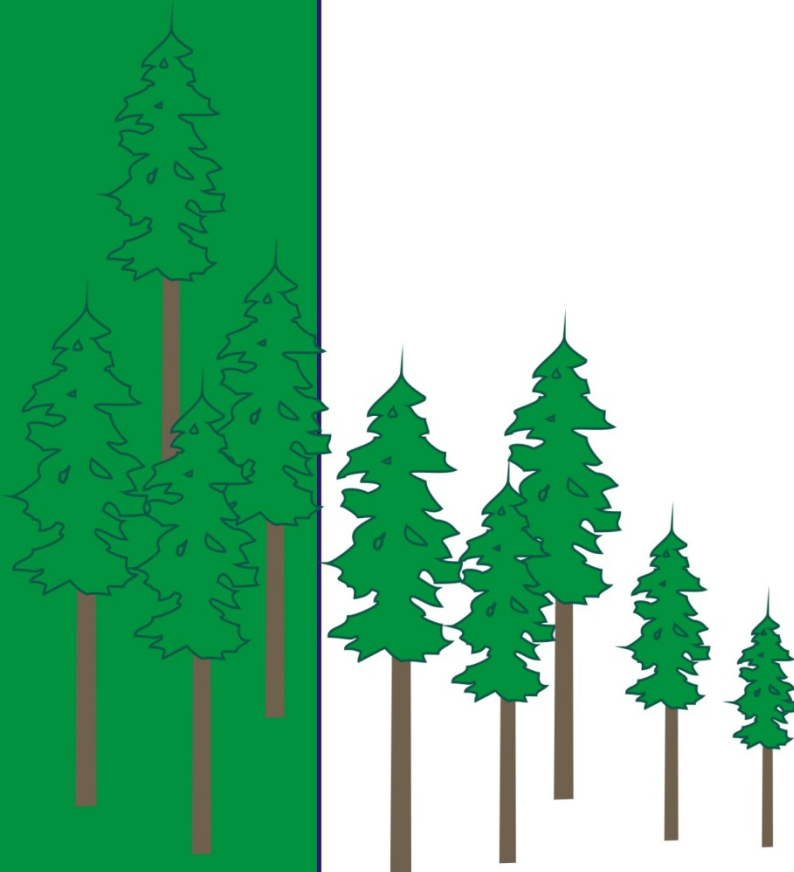


Table of Contents

1. Introduction.....	1
2. Auction Dataset.....	1
3. Equations.....	1
4. Specified Operations.....	6
5. Tenure Obligation Adjustments.....	7
6. Summary.....	7
Appendix 1.....	8
Final Estimated Winning Bid.....	8
Final Number of Bidders.....	9
Variables and definitions for equations.....	10
Appendix 2.....	13
Description of specified operations.....	13

Interior Market Pricing System: Update – 2018

1. INTRODUCTION

The purpose of this paper is to provide an overview of the July 1, 2018 update to the Interior Market Pricing System (MPS).¹

2. AUCTION DATASET

The new auction dataset used in the update contains winning bids and data from 2863 sales over the 11-year period January 1, 2007 through December 31, 2017.

3. EQUATIONS

The 2017 MPS equations were re-estimated with the new dataset to establish the benchmark equations, shown below. No other changes were made.

¹ This paper is not intended to provide the basis for calculating stumpage rates nor should it be used as guidance for interpreting the legal policies and procedures for calculating stumpage rates, which are contained in the *Interior Appraisal Manual*. The *Interior Appraisal Manual* contains the policies and procedures referred to in Section 105 of the *Forest Act*.

Interior Market Pricing System: Update – 2018

Estimated Winning Bid Equation

² Variable	2017 Equation		¹ Benchmark Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	5.035903	19.92352	5.322069	20.51442
Constant	6.114657	1.352278	11.90890	2.585851
Real Stand Selling Price	0.308813	30.25862	0.323410	31.70014
Cedar Fraction	15.01446	3.641550	14.62041	3.595547
Cedar Fraction*Cedar Decay	-105.8616	-6.169482	-108.2344	-6.272296
Hemlock Fraction	-13.31886	-9.256389	-13.94759	1.448120
Balsam Fraction	-4.619893	-4.119007	-5.235150	-4.734983
Larch Fraction + Yellow Pine Fraction	-6.925268	-2.188638	-10.96017	-3.446770
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-4.760375	-2.837317	-3.903509	-2.401711
Cable Yarding	-18.05816	-13.92709	-19.38370	-15.32447
LN(Volume/1000)	1.411551	6.677390	1.775786	8.265193
Decay Fraction	-14.46983	-3.089052	-13.96653	-2.946737
Fire Damaged Fraction	-10.37213	-3.637009	-10.82611	-3.561603
LN(VPH)	1.324141	2.197531	0.886483	1.431921
LN (Volume per Tree)	6.858243	13.42129	7.434972	14.18431
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.594167	-15.35166	-1.731589	-17.09460
Zone 9	-7.337254	-10.79707	-7.482190	-10.93551
Cruise Based * (1 – RG35)	-5.409600	-7.873639	-5.578793	-8.033381
Cruise Based * (RG35)	-5.764556	-10.47673	-5.203920	-9.502738
Decked Fraction	56.92729	4.787580	57.73184	4.995774
Ground Skid Slope Squared (15-50)	-0.006408	-4.225500	-0.006212	-4.084750
2016 Auctions	2.256344	3.568087	n/a	n/a
2017 Auctions	n/a	n/a	4.016055	6.150542
Grey Fraction	-0.975832	-7.025132	-1.329167	-11.73036
Exchange Rate	-24.88612	-10.49340	-31.05706	-14.90797
Total Interior Harvest	0.398547	11.30268	0.429144	11.56404
Blowdown	-8.172313	-2.185087	-11.45952	-2.899315
Deciduous (Cruise Based)	-10.55908	-4.142080	-12.01514	-4.600346
# of Observations	2,580		2,863	
Adjusted R ²	0.738819		0.764668	

¹2017 Equation using Updated Auction Set

²LN means the natural logarithm

Interior Market Pricing System: Update – 2018

Number of Bidders Equation

Dep. Var.= LN(NB) Variable	2017 Equation		¹ Benchmark Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.025940	25.50947	0.021198	25.01859
Constant	-0.514000	-8.978989	-0.451411	-8.186144
2016 Auctions	-0.289163	-8.683163	n/a	n/a
2017 Auctions	n/a	n/a	-0.255355	-6.779209
Cruise Based * (1 – (RG35))	0.148903	3.293183	0.082728	1.920233
Cruise Based * (RG35)	0.170049	6.342296	0.120363	4.782847
District Average Number of Bidders	0.251540	15.19785	0.264230	16.38619
Partial Cut Fraction	-0.720291	-3.108886	-0.571757	-2.583784
Slope	-0.007205	-7.137896	-0.006912	-7.171576
First and Second Quarter Auctions	0.080154	3.876889	0.088707	4.491787
Highway Haul	0.121060	4.200933	0.091307	3.351099
# of Observations	2,580		2,863	
Adjusted R ²	0.324349		0.303532	

¹2017 Equation using Updated Auction Set

The final equations, compared to the Benchmark Equations, are shown below.

Interior Market Pricing System: Update – 2018

Estimated Winning Bid Equation

² Variable	¹ Benchmark Equation		2018 Final Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	5.322069	20.51442	4.882293	18.73092
Constant	11.90890	2.585851	12.34014	2.701086
Real Stand Selling Price	0.323410	31.70014	0.321006	31.90652
Cedar Fraction	14.62041	3.595547	15.64885	3.901579
Cedar Fraction*Cedar Decay	-108.2344	-6.272296	-108.3408	-6.361644
Hemlock Fraction	-13.94759	1.448120	-16.95987	-11.57038
Balsam Fraction	-5.235150	-4.734983	-6.444100	-5.871217
Larch Fraction + Yellow Pine Fraction	-10.96017	-3.446770	-12.65617	-4.027727
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-3.903509	-2.401711	-4.637923	-2.890285
Cable Yarding	-19.38370	-15.32447	-19.66321	-15.69822
LN(Volume/1000)	1.775786	8.265193	1.857719	8.730014
Decay Fraction	-13.96653	-2.946737	-7.434944	-1.573458
Fire Damaged Fraction	-10.82611	-3.561603	-12.09745	-4.025529
LN(VPH)	0.886483	1.431921	0.906263	1.477537
LN (Volume per Tree)	7.434972	14.18431	7.970377	15.29429
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.731589	-17.09460	-1.331440	-12.20104
Zone 9	-7.482190	-10.93551	-8.595126	-12.36981
Cruise Based * (1 – RG35)	-5.578793	-8.033381	-5.906503	-8.617753
Cruise Based * (RG35)	-5.203920	-9.502738	-4.798896	-8.860104
Decked Fraction	57.73184	4.995774	53.67498	4.708957
Ground Skid Slope Squared (15-50)	-0.006212	-4.084750	-0.005954	-3.950435
2017 Auctions	4.016055	6.150542	4.386529	6.800024
Grey Fraction	-1.329167	-11.73036	-1.364460	-12.20796
Exchange Rate	-31.05706	-14.90797	-31.23580	-15.20823
Total Interior Harvest	0.429144	11.56404	0.429197	11.72246
Blowdown	-11.45952	-2.899315	-14.40353	-3.684896
Deciduous (Cruise Based)	-12.01514	-4.600346	-11.50487	-4.468151
Distance to Support Centre	n/a	n/a	-0.023724	-7.565300
Camp	n/a	n/a	-1.000290	-2.664921
Adjusted R ²	0.764668		0.771389	

¹2017 Equation using Updated Auction Set

²LN means the natural logarithm

Interior Market Pricing System: Update – 2018

Number of Bidders Equation

Variable	¹ Benchmark Equation		2018 Final Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.021198	25.01859	0.020570	23.98552
Constant	-0.451411	-8.186144	-0.391719	-7.104697
2017 Auctions	-0.255355	-6.779209	-0.246139	-6.479509
Cruise Based * (1 – (RG35))	0.082728	1.920233	0.076465	1.762103
Cruise Based * (RG35)	0.120363	4.782847	0.113136	4.454770
District Average Number of Bidders	0.264230	16.38619	0.251390	15.30768
Partial Cut Fraction	-0.571757	-2.583784	-0.545238	-2.446274
Slope	-0.006912	-7.171576	-0.006906	-7.109679
First and Second Quarter Auctions	0.088707	4.491787	0.091342	4.591913
Highway Haul	0.091307	3.351099	0.083135	3.029907
Adjusted R ²	0.303532		0.293247	

¹2017 Equation using Updated Auction Set

The new dataset is made up of 11 years of sales. The oldest year (2007) was preserved in order to make sure an entire market cycle is represented in the dataset, including the last major downturn. Two new variables were added, isolation and camp, which both help to improve the model with regard to remote areas.

To implement the new equation in the *Interior Appraisal Manual*, the two equations are reduced to one MPS equation. This is done by substituting the Number of Bidders equation into the Estimated Winning Bid Equation (and thereby eliminating the variable: LN (Number of Bidders)). See Appendix 1 for detailed statistics on the estimated winning bid and number of bidder's equations and variable definitions.

Interior Market Pricing System: Update – 2018

4. SPECIFIED OPERATIONS

The auction dataset used to develop the MPS equation is comprised of 2863 auctions. There are some harvesting situations that are not accounted for in the data and equation, and therefore a specified operation cost estimate may be used for these situations in the calculation of stumpage rates.

The specified operations are shown below and described in Appendix 2.

Specified Operations	Current Adjustment (October 1, 2017)	Update July 1, 2018
1. Rail Haul	Appraisal Manual	Appraisal Manual
2. Barge/Ferry	Appraisal Manual	Appraisal Manual
3. Dump, Boom, Tow, Dewater and Reload	Appraisal Manual	Appraisal Manual
4. Camp Costs	\$4.11/m ³ if rail Remote camps: \$3.53/m ³ All other camps: \$1.65/m ³	N/A
5. Skyline Yarding	\$3.99/m ³	\$2.85/m ³
6. Horse Logging	\$8.67/m ³	\$8.67/m ³
7. Market Logger Specified Operations Cost	\$0.09/m ³	\$0.07/m ³ Combined in Final Tenure Obligation Adjustment
8. Helicopter	\$96.75/m ³	\$99.64/m ³

Interior Market Pricing System: Update – 2018

5. TENURE OBLIGATION ADJUSTMENTS

As outlined in the Interior Tenure Obligations Adjustment paper (dated June 5, 2006), the adjustments are based on licensee data submitted in the Interior Log Cost Report.

The tenure obligation adjustments are shown below.

Tenure Obligation	Current Adjustment	Update October 1, 2017
Total Administration Cost	2014/15 Cost Base	2015/16 Cost Base
Development Cost	2014/15 Cost Base	2015/16 Cost Base
Total Road Management Cost	2014/15 Cost Base	2015/16 Cost Base
Market Logger Development Cost	\$1.35/m ³	\$1.39/m ³
Total Silviculture Cost	2014/15 Cost Base	2015/16 Cost Base
Return to Forest Management	1.041	1.042
Low Grade Percent Adjustment	Mark Specific 1/(1-%low grade/100)	Mark Specific 1/(1-%low grade/100)

6. SUMMARY

The new final equation, specified operations and tenure obligation adjustments will be used in the MPS for the Interior, starting July 1, 2018.

Interior Market Pricing System: Update – 2018

APPENDIX 1

FINAL ESTIMATED WINNING BID

Dependent Variable: BID*147.3/CPI

Method: Least Squares

Date: 05/17/18 Time: 12:41

Sample: 1 3337 IF NEW_LIVE_IN=1 AND D11_YEAR=1

Included observations: 2863

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.34014	4.568584	2.701086	0.0070
LN_NB	4.882293	0.260654	18.73092	0.0000
LUM_AMV*147.3/CPI	0.321006	0.010061	31.90652	0.0000
CE	15.64885	4.010902	3.901579	0.0001
CE*CEDAR_DECAY	-108.3408	17.03031	-6.361644	0.0000
HE	-16.95987	1.465800	-11.57038	0.0000
BA+2*(BA-0.5)*(BA>.5)	-6.444100	1.097575	-5.871217	0.0000
LA+YE	-12.65617	3.142262	-4.027727	0.0001
(FI+YE)*DRY_OR_DRM_DMH	-4.637923	1.604659	-2.890285	0.0039
CABLE*(AWARD_YEAR<=2010)	-2.758559	1.813450	-1.521167	0.1283
CABLE*(AWARD_YEAR>=2011)	-19.66321	1.252576	-15.69822	0.0000
LOG(CVOL/1000)	1.857719	0.212797	8.730014	0.0000
DECAY	-7.434944	4.725227	-1.573458	0.1157
FIRE	-12.09745	3.005181	-4.025529	0.0001
LOG(VPT)	7.970377	0.521134	15.29429	0.0000
LOG(VPH)	0.906263	0.613361	1.477537	0.1396
Z9	-8.595126	0.694847	-12.36981	0.0000
CYCLE+0.5*CYCLE_6PLUS	-1.331440	0.109125	-12.20104	0.0000
GREY*((AWARD_YEAR-2008)*(AWARD_YEAR>=2008)+3*(AWARD_YEAR-2015)*(AWARD_YEAR>=2015))*CB*D_RG35	-1.364460	0.111768	-12.20796	0.0000
CB*(1-D_RG35)	-5.906503	0.685388	-8.617753	0.0000
CB*D_RG35	-4.798896	0.541630	-8.860104	0.0000
DECKED	53.67498	11.39849	4.708957	0.0000
GS*GS_SLOPE_SQ_15_50	-0.005954	0.001507	-3.950435	0.0001
FX_3_0	-31.23580	2.053875	-15.20823	0.0000
HARVOL_S	0.429197	0.036613	11.72246	0.0000
NET_BLOWDOWN	-14.40353	3.908802	-3.684896	0.0002
NET_DECID*(CB+DECID_BONUS*SB)	-11.50487	2.574863	-4.468151	0.0000
D2017	4.386529	0.645075	6.800024	0.0000
(DSC-100)*(DSC>100)	-0.023724	0.003136	-7.565300	0.0000
CAMP	-1.000290	0.375354	-2.664921	0.0077
R-squared	0.773705	Mean dependent var	25.40943	
Adjusted R-squared	0.771389	S.D. dependent var	16.51768	

Interior Market Pricing System: Update – 2018

FINAL NUMBER OF BIDDERS

Dependent Variable: LOG(NB)

Method: Least Squares

Date: 05/17/18 Time: 13:06

Sample: 1 3337 IF NEW_LIVE_IN=1 AND D11_YEAR=1

Included observations: 2863

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.391719	0.055135	-7.104697	0.0000
BIDF*147.3/CPI	0.020570	0.000858	23.98552	0.0000
LUMPSUM*(1-D_RG35)	0.076465	0.043394	1.762103	0.0782
LUMPSUM*D_RG35	0.113136	0.025397	4.454770	0.0000
PARCUT	-0.545238	0.222885	-2.446274	0.0145
SLOPE	-0.006906	0.000971	-7.109679	0.0000
DANB_2863	0.251390	0.016422	15.30768	0.0000
HWY_TRAN	0.083135	0.027438	3.029907	0.0025
D_Q1+D_Q2	0.091342	0.019892	4.591913	0.0000
D2017	-0.246139	0.037987	-6.479509	0.0000
R-squared	0.295470	Mean dependent var		0.846580
Adjusted R-squared	0.293247	S.D. dependent var		0.627671

Interior Market Pricing System: Update – 2018

VARIABLES AND DEFINITIONS FOR EQUATIONS

Variable	Definition
2013 Auctions	If the auction sold in 2013, then AUC 2013 =1.
2014 Auctions	If the auction sold in 2014, then AUC 2014 =1.
2015 Auctions	If the auction sold in 2015, then AUC 2015 =1.
2016 Auctions	If the auction sold in 2016, then AUC 2016 =1.
2017 Auctions	If the auction sold in 2017, then AUC 2016 =1.
Balsam Fraction	Fraction of the Total Net Coniferous Volume that is balsam.
Blowdown	Blowdown fraction – grey fraction (can't be < 0)
Camp	1 if eligible for CAMP under IAM Section 3.2.30
Cable Yard Fraction	Fraction of harvest method volume that is appraised as overhead cable yarding (includes Skyline <600m horizontal).
Cable Yarding	Cable Yard Fraction – from 2013, 2014, 2015, 2016, 2017 auctions.
Cedar Decay Fraction	Cedar decay (%) from the appraisal summary report/100.
Cedar Fraction	Fraction of total net coniferous volume that is cedar.
Cedar Fraction * Cedar Decay Fraction	Fraction of total net coniferous volume that is cedar * Cedar decay (%) from the appraisal summary report/100.
Constant	Fixed value.
Cruise Based	1 if cruise based, 0 if scale based.
CYCLE	Hauling round trip cycle time (Primary CT (hrs) + Secondary CT (hrs)). See sections 3.5.1 and 3.5.2 of the Interior Appraisal Manual.
CYCLE_INC6	CYCLE – 6.0 hours. If <0, then 0.
Decay Fraction	Prorated coniferous species decay % (from appraisal summary report) / 100.
Deciduous Fraction	Fraction of the total net cruise volume that is the total net deciduous volume
Deciduous (Cruise Based)	Same as Deciduous Fraction but applies to cruise based only.
Decked Fraction	Fraction of cutting authority volume that has been decked and/or partially harvested in the timber sale licence. Cutting authority volume = total net cruise volume + volume of decked/partially harvested timber + right-of-way volume.
DSC (Distance to Support Centre)	Distance to Support Centre: see IAM section 3.2.29
District Average Number of Bidders	Average number of bidders for the district, in which the cutting authority area is located (see Table 3-2, section 3.3 Appraisal Manual).

Interior Market Pricing System: Update – 2018

District DRM or DMH	See 'Dry Belt'
Dry Belt	<p>Dry Belt = 1 if the cutting authority volume is located in the Rocky Mountain (DRM) or 100 Mile House (DMH) Forest Districts.</p> <p>Otherwise, Dry Belt is the fraction of the Net Merchantable Area of the cutting authority that is located in Dry Belt Douglas Fir Zones as per the table in the <i>Cruising Manual</i>. If the BEC zone/subzone combination does <u>not</u> appear in that table, then the following logic must apply:</p> <ul style="list-style-type: none"> - If the subzone is very dry (begins with x) then the zone/subzone combination is Dry Belt. - If the subzone is dry (begins with d) then the zone/subzone combination is Dry Belt only if the BEC zone is IDF, MS or PP. <p>If the subzone is not very dry or dry (does not begin with x or d) then the zone/subzone combination is not Dry Belt.</p>
Exchange Rate	US\$/C\$ (a stronger C\$ leads to a higher value) in decimal form.
Fir Fraction + Yellow Pine Fraction	Fraction of total net coniferous volume that is Douglas fir and yellow pine.
Fire Damaged Fraction	Fraction of total net coniferous volume that is fire damaged.
First and Second Quarter Auctions	If the auction sold in January to June, D_Q1 + Q2 = 1.
Forecast Real Winning Bid	Estimated winning bid from the estimated winning bid equation.
GREY	Fraction of total net coniferous volume that is grey Mountain Pine Beetle attacked lodgepole pine.
Grey Fraction	$GREY * 3 * (2018.5 - 2015) * Cruise_Based * RG35$
Ground Skid Slope Squared (15-50)	See 'GS_Slope' definition in Section 3.3 'Estimated Winning Bid Variables' of the Interior Appraisal Manual for more information.
HemBal Fraction	Fraction of total net coniferous volume that is hemlock and balsam.
Hemlock Fraction	Fraction of the Total Net Coniferous Volume that is hemlock.
Highway Haul	1 if primary haul method is highway, otherwise HWY = 0.
LAG	Lag in years. LAG = 0 if Zone 5 or Zone 6 as defined in Section 3.5 of the Interior Appraisal Manual or Cariboo Chilcotin District or Quesnel District,

Interior Market Pricing System: Update – 2018

	otherwise LAG = 2.
Larch Fraction + Yellow Pine Fraction	Fraction of total net coniferous volume that is larch and yellow pine.
Partial Cut Fraction	Fraction of the harvest method volume that is appraised as partial cut. $PC = (100 - CAPCUT\%) / 100$. See section 4.5 of Appraisal Manual for definition of CAPCUT%. The 80% limit in the definition of CAPCUT in section 4.5 does not apply.
RBID	Winning bid in 1997 dollars
Real Stand Selling Price	Estimated stand lumber value (\$/m ³) in 1997 dollars. Weighted average of (LRF * Lumber price by coniferous species). See Appraisal Manual section 3.2.
Red + Grey Attack Fraction	Fraction of total net coniferous volume that is red and grey mountain pine beetle attack.
RG35	1 if Total Net Coniferous Volume of timber on the cutting authority area is comprised of 35% or greater red and grey Mountain Pine Beetle attacked Lodgepole pine, otherwise RG35 = 0.
Slope	Cutting authority average slope from the appraisal summary report.
Total Interior Harvest	Total Interior harvest (million m ³) in a recent 12 month period. Includes all species and tenure types. Excludes waste.
Volume	The zonal volume from Table 3-3 (See Appraisal Manual section 3.3) for the cutting authority unless: <ol style="list-style-type: none"> 1. The cutting authority is a BCTS cutting authority; if so then use the Total Net Coniferous Volume for the cutting authority. 2. The cutting authority is not a BCTS cutting authority and, the sum of all the AAC's for all the licences that the licensee has in the same TSA as the cutting authority being appraised is less than the zonal volume indicated in Table 3-3 for the selling price zone in which the cutting authority is located, if so, then use the greater of: <ul style="list-style-type: none"> - The Total Net Coniferous Volume, or - The sum of the AAC volumes described above
Volume per Tree	Cutting authority average net volume per tree, from appraisal summary report (m ³).
Log volume per hectare	Natural logarithm of volume per hectare.

Interior Market Pricing System: Update – 2018

Zone 6	Skeena selling price zone variable. Zone 6 = 1 if cutting authority is appraised with selling price zone 6, otherwise Zone 6 = 0.
Zone 9	Fort Nelson – Peace selling price zone variable. Zone 9 = 1 if cutting authority is appraised with selling price zone 9, otherwise Zone 9 = 0.

APPENDIX 2

DESCRIPTION OF SPECIFIED OPERATIONS

If sufficient auction data is not available for an activity employed by either BCTS or other licences, the ministry may, for those identified situations, implement a specified operations cost estimate in the calculation of the stumpage rate.

The specified operations will be used to adjust the MPS stumpage rate for the estimated incremental cost of the identified situation. The explicit assumption is that if a bidder was faced with a similar situation he or she would lower the bid by the extra cost incurred because of the identified situation.

The situations that may be eligible for specified operations adjustment will be determined according to the following principles:

- the expectation that a bid would be influenced by this situation;
- representation (number of samples, if any, in the auction data set);
- materiality of estimated cost differential (supported by verifiable financial data); and,
- statistical analysis (including the premise that other represented situations and variables in the MPS database and equations may serve as a proxy for the situation in question).

The ministry, after considering the above and any other relevant technical information, may or may not designate the situation as an identified situation eligible for specified operations and, if eligible, will specify the dollars per cubic meter adjustment.

The ultimate objective is to have a representative auction database and hence, few, if any, specified operations adjustments.

The following are identified as specified operations for the Interior MPS. Cost estimates from the updated *Interior Appraisal Manual* are used for the following:

- Rail Haul
- Rail haul including truck to rail transfer and rail transport.
- Barge/Ferry
- Barge/ferry used to truck haul (private).
- Barge/ferry not used for truck haul (private).
- Dump and boom

Interior Market Pricing System: Update – 2018

- Tow
- Dewater and reload
- Camp costs
- Skyline Yarding
- Horse Logging
- Market Logger Specified Operations Cost
- High Development Cost (BCTS only)
- Helicopter