C5 FOREST MANAGEMENT PLAN 2006–2026

APPENDIX 8B. GROWTH AND YIELD MONITORING PROGRAM

FMU C5
FOREST MANAGEMENT PLAN

Growth and Yield Monitoring Program

Table of Contents

1.0 BACKGROUND

This document outlines the growth and yield monitoring program for Forest Management Unit (FMU) C5. As a component of the detailed forest management plan (DFMP), there is a requirement by Alberta Sustainable Resource Development (SRD) to develop a growth and yield monitoring program. This program is intended to help satisfy the objective to maintain sustainable timber harvest levels, as outlined in the goals and objectives matrix (see Appendix 5A). In order to ensure that this objective is met, this program is designed to address the topics of future volume sampling, forest growth monitoring, and the monitoring of post-harvest regenerating stands.

PROGRAM OBJECTIVES

There are three primary objectives for this growth and yield monitoring program:
- First, this program is designed to monitor yield estimations made for the existing timber supply analysis (TSA) and collect data necessary to develop more robust yield estimates for future TSA exercises.
- Secondly, this program is designed to monitor forest growth across the landbase in FMU C5.
- Finally, this program is designed to monitor growth and yield characteristics in regenerating stands.

CURRENT SITUATION

The inventory in FMU C5 is an Alberta Vegetation Inventory (AVI) ranging in inventory year from 1989 to 2001. Details on the AVI in FMU C5 can be found in the DFMP Landbase Determination documentation (Appendix 6A).

A volume sampling program consisting of temporary sample plots (TSP) was conducted in 1997. The sampling program was originally scheduled to establish 1000 TSPs in FMU C5 over two years; however, due to budget constraints only the first half of the program was carried out, resulting in approximately 457 TSPs. These TSPs occurred exclusively in the northern portion of FMU C5.

This inventory and the aforementioned TSP data were used as the basis for the development of yield curves for use in the current TSA. A number of assumptions were made during this process, as follows:
- The yields for given stratum in the northern portion of the management unit are assumed to not be significantly different than yields in these same stratum in the southern portion of the management unit.
- The model form used to develop yield curves created a yield/age relationship that appeared to be biologically reasonable in the mature stand types, but which did not appear to reasonably reflect yields in younger stands.

- The general TSA transition assumption used in the current TSA is that post-harvest stands would return as the same yield stratum.
- All area in the harvest blocks is expected to make the same transition. This includes in-block roads, landings and decking areas.
- Existing TSP data were insufficient to generate piece size curves due to the inherent variation in piece size as related to age and the relatively small number of plots available for analysis. Additional TSP sampling is required to model piece size over time for FMU C5.

It is important this growth and yield plan includes sampling programs that will address/monitor these assumptions and provide improved information for future TSA exercises.

A few additional data sources available in FMU C5 are the natural stand provincial permanent sample plots (PSP), Stand Dynamic System (SDS) plots and the monitoring plots (MP). There are approximately 52 provincial natural stand PSPs, 11 sets of MP plots and 15 SDS plots in FMU C5. These are a valuable source of information. SRD intends to continue measurement of these provincial PSPs outside the scope of this monitoring plan.

2.0 FUTURE SAMPLING INITIATIVES

Three distinct sampling programs are to be carried out in FMU C5. The first is a temporary sample plot (TSP) program intended to assess current growing stock for the purpose of yield curve development. The second is a PSP network intended to assess forest growth on the landbase over time. The third is a regeneration monitoring program intended to assess the development of stands post-harvest. In aggregate, the following sampling initiatives will provide valuable information that will allow better management of the forest resource in FMU C5.

TEMPORARY SAMPLE PLOT (TSP) PROGRAM

A temporary sample plot (TSP) program is to be established on the basis of stratified random sampling, with the most current inventory and associated strata definitions used as the sampling framework. Each individual plot sample must contain a valid spatial and temporal link to the most current AVI. This program is intended to provide a yield estimate of current standing growing stock.

The program shall provide data to build yield by age relationships, which represent the current forest conditions. Single measurement TSPs do not directly capture forest growth (e.g., increase in stand height, increase in individual tree diameter, succession in species composition) that occurs over time. A separate permanent sampling program will be used to monitor growth.

The TSP sampling is largely dependent on what the plans are for a re-inventory in FMU C5. Depending on whether a re-inventory will be conducted in FMU C5 over the next 10 years, one of the following TSP program scenarios should be pursued. Scenario 1 is where a new AVI is interpreted prior to the next DFMP process, and Scenario 2 is where a new AVI is not interpreted. Scenario 2 is much less desirable than Scenario 1, as the inventory will be over 10 to 15 years old in the majority of the FMU C5 by the next DFMP.

Scenario 1: Re-inventory in C5

If a new AVI and/or update of all AVI attributes information is scheduled for C5, then a new TSP program should be developed in close spatial and temporal link to this new inventory. A TSP sampling program would be constructed with a stratified random sample based on the new AVI or update of all AVI attribute information. The TSPs would be fixed area plots of 100 m^2 in size. Three TSPs would be established within each selected AVI polygon and GPS locations would be recorded for each plot center. In total, 1000 plots would be established prior to the start of the next DFMP process. A detailed sampling protocol in the form of a TSP manual would be developed in the first year following plan approval.

The validity of linking the existing 457 plots to the new inventory attribute information via GPS locations would also be investigated. These could be considered valid samples within their respective stratum, as the sample year would be within 10 years of the photo year (effective inventory year). This would work only where reliable GPS locations were available for the existing plots. It would create a mix of data sources with variable temporal and spatial links to the AVI, which has the potential to create some additional interference ("noise") when evaluating yield in the FMU. The samples are not to be considered substitutes for the proposed 1000 TSPs, but rather a supplement of additional data.

Scenario 2: No Re-inventory in C5

If a new AVI interpreted inventory in C5 is not completed, then a new TSP program is not recommended. Completion of the existing TSP sampling program would be the most effective course of action under these circumstances. By establishing approximately 500 additional TSPs with a focus on the southern half of C5, the FMU would be completely sampled as originally intended. This sampling should be conducted following the same procedures as outlined in the Terms of Reference[1]. Both the TSPs collected in 1997 and newly collected data would then be used to evaluate yield in C5.

GROWTH MONITORING

Another sampling initiative to be conducted under this program involves a network of permanent sample plots (PSPs) across the landbase. This program will serve two purposes: to provide a means of verification of current yield estimates, and to track these yields on the landbase over time.

These PSPs will be established on a predetermined grid across the FMU. A grid-based system is preferable to a stratified-random approach, as it provides an unbiased representation of the landbase, which is set up independent of current or future inventories. As management plans change, the yield strata may change as well, and a PSP-based monitoring program needs to have greater longevity than the current inventory and the yield strata associated with it.

The grid system will account for forested polygons from the net landbase (NLB) and potentially forested polygons (unproductive forest and grasslands) from the passive landbase. Part of the

---

[1] FMU C5 Forest Management Plan: Southern Rockies Landscape Planning Pilot Project Field Sampling Component (Part 2 of Terms of Reference)

reasoning for this is to capture detailed information on succession[2], as well as to monitor productivity assumptions made when creating a net landbase. Permanent non-forested polygons (water, highways, mountain tops, etc.) will not be sampled.

The grid spacing that shall be used is 10 km by 10 km, which translates to approximately 30 forested PSPs on the C5 landbase. This grid can be established nested within the 20 km by 20 km area the National Forest Inventory (NFI) uses in an effort to promote continuity within and outside the administrative boundaries for C5.

PSP measurement procedures will be followed as outlined by the Public Lands and Forests Division (2004)[3]. The intent would be to establish and measure all the forested grid sample points in the first five years from the point of program implementation.

REGENERATION MONITORING

Post–harvest monitoring has been an area that continues to be of particular interest due to the relative lack of empirical data supporting stand dynamics in young post-harvest stands. Currently, a number of assumptions are made regarding the regeneration of post-harvest stands. These assumptions are typically not based on empirical observations but rather on professional judgement or results from relatively localized experimental trials. Steps need to be taken to ensure these assumptions are operationally valid by establishing monitoring plots in post-harvest stands.

There are two specific areas of focus relating to the growth and yield monitoring in post-harvest stands. The first is the desire to evaluate a regenerating stand's transition into a new yield class (i.e., relating regeneration survey results to a predefined yield trajectory at approximately age 25). The second is the need to verify that stocking and productivity are not being significantly affected on reclaimed in-block roads, landings and decking areas relative to the rest of the harvest area.

Two sampling programs will be used to monitor the growth and yield in post harvest stands: regeneration survey and post-harvest PSPs. These two programs in tandem will be used to improve the understanding of regenerating stand dynamics in FMU C5.

REGENERATION SURVEY DATA

The regeneration survey data, which has already been collected as a legislated requirement, forms the anchor for the post-harvest component of the growth and yield program. These data have the unique advantage of being established in *every member (block) of the population*, and so provide an "anchor" for the regenerated yield monitoring. Regeneration surveys will continue to be the responsibility of quota holders and FRIAA in the case of the Community Timber Program.

---

[2] This is intended to go beyond looking at the change AVI types. In theory, if AVI standards did not change, comparing the two inventories could capture a rough estimate of succession, but this approach would fail to capture the data needed to predict this pattern in the future.
[3] Public Lands and Forests Division, 2004. Permanent Sample Plot (PSP) Field Procedures Manual, February 2004.

These data for every block will be used to help define the expected yield class the block is developing into. First a model must be developed that links the regeneration survey data to the condition of a stand at around age 25. In order to develop such a model, a post-harvest PSP program is required to close the gap between the time of the regeneration survey and the time of integration with the inventory.

In time, this relationship will take the form of Strata Specific Regeneration Standards (SSRS). An SSRS would be evaluated by the regeneration survey and, if met, a block could be assigned to a specific predetermined yield class stratum.

Another area where the regeneration survey data can be used is to assess the stocking differences between various areas in the block; i.e., reclaimed roads, landings and decking areas. The current management assumption is that roads, landings and decking areas are being regenerated to the same standard as the rest of the block. In order to monitor stocking differences on the roads, landings and decking areas as compared to the rest of the harvested area, individual regeneration survey plots need to be flagged with an indicator in the data when they occur in these areas. This flagging process should occur on all blocks during both the establishment and performance surveys.

Cumulatively, and specific to reclamation strata with multiple years of regeneration survey data, the proportion of stocked to not-stocked plots on roads, landings and decking areas will be compared to those plots in the rest of the harvest area. This would only be intended to measure stocking at the macro scale for these defined areas over time. The information may be used to evaluate reclamation techniques and improve current assumptions regarding regeneration in these areas. It is not intended for evaluation of stocking for individual blocks.

Mean crop tree heights could also be used to compare establishment vigour on roads, landings, decking areas and the rest of the harvest area. Multiple measurements of PSPs will be required for a more detailed look at stand dynamics and growth in these various areas.

POST-HARVEST MONITORING PSPS

One key component of the monitoring program is to validate the growth trajectories of juvenile post-harvest stands. This goes beyond the legislated need to prove stand establishment and free-to-grow status, as would be provided by the regeneration survey data.

A PSP program shall be established with the purpose of monitoring growth and stand dynamics in regenerating post-harvest stands. PSPs for this purpose will be established on the basis of regenerated strata for the current DFMP. The grid spacing for this PSP program will be imbedded in the provincial 20 km by 20 km master grid. For this program, a grid spacing of 2 km by 2 km is proposed for post-harvest stands, thus providing a sampling intensity of approximately 1 PSP for every 400 ha harvested. Intersection points from this grid that occur in post-harvest blocks will have a PSP established, and all points that fall in new blocks will have a PSP established following harvest. Therefore, in the first 10 years from the point of program implementation approximately 60 post-harvest PSPs will be established and measured in FMU C5.

Whenever logistically possible, PSPs will be established and measured in conjunction with the timing of regeneration surveys for the blocks being sampled. This allows a unique relationship to be

built for each stratum, allowing the PSPs to be used to bridge the time gap from the end of the performance survey (10 to 14 years) to the integration with the inventory (expected around 25 to 40 years). It will enable some assessment and revision of what general management strategies appear to work in FMU C5, as the long-term outcome (conceptually the inventory label applied at around 25 to 40 years) can be assessed against the management activities from the record keeping system (ARIS) and the early stand conditions as described by the raw plot data from the two regeneration surveys. This link can help define the post-harvest transitions for subsequent TSA exercises.

The detailed protocol for this plot establishment and measurement will be developed in the first year following plan approval. In general terms, this protocol should have a gradient of plot sizes for trees, saplings and regeneration for which trees will be tagged and measured. These plots should be established immediately following harvest and re-measured on an approximately five-year cycle.

Fifteen of the 60 post-harvest PSPs will be established as paired plots to assess whether there are differences in growth and stand dynamics in reclaimed in-block roads, landings and decking areas versus the remainder of the block. Paired plot protocols will also be established in the first year following plan approval.

3.0 FIRESMART

In Forest Management Unit C5 a FireSmart plan is being implemented as a part of the DFMP process. The activities conducted under this plan can have implications on growth and yield. This does represent a relatively small portion of the entire C5 landbase and therefore, should not receive a disproportionate amount of effort in terms of monitoring. With that said it is important to revisit assumptions made regarding growth and yield in the DFMP for FireSmart treatment areas. If field measurements become available through alternate funding sources to assess growth and yield in FireSmart treatment areas, this would represent a valuable source of information which could be used to assess existing assumptions and help guide future assumptions for similar FireSmart treatments. No field measurements are currently planned within the scope of this monitoring program specifically to assess FireSmart treatment response.

4.0 SUMMARY

In summary, a number of sampling programs are included in this plan in order to effectively monitor growth and yield in FMU C5 to meet the following objectives:

1. To monitor yield estimations made for existing timber supply analysis (TSA) and collect data necessary to develop more robust yield estimates for future TSA exercises;
2. To monitor forest growth across the landbase in FMU C5;
3. To monitor growth and yield characteristics in regenerating stands.

The following table outlines the sampling programs discussed in this document.

Table 1. Growth and yield monitoring sampling program summary.

Sampling Program	Purpose	Number of plots proposed	Schedule	Responsibility	Approximate Unit Cost	Approximate Cost
TSP Program	• A stratified assessment of current standing timber yields.	1000 TSP (Scenario 1)	Closely following AVI reinterpretation	SRD	~$300/plot	~$300,000
		OR				*OR*
		500 TSP (Scenario 2)	In first year following plan approval			~$150,000
PSP Grid Program	• A long-term unstratified monitoring of forest growth.	~30 PSPs	Established and measured in first 10 years following plan approval	SRD	~$4,000/plot measurement	~$120,000
Regeneration Survey	• To satisfy legislative requirement and provide the anchor for post harvest yield assessment. • To assess stocking differences on roads, landings, decking areas and the rest of the harvest area.	Legislated regeneration survey requirements in every post harvest block	As required by legislation following harvest	Quota Holders	NA	NA
Post-Harvest PSP Grid Program	• To bridge the gap between regeneration establishment and defined yield classes. • To assess growth differences between roads, landings, decking areas and the rest of the harvest area.	~60 post harvest stands (15 of which will be sampled with paired plots)	Established and remeasured in the first 10 years following plan approval	SRD	establishment costs + ~$2,000/plot measurement	~$240,000