



Interior MARKET PRICING SYSTEM

Update – 2017

October 1, 2017

Timber Pricing
Branch



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1. INTRODUCTION

The purpose of this paper is to provide an overview of the October 1, 2017 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 2580 sales over the 10-year period January 1, 2007 through December 31, 2016.

3. EQUATIONS

The 2016 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*.

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Estimated Winning Bid Equation

² Variable	2016 Equation		¹ Benchmark Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	6.032858	16.70605	6.220824	14.31828
Constant	23.00715	6.876004	25.88712	9.569117
Real Stand Selling Price	0.132415	5.141023	0.162088	7.994867
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 – Zone 6)	12.00658	2.116891	4.582299	1.025713
HemBal Fraction	-14.61571	-7.457253	-18.44156	-9.472607
Larch Fraction + Yellow Pine Fraction	-8.618703	-2.364712	-14.53107	-3.198552
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-9.966618	-5.021126	-11.24036	-5.015454
Cable Yarding	-16.52532	-9.438077	-19.06436	-11.90281
LN(Volume/1000)	1.384464	5.285261	2.148750	6.754659
Decay Fraction	-34.11403	-3.957303	-30.61205	-4.719373
Fire Damaged Fraction	-4.743132	-1.382393	-6.009679	-1.415516
LN (Volume per Tree)	7.133896	8.821263	8.041577	9.976241
Volume per Hectare	0.001599	0.387642	-0.001931	-0.518449
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.490939	-10.82000	-1.797666	-12.13019
Zone 9	-7.944755	-9.218769	-10.96685	-9.953133
Deciduous Fraction	-13.38562	-4.634769	-16.20830	-4.823501
Cruise Based * (1 – RG35)	-6.987352	-8.268355	-8.434221	-7.697130
Cruise Based * (RG35)	-7.464388	-10.45138	-6.330613	-6.049185
Decked Fraction	51.02490	2.855244	-2.615055	-8.964730
Ground Skid Slope Squared (15-50)	-0.008225	-3.255271	-0.012542	-5.588297
2012 Auctions	2.600016	4.256970	n/a	n/a
2013 Auctions	5.688381	6.166426	3.017004	3.378635
2014 Auctions	8.827538	7.487416	5.976534	5.647912
2015 Auctions	12.29224	11.50943	10.13887	9.808094
2016 Auctions	n/a	n/a	13.16847	12.05387
Grey Fraction	-1.553657	-6.782405	-2.615055	-8.964730
# of Observations	1309		1371	
Adjusted R ²	0.753602		0.748728	

¹2016 Equation using Updated Auction Set

²LN means the natural logarithm

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Number of Bidders Equation

Variable	2016 Equation		¹ Benchmark Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.041707	28.57105	0.033528	27.26706
Constant	-0.518459	-7.340789	-0.415161	-5.665474
2012 Auctions	-0.161572	-4.078646	n/a	n/a
2013 Auctions	-0.368334	-9.641104	-0.183007	-4.646765
2014 Auctions	-0.548566	-13.19020	-0.324317	-7.819608
2015 Auctions	-0.627406	-15.84774	-0.411257	-10.13866
2016 Auctions	n/a	n/a	-0.448986	-10.88668
Cruise Based * (1 – (RG35))	0.389297	7.273312	0.305442	5.842121
Cruise Based * (RG35)	0.511616	13.83661	0.473698	12.92286
District Average Number of Bidders	0.142616	7.528449	0.106835	2.228615
Partial Cut Fraction	-0.621568	-2.084092	-0.380680	-1.414040
Slope	-0.003371	-2.822624	-0.001740	-1.474638
First and Second Quarter Auctions	0.049969	2.118669	0.052341	2.228615
Highway Haul	0.110756	3.213283	0.098966	2.924571
# of Observations	1,309		1,371	
Adjusted R ²	0.520020		0.459850	

¹2016 Equation using Updated Auction Set

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

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Estimated Winning Bid Equation

² Variable	¹ Benchmark Equation		2017 Final Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	6.220824	14.31828	5.035903	19.92352
Constant	25.88712	9.569117	6.114657	1.352278
Real Stand Selling Price	0.162088	7.994867	0.308813	30.25862
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 – Zone 6)	4.582299	1.025713	n/a	n/a
Cedar Fraction	n/a	n/a	15.01446	3.641550
Cedar Fraction*Cedar Decay	n/a	n/a	-105.8616	-6.169482
HemBal Fraction	-18.44156	-9.472607	n/a	n/a
Hemlock Fraction	n/a	n/a	-13.31886	-9.256389
Balsam Fraction	n/a	n/a	-4.619893	-4.119007
Larch Fraction + Yellow Pine Fraction	-14.53107	-3.198552	-6.925268	-2.188638
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-11.24036	-5.015454	-4.760375	-2.837317
Cable Yarding	-19.06436	-11.90281	-18.05816	-13.92709
LN(Volume/1000)	2.148750	6.754659	1.411551	6.677390
Decay Fraction	-30.61205	-4.719373	-14.46983	-3.089052
Fire Damaged Fraction	-6.009679	-1.415516	-10.37213	-3.637009
Volume per Hectare	0.001233	0.387642	n/a	n/a
LN(VPH)	n/a	n/a	1.324141	2.197531
LN (Volume per Tree)	8.041577	9.976241	6.858243	13.42129
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.797666	-12.13019	-1.594167	-15.35166
Zone 9	-10.96685	-9.953133	-7.337254	-10.79707
Deciduous Fraction	-16.20830	-4.823501	n/a	n/a
Cruise Based * (1 – RG35)	-8.434221	-7.697130	-5.409600	-7.873639
Cruise Based * (RG35)	-6.330613	-6.049185	-5.764556	-10.47673
Decked Fraction	70.11029	4.710803	56.92729	4.787580
Ground Skid Slope Squared (15-50)	-0.012542	-5.588297	-0.006408	-4.225500
2013 Auctions	3.017004	6.166426	n/a	n/a
2014 Auctions	5.976534	7.487416	n/a	n/a
2015 Auctions	10.13887	11.50943	n/a	n/a
2016 Auctions	13.16847	12.05387	2.256344	3.568087
Grey Fraction	-2.615055	-8.964730	-0.975832	-7.025132
Exchange Rate	n/a	n/a	-24.88612	-10.49340
Total Interior Harvest	n/a	n/a	0.398547	11.30268
Blowdown	n/a	n/a	-8.172313	-2.185087
Deciduous (Cruise Based)	n/a	n/a	-10.55908	-4.142080
# of Observations	1,371		2,580	
Adjusted R ²	0.748728		0.738819	

¹2016 Equation using Updated Auction Set

²LN means the natural logarithm

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Number of Bidders Equation

Variable	¹ Benchmark Equation		2017 Final Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.033528	27.26706	0.025940	25.50947
Constant	-0.415161	-5.665474	-0.514000	-8.978989
2013 Auctions	-0.183007	-4.646765	n/a	n/a
2014 Auctions	-0.324317	-7.819608	n/a	n/a
2015 Auctions	-0.411257	-10.13866	n/a	n/a
2016 Auctions	-0.448986	-10.88668	-0.289163	-8.683163
Cruise Based * (1 – (RG35))	0.305442	5.842121	0.148903	3.293183
Cruise Based * (RG35)	0.473698	12.92286	0.170049	6.342296
District Average Number of Bidders	0.106835	4.686098	0.251540	15.19785
Partial Cut Fraction	-0.380680	-1.414040	-0.720291	-3.108886
Slope	-0.001740	-1.474638	-0.007205	-7.137896
First and Second Quarter Auctions	0.052341	2.228615	0.080154	3.876889
Highway Haul	0.098966	2.924571	0.121060	4.200933
# of Observations	1,371		2,580	
Adjusted R ²	0.459850		0.324349	

¹2016 Equation using Updated Auction Set

For the 2017 update the auction dataset was lengthened to 10 years and all but the last annual dummy variables were removed. These changes were made to increase the overall market sensitivity of the model through increased power of the market variables and a reduction in the importance of the annual dummy variables. The longer scope of the dataset also allowed the introduction of some new market variables, further enhancing the market sensitivity of the final MPS equation.

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 bidders equations and variable definitions.

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4. SPECIFIED OPERATIONS

The auction dataset used to develop the MPS equation is comprised of 2580 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 (July 1, 2016)	Update October 1, 2017
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	$\$3.92/m^3$ if rail Remote camps: $\$3.37/m^3$ All other camps: $\$1.65/m^3$	$\$4.11/m^3$ if rail Remote camps: $\$3.53/m^3$ All other camps: Formula Based on CAMPV (Appraisal Manual)
5. Skyline Yarding	$\$4.07/m^3$	$\$3.99/m^3$
6. Horse Logging	$\$8.67/m^3$	$\$8.67/m^3$
7. Market Logger Specified Operations Cost	$\$0.07/m^3$	$\$0.09/m^3$ Combined in Final Tenure Obligation Adjustment
8. Helicopter	$\$95.64/m^3$	$\$96.75/m^3$

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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	\$1.30/m ³	\$1.35/m ³
Total Silviculture Cost	2014/15 Cost Base	2015/16 Cost Base
Return to Forest Management	1.035	1.041
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 October 1, 2017.

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APPENDIX 1

FINAL ESTIMATED WINNING BID

Dependent Variable: RBID
 Method: Least Squares
 Date: 08/21/17 Time: 15:18
 Sample: 1 3063 IF LIVE_IN=1
 Included observations: 2580

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.114657	4.521746	1.352278	0.1764
LOG(NB)	5.035903	0.252762	19.92352	0.0000
RSPI	0.308813	0.010206	30.25862	0.0000
CE	15.01446	4.123095	3.641550	0.0003
CE*CEDAR_DECAY	-105.8616	17.15892	-6.169482	0.0000
HE	-13.31886	1.438883	-9.256389	0.0000
BA+2*(BA-0.5)*(BA>.5)	-4.619893	1.121604	-4.119007	0.0000
LA+YE	-6.925268	3.164191	-2.188638	0.0287
(FI+YE)*DRY_OR_DRM_DMH	-4.760375	1.677773	-2.837317	0.0046
CABLE*(AWARD_YEAR<=2010)	-2.732014	1.629285	-1.676818	0.0937
CABLE*(AWARD_YEAR>=2011)	-18.05816	1.296621	-13.92709	0.0000
LOG(CVOL/1000)	1.411551	0.211393	6.677390	0.0000
DECAY	-14.46983	4.684229	-3.089052	0.0020
FIRE	-10.37213	2.851831	-3.637009	0.0003
LOG(VPT)	6.858243	0.510997	13.42129	0.0000
LOG(VPH)	1.324141	0.602558	2.197531	0.0281
CYCLE+.5*CYCLE_6PLUS	-1.594167	0.103843	-15.35166	0.0000
Z9	-7.337254	0.679560	-10.79707	0.0000
GREY*((AWARD_YEAR-2008)*(AWARD_YEAR>=2008)+3*(AWARD_YEAR-2015)*(AWARD_YEAR>=2015))*CB*D_RG35	-0.975832	0.138906	-7.025132	0.0000
CB*(1-D_RG35)	-5.409600	0.687052	-7.873639	0.0000
CB*D_RG35	-5.764556	0.550225	-10.47673	0.0000
DECKED	56.92729	11.89062	4.787580	0.0000
GS*GS_SLOPE_SQ_15_50	-0.006408	0.001517	-4.225500	0.0000
FX_3_0	-24.88612	2.371598	-10.49340	0.0000
TOT_HARV_12MR	0.398547	0.035261	11.30268	0.0000
NET_BLOWDOWN	-8.172313	3.740040	-2.185087	0.0290
NET_DECID*(CB+DECID_BONUS*SB)	-10.55908	2.549222	-4.142080	0.0000
D2016	2.256344	0.632368	3.568087	0.0004
R-squared	0.741553	Mean dependent var		23.52541
Adjusted R-squared	0.738819	S.D. dependent var		14.62645

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FINAL NUMBER OF BIDDERS

Dependent Variable: LOG(NB)
Method: Least Squares
Date: 10/11/17 Time: 08:39
Sample: 1 3063 IF LIVE_IN=1
Included observations: 2580

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.514000	0.057245	-8.978989	0.0000
RBIDF	0.025940	0.001017	25.50947	0.0000
LUMPSUM*(1-D_RG35)	0.148903	0.045216	3.293183	0.0010
LUMPSUM*D_RG35	0.170049	0.026812	6.342296	0.0000
PARCUT	-0.720291	0.231688	-3.108886	0.0019
SLOPE	-0.007205	0.001009	-7.137896	0.0000
DANB_2580	0.251540	0.016551	15.19785	0.0000
HWY_TRAN	0.121060	0.028818	4.200933	0.0000
D_Q1+D_Q2	0.080154	0.020675	3.876889	0.0001
D2016	-0.289163	0.033302	-8.683163	0.0000
R-squared	0.326707	Mean dependent var		0.843084
Adjusted R-squared	0.324349	S.D. dependent var		0.632881

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VARIABLES AND DEFINITIONS FOR EQUATIONS

Variable	Definition
2012 Auctions	If the auction sold in 2012, then AUC 2012 =1.
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.
Balsam Fraction	Fraction of the Total Net Coniferous Volume that is balsam.
Blowdown	Blowdown fraction minus grey fraction (can't be <0)
Cable Yarding	Fraction of harvest method volume that is appraised as overhead cable yarding (includes Skyline <600m horizontal).
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.
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).
District DRM or DMH	See 'Dry Belt'
Dry Belt	Dry Belt = 1 if the cutting authority volume is located in the Rocky Mountain (DRM) or 100 Mile House

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	<p>(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	$GREY * (Award\ Year - 2008 - LAG) * Cruise\ Based * RG35$
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, otherwise $LAG = 2$.
Larch Fraction + Yellow Pine Fraction	Fraction of total net coniferous volume that is larch

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	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 Hectare	Net coniferous volume per hectare (m ³ /ha)
Log volume per hectare	Natural logarithm of VPH
Volume per Tree	Cutting authority average net volume per tree, from appraisal summary report (m ³).

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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

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