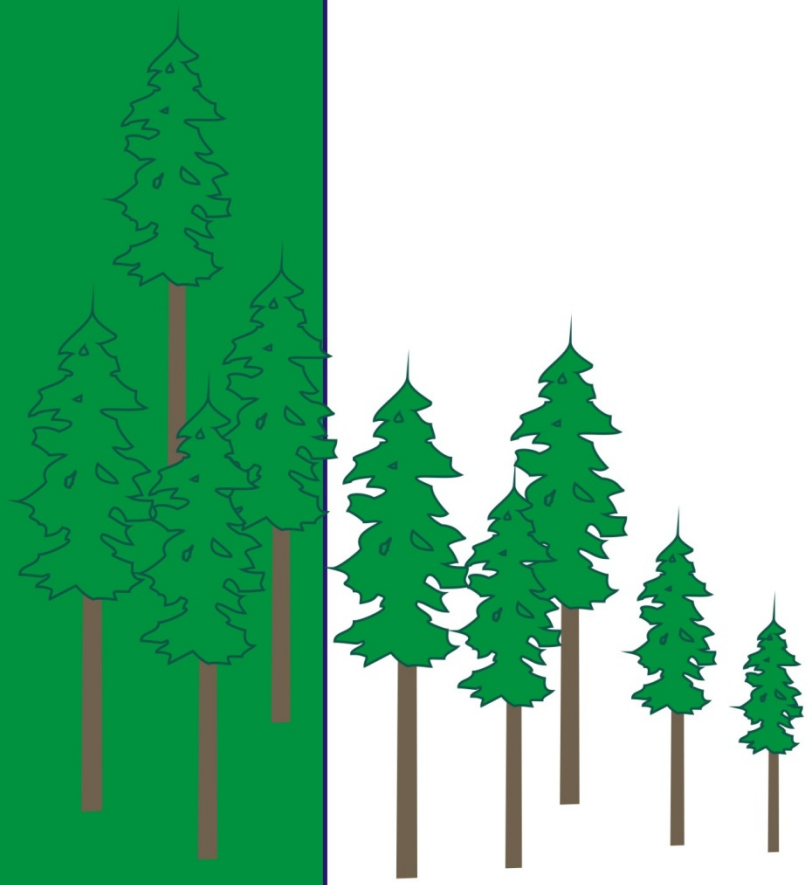
Interior

MARKET PRICING SYSTEM

Update – 2015



July 1, 2015

Timber Pricing Branch

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Interior Market Pricing System: Update – 2015

1. INTRODUCTION

The purpose of this paper is to provide an overview of the July 1, 2015 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 1243 sales over the 5-year period January 1, 2010 through December 31, 2014.

3. EQUATIONS

The 2014 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*.

Estimated Winning Bid Equation

[2]Variable	2014 Equation		[1]Benchmark Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	3.274986	15.26961	4.119237	16.95292
Constant	7.237511	2.009679	7.765104	2.110993
Real Stand Selling Price	0.166190	7.487572	0.200046	8.776963
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 – Zone 6)	18.30951	3.814480	11.95035	2.739725
HemBal Fraction	-8.193420	-7.009397	-6.641310	-5.292600
Larch Fraction + Yellow Pine Fraction	-8.176076	-3.096321	-7.583395	-2.822176
(Fir Fraction + Yellow Pine Fraction) * Dry Belt	-2.852114	-1.303679	-3.485418	-1.631010
Cable Yarding (2010 or earlier)	-3.563543	-2.416469	1.080918	0.670686
Cable Yarding (2011 or later)	-12.42911	-9.117514	-13.10269	-11.01594
LN(Volume/1000)	1.016810	5.412050	0.967286	4.998092
Decay Fraction	-15.19305	-3.709597	-19.29742	-4.300427
Fire Damaged Fraction	-9.325636	-3.061021	-10.38216	-3.628434
LN (Volume per Tree)	4.225069	9.489971	4.017571	8.893693
LN (Volume per Hectare)	0.674758	1.238620	0.193540	0.365782
Cycle + 0.5 *(Cycle – 6.0 hours)	-0.976571	-10.60741	-1.084100	-11.99040
Zone 9	-4.051397	-7.351561	-4.203958	-6.911460
Deciduous Fraction	-6.631968	-3.169185	-9.511929	-3.677888
Cruise Based * (1 – RG35)	-4.721216	-8.286026	-4.409381	-7.100474
Cruise Based * (RG35)	-5.282856	-14.13340	-5.136118	-11.87908
2010 Auctions	-0.051269	-0.130129	n/a	n/a
2011 Auctions	2.299693	5.300991	2.490973	6.545343
2012 Auctions	3.950930	6.899441	4.086012	8.712726
2013 Auctions	5.519684	-0.971210	4.952688	7.477043
2014 Auctions	n/a	n/a	6.289019	7.509209
Grey Fraction	-0.971210	-5.268556	-0.871111	-5.006977
Adjusted R^2	0.720734		0.757905	

[1]2014 Equation using Updated Auction Set

[2]LN means the natural logarithm

Number of Bidders Equation

Variable	2014 Equation		[1]Benchmark Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.069830	21.43159	0.061803	24.01268
Constant	-0.815361	-11.56033	-0.616266	-8.989008
2010 Auctions	-0.000865	-0.018732	n/a	n/a
2011 Auctions	-0.016713	-0.363231	-0.000150	-0.003689
2012 Auctions	-0.216965	-4.582057	-0.177770	-4.371450
2013 Auctions	-0.462285	-8.952072	-0.420970	-9.751602
2014 Auctions	n/a	n/a	-0.574501	-13.04564
Cruise Based * (1 – (RG35))	0.366326	6.076211	0.362057	6.432101
Cruise Based * (RG35)	0.513568	12.57798	0.476614	12.64786
District Average Number of Bidders	0.202823	11.80530	0.165749	9.643735
Partial Cut Fraction	-1.124057	-3.425801	-1.222853	-3.571986
Slope	-0.008599	-6.006887	-0.007223	-5.896301
First and Second Quarter Auctions	0.105665	3.876285	0.095363	3.861752
Highway Haul	0.094700	2.636562	0.105377	2.952617
Adjusted R^2	0.483971		0.523989	

[1]**2014 Equation using Updated Auction Set**

New variables were tested to see if they would improve the statistics, compared to the benchmark equations. Likewise, variables that were no longer significant were removed. The final data set contains 1243 auction sales.

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

Estimated Winning Bid Equation

[2]Variable	[1]Benchmark Equation		2015 Final Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	4.119237	16.95292	3.924738	16.12446
Constant	7.765104	2.110993	8.010398	4.075526
Real Stand Selling Price	0.200046	8.776963	0.199396	8.870234
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 – Zone 6)	11.95035	2.739725	13.08726	2.924057
HemBal Fraction	-6.641310	-5.292600	-6.907073	-5.279347
Larch Fraction + Yellow Pine Fraction	-7.583395	-2.822176	-5.254702	-1.983534
(Fir Fraction + Yellow Pine Fraction) * Dry Belt	-3.485418	-1.631010	n/a	n/a
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	n/a	n/a	-4.767119	-2.284386
Cable Yarding (2010)	1.080918	0.670686	0.377003	0.230215
Cable Yarding (2011 or later)	-13.10269	-11.01594	-13.69855	-11.02807
LN(Volume/1000)	0.967286	4.998092	0.871630	4.521861
Decay Fraction	-19.29742	-4.300427	-20.31622	-4.326746
Fire Damaged Fraction	-10.38216	-3.628434	-8.319698	-3.597722
LN (Volume per Tree)	4.017571	8.893693	3.776852	8.378435
LN (Volume per Hectare)	0.193540	0.365782	n/a	n/a
Volume per Hectare	n/a	n/a	0.004971	2.067810
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.084100	-11.99040	-1.090347	-12.21274
Zone 9	-4.203958	-6.911460	-4.366803	-7.292188
Deciduous Fraction	-9.511929	-3.677888	-8.915075	-3.902107
Cruise Based * (1 – RG35)	-4.409381	-7.100474	-4.506163	-7.113684
Cruise Based * (RG35)	-5.136118	-11.87908	-5.223666	-11.97857
Decked Fraction	n/a	n/a	34.74072	2.728463
Ground Skid Slope Squared (15-50)	n/a	n/a	-0.004903	-3.233063
2011 Auctions	2.490973	6.545343	2.491357	6.544849
2012 Auctions	4.086012	8.712726	4.133419	8.733717
2013 Auctions	4.952688	7.477043	5.030823	7.571774
2014 Auctions	6.289019	7.509209	6.378405	7.630386
Grey Fraction	-0.871111	-5.006977	-0.868056	-4.950982
Adjusted R^2	0.757905		0.762461	

[1]2014 Equation using Updated Auction Set

[2]LN means the natural logarithm

Number of Bidders Equation

Variable	[1]Benchmark Equation		2015 Final Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.061803	24.01268	0.060408	23.85836
Constant	-0.616266	-8.989008	-0.636928	-9.172693
2011 Auctions	-0.000150	-0.003689	0.003211	0.078016
2012 Auctions	-0.177770	-4.371450	-0.172023	-4.188007
2013 Auctions	-0.420970	-9.751602	-0.412015	-9.496835
2014 Auctions	-0.574501	-13.04564	-0.563187	-12.76312
Cruise Based * (1 – (RG35))	0.362057	6.432101	0.355234	6.320825
Cruise Based * (RG35)	0.476614	12.64786	0.476321	12.52385
District Average Number of Bidders	0.165749	9.643735	0.168910	9.739657
Partial Cut Fraction	-1.222853	-3.571986	-1.135744	-3.370085
Slope	-0.007223	-5.896301	-0.006042	-4.942258
First and Second Quarter Auctions	0.095363	3.861752	0.099512	3.994412
Highway Haul	0.105377	2.952617	0.110019	3.043054
Adjusted R^2	0.523989		0.515516	

[1]2014 Equation using Updated Auction Set

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)). The two equations together result in greater statistical accuracy and reliability compared to the 2014 benchmark equations. See Appendix 1 for detailed statistics on the estimated winning bid and number of bidders equations and variable definitions.

4. SPECIFIED OPERATIONS

The auction dataset used to develop the MPS equation is comprised of 1243 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	Update July 1, 2015
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	$2.62/$m^3$ if rail Remote camps: $1.93/$m^3$ All other camps: $1.11/m3	$3.61/$m^3$ if rail Remote camps: $3.66/$m^3$ All other camps: $1.35/m3
5. Skyline Yarding	$5.92/$m^3$	$4.34/$m^3$
6. Horse Logging	$8.67/$m^3$	$8.67/$m^3$
7. Market Logger Specified Operations Cost	$0.06/$m^3$	$0.08/$m^3$
8. Helicopter	$78.08/m3	$88.59/$m^3$

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 July 1, 2015
Total Administration Cost	2011/12 Cost Base	2012/13 Cost Base
Development Cost	2011/12 Cost Base	2012/13 Cost Base
Total Road Management Cost	2011/12 Cost Base	2012/13 Cost Base
Market Logger Road Cost	$1.17/$m^3$	$1.30/$m^3$
Total Silviculture Cost	2011/12 Cost Base	2012/13 Cost Base
Return to Forest Management	1.022	1.031
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, 2015.

APPENDIX 1

FINAL ESTIMATED WINNING BID

Dependent Variable: RBID (Winning Bid in 1997 Dollars)
Method: Least Squares
Date: 04/13/15 Time: 11:41
Sample: 1 2058 IF LIVE_IN=1
Included observations: 1243
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	8.010398	1.965488	4.075526	0.0000
LN (Number of Bidders)	3.924738	0.243403	16.12446	0.0000
Real Stand Selling Price	0.199396	0.022479	8.870234	0.0000
Cedar Fraction * (1-Cedar Decay Fraction) * (1 – Zone 6)	13.08726	4.475722	2.924057	0.0035
HemBal Fraction	-6.907073	1.308320	-5.279347	0.0000
Larch Fraction + Yellow Pine Fraction	-5.254702	2.649162	-1.983534	0.0475
(Fir Fraction + Yellow Pine Fraction * Dry Belt) OR (District DRM or DMH)	-4.767119	2.086828	-2.284386	0.0225
Cable Yarding (2010)	0.377003	1.637613	0.230215	0.8180
Cable Yarding (2011 to 2014)	-13.69855	1.242153	-11.02807	0.0000
LN (Volume/1000)	0.871630	0.192759	4.521861	0.0000
Decay Fraction	-20.31622	4.695496	-4.326746	0.0000
Fire Damaged Fraction	-8.319698	2.312491	-3.597722	0.0003
LN (Volume per Tree)	3.776852	0.450783	8.378435	0.0000
Volume per Hectare	0.004971	0.002404	2.067810	0.0389
Cycle + 0.5 (Cycle – 6 hours)	-1.090347	0.089279	-12.21274	0.0000
Zone 9	-4.366803	0.598833	-7.292188	0.0000
Deciduous Fraction	-8.915075	2.284682	-3.902107	0.0001
Cruise Based *(1- RG35)	-4.506163	0.633450	-7.113684	0.0000
Cruise Based * RG35	-5.223666	0.436084	-11.97857	0.0000
Grey Fraction	-0.868056	0.175330	-4.950982	0.0000
Decked Fraction	34.74072	12.73271	2.728463	0.0065
Ground Skid Slope Squared (15-50)	-0.004903	0.001517	-3.233063	0.0013
2011 Auctions	2.491357	0.380659	6.544849	0.0000
2012 Auctions	4.133419	0.473271	8.733717	0.0000
2013 Auctions	5.030823	0.664418	7.571774	0.0000
2014 Auctions	6.378405	0.835922	7.630386	0.0000

R-squared	0.767242	Mean dependent var	16.07069
Adjusted R-squared	0.762461	S.D. dependent var	9.554342

FINAL NUMBER OF BIDDERS

Dependent Variable: LN (Number of Bidders)
Method: Least Squares
Date: 04/13/15 Time: 11:52
Sample: 1 2058 IF LIVE_IN=1
Included observations: 1243
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-0.636928	0.069437	-9.172693	0.0000
Forecast Real Winning Bid	0.060408	0.002532	23.85836	0.0000
Cruise Based *(1- RG35)	0.355234	0.056201	6.320825	0.0000
Cruise Based * RG35	0.476321	0.038033	12.52385	0.0000
2011 Auctions	0.003211	0.041152	0.078016	0.9378
2012 Auctions	-0.172023	0.041075	-4.188007	0.0000
2013 Auctions	-0.412015	0.043384	-9.496835	0.0000
2014 Auctions	-0.563187	0.044126	-12.76312	0.0000
District Average Number of Bidders	0.168910	0.017343	9.739657	0.0000
Partial Cut Fraction	-1.135744	0.337008	-3.370085	0.0008
Slope	-0.006042	0.001223	-4.942258	0.0000
First and Second Quarter Auctions	0.099512	0.024913	3.994412	0.0001
Highway Haul	0.110019	0.036154	3.043054	0.0024

R-squared	0.520197	Mean dependent var	0.854459
Adjusted R-squared	0.515516	S.D. dependent var	0.626788

VARIABLES AND DEFINITIONS FOR EQUATIONS

Variable	Definition
2010 Auctions	If the auction sold in 2010, then AUC 2010 =1.
2011 Auctions	If the auction sold in 2011, then AUC 2011 =1.
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.
Cable Yard Fraction	Fraction of harvest method volume that is appraised as overhead cable yarding (includes Skyline <600m horizontal).
Cable Yarding (2010 or earlier)	Cable Yard Fraction – from 2010 or earlier auctions
Cable Yarding (2011 or later)	Cable Yard Fraction – from 2011, 2012, 2013 or 2014 auctions
Cedar Decay Fraction	Cedar decay (%) from the appraisal summary report/100
Cedar Fraction	Fraction of total net coniferous volume that is cedar.
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
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 (DMH) Forest Districts.

	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 *Cruising Manual*. If the BEC zone/subzone combination does <u>not</u> appear in that table, then the following logic must apply: - 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. 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.
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.
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 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 ($/m3) 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.
Volume	The zonal volume from Table 3-3 (See Appraisal Manual section 3.3) for the cutting authority unless: 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: - 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)
Volume per Tree	Cutting authority average net volume per tree, from appraisal summary report (m3).
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 licenses, 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 metre 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
- Tow
- Dewater and reload
- Camp costs
- Skyline Yarding
- Horse Logging
- Market Logger Specified Operations Cost
- High Development Cost (BCTS only)
- Helicopter