Appendix 1 – Assessment of Operational Adjustment Factors for Seismic Lines

Assessment of Operational Adjustment Factors for Seismic Lines

Rationale

Past timber supply analyses have used a net area approach to account for seismic activity within the FMA in order to substantially reduce the number of polygon slivers and complexity of the net landbase for modeling. The net area technique identifies the existing seismic lines on the landbase and calculates a net area for those landbase polygons that contain seismic (total area - seismic area). That net area is then used within the wood supply model to account for seismic depletions without increasing and fragmenting the net landbase. The seismic net down persists in those stands for the entire planning horizon and becomes a permanent landbase withdrawal.

For the 2015 TSA we propose an alternate method to address seismic line disturbances. This method correctly accounts for current disturbances, and also accounts for the restoration and reforestation of legacy seismic disturbances over time. This method calculates the operational adjustment factors by strata and FMU for the operable portion of the landbase that has not already been harvested and restored. The operational adjustment factors (OAF) are based on the ratio of seismic area to available forest for each strata by FMU. The adjustment factor is applied to the yield curves for the natural forest. After harvest, the seismic disturbance within polygons will have been restored, and the polygons will use yield curves without the operational adjustment factors. The spatial variation of seismic activity within areas of the FMA is accounted for by calculating unique factors for each FMU/YC combination.

A sensitivity analysis of the two seismic accounting systems was undertaken to assess any significant impacts to wood supply using the proposed operational adjustment factor (OAF) technique. FMU S23 and A14 were assessed for seismic impacts using simple maximum even-flow wood scenarios. We expect that the maximum sustainable yield estimates will increase marginally, since over time more land is restored and returned to productive conditions.

Assumptions

Two Patchworks models were developed (FMUs A14 and S23) to assess the difference between the two seismic accounting methods. The traditional net area seismic model was created using the F_AREA field in the modeling version of the net landbase (June 5th, 2015 version). The F_AREA field removes the seismic area from the original area of each polygon. No factors were applied to the yield curves in this model. This model and scenario were referred to as 'seismic'. Table 1 summarizes the amount of seismic area within the FMA by FMU for each of the natural condition (pre-harvest) strata on the available landbase.

Table 1. The amount of seismic area by strata type and FMU within the managed (active) landbase.

Strata	YC #	Area of seismic by strata and FMU (hectares)											
		A14	A15	L1	L11	L2	L3	L8	S11	S14	S18	S22	S23
Aw	1	211	330	665	1218	436	252	252	1412	1394	652	1549	710
AwU	2	454	498	89	333	463	92	69	761	1428	917	884	381
AwSx	3	62	68	65	93	109	76	21	206	189	189	151	68
SxAw	4	47	42	53	47	144	68	20	112	136	185	92	51
Sw	5	189	115	96	132	208	208	58	292	478	288	231	109
SbFM	6	215	0	0	0	0	262	0	0	0	0	0	0
SbG	7	163	52	42	163	104	171	21	93	47	80	60	63
PjMx	8	76	48	25	84	32	33	5	206	193	60	74	33
Pj	9	228	281	247	882	118	102	83	882	992	203	467	148

The alternative model was developed using the ORIG_AREA within the net landbase that represented the original polygon area with no seismic reductions. Operational adjustment factors ((ORIG_AREA-SEIS_AREA)/ORIG_AREA) were calculated for each natural condition no-harvest strata in each FMU for the available forest. The operational adjustment factors are applied to the yield curves for natural unharvested strata only and are not applied to the post-harvest stands. Unharvested stands receive the seismic netdown, and post harvest stands are assumed to have seismic lines restored and have productivity on 100% of the area. Table 2 summarizes the operational factors applied across the FMA for the 'OAF' model.

Table 2. The operational adjustment factors calculated by strata and FMU for seismic reductions to yield curves.

Strata	YC #	Operational Adjustment Factors for seismic lines by FMU and operable natural strata in Al-Pac FMA											
		A14	A15	L1	L11	L2	L3	L8	S11	S14	S18	S22	S23
Aw	1	0.993	0.994	0.983	0.984	0.978	0.989	0.983	0.969	0.966	0.982	0.985	0.965
AwU	2	0.99	0.994	0.983	0.983	0.979	0.988	0.987	0.969	0.963	0.981	0.985	0.968
AwSx	3	0.993	0.994	0.984	0.986	0.978	0.991	0.989	0.969	0.966	0.982	0.986	0.973
SxAw	4	0.993	0.994	0.985	0.987	0.977	0.993	0.99	0.968	0.97	0.983	0.986	0.975
Sw	5	0.993	0.996	0.985	0.987	0.981	0.991	0.987	0.97	0.97	0.984	0.987	0.971

SbFM	6	0.988	1	1	1	1	0.983	1	1	1	1	1	1
SbG	7	0.989	0.993	0.985	0.987	0.979	0.985	0.984	0.966	0.959	0.984	0.984	0.968
PjMx	8	0.989	0.994	0.986	0.985	0.98	0.984	0.983	0.969	0.962	0.981	0.984	0.965
Pj	9	0.994	0.993	0.988	0.981	0.982	0.988	0.986	0.97	0.964	0.982	0.986	0.969

Impacts

Two scenarios were run for each of the FMUs: one each for the net area model and OAF model, for a total of 4 scenarios. All scenarios used the same harvest flow policy objectives. The traditional net area technique scenario is referred to as 'maxEven_seismic' and the factored yield curve technique is referred to as 'maxEven_oaf' (Table 3 and Table 4 Scenario Design).

Table 3. Scenario design and objectives for FMU 23 seismic sensitivity analysis.

Scenario Name	Description	Flow policy		Transitions Silviculture	Preblock schedule	Growing stock	Transportation objectives	Yield Curves	Seismic
		Max evenflow primary Con/Dec by FMU	Light weighting on incidental flow control	Control transitions for understory protection, control access to SbFM in FMUs and transitions of AwSx,SxAw,Sw	Manually schedule preblocks selected by companys	NDY last 50 years by primary operable	Active control on maintenance, hauling and construction costs as a ratio of volume harvested ($/m3)	Test yield curve variations for long term decline (original curve, 50% or 70% of peak volume flatlined)	Traditional net area method (F_AREA) or seismic retention factors (OAF) for natural yield curves.
V1_S23_BAU_maxEven_seismic	max even flow on primary and NDY OPGS, no succession with original yield curves and net area (no yield curve factors).	Max evenflow Primary.Conif Primary.Decid	NA	AwU transitional ratio (70%/15%/15%)	Preblock schedule Deferrals Allow additional harvest in P1/P2	Primary OPGS NDY for last 50 years	NA	Original without succession	Polygon net area (raw yield curves)
V1_S23_BAU_maxEven_oaf	max even flow scenario with no succession and original yield curves with OAF applied.	Max evenflow Primary.Conif Primary.Decid	NA	AwU transitional ratio (70%/15%/15%)	Preblock schedule Deferrals Allow additional harvest in P1/P2	Primary OPGS NDY for last 50 years	NA	Original without succession	OAF applied to yc 1-9

The results from FMU S23 show very little difference to wood supply using the two seismic techniques for both primary conifer and deciduous (Figure 1 and Figure 2). The 150-year average harvest was 0.1% lower for conifer and 0.3% higher for deciduous.

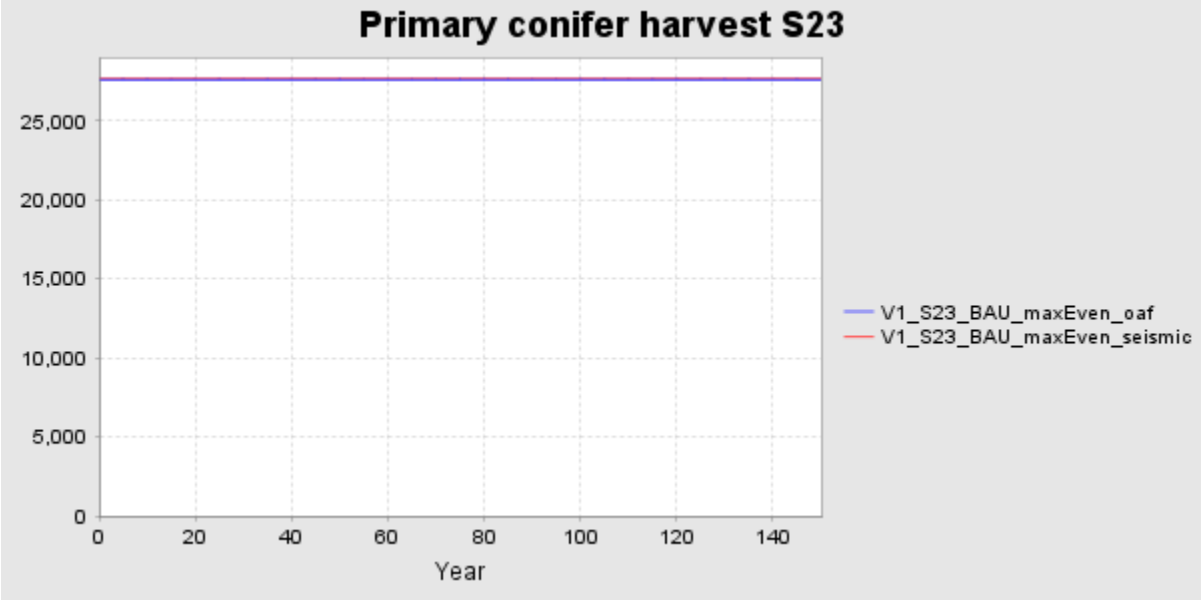

Figure 1. Comparison of primary conifer harvest for FMU 23 using the tradition net area seismic technique and yield curve reduction factors (OAF).

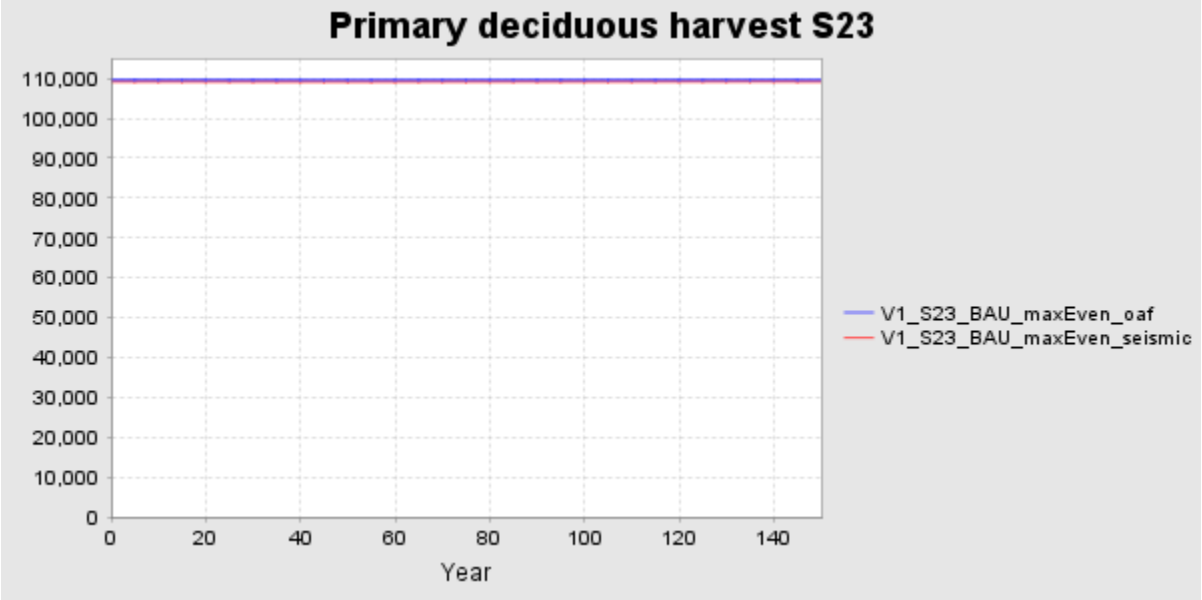

Figure 2. Comparison of primary deciduous harvest for FMU S23 using net area seismic technique and yield curve reductions (oaf).

The two scenarios were simulated for FMU A14 in the north eastern FMA (Table 4). This is a larger unit with potentially more oil and gas activity and therefore provided different conditions to FMU S23.

Table 4. Scenario design and objectives for FMU A14 seismic sensitivity analysis.

Scenario Name	Description	Flow policy		Transitions Silviculture	Preblock schedule	Growing stock	Transportation objectives	Yield Curves	Seismic
		Max evenflow primary Con/Dec by FMU	Light weighting on incidental flow control	Control transitions for understory protection, control access to SbFM in FMUs and transitions of AwSx,SxAw,Sw	Manually schedule preblocks selected by companys	NDY last 50 years by primary operable	Active control on maintenance, hauling and construction costs as a ratio of volume harvested ($/m3)	Test yield curve variations for long term decline (original curve, 50% or 70% of peak volume flatlined)	Traditional net area method (F_AREA) or seismic retention factors (OAF) for natural yield curves.
V1_A14_BAU_maxEven_seismic	max even flow on primary and NDY OPGS, no succession with original yield curves and net area (no yield curve factors).	Max evenflow Primary.Conif Primary.Decid	NA	AwU transitional ratio (70%/15%/15%) YC 3,4,5 transitional ratio SbFM control	Preblock schedule Deferrals Allow additional harvest in P1/P2	Primary OPGS NDY for last 50 years	NA	Original without succession	Polygon net area (raw yield curves)
V1_A14_BAU_maxEven_oaf	max even flow on primary and NDY OPGS, no succession with original yield curves with sesimic operational adjustment factors applied.	Max evenflow Primary.Conif Primary.Decid	NA	AwU transitional ratio (70%/15%/15%) YC 3,4,5 transitional ratio SbFM control	Preblock schedule Deferrals Allow additional harvest in P1/P2	Primary OPGS NDY for last 50 years	NA	Original without succession	OAF applied to yc 1-9

Comparison of wood supply for both the primary conifer and deciduous shows very little difference over the long term planning horizon (Figure 3 and Figure 4). The 150-year average harvest was 0.8% higher for conifer and 1.0% higher for deciduous.

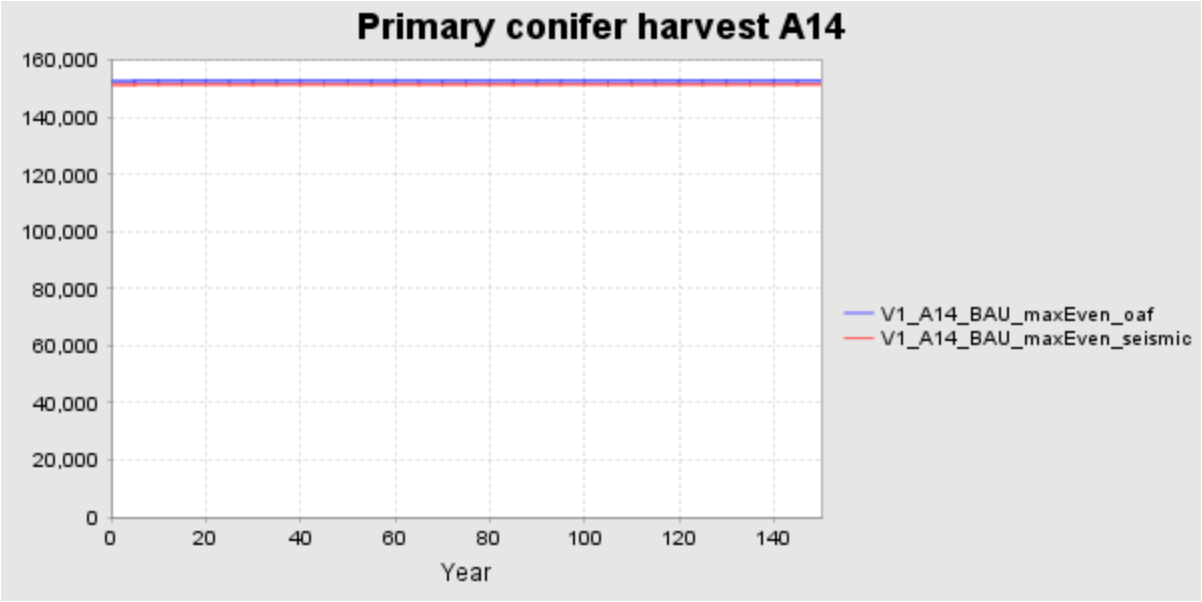

Figure 3. Comparison of primary conifer harvest from FMU A14 using net area seismic technique and yield curve reduction (oaf).

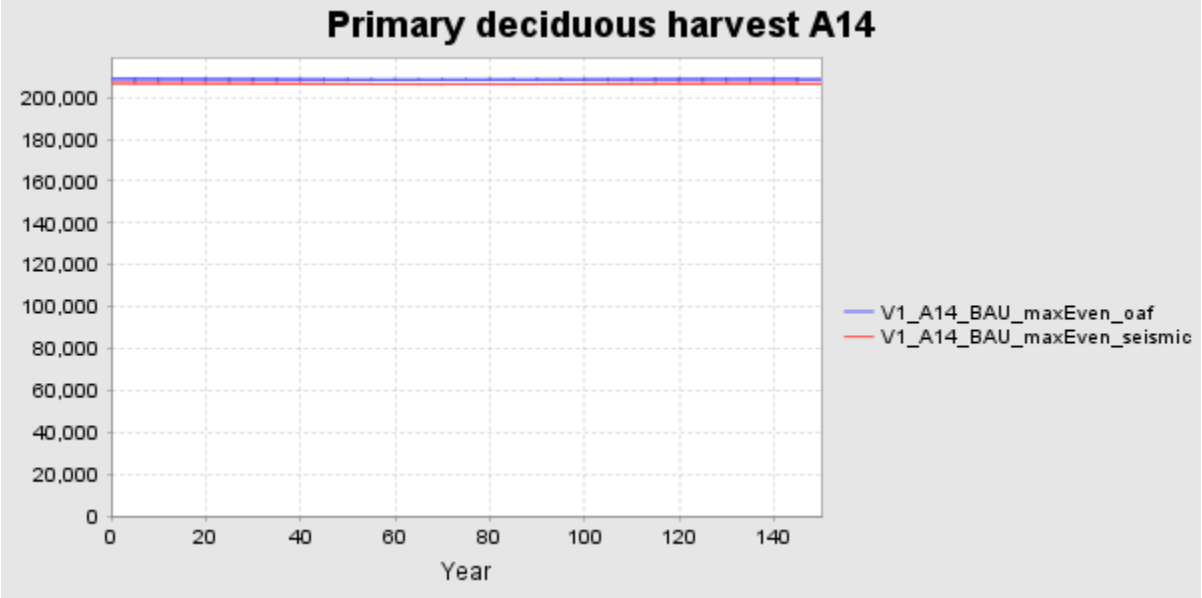

Figure 4. Comparison of primary deciduous harvest from FMU A14 using net area seismic technique and yield curve reduction (oaf).

Conclusion

Our overall observation is that relatively little impact is seen on the long term allowable cut using operational adjustment factors to yield curves. We anticipated a small increase in long-term sustainable yield as seismic disturbance were rehabilitated to productive available forest, but the areas were small and so were the impacts. The amount of seismic area that is a candidate for rehabilitation (27,000 ha) is relatively small compared to the total operable area (1.7 million ha) in the FMA, and the increased yield only shows up many decades in the future when the stands are harvested for a second time. The maximum even-flow harvest objective is limited by the amount of wood available in the first 60-years of simulated time, and the simulated seismic restoration does not alter this limit. The OAF approach will narrow the gap between modeling and practices, but the impact on simulated harvest levels will be negligible.

TSA Parameter

Adjustment factors will be used in the forecasting model to calculate standing timber in natural stands when seismic lines are not explicitly defined in the classified landbase. One adjustment factor will be calculated for each unique combination of sustained yield unit (SYU) and yield strata (YS) and will be applied to the natural stand yield estimates for the appropriate SYU/YS. Adjustment factors will not be modeled for managed stand yield estimates.