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Monday, October 19, 2015

Comments to the BOF Forest Planning Subcommittee

I am David Walters, Director of Institutional Transactions and western region manager for LandVest, a timberland marketing, forest management, and natural resource consulting firm based in Boston. I have been working directly in forest inventory, growth and yield, and planning since 1984; this work has been done for academia, industry, and as a consultant. Notable among these experiences are the 15 years spent with Roseburg Forest Products as biometrician and technical services manager and the last 4 years working for LandVest. In the latter capacity, I have worked, in some capacity, on growth and yield, planning, and valuation issues on every major public sale of timberland that has occurred in Oregon, Washington, and California since 2012. In particular, I have personally completed the growth and yield analysis, reviewed inventories, developed harvest schedules, and suggested value using discounted cash flow analyses on over 1.5M acres of timberland in the last 3 years.

On behalf of the Oregon Forest Industries Council, I have been participating in the TERG group since our first meeting on July 10. The team has been very forthcoming and I have learned much about the specific process that they have undertaken in updating the forest management plan for our state forests.

Today, I would like to focus on my perceptions regarding the process and make some specific recommendations. These recommendations are formed by my direct experience with forest planning models, growth and yield, and forest inventory.

Our time is short, so I am offering a brief synopsis here and more detail in written form, below.

Respectfully submitted,

David K. Walters

David K. Walters, PhD

Director ITM Group, Biometrician, and Western Region Manager
dwalters@landvest.com | 541.430.8605 (Mobile) | 541.790.215 (office)

Oregon State Forest - FMP Development

Key Issues – Overview

In my experience, the most influential items in a forest planning model are (1) starting inventory, (2), growth rates on existing stands, (3) planning model constraints or goals, (4) volume computations. My focus has been on understanding these items.

The key issues include:

1. The Starting Point - The beginning of the FMP Analysis is 12-15% lower than the SLI.
2. FMP Growth Projections
    a. Adjustments to the selected growth model, FVS, based upon dated and possibly unrepresentative permanent plots. A 5- 15% reduction in basal area growth rates.
    b. Use of soil site index instead of measured site index, resulting in a 3-15% lower estimate of productivity in the growth models.
3. Volume/Taper Equations – different equations and merchandizing specifications bet ween SLI and FMP (1) and adjustments to tree form class (2) made to the application of the FMP equations.
4. Static Production and Conservation Acres.
5. Future Stand Yields – generally lower than previous FMP efforts.
6. Modelling System and Details – residual standing inventory target and minimum harvest ages.
7. Compounding conservatism – a general caution.

Detailed Comments

1. Starting Point – As the basic driver of the FMP, the initial timber inventory and associated acreage estimates (GIS) are critical. The forest inventory system used by ODF, the State Lands Inventory (SLI), reports 15,515MMBF on 1/1/2014. In preparation of doing the FMP, each of the forested stands were recompiled and re-grown from the time of field measurement to 1/1/2015. The starting point used for the FMP development is 13,597MMBF. This represents a 12% reduction in the initial volume included in the FMP. Considering the additional 1-year differential, the actual reduction from the SLI to the starting of the FMP may be **15-16**%. The reduction is due, primarily, to the decision to use FVS (FMP growth model) instead of FPS (the SLI growth model). The rationale for this decision is provided in various documents and, sources largely from the view that FVS is more appropriate for long-term projections. This view may be true, though **both** models need careful adjustment over long time frames. However, the SLI update process is a short term process and it would be more appropriate to use FPS for inventory update processes and simply hand-off the SLI as the beginning point for the FMP.

Recommendation – Begin the FMP analysis with the 1/1/2014 operational inventory figure of 15,515MBF.

2. FMP Growth Projections – Notwithstanding item 1, the FMP growth model was selected to be FVS.
    a. FVS modifiers – FVS has the ability to be locally calibrated with observed /measured growth data. This feature is often utilized by users to fine-tune growth projections to local conditions. Unadjusted, the model has been developed to project well *regionally*. The model was locally calibrated for the FMP based on a limited number of permanent plots (reference ppi_spp_bagrat.xls), that have since been essentially abandoned. The adjustments were based on increment cores collected at the time the plots were installed (not re-measured data) and the resulting adjustments are downward in virtually all cases and often very significant. Example adjustments include:
        i. Astoria – DF .945, WH .849, SS .916
        ii. Forest Grove – DF .885, WH .993, SS 1.00
        iii. Tillamook – DF .842, WH .880, SS .839

    Recommendation – regarding the data used to derive growth calibration factors, the sample size is somewhat limited, the data are *dated*, and there is little clarity on how representative the data are across the various state forests. I would recommend that the regionally calibrated (default) version of FVS be utilized instead, without the use of the local calibration option.

    b. Site Index – Site Index is a key driver to future tree growth with either FPS or FVS. The usual method of estimating site index is through the collection of Age and Height measurements on a sample of trees (integrated in the inventory sampling process). Where a forest stand has been field-sampled, site index has been measured in the stand. In other cases, where a forest stand has not been sampled, the inventory is estimated through an "expansion" process. This percentage ranges from 20% on the Tillamook district to 54% on the Forest Grove district, with an overall estimated 31% of stands cruised across all 613,861 acres (Reference SLI_Yields.pptx). Since site index is a required variable in order to do the growth projections, the modeling team used the soil site estimate of site index instead of measured site. Soil site index is available across all stands and derives from soil survey information. A comparison between soil site and measured site (Reference sli_site_diff.pdf) shows a consistent bias ranging from -3.1% (North Coast) to -14.9% (West Lane); that is the soil site is consistently less than the measured site. This is consistent with my personal experience in using or reviewing soil site index estimates across the west. These soil-based estimates are always lower than those measured from inventory data.

Recommendation – Utilize the measured site index where available for all growth predictions. Where not available, adjust the soil site estimate to compensate for the bias demonstrated in the measured data. This is the approach I have taken in countless projects.

3. Volume/Taper Equations – The volumes in SLI are calculated with the volume lookup functions in FPS. The volumes in FMP are calculated with equations from the National Volume Estimator Library (NVEL). Within this library, the Flewelling taper equations are used for most primary commercial species. I wish to make two points about this:

    a. There are small differences in merchandizing specifications (34' for SLI, 40' for FMP yield tables).
    b. The NVEL system requires a form class variable as a driver. The form class variable used is obtained from the inventory. However, in an effort to force the volume estimate from NVEL to mimic the predictions in SLI, the inventory-based form class was iteratively adjusted until the answers were similar.

    Recommendation – Be consistent in merchandizing spec's between SLI and the FMP. If the NVEL estimates are thought, and can be justified, to be the most appropriate, they should be used without adjusting the inventory estimates of tree form class.

4. Static Production and Conservation Acres - As a basic precept, the FMP is being developed around two distinct management approaches. The first approach is to manage forest stands for timber production; the second approach is to manage forest stands to meet conservation objectives – the 70-30 plan. At present, this split (approximately 65-35) has been made based upon existing inventory and other data describing the forest ; a relatively hard line has been established upfront in the modelling effort. Consideration should be given to both choosing stands initially for production or conservation emphasis based on stand conditions and to allowing the emphasis of a stand to change over time. In particular, it may be possible to:
    a. Target the 70-30 goal more exactly
    b. Determine whether forested stands with a production emphasis can also meet conservation emphasis objectives.
    c. Transition forested stands from production to conservation emphasis (and vice-versa) Allowing these transition events may result in higher financial returns.

5. Future Yields – future yields are provided to the *Patchworks* model as tables of yields for *categories* of future plantations – for example, an existing stand in the Astoria district may get harvested and the acres placed into a future stand type. These future stand types are representative of different density's, species mix, and site quality. Additional review is needed of these yield tables; however, the stated intent by the modelling team is to have future yield tables which illustrate the yields under best forest management practices which include the use of current silvicultural techniques in reforestation (including genetic improvement),

release/establishment, young stand density (PCT, Fertilization), and older stand management (thinning, fertilization). Given this intent, these yields appear low relative to my experience with similar industrial forest regeneration tables. I believe Mark is going to address this item in more detail. Given the impact of these yields on the harvest flows, in particularly in light of how they may be used in determining a residual inventory goal within the model, more **critical** review is needed.

6. Modelling System and Details
    a. Overview - *Patchworks* is a spatially explicit wood supply modeling system which utilizes a goal programming framework. Simply put, it is designed to compare alternative futures given the attempted attainment of certain pre-specified goals. This is different than Woodstock, the model I am most familiar with. Woodstock is the most widely used commercial harvest scheduling software and is designed to seek an optimum solution given constraints and an objective function. The distinction is possibly unimportant in most cases. However, it is critical to understand that certain elements of a long term schedule are provided to Patchworks a priori as goals or targets. To derive these goals or targets requires a degree of pre-work and justification.

    As an example, at present, the residual standing inventory over the planning horizon is provided as a goal. The financial return is provided as a goal. Patchworks then attempts to find a flow of harvest that can meet these goals. Thus the resultant harvest flow is influenced by both the inventory goal and the financial goals. The two goals compete with one another and influence the potential harvest flows. The point being, it is very important to clearly understand the importance of setting these goals and their impact on the results. The residual inventory, in particular, is really a policy decision and whether it declines or increases , may be best be set in that venue.

    Recommendation – Clearly define and document all work done outside of Patchworks which sets model goals and constraints. In particular, the residual inventory goal or any other goals which are, perhaps, best set by policy makers.

    b. Underlying constraints and information –More review is needed but one early observation is that there are somewhat arbitrary harvest age constraints included in the modelling effort. Specifically, minimum stand age to be eligible for harvest is 50). An age constraint, if employed, should be based on site index and influenced by location. Fifty (50) as a general constraint is too high. To some degree, this also is a policy decision.

    Recommendation – Remove the age constraints on forest harvest; replacing this with a constraint more consistent with operational matters such as volume per acre, piece size, or direct calculation of product value.

7. Compounding Conservatism – taken individually, items 1-6, above illustrate individual items which may have positive or negative impacts on the harvest level in the FMP. However, at present, they all represent reductions in harvest levels, both in the near and the far term. Foresters are not alone in often being conservative in making decisions that affect the long-term. However, the risk is that the impact of multiple, conservative decisions compounded and result in a final outcome that significantly differs from the potential. Much as errors propagate through complex systems or models, conservative biases can do the same.

   Recommendation – Guard against bias in the modelling process; taking care to cleanly isolate policy decisions or directives.