Millar Western Forest Products Ltd.

Yield Curve Documentation

2007-2016 Detailed Forest Management Plan

February 28, 2007

EXECUTIVE SUMMARY

Millar Western Forest Products Ltd. holds a Forest Management Agreement encompassing two Forest Management Units, W11 and W13. Together, these FMUs form the Defined Forest Area.

In preparation for the timber supply analysis that will be conducted as part of their 2007-2016 Detailed Forest Management Plan submission, The Forestry Corp. has developed a series of yield curves for Millar Western's managed landbase.

This report documents the development of yield curves and ancillary analyses required for preparation of the plan.

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1. Background

1.1 Overview

Millar Western Forest Products Ltd. (Millar Western) holds a Forest Management Agreement (FMA) encompassing two Forest Management Units (FMUs), W11 and W13. Together, these FMUs form the *Defined Forest Area*[1] (DFA).

In preparation for the *timber supply analysis* (TSA) that will be conducted as part of their 2007-2016 Detailed Forest Management Plan (DFMP) submission, The Forestry Corp. has developed a series of *yield curves* for Millar Western's *managed landbase*.

This document describes the methods used in yield curve development and presents the final results. Accompanying this document is a Regulated Forestry Professional (RFP) checklist derived from the Alberta Sustainable Resource Development (SRD) Forest Management Planning Standard, Version 4.1 (SRD 2006) relating to yield curve development and documentation deliverables.

1.2 Past Plans

Millar Western received tenure over FMU W13 in 1997, and has already developed one Detailed Forest Management Plan (DFMP) for the FMU (Millar Western 2000) for the 1997-2006 planning period. Forest Management Unit W11 was incorporated into Millar Western's DFA in

[1] Terms that are defined in the glossary will be shown in italics the first time they are presented in this document. The glossary is provided in Appendix I. To help clarify the relationship between types of volume, yield strata, yield curves, and landbase-related terms, a structure of terminology is also provided. See Appendix II.

2002. A Preliminary Forest Management Plan (PFMP) for this FMU was completed in 2004 (Millar Western 2004e).

1.2.1 FMU W11

Stratification

In the 2004 PFMP, six *yield strata* were defined for the FMU W11 managed landbase. Stratum assignment was based on layer 1 AVI attributes for all A, B, C and D density *stands*, with the following exceptions:

- Multistory stands with an A density overstory layer and a productive forested understory;
- Multistory stands with a B density overstory layer and a C or D density productive forested understory layer;
- Horizontal stands with a nonforested or nonproductive layer 1; or
- Horizontal stands with a forested layer 2 comprising > 50% of the polygon area.

In these cases, layer 2 AVI attributes were used to assign yield strata.

Yield strata were assigned based on *broad cover group*, crown closure class and leading conifer species (Table 1-1). Leading species was assigned based on percent cover. For white spruce types, total percent SW was calculated as (SW+FB); for aspen types, total percent AW was calculated as (AW+PB). Stands in pure conifer and mixedwood broad cover groups with black spruce as the leading conifer were assigned to the SB_ABCD *yield stratum*.

Larch and white birch-leading stands were considered part of the *unmanaged landbase*, for which no yield strata were assigned. Black spruce stands were also considered part of the unmanaged landbase, with the exception of ~60 ha of planned blocks in place at the time of PFMP development (Millar Western 2004d).

Table 1-1. Yield strata used in the 2004 PFMP, FMU W11.

Yield Stratum	Broad Cover Group	Leading Coniferous Species	Crown Closure Class	Description
D_AB	D	n/a	AB	Pure deciduous - open
D_CD	D	n/a	CD	Pure deciduous - closed
MX_ABCD	DC/CD	not SB	ABCD	Mixedwood
SB_ABCD	C, CD, DC	SB	ABCD	Black spruce
C_AB	C	not SB	AB	Pure conifer - open
C_CD	C	not SB	CD	Pure conifer - closed

Yield Curve Development

One *yield curve* was empirically fit for each yield stratum in the 2004 PFMP. Each yield curve was fit using equations representing volume as a function of stand age. These equations were

used to represent both managed and *natural stands* within timber supply analysis. No other *stand types* (*e.g.*, *thinning*) were represented in timber supply analysis.

1.2.2 FMU W13

Stratification

For the 1997-2006 DFMP, six yield strata were defined in FMU W13 to classify stands in the managed landbase. Stratum assignment was based upon layer 1 (overstory) AVI attributes for all A, B, C and D density stands. Stands with less than 6% crown closure were assigned to strata based on layer 2 (understory) attributes.

Yield strata were assigned based on broad cover group and leading *species groups* (Table 1-2). Leading species group was assigned based on percent cover. For white spruce types, total percent SW was calculated as (SW+FB); for aspen types, total percent AW was calculated as (AW+PB).

White birch-leading deciduous and larch-leading coniferous or mixedwood stands were considered part of the unmanaged landbase, for which no strata were assigned.

Table 1-2. Yield strata used in the 1997-2006 DFMP, FMU W13.

Yield Stratum	Broad Cover Group	Leading Species	Crown Closure Class	Description
AW	D	AW%+PB%>=BW%	ABCD	Pure deciduous
PA	DC/CD	PL%>=SB%+SW%+FB%	ABCD	Pine leading mixedwood
SA	DC/CD	PL%<SB%+SW%+FB%	ABCD	Spruce leading mixedwood
PL	C	PL%>=SB% and PL%>=SW%+FB% and LT%<=50	ABCD	Pine leading pure conifer
SB	C	SB%>PL% and SB%>SW%+FB% and LT%<=50	ABCD	Black spruce leading pure conifer
SW	C	SW%+FB%>PL% and SW%+FB%>=SB% and LT%<=50	ABCD	White spruce leading pure conifer

Yield Curve Development

A series of yield curves were developed for the 1997-2006 DFMP:

Natural Stand Yield Curves. *Natural stand yield curves* were developed for each yield stratum in the 1997-2006 DFMP. Volume as a function of age was empirically fit using TSP and PSP *plot* data. *TPR scaling* was used to represent the effects of site: the empirically-fit curve was assumed to represent medium TPR sites; the curve was then increased 33% upwards to represent good sites and 25% downwards to represent fair sites.

Managed Stand Yield Curves. *Managed stand yield curves* were developed for each yield stratum in the 1997-2006 DFMP. Managed stand yield curves were developed by increasing all TPR-scaled natural stand yield curves by 11% (15% to represent *fully stocked* stand conditions minus 4% to reflect losses to roads and landings).

Crop Plan Yield Curves. *Crop plan yield curves* were developed for the PL, SB and SW yield strata in the 1997-2006 DFMP. Yield curves were developed using Phase 3 volumes, modified

to reflect regenerated yields and thinning events in *crop plan* (density management) stands. TSP and PSP data were used to convert gross total (Phase 3) stand volumes to gross *merchantable stand volumes* for the plan.

Windfall Burn Yield Curves. *Windfall Burn yield curves* were developed for regenerating pine stands within the Windfall Burn boundary. Due to a lack of information on anticipated stand development, a modified natural stand yield curve was used to represent these post-fire pine stands. Medium TPR natural stand yield curves were reduced by 50% to reflect decreased gross merchantable volume production in these stands.

Thinning Yield Curves. Thinning yield curves were developed for all strata, with the exception of the AW yield stratum. Natural stand yield curves were modified to reflect volume removal and subsequent recovery. *Commercial thinning yield curves* were developed based on a scenario of 35% volume removal at 45 years, with a recovery to 90% of natural stand volume 20 years after thinning. *Salvage thinning yield curves* were developed based on a scenario of 33% volume removal at 90 years, with no recovery assumption (67% of natural stand volume at final harvest).

Aspen W5/W9 Yield Curves. Separate natural stand yield curves were developed for the W5 (now Whitecourt/Blue Ridge) and W9 (now McLeod/Virginia Hills) *subunits*, to reflect subunit-specific differences in productivity. Data were split by subunit. The same methods used to develop natural stand yield curves were used to develop TPR-scaled yield curves for each subunit.

Composite Yield Curves. Composite (area-weighted) yield curves for natural stands were developed for coniferous volume on the coniferous landbase (C, CD, and DC broad cover groups) and deciduous volume on the deciduous landbase (D broad cover group).

1.3 The Current (2007-2016) DFMP

Stratification

In consultation with Alberta SRD, Millar Western has revised the yield strata used in past plans. The main change for both FMUs was the separation of mixedwood yield strata by broad cover group (CD vs. DC). Another change was the inclusion of stratification rules for assigning yield strata to forested stands in the unmanaged landbase. The yield strata in FMU W11 were also renamed to parallel the FMU W13 yield strata naming conventions.

The term *DFMP yield strata* refers specifically to yield stratification used in the current (2007-2016) DFMP. DFMP yield strata are applied to all stands in the *forested landscape*.

DFMP yield stratum assignment was based on layer 1 (overstory), layer 2 (understory), or composite AVI attributes. Stratum assignment was primarily based on layer 1 AVI attributes, with the following exceptions:

- Nonforested overstory with forested understory (use understory AVI attributes);

- Multistory stands with an A, B or C density overstory layer, overstory height > 14 m and understory height at least 2/3 of the overstory height (use composite AVI attributes); or

- Multistory stands with an A density overstory layer and B, C, or D density understory layer (use understory AVI attributes).

- Horizontal stands with a forested layer 2 comprising > 50% of the polygon area (use layer 2 attributes).

The layer used for assigning DFMP yield strata is referred to as the *defining layer*.

DFMP yield strata were assigned based on broad cover group, species composition and crown closure class from the defining layer (Table 1-3). Yield stratification is a much more complex process than shown here. Full details on DFMP yield stratum assignment are provided in Chapter 2.

For the 2007-2016 DFMP, the BW DFMP yield stratum is considered part of the managed landbase, while the LT DFMP yield stratum is considered part of the unmanaged landbase. Larch is an acceptable species component in stands assigned to other DFMP yield strata. In FMU W11, the SB DFMP yield stratum is considered part of the unmanaged landbase, but black spruce is considered an acceptable species component in stands assigned to other W11 DFMP yield strata.

Table 1-3. DFMP yield strata for the 2007-2016 DFMP.

FMU	DFMP Yield Stratum	Broad Cover Group	Leading Coniferous Species Group[1]	Leading Deciduous Species Group[1]	Crown Closure Class	Description
W11	AW_AB	D	n/a	AW, PB	AB	Aspen or poplar leading deciduous stand, open crown closure
	AW_CD	D	n/a	AW, PB	CD	Aspen or poplar leading deciduous stand, closed crown closure
	BW	D	n/a	BW	ABCD	Birch leading deciduous stand
	APAS_ABCD	DC	n/a	n/a	ABCD	Deciduous leading mixedwood stand
	PASA_ABCD	CD	n/a	n/a	ABCD	Coniferous leading mixedwood stand[2]
	LT	C	LT	n/a	ABCD	Larch leading conifer stand
	PL_AB	C	PL	n/a	AB	Pine leading conifer stand, open crown closure
	PL_CD	C	PL	n/a	CD	Pine leading conifer stand, closed crown closure
	SB	C	SB	n/a	ABCD	Black spruce leading conifer stand
	SW_AB	C	SW	n/a	AB	White spruce leading conifer stand, open crown closure
	SW_CD	C	SW	n/a	CD	White spruce leading conifer stand, closed crown closure
W13	AW	D	n/a	AW, PB	ABCD	Aspen or poplar leading deciduous stand
	BW	D	n/a	BW	ABCD	Birch leading deciduous stand
	AP	DC	PL	n/a	ABCD	Deciduous leading pine mixedwood
	AS	DC	SW, SB, FB	n/a	ABCD	Deciduous leading spruce mixedwood
	PA	CD	PL	n/a	ABCD	Coniferous leading pine mixedwood
	SA	CD	SW, SB, FB	n/a	ABCD	Coniferous leading spruce mixedwood
	LT	C	LT	n/a	ABCD	Larch leading conifer stand
	PL	C	PL	n/a	ABCD	Black spruce leading conifer stand
	SB	C	SB	n/a	ABCD	Pine leading conifer stand
	SW	C	SW, FB	n/a	ABCD	White spruce leading conifer stand

[1] Assignment of leading species group is described in Chapter 2.

[2] Includes a small area of poplar-leading pine mixedwood.

Yield Curve Development

A series of yield curves were developed for the 2007-2016 DFMP:

Base Natural Stand Yield Curves. Base natural stand yield curves were developed for each DFMP yield stratum. In FMU W11, volume as a function of age was empirically fit using TSP and PSP data. In FMU W13, volume as a function of AVI-based *site index* and age was empirically fit using TSP and PSP data. Average AVI-based site index for leading conifer and deciduous species were inserted into these equations to develop *site-specific* yield curves for fair, medium and good *site types*.

Base Managed Stand Yield Curves. Base managed stand yield curves were developed for each DFMP yield stratum. Base managed stand yield curves were developed using data from natural stands with a C or D density crown closure class as a proxy for fully stocked natural stands. The same methods used for fitting base natural curves were applied to develop base managed curves.

Base Composite Yield Curves. Base composite (area-weighted) yield curves for natural stands were developed for natural stands in the managed landbase. Five area-weighted curves were developed for natural stands for each FMU: four to represent each broad cover group (D, DC, CD, and C) and one overall composite for the coniferous landbase (DC, CD and C combined).

Site Index Increase Yield Curves. *Site index increase yield curves* were developed for the FMU W13 PL DFMP yield stratum, to reflect the effect of management on pine volume yield. Average site index inputs used to create site-specific natural stand PL yield curves were increased using results from a Foothills Growth and Yield Association study (Dempster 2004). These increased site indices were used as inputs to the PL natural stand yield curve equation, to create site-specific site index increase yield curves.

Thinning Yield Curves. Thinning yield curves were developed for the PL and SB DFMP yield strata in FMU W13. Natural stand yield curves were modified to reflect volume removal and subsequent recovery. Commercial thinning yield curves were developed based on a scenario of 35% volume removal at 45 years, with a recovery to 90% of natural stand volume after thinning after 15 years. Salvage thinning yield curves were developed based on a scenario of 33% volume removal at 90 years, with no recovery assumption (67% of natural stand volume at final harvest).

Athabasca Flats Selective Logging Yield Curves. Yield curves were developed for stands in the *Athabasca Flats* area that have been harvested using selective logging methods. Because this area was comprised of a number of different DFMP yield strata, a composite natural stand yield curve was developed using area-weighting of natural stand yield curves. This composite curve was then localized using plot data to create a pre-treatment Athabasca Flats natural stand yield curve. Plot data were then used to calculate the percent volume removed by selective logging, which was applied to the localized natural stand yield curve to create a post-treatment Athabasca Flats yield curve. No post-treatment recovery assumptions were applied to this curve.

Subunit-Specific Aspen Yield Curves. Separate *subunit-specific aspen yield curves* for natural stands were developed for the Whitecourt/Blue Ridge and McLeod/Virginia Hills subunits of

FMU W13, to reflect subunit-specific differences in productivity. Data were split by subunit. The same methods used to develop natural stand yield curves were used to develop site-specific yield curves for each subunit.

1.4 Terms of Reference

Millar Western's Terms of Reference for the 2007-2016 DFMP (Millar Western 2005a) provides the context for yield curve development. The Terms of Reference states that:

The general yield projection approach is:

- *Standing timber yield curves will be developed following the same process used for the 1997-2006 DFMP but updated with additional new temporary and permanent sample plot (TSP and PSP) information.*

- *Yield curves for regenerating stands will be developed either:*

1. *To represent fully stocked natural stands, using the same scaled empirical yield curve process used for the 1997-2006 DFMP but updated for new plot data, or;*

2. *According to Crop Plans, using the same curves as for the 1997-2006 DFMP.*

Millar Western's intention under the Terms of Reference was to define a baseline expectation for yield curve development. Where Millar Western could improve projections using alternate methods, Millar Western has done so. All changes to methods from the 1997-2006 DFMP, and justifications for those changes, are presented in this document. Where no improvement over previous methods was evident, the 1997-2006 DFMP procedures were followed.

1.5 Yield Curve Development

DFMP yield strata form the basis for the development of a number of yield curves used in timber supply analysis for the 2007-2016 DFMP. Each DFMP yield stratum has one or more associated yield curves for both natural stands and *managed stands*.

In this document, the term yield stratum is not used interchangeably with yield curve[2]. A yield curve is a graphical representation of a predictive *yield equation* that presents yield (volume, *piece size*) as a function of stand age. Yield strata are a set of strata with associated yield projections (yield curves and/or *yield tables*). Each DFMP yield stratum can have one or more associated yield curves. These can be *base yield curves* and/or *modified yield curves*.

[2] The term yield curve is used to represent a set of three separate curves: a volume-age curve for conifer volume, a volume-age curve for deciduous volume, and a volume-age curve for total volume.

In addition, several types of *strata* are discussed, and while these are related, they are not interchangeable. Stratification is a classification scheme used to define *polygons* within the *gross landbase.* For example, there are *extended strata*, *BAP strata*, *species strata* and DFMP yield strata. DFMP yield strata are the set of strata used in the 2007-2016 DFMP and are the only strata to use the term "yield". Yield projections that were developed for the 2007-2016 DFMP are specific to DFMP yield strata.

The full complement of yield curves that were developed for the 2007-2016 DFMP are described in Chapters 5, 6, and 7.

1.6 A Note Regarding Yield Curve Development

Development of yield curves for use in timber supply analysis generally occurs in conjunction with the landbase development process. Development of yield curves cannot be held until landbase development is complete, particularly since landbase and yield curves must be submitted to the government for review around the same time.

The yield curves presented here were developed using information from version 9 of the Millar Western landbase. This landbase was selected since significant changes were not anticipated beyond this point. The final landbase submission is based on landbase version 12. Therefore it is important to note the following:

- All yield curve development was based on landbase version 9 except for base composite yield curves. Athabasca Flats composite yield curves were developed using information from landbase version 9.
- Base composite yield curves were developed using areas from landbase version 12.
- All landbase area summaries presented in this document are based on landbase version 12.
- Landbase areas included in yield tables were obtained from landbase version 12.
- A reconciliation between landbase 9 and 12, and an examination of the effects on plot assignment and eligibility for yield curve development is provided in Sections 4.4 and 4.5.

2. Stratification

2.1 Overview

Stratification is used to group a large number of polygons with varied attribute information into units meaningful for management. Predictions of yield for individual stands over time are required for timber supply analysis. Volumes are not predicted on an individual stand basis; rather, an average yield is applied, based on which yield stratum the stand is classified to (stratum-level yield prediction). As such, stratification is important to ensure that stands are grouped based on similarities relevant to timber yield and planned management practices.

DFMP yield strata are the basic units for forest management in the 2007-2016 DFMP.

Plot data (*observations*) must be assigned to a DFMP yield stratum for empirical yield curve development. Plots were spatially intersected with the landbase in order to objectively assign this information (see Chapter 3). This section describes how DFMP yield strata were assigned to the *landbase polygons* used in spatial intersection.

Note that while this section describes how the landbase is classified into DFMP yield strata, it does not discuss how the landbase is classified into the managed vs. unmanaged landbase, or how stand type (natural, managed, thinned, *etc.*) is assigned. For more information on these aspects of landbase classification, please refer to Millar Western (2007).

Figure 2-1 provides an overview of the process for assigning DFMP yield strata. This process is explained in detail in the sections that follow.

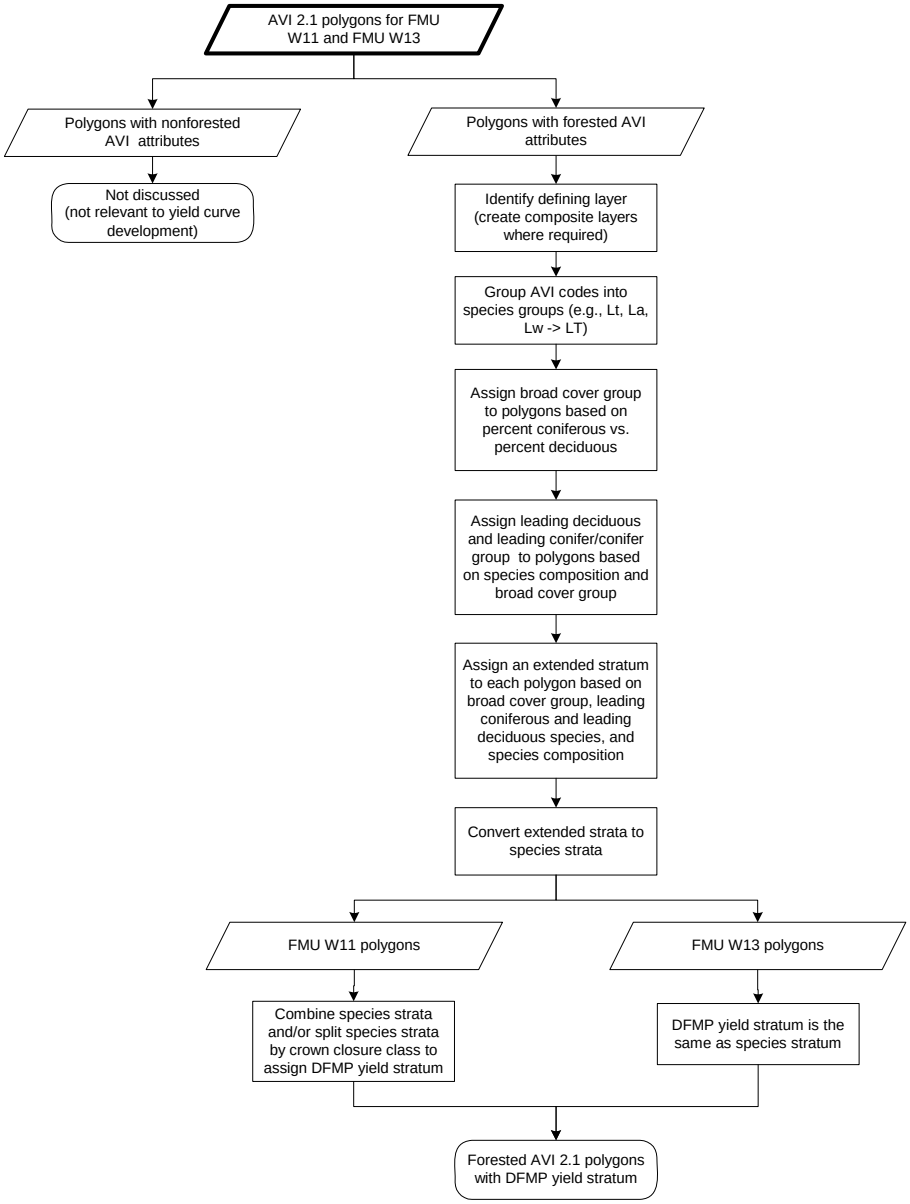


Figure 2-1. Overview of DFMP yield stratum assignment process.

2.2 Identifying Forested Polygons

Stratification was based on Alberta Vegetation Inventory (AVI) 2.1 polygon attributes (AFLW 1991). The first step in assigning DFMP yield strata was to identify the polygons of interest. DFMP yield strata were assigned to forested polygons only, since these are the areas that would potentially be managed for timber. Polygons with a natural or anthropogenic nonforested code in the defining layer were deemed nonforested, and were not included in the DFMP yield stratum assignment process. All other polygons were deemed forested and were assigned to a DFMP yield stratum as described in the following sections.

2.3 Selecting a Defining Layer

In order to classify forested polygons, a defining layer (layer used for stratification) was identified. The defining layer for a polygon could be the overstory layer, the understory layer, or a combination of the two (*composite layer*). The intent of selecting a defining layer based on attributes of one or more chosen layers was to best represent the forest being managed.

The defining layer was selected based on *AVI polygon* attributes. The AVI attributes used to determine the defining layer include stand structure type (single storied, complex, horizontal, or multistoried), structure value (for horizontal stands, the proportion of area in AVI layer 1 vs. AVI layer 2), height, crown closure class (density), and presence of forested species. A decision key used to assign the defining layer is presented in Figure 2-2.

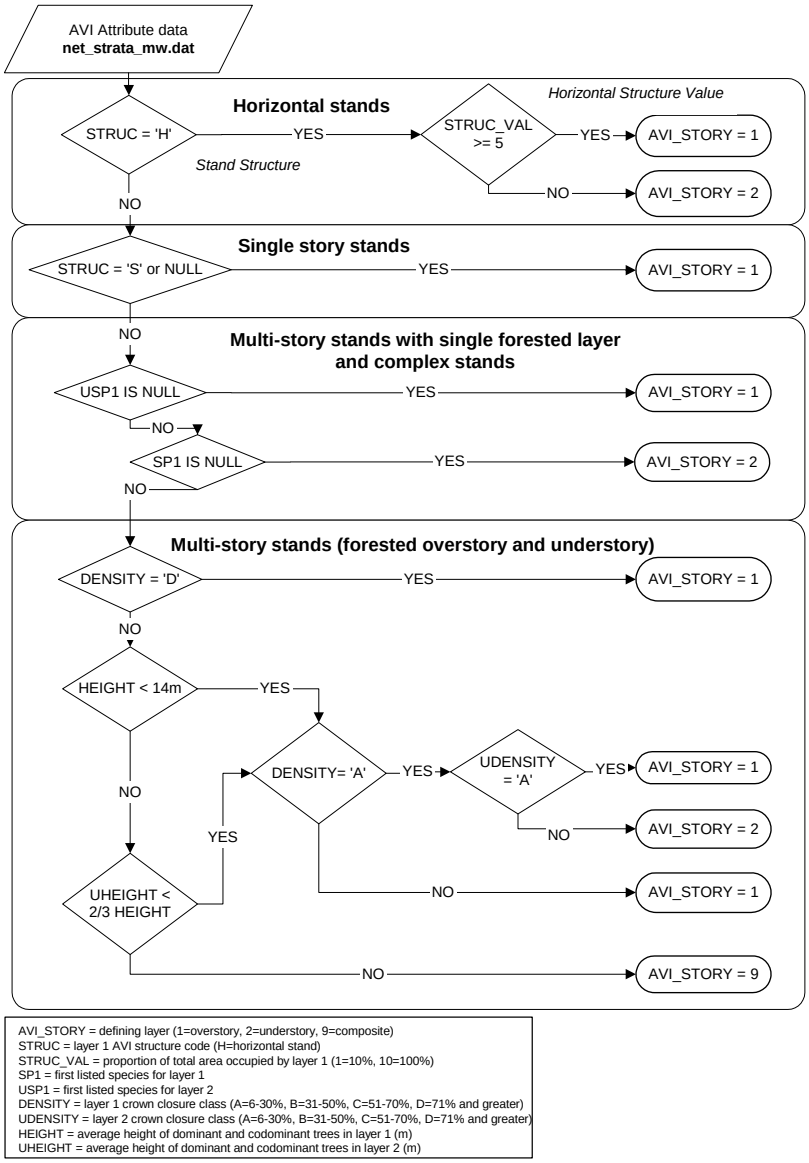


Figure 2-2. Rules for determining the defining layer.

2.3.1 Creating Composite Layers

Composite attributes had to be created for polygons with a composite defining layer. Composite layers were developed by combining AVI 2.1 overstory and understory attributes, generally involving some form of weighting. The following sections describe how composite attributes were developed for the polygons requiring a composite defining layer.

Crown Closure Class

Composite crown closure class was assigned based on overstory and understory crown closure class (Table 2-1). The rules were:

1. Where the overstory and understory were different crown closure classes, the denser of the two was selected.

2. Where the overstory and understory were either a) both B crown closure class or b) both C crown closure class, crown closure class was increased by one level (B -> C or C -> D).

3. Where the overstory and understory were either a) both A crown closure class or b) both D crown closure class, composite crown closure class stayed the same.

Table 2-1. Assignment of composite crown closure class.

Overstory Crown	Understory Crown Closure			
Closure	A	B	C	D
A	A	B	C	D
B	B	C	C	D
C	C	C	D	D
D	D	D	D	D

Height

Composite height for the defining layer was developed by weighting both the understory and overstory heights by their respective crown closure classes. To do so, the range of crown closure percent was converted to a midpoint value for each crown closure class (Table 2-2).

Table 2-2. Midpoint values of crown closure classes.

Crown Closure Class	Range	Midpoint
A	6-30%	18
B	31-50%	40
C	51-70%	60
D	71-100%	85

The composite height was then calculated as follows:

$$Height_{composite} = \frac{\left(Height_{overstory} * CCMidpt_{overstory}\right) + \left(Height_{understory} * CCMidpt_{understory}\right)}{\left(CCMidpt_{overstory} + CCMidpt_{understory}\right)}$$

Where: $Height_{composite}$ = composite layer height in m

$Height_{overstory}$ = height of the AVI 2.1 overstory layer in m

$Height_{understory}$ = height of the AVI 2.1 understory layer in m

$CCMidpt_{overstory}$ = midpoint of the overstory layer's crown closure class

$CCMidpt_{understory}$ = midpoint of the understory layer's crown closure class

Composite height was then rounded to the nearest meter.

Origin

The origin of the oldest layer was used as the origin of the composite layer.

Timber Productivity Rating

Within the AVI, *timber productivity rating* (TPR) was originally assigned to each layer based on the height and age of the leading species (species 1). TPR reflects the potential of the site to grow timber, therefore the most productive TPR was assigned to the composite layer.

Species Composition

The species composition for each layer was weighted using the midpoint of the crown closure class and summed to provide the overall percentages for each species; *e.g.*, for white spruce:

$$PctSW_{composite} = \frac{\left(PctSW_{overstory} * CCMidpt_{overstory}\right) + \left(PctSW_{understory} * CCMidpt_{understory}\right)}{\left(CCMidpt_{overstory} + CCMidpt_{understory}\right)}$$

Where: $PctSW_{composite}$ = composite percent SW (10-percent AVI class, no rounding)

$PctSW_{overstory}$ = percent SW, AVI 2.1 overstory layer (10-percent AVI class)

$PctSW_{understory}$ = percent SW, AVI 2.1 understory layer (10-percent AVI class)

$CCMidpt_{overstory}$ = midpoint of the overstory layer's crown closure class

$CCMidpt_{understory}$ = midpoint of the understory layer's crown closure class

The species were then ranked in order of descending percent from species 1 to species 6. If two species had the same composite percent, species present in layer 1 took priority over those in

layer 2, and the original species order took precedence where both species were present in the same layer. Species percents were not rounded.

2.4 Assigning a DFMP Yield Stratum to the Defining Layer

This section describes the process by which the attributes from the defining layer were used to assign DFMP yield strata. In order to assign DFMP yield strata, a series of steps were involved. First, AVI species were grouped into species groups, and broad cover group was assigned. Using this information, extended strata were assigned; these were combined to form species strata, which were then either combined, split or directly assigned to DFMP yield strata.

2.4.1 Species Group

For the purposes of amalgamating similar species, individual species (AVI species codes) were combined into species groups within *species type* (deciduous and coniferous) (Table 2-3).

Table 2-3. Assignment of species group.

Species Type	Species Group	AVI Species Codes	Description
Deciduous	AW	A, Aw	Trembling aspen
	BW	Bw	White birch
	PB	Pb	Balsam poplar
Coniferous	FB	Fb, Fa	True firs
	FD	Fd	Douglas-fir
	LT	Lt, La, Lw	Larches
	PL	P, Pl, Pj, Pa, Pf	Pines
	SB	Sb	Black spruce
	SW	Sw, Se	White and Engelmann spruce

2.4.2 Broad Cover Group

Percent deciduous and percent coniferous were obtained by summing the percent composition within species types. Broad cover group was assigned using the rules outlined in Table 2-4.

Table 2-4. Broad cover group assignment using deciduous and coniferous species percent.

Broad Cover Group	Percent Deciduous	Percent Coniferous	Description
D	≥ 80	< 20	Deciduous
DC[1]	50-79	21-50	Deciduous-leading mixedwood
CD[1]	21-50	50-79	Coniferous-leading mixedwood
C	< 20	≥ 80	Coniferous

[1] A 50/50 split is assigned to CD if SP1 is coniferous and DC if SP1 is deciduous.

2.4.3 Extended Strata

Extended strata are defined in the Alberta Forest Management Planning Standard (SRD 2006). In order to assign extended strata, an intermediary step was required. This step identified leading deciduous species (DRULE) and the leading coniferous species or combination of coniferous species (CRULE) as a function of broad cover group and species composition. The first listed deciduous species was deemed the leading deciduous species. The assignment of leading

coniferous species was more complex, and was based on relative percent composition by species. The rules for assignment are presented in Table 2-5 and Table 2-6.

Table 2-5. Rules for assigning DRULE based on BCG and species composition.

DRULE	Description	Selection Criteria
'AW_LEAD'	Aspen leading deciduous	*HARDPCT* > 0 and *AW_ORD* < *BW_ORD* and *AW_ORD* < *PB_ORD*
'BW_LEAD'	White birch leading deciduous	*HARDPCT* > 0 and *BW_ORD* < *AW_ORD* and *BW_ORD* < *PB_ORD*
'PB_LEAD'	Balsam poplar leading deciduous	*HARDPCT* > 0 and *PB_ORD* < *AW_ORD* and *PB_ORD* < *BW_ORD*
'NO_D'	No deciduous present	*HARDPCT* = 0

Table 2-6. Rules for assigning CRULE based on BCG and species composition.

CRULE	Description	Selection Criteria
'FBFD_LEAD_MW'	True fir or Douglas-fir leading conifer in mixedwood	*C_CODE* = ('DC', 'CD') and (((*FB_PCT* + *FD_PCT*) > *PL_PCT* and (*FB_PCT* + *FD_PCT*) > (*SB_PCT* + *LT_PCT*) and (*FB_PCT* + *FD_PCT*) > *SW_PCT*) or (*LEAD_CON* = ('FB','FD') and (*FB_PCT* + *FD_PCT*) >= *PL_PCT* and (*FB_PCT* + *FD_PCT*) >= (*SB_PCT* + *LT_PCT*) and (*FB_PCT* + *FD_PCT*) >= *SW_PCT*))
'PL_LEAD_MW'	Pine leading conifer in mixedwood	*C_CODE* = ('DC', 'CD') and ((*PL_PCT* > (*FB_PCT* + *FD_PCT*) and *PL_PCT* > (*SB_PCT* + *LT_PCT*) and *PL_PCT* > *SW_PCT*) or (LEAD_CON = 'PL' and *PL_PCT* >= (*FB_PCT* + *FD_PCT*) and *PL_PCT* >= (*SB_PCT* + *LT_PCT*) and *PL_PCT* >= *SW_PCT*))
'SBLT_LEAD_MW'	Black spruce or larch leading conifer in mixedwood	*C_CODE* = ('DC', 'CD') and (((*SB_PCT* + *LT_PCT*) > (*FB_PCT* + *FD_PCT*) and (*SB_PCT* + *LT_PCT*) > *PL_PCT* and (*SB_PCT* + *LT_PCT*) > *SW_PCT*) or (*LEAD_CON* = ('SB', 'LT') and (*SB_PCT* + *LT_PCT*) >= (*FB_PCT* + *FD_PCT*) and (*SB_PCT* + *LT_PCT*) >= *PL_PCT* and (*SB_PCT* + *LT_PCT*) >= *SW_PCT*))
'SW_LEAD_MW'	White spruce leading conifer in mixedwood	*C_CODE* = ('DC', 'CD') and ((*SW_PCT* > (*FB_PCT*+*FD_PCT*) and *SW_PCT* > *PL_PCT* and *SW_PCT* > (*SB_PCT* + *LT_PCT*)) or (*LEAD_CON* = 'SW' and *SW_PCT* >= (*FB_PCT*+*FD_PCT*) and *SW_PCT* >= *PL_PCT* and *SW_PCT* >= (*SB_PCT* + *LT_PCT*)))
'FB_LEAD'	True fir leading conifer in pure stand	*C_CODE* = ('C', 'D') and ((*FB_PCT* > *FD_PCT* and *FB_PCT* > *LT_PCT* and *FB_PCT* > *PL_PCT* and *FB_PCT* > *SB_PCT* and *FB_PCT* > *SW_PCT*) or (*LEAD_CON* = 'FB' and *FB_PCT* >= *FD_PCT* and *FB_PCT* >= *LT_PCT* and *FB_PCT* >= *PL_PCT* and *FB_PCT* >= *SB_PCT* and *FB_PCT* >= *SW_PCT*))
'FD_LEAD'	Douglas-fir leading conifer in pure stand	*C_CODE* = ('C', 'D') and ((*FD_PCT* > *FB_PCT* and *FD_PCT* > *LT_PCT* and *FD_PCT* > *PL_PCT* and *FD_PCT* > *SB_PCT* and *FD_PCT* > *SW_PCT*) or (*LEAD_CON* = 'FD' and *FD_PCT* >= *FB_PCT* and *FD_PCT* >= *LT_PCT* and *FD_PCT* >= *PL_PCT* and *FD_PCT* >= *SB_PCT* and *FD_PCT* >= *SW_PCT*))
'LT_LEAD'	Larch leading conifer in pure stand	*C_CODE* = ('C', 'D') and ((*LT_PCT* > *FB_PCT* and *LT_PCT* > *FD_PCT* and *LT_PCT* > *PL_PCT* and *LT_PCT* > *SB_PCT* and *LT_PCT* > *SW_PCT*) or (*LEAD_CON* = 'LT' and *LT_PCT* >= *FB_PCT* and *LT_PCT* >= *FD_PCT* and *LT_PCT* >= *PL_PCT* and *LT_PCT* >= *SB_PCT* and *LT_PCT* >= *SW_PCT*))
'PL_LEAD'	Pine leading conifer in pure stand	*C_CODE* = ('C', 'D') and ((*PL_PCT* > *FB_PCT* and *PL_PCT* > *FD_PCT* and *PL_PCT* > *LT_PCT* and *PL_PCT* > *SB_PCT* and *PL_PCT* > *SW_PCT*) or (*LEAD_CON* = 'PL' and *PL_PCT* >= *FB_PCT* and *PL_PCT* >= *FD_PCT* and *PL_PCT* >= *LT_PCT* and *PL_PCT* >= *SB_PCT* and *PL_PCT* >= *SW_PCT*))
'SB_LEAD'	Black spruce leading conifer in pure stand	*C_CODE* = ('C', 'D') and ((*SB_PCT* > *FB_PCT* and *SB_PCT* > *FD_PCT* and *SB_PCT* > *LT_PCT* and *SB_PCT* > *PL_PCT* and *SB_PCT* > *SW_PCT*) or (*LEAD_CON* = 'SB' and *SB_PCT* >= *FB_PCT* and *SB_PCT* >= *FD_PCT* and *SB_PCT* >= *LT_PCT* and *SB_PCT* >= PL_*PCT* and *SB_PCT* >= *SW_PCT*))
'SW_LEAD'	White spruce leading conifer in pure stand	*C_CODE* = ('C', 'D') and ((*SW_PCT* > *FB_PCT* and *SW_PCT* > *FD_PCT* and *SW_PCT* > *LT_PCT* and *SW_PCT* > *PL_PCT* and *SW_PCT* > *SB_PCT*) or (*LEAD_CON* = 'SW' and *SW_PCT* >= *FB_PCT* and *SW_PCT* >= *FD_PCT* and *SW_PCT* >= *LT_PCT* and *SW_PCT* >= PL_*PCT* and *SW_PCT* >= *SB_PCT*))
'NO_C'	No coniferous present	*SOFTPCT* = 0

Based on CRULE, DRULE, broad cover group and species composition, forested polygons were then assigned to an extended stratum (Table 2-7).

Table 2-7. Assigning extended strata based DRULE, CRULE, BCG and species composition.

STRATA_SRD	Description	Selection Criteria
'D1'	Pure aspen	*C_CODE* = 'D' and *AW_PCT* >= 9
'D2'	Aspen leading with poplar	*C_CODE* = 'D' and *DRULE* = 'AW_LEAD' and *AW_PCT* < 9 and *PB_PCT* > 1
'D3'	Aspen leading without poplar	*C_CODE* = 'D' and *DRULE* = 'AW_LEAD' and *AW_PCT* < 9 and *PB_PCT* <= 1
'D4'	Poplar leading	*C_CODE* = 'D' and *DRULE* = 'PB_LEAD'
'D5'	Birch leading	*C_CODE* = 'D' and *DRULE* = 'BW_LEAD'
'DC1'	Aspen/white spruce	*C_CODE* = 'DC' and *DRULE* = 'AW_LEAD' and *CRULE* = 'SW_LEAD_MW'
'DC2'	Aspen/pine	*C_CODE* = 'DC' and *DRULE* = 'AW_LEAD' and *CRULE* = 'PL_LEAD_MW'
'DC3'	Aspen/black spruce	*C_CODE* = 'DC' and *DRULE* = 'AW_LEAD' and *CRULE* = 'SBLT_LEAD_MW'
'DC4'	Aspen/fir	*C_CODE* = 'DC' and *DRULE* = 'AW_LEAD' and *CRULE* = 'FBFD_LEAD_MW'
'DC5'	Poplar/white spruce	*C_CODE* = 'DC' and *DRULE* = 'PB_LEAD' and *CRULE* = 'SW_LEAD_MW'
'DC6'	Poplar/pine	*C_CODE* = 'DC' and *DRULE* = 'PB_LEAD' and *CRULE* = 'PL_LEAD_MW'
'DC7'	Poplar/black spruce	*C_CODE* = 'DC' and *DRULE* = 'PB_LEAD' and *CRULE* = 'SBLT_LEAD_MW'
'DC8'	Poplar/fir	*C_CODE* = 'DC' and *DRULE* = 'PB_LEAD' and *CRULE* = 'FBFD_LEAD_MW'
'DC9'	Birch/white spruce	*C_CODE* = 'DC' and *DRULE* = 'BW_LEAD' and *CRULE* = 'SW_LEAD_MW'
'DC10'	Birch/pine	*C_CODE* = 'DC' and *DRULE* = 'BW_LEAD' and *CRULE* = 'PL_LEAD_MW'
'DC11'	Birch/black spruce	*C_CODE* = 'DC' and *DRULE* = 'BW_LEAD' and *CRULE* = 'SBLT_LEAD_MW'
'DC12'	Birch/fir	*C_CODE* = 'DC' and *DRULE* = 'BW_LEAD' and *CRULE* = 'FBFD_LEAD_MW'
'CD1'	White spruce/aspen	*C_CODE* = 'CD' and *CRULE* = 'SW_LEAD_MW' and *DRULE* = 'AW_LEAD'
'CD2'	White spruce/poplar	*C_CODE* = 'CD' and *CRULE* = 'SW_LEAD_MW' and *DRULE* = 'PB_LEAD'
'CD3'	White spruce/birch	*C_CODE* = 'CD' and *CRULE* = 'SW_LEAD_MW' and *DRULE* = 'BW_LEAD'
'CD4'	Pine/aspen	*C_CODE* = 'CD' and *CRULE* = 'PL_LEAD_MW' and *DRULE* = 'AW_LEAD'
'CD5'	Pine/poplar	*C_CODE* = 'CD' and *CRULE* = 'PL_LEAD_MW' and *DRULE* = 'PB_LEAD'
'CD6'	Pine/birch	*C_CODE* = 'CD' and *CRULE* = 'PL_LEAD_MW' and *DRULE* = 'BW_LEAD'
'CD7'	Black spruce/aspen	*C_CODE* = 'CD' and *CRULE* = 'SBLT_LEAD_MW' and *DRULE* = 'AW_LEAD'
'CD8'	Black spruce/poplar	*C_CODE* = 'CD' and *CRULE* = 'SBLT_LEAD_MW' and *DRULE* = 'PB_LEAD'
'CD9'	Black spruce/birch	*C_CODE* = 'CD' and *CRULE* = 'SBLT_LEAD_MW' and *DRULE* = 'BW_LEAD'
'CD10'	Fir/aspen	*C_CODE* = 'CD' and *CRULE* = 'FBFD_LEAD_MW' and *DRULE* = 'AW_LEAD'
'CD11'	Fir/poplar	*C_CODE* = 'CD' and *CRULE* = 'FBFD_LEAD_MW' and *DRULE* = 'PB_LEAD'
'CD12'	Fir/birch	*C_CODE* = 'CD' and *CRULE* = 'FBFD_LEAD_MW' and *DRULE* = 'BW_LEAD'
'C1'	Pure white spruce	*C_CODE* = 'C' and *SW_PCT* >= 9
'C2'	White spruce leading with pine	*C_CODE* = 'C' and *CRULE* = 'SW_LEAD' and *SW_PCT* < 9 and *PL_PCT* > 1
'C3'	White spruce leading without pine	*C_CODE* = 'C' and *CRULE* = 'SW_LEAD' and *SW_PCT* < 9 and *PL_PCT* <= 1
'C4'	Pure pine	*C_CODE* = 'C' and *PL_PCT* >= 9
'C5'	Pine leading with white spruce	*C_CODE* = 'C' and *CRULE* = 'PL_LEAD' and *PL_PCT* < 9 and *SW_PCT* > 1 and *SW_ORD* < *FB_ORD* and *SW_ORD* < *SB_ORD*
'C6'	Pine leading with black spruce	*C_CODE* = 'C' and *CRULE* = 'PL_LEAD' and *PL_PCT* < 9 and *SB_PCT* > 1 and *SB_ORD* < *FB_ORD* and *SB_ORD* < *SW_ORD*
'C7'	Pine leading with fir	*C_CODE* = 'C' and *CRULE* = 'PL_LEAD' and *PL_PCT* < 9 and *FB_PCT* > 1 and *FB_ORD* < *SB_ORD* and *FB_ORD* < *SW_ORD*
'C8'	Pine leading without spruce and fir	*C_CODE* = 'C' and *CRULE* = 'PL_LEAD' and *PL_PCT* < 9 and *FB_PCT* <= 1 and *SB_PCT* <=1 and *SW_PCT* <= 1
'C9'	Pure black spruce	*C_CODE* = 'C' and *SB_PCT* >= 9
'C10'	Black spruce leading with pine	*C_CODE* = 'C' and *CRULE* = 'SB_LEAD' and *SB_PCT* <9 and *PL_PCT* > 1
'C11'	Black spruce leading without pine	*C_CODE* = 'C' and *CRULE* = 'SB_LEAD' and *SB_PCT* <9 and *PL_PCT* <= 1
'C12'	Larch leading	*C_CODE* = 'C' and *CRULE* = 'LT_LEAD'
'C13'	Pure Douglas-fir	*C_CODE* = 'C' and *FD_PCT* >= 9
'C14'	Douglas-fir leading	*C_CODE* = 'C' and *CRULE* = 'FD_LEAD' and *FD_PCT* < 9
'C15'	Pure balsam fir	*C_CODE* = 'C' and *FB_PCT* >= 9
'C16'	Balsam fir leading with pine	*C_CODE* = 'C' and *CRULE* = 'FB_LEAD' and *FB_PCT* < 9 and *PL_PCT* > 1
'C17'	Balsam fir leading without pine	*C_CODE* = 'C' and *CRULE* = 'FB_LEAD' and *FB_PCT* < 9 and *PL_PCT* <= 1
'XX0'	Non-forested	*C_CODE* = NULL

2.4.4 DFMP Yield Strata

Extended strata convert to species strata as shown in Table 2-8.

Table 2-8. Conversion of extended strata to species strata.

Broad Cover Group	Species Stratum	Extended Stratum	Description
D	AW	D1, D2, D3, D4	Aspen or poplar leading deciduous stand
	BW	D5	Birch leading deciduous stand
DC	AP	DC2, DC10	Deciduous leading pine mixedwood
	AS	DC1, DC3, DC4, DC5, DC6, DC7, DC8, DC9, DC11, DC12	Deciduous leading spruce mixedwood[1]
CD	PA	CD4, CD5, CD6	Coniferous leading pine mixedwood
	SA	CD1, CD2, CD3, CD7, CD8, CD9, CD10, CD11, CD12	Coniferous leading spruce mixedwood
C	LT	C4, C5, C6, C7, C8	Larch leading conifer stand
	PL	C9, C10, C11	Black spruce leading conifer stand
	SB	C1, C2, C3, C13, C14, C15, C16, C17	Pine leading conifer stand
	SW	C12	White spruce leading conifer stand

[1] Includes a small area of poplar-leading pine mixedwood.

Species strata are the basis upon which DFMP yield strata are assigned. In FMU W13, species strata were converted directly to DFMP yield strata. In FMU W11, some species strata were grouped together to form DFMP yield strata while others were split based on crown closure class (Table 2-9).

Table 2-9. Conversion of species strata to DFMP yield strata.

FMU	Broad Cover Group	DFMP Yield Stratum	Species Stratum	Crown Closure Class	Description
W11	D	AW_AB	AW	AB	Aspen or poplar leading deciduous stand, open crown closure
		AW_CD	AW	CD	Aspen or poplar leading deciduous stand, closed crown closure
		BW	BW	ABCD	Birch leading deciduous stand
	DC	APAS_ABCD	AP, AS	ABCD	Deciduous leading mixedwood stand
	CD	PASA_ABCD	PA, SA	ABCD	Coniferous leading mixedwood stand
	C	LT	LT	ABCD	Larch leading conifer stand
		PL_AB	PL	AB	Pine leading conifer stand, open crown closure
		PL_CD	PL	CD	Pine leading conifer stand, closed crown closure
		SB	SB	ABCD	Black spruce leading conifer stand
		SW_AB	SW	AB	White spruce leading conifer stand, open crown closure
		SW_CD	SW	CD	White spruce leading conifer stand, closed crown closure
W13	D	AW	AW	ABCD	Aspen or poplar leading deciduous stand
		BW	BW	ABCD	Birch leading deciduous stand
	DC	AP	AP	ABCD	Deciduous leading pine mixedwood
		AS	AS[1]	ABCD	Deciduous leading spruce mixedwood
	CD	PA	PA	ABCD	Coniferous leading pine mixedwood
		SA	SA	ABCD	Coniferous leading spruce mixedwood
	C	LT	LT	ABCD	Larch leading conifer stand
		PL	PL	ABCD	Black spruce leading conifer stand
		SB	SB	ABCD	Pine leading conifer stand
		SW	SW	ABCD	White spruce leading conifer stand

3. Plot Attribute Assignment and Volume Compilation

3.1 Overview

This section describes how plot data were prepared for use in yield curve development. Data sources and the initial number of observations are described. The method of assigning landbase attributes to observations using spatial locations of plot data is then described, along with the methods of deleting observations from the dataset based on plot attributes. Finally, the methods for compiling gross merchantable stand volume (m^3/ha) for each eligible observation are described.

3.2 Data Sources

Plot data were available from a variety of data sources (Table 3-1). Both permanent sample plot and temporary sample plot data were used. A summary of sampling programs is provided in Appendix III, Appendix IV and Appendix V.[3]

[3] All data and data dictionaries are included with this submission in digital format.

Table 3-1. Data sources used in yield curve development.

Data Set	Data Type	Sampling Program	Ownership	Location FMU(s)	Collection Year(s)	Number of Plots	Number of Observations[1]
PSP/TSP	PSP	Existing W13 PSP	MWFP	W13	1996 to 2003	197	302
		New W11 PSP	MWFP	W11	2004	40	40
	TSP	Existing W13 TSP	MWFP	W13	1997, 1998	584	584
		Existing W11 TSP	ASRD	W11	2000	359	359
		New Volume Sampling TSP	MWFP	W11, W13	2004, 2005	562	562
		New Birch TSP	MWFP	W11, W13	2005	36	36
	Total					1,778	1,883
Athabasca	TSP	Athabasca Flats TSP	MWFP	W13	2004, 2005	57	57

[1] Where PSP remeasurement data exist, each measurement is treated as an independant observation.

Data used in yield curve development were either from existing data sources, or were collected specifically to increase sample size for target yield strata. Existing growth and yield data (Existing W13 TSP, Existing W11 TSP, Existing W13 PSP) were catalogued in July 2004 (Millar Western 2004d). These data included existing PSP data from FMU W13, and existing TSP data from both FMUs.

Based on the existing number of plots, a sampling program was developed to increase sample sizes in target areas (New Volume Sampling TSP). In addition, a PSP program was initiated in FMU W11 in 2004, further increasing sample sizes (New W11 PSP). A birch sampling program was later added to increase the sample size in birch stands (New Birch TSP). Together, these data comprise the base dataset used for empirical yield curve development.

The Athabasca Flats selective logging area was treated as a separate entity and sampled under its own program in 2004 and 2005 (Millar Western 2004a). These data were specifically collected to develop yield curves for the Athabasca Flats selective logging area, and are discussed later in this document (Section 7.4: Athabasca Flats Selective Logging Yield Curves).

3.3 Plot Attribute Assignment

Spatial locations of all sample plots were available. Spatial plot locations were compiled into two shapefiles: one for permanent sample plots (***all_psps.shp***) and one for temporary sample plots (***all_tsp_to_2005.shp***). Attribute tables for shapefiles were standardized to contain polygon number, *cutblock* number, plot number, establishment year (year of first measurement for PSPs and sample year for TSPs), original spatial data source, and sampling program name. A unique ID was assigned to each plot using a combination of polygon, cutblock, plot and establishment year. These two shapefiles were merged together to create ***plot_attributes20060221.shp***.

Attributes were assigned to each plot by intersecting ***plot_attributes20060221.shp*** with the Millar Western spatial landbase, version 9 (***mwfp_lb9a_model2.shp***). This version of the landbase did not include spatial locations of seismic lines; rather, individual polygon areas were reduced to account for losses due to seismic exploration. Plot deletions to account for seismic disturbance are described in Section 3.4.

Where there was more than one observation per plot, plot attributes were attached to each observation.

3.4 Deletions

To be eligible for empirical yield curve development, observations had to be from plots:

1. Within the managed landbase[4]; and

2. In natural (non-regenerating, non-thinned) stands that had not been burned since sampling, and had not been harvested either before or after sampling.

The following deletions were applied to the base TSP/PSP dataset[5].

Fire Disturbance

Two major fires occurred in the FMA area between the time when the last AVI inventory was obtained (1994) and the effective date of the classified landbase (2004). These occurred in the Virginia Hills and Roche Lake areas in 1998. TSP data were collected in 1997/1998 in these areas, and it was assumed that these stands were burned during the fire. Any observations from plots classified as within the Virginia Hills or Roche Lake burn areas were removed from the sample.

Two small fires also occurred since the last inventory was obtained. No plots were sampled within these areas.

Harvesting or Thinning

Observations from stands harvested or thinned after sampling no longer represent standing timber in natural stands on the managed landbase. These observations were removed from the dataset. Some of these plots had also been sampled in regenerating cutblocks for use in an unrelated modelling endeavour; these observations were also removed from the base dataset for yield curve development.

Landbase Deletions

To ensure consistency with the landbase classification, plot locations were spatially intersected with the classified landbase. This allowed the removal of plots falling within the unmanaged landbase (*e.g.*, unproductive TPR, W11 black spruce stands, larch stands, buffers, roads, *etc.*).

[4] The managed landbase excludes all deletion areas (parks, roads, buffers, unproductive TPR, larch stands, W11 black spruce stands, *etc.* See Millar Western 2007 for full details). As such, plots in the managed landbase had already been screened for these attributes.

[5] Excluding Athabasca Flats selective logging plots.

All observations from the unmanaged landbase, excluding seismic disturbance, were removed from the sample.

Seismic Disturbance

All 2004/2005 TSPs were offset from seismic disturbance and all PSPs are protected from seismic disturbance. No observations were deleted from these datasets.

The 1997/1998 TSPs were not offset from seismic disturbance, however, plot data contained an annotation indicating whether the sampled plot contained seismic disturbance. Observations from plots containing seismic disturbance were removed from the 1997/1998 TSP dataset.

The 2000 SRD TSPs were not protected from seismic disturbance, nor was there plot annotation indicating whether seismic disturbance was present within the plot. No plots were deleted, but there is an inherent assumption that *plot volumes* may be underestimated due to an unknown quantity of seismic disturbance within plots.

Additional Deletions: PSPs

Millar Western has established PSPs in managed stands. These may be Plantation PSPs (PPSPs), established in *clearcuts*, or Enhanced Forest Management PSPs (EFMPSPs), established in thinned stands (Millar Western 2006b). Observations from these plots were generally removed using landbase attribute information, which indicated that they were in managed stands.

A few EFMPSPs were not excluded using landbase attribute information, but should have been removed from the dataset[6]. These plots were subjectively removed. A few Plantation PSPs (PPSPs) were classified as natural stands based on landbase information, generally with an AVI modifier set to 'CC'. These plots were also removed from the dataset.

Additional Deletions: Influential Points

During the fitting of empirical yield curves, ten *influential points* were identified and were entirely removed from the dataset. An additional 3 influential points were also identified for deciduous volumes and removed from the deciduous dataset.

These were points that were outliers, exhibited strongly atypical volumes for their site type (fair, medium or good), and/or inordinately affected model performance. A list of influential points by FMU, plot volumes and ages, dataset deleted from and reason for deletion are provided in Table 3-2.

[6] Control EFM PSPs were retained, since they were established in unthinned portions of EFM stands.

Table 3-2. Influential points by FMU, deletion type and reason for deletion.

FMU	Unique Plot Identifier	DFMP Yield Stratum	Age	Volume (m^3/ha) Coniferous	Deciduous	Total	TPR	Deletion	Reason for Deletion
W11	366331-0-1-2004	AW_AB	134	62.1	81.8	143.9	n/a	Both	The regression couldn't converge
	366331-0-2-2004	AW_AB	134	97.4	6.5	103.9	n/a	Both	The regression couldn't converge
	366331-0-3-2004	AW_AB	134	63.7	236.3	300.0	n/a	Both	The regression couldn't converge
	374355-0-2-2004	PASA_ABCD	134	124.1	520.0	644.1	n/a	Decid.	Outlier
	406637-0-2-2004	PASA_ABCD	64	0.0	579.4	579.4	n/a	Decid.	Outlier
	367044-0-2-2000	PASA_ABCD	100	96.5	796.1	892.6	n/a	Decid.	Outlier
W13	591650276-0-2-2004	AP	104	344.4	234.6	579.0	F	Both	Resulted in inappropriate model form using site
	621450328-0-2-2004	AP	124	344.0	0.0	344.0	M	Both	Resulted in inappropriate model form using site
	581550449-0-3-2004	PA	104	0.0	690.7	690.7	M	Both	Outlier
	581350372-0-1-2004	SA	124	209.6	0.0	209.6	G	Both	Resulted in inappropriate model form using site
	581350372-0-3-2004	SA	124	117.7	0.0	117.7	G	Both	Resulted in inappropriate model form using site
	591550612-0-1-2004	SA	104	399.1	0.0	399.1	M	Both	Resulted in inappropriate model form using site
	601550004-0-593-1997	SA	77	278.9	0.0	278.9	G	Both	Resulted in inappropriate model form using site

Final Number of Observations

The original number of available TSP/PSP observations from Table 3-1 is broken down by FMU in Table 3-3. Deletions based on landbase information are also classified by FMU, as are additional PSP and influential plot deletions. The final number of observations used in yield curve development was 582 and 769 for FMUs W11 and W13, respectively.

Table 3-3. Reconciliation of the initial number of observations, number of deleted observations and final number of observations used in empirical yield curve development.

Description	Reason for Deletion	Number of Observations FMU W11	FMU W13	Total
Original Number of Observations[1]		726	1,157	1,883
Initial Deletions: Landbase	Burned or harvested	22	160	182
	Seismic disturbance within plot	-	59	59
	Unmanaged landbase	119	152	271
Additional Deletions: PSPs	EFM (thinned) plots	-	3	3
	Plantation plots	-	7	7
Additional Deletions: Influential Points[2]		3	7	10
Total Observations for Yield Curve Development		582	769	1,351

[1] Athabasca Flats selective logging plots are treated separately and are not included in this discussion.

[2] Does not include three influential points in FMU W11 which were deleted from the deciduous dataset but not from the coniferous dataset.

3.5 DFMP Yield Stratum and Age Assignment

Chapter 2 described the methods for assigning DFMP yield strata and other landbase attributes to landbase polygons. Section 3.3 described how landbase attributes were assigned to plots using a spatial intersection of plot locations with the Millar Western landbase, version 9. As a result of these two processes, each observation was provided with a species stratum assignment (F_YC) and a crown closure class assignment (F_DEN) consistent with the landbase assignment process. These two variables were combined using the rules in Table 3-4 to assign DMFP yield strata.

Table 3-4. Rules for assigning DFMP yield strata to plots based on FMU, species stratum and density.

FMU	Broad Cover Group	DFMP Yield Stratum	Species Stratum (F_YC)	Crown Closure Class (F_DEN)
W11	D	AW_AB	AW	A, B
		AW_CD	AW	C, D
		BW	BW	Any
	DC	APAS_ABCD	AP, AS	Any
	CD	PASA_ABCD	PA, SA	Any
	C	LT	LT	Any
		PL_AB	PL	A, B
		PL_CD	PL	C, D
		SB	SB	Any
		SW_AB	SW	A, B
		SW_CD	SW	C, D
W13	D	AW	AW	Any
		BW	BW	Any
	DC	AP	AP	Any
		AS	AS[1]	Any
	CD	PA	PA	Any
		SA	SA	Any
	C	LT	LT	Any
		PL	PL	Any
		SB	SB	Any
		SW	SW	Any

The number of eligible observations by DFMP yield stratum assignment is presented in Table 3-5.

Table 3-5. Number of eligible observations for empirical yield curve development by FMU and DFMP yield stratum.

FMU	DFMP Yield Stratum	Number of Observations
W11	AW_AB	60
	AW_CD	105
	BW	6
	APAS_ABCD	72
	PASA_ABCD	80
	PL_AB	71
	PL_CD	66
	SW_AB	59
	SW_CD	63
	Total	582
W13	AW	138
	BW	36
	AP	56
	AS	96
	PA	63
	SA	60
	PL	183
	SB	61
	SW	76
	Total	769
Grand Total		1,351

Stand age for the defining layer at the reference year (2004) was also already appended to plot data from intersecting plot locations with landbase attributes (F_AGE).

Stand age for each observation at the year of measurement was calculated as stand age in 2004 (the reference year) minus the number of years between 2004 and the measurement year:

$$Age_{Obs} = Age_{2004} - (2004 - MmtYear)$$

Where : Age_{Obs} = stand age at year of measurement

Age_{2004} = stand age in 2004 (F_AGE)

MmtYear = measurement year (establishment year for TSPs, varies for PSPs)

Other landbase attributes were also retained for use in empirical yield curve development. These included density, height, and TPR.

3.6 Volume Compilation

Each eligible observation from the combined TSP/PSP dataset was used to compile gross merchantable stand volume estimates. Use of the term *gross* indicates that there has been no deduction for *cull*. Each PSP plot measurement was considered an independent observation for the purposes of yield curve development.

For each sample plot, the merchantable length of each live tree with a minimum stump diameter of 15.0 cm was calculated. Both birch and larch were considered merchantable species[7]. This calculation was based on the measured height of the tree, a 10.0 cm minimum top diameter and minimum stump height as defined in Table 3-6.

Table 3-6. Utilization limits for determining gross merchantable volume of individual trees.

Utilization Characteristic	FMU W11	FMU W13
Minimum top diameter inside bark	10 cm	10 cm
Minimum stump diameter outside bark	15 cm	15 cm
Stump height	30 cm	30 cm - SW
		20 cm - all other spp.
Minimum log length	4.88 m	4.88 m
Species	all	all

Calculations involved the iterative process presented in 'Ecologically Based Individual Tree Volume Estimation For Major Alberta Tree Species' (Huang 1994b). Trees not meeting utilization limits were deleted from the dataset.

[7] The BW DFMP yield stratum is part of the managed landbase, and birch is also considered an acceptable component of stands in other DFMP yield strata. The LT DFMP yield stratum is not considered part of the managed landbase; however, larch trees within stands are considered eligible for harvest, and as such are included in volume compilations.

The merchantable length of each tree was divided into 30 sections of equal length. Diameters were determined for the top, middle and bottom of each section using Kozak's variable exponent taper equation (Kozak 1988) and ecoregion/tree species-specific coefficients for the province of Alberta (Huang 1994a). The equation was:

$$dib = a_0 DBH^{a_1} * a_2^{DBH} * X^{b_1 Z^2 + b_2 \ln(Z+0.001) + b_3 \sqrt{Z} + b_4 e^Z + b_5 \left(\frac{DBH}{H}\right)}$$

Where: *dib* = stem diameter inside bark (cm) at height h (m)

DBH = diameter at breast height outside bark (cm)

H = total tree height[8] (m)

$$X = \frac{1 - \sqrt{h/H}}{1 - \sqrt{p}}$$

$Z = h/H$

h = stem height (m)

p = relative height of inflection point from the ground

$a_0, a_1, a_2, b_1, b_2, b_3, b_4, b_5$ = coefficients

For each tree, volumes for each section were calculated using Newton's equation (Husch *et al.* 1982):

$$MV = \frac{ML/10}{6} * (0.00007854) * (d_0^2 + 4d_1^2 + d_2^2)$$

Where: *MV* = merchantable volume (m^3)

ML = merchantable length (m)

d_0 = diameter at bottom of section (cm)

d_1 = diameter at middle of section (cm)

d_2 = diameter at top of section (cm)

[8] Recorded total height was used for volume calculations. Where heights were missing, equations from Huang (1994a) were used to estimate total height.

Gross *merchantable tree volumes* were then determined by summing individual section volumes for each tree. Tree volumes were converted to gross merchantable stand volume (volume per hectare) using the appropriate plot size expansion factor. Observations with no merchantable trees were assigned zero gross merchantable volume (0 m^3/ha) and retained within the dataset.

For each observation, the total coniferous gross merchantable stand volume was calculated by summing the m^3/ha estimates for each live coniferous tree within the plot. The total deciduous gross merchantable stand volume was calculated by summing the m^3/ha estimates for each live deciduous tree within the plot.

4. Landbase Summaries and Reconciliation

4.1 Overview

This section provides summaries of landbase areas based on the final landbase prepared for Millar Western, which is landbase version 12. The landbase is described in the document "Landbase Classification: 2007-2016 Detailed Forest Management Plan." (Millar Western 2007).

Only the managed landbase is summarized here, since this is the only portion relevant to yield curve development. For summaries of the unmanaged landbase, see Millar Western (2007).

4.2 Landbase Summaries

The file ***lb12_tsa_attr.shp*** (landbase version 12) was used to obtain managed landbase areas. Landbase areas by DFMP yield stratum and stand type are presented in Table 4-1 and Table 4-2 for FMUs W11 and W13, respectively.

Table 4-1. Total managed landbase area (ha) by DFMP yield stratum and stand type, FMU W11.

DFMP Yield Stratum	Stand Type		Total
	Natural	Managed	
AW_AB	8,140	-	8,140
AW_CD	41,554	3,492	45,046
BW	130	-	130
APAS_ABCD	4,488	1,892	6,380
PASA_ABCD	5,027	1,594	6,621
PL_AB	3,582	-	3,582
PL_CD	6,844	1,162	8,006
SB	-	-	-
SW_AB	2,863	-	2,863
SW_CD	5,116	1,484	6,600
Total	77,744	9,625	87,369

Table 4-2. Total managed landbase area (ha) by DFMP yield stratum and stand type, FMU W13.

DFMP Yield Stratum	Stand Type				Total
	Natural	Managed	Thinning[1]	Selective Logging[2,3,4]	
AW	52,397	5,447	2	-	57,846
BW	1,024	80	1	-	1,105
AP	5,498	527	17	-	6,042
AS	13,549	5,562	4	-	19,115
PA	7,602	2,647	45	61	10,354
SA	10,207	6,774	8	711	17,700
PL	44,707	20,802	1,132	-	66,641
SB	16,558	179	69	-	16,806
SW	11,929	4,876	3	-	16,808
Total	163,471	46,892	1,280	772	212,416

[1] Salvage and commercial thinning in natural stands; excludes selective logging.

[2] Selective logging took place in the Athabasca Flats vicinity of the Athabasca river using horse logging methods.

[3] Includes blocks classified as planned in 2004 but that have subsequently been harvested.

[4] DFMP yield strata are based on post-harvest assignment.

4.3 Distribution of Data

This section summarizes the number of plots used in yield curve development relative to the managed landbase areas that these curves represent. The number of plots is summarized by DFMP yield stratum and various attributes of interest (height class, age class, TPR class (in the case of FMU W13) and defining layer. Note that all landbase summaries were generated using landbase 12 attributes.

The number and percent of observations by DFMP yield stratum and height class for FMU W11 is shown in Table 4-3. The table also presents the landbase area and percent area by DFMP yield stratum, stand type and height class. Observations are generally in proportion to the distribution of natural stands, with the exception of the SW_AB DFMP yield stratum, where taller height classes are underrepresented.

Table 4-3. Number and percent of observations by height class relative to the amount (area in ha) and percent landbase, FMU W11.

DFMP Yield	Height	Observations		Landbase Area (ha)			Percent Landbase Area		
Stratum	Class (m)	Total	%	Natural	Managed	Total	Natural	Managed	Total
AW_AB	0-10	19	32%	3,160	-	3,160	39%	n/a	39%
	11-20	6	10%	1,084	-	1,084	13%	n/a	13%
	21+	35	58%	3,895	-	3,895	48%	n/a	48%
	Total	60	100%	8,140	-	8,140	100%	n/a	100%
AW_CD	0-10	31	30%	12,563	3,420	15,983	30%	98%	35%
	11-20	22	21%	9,447	0	9,447	23%	0%	21%
	21+	52	50%	19,543	72	19,615	47%	2%	44%
	Total	105	100%	41,554	3,492	45,046	100%	100%	100%
BW	0-10	-	0%	76	-	76	59%	0%	59%
	11-20	-	0%	54	-	54	41%	0%	41%
	21+	-	0%	-	-	-	0%	0%	0%
	Total	-	0%	130	-	130	100%	0%	100%
APAS_ABCD	0-10	13	18%	512	1,806	2,318	11%	95%	36%
	11-20	23	32%	1,070	0	1,070	24%	0%	17%
	21+	36	50%	2,907	85	2,992	65%	5%	47%
	Total	72	100%	4,488	1,892	6,380	100%	100%	100%
PASA_ABCD	0-10	7	9%	459	1,408	1,867	9%	88%	28%
	11-20	29	36%	1,391	1	1,392	28%	0%	21%
	21+	44	55%	3,178	185	3,363	63%	12%	51%
	Total	80	100%	5,027	1,594	6,621	100%	100%	100%
PL_AB	0-10	17	24%	1,119	-	1,119	31%	n/a	31%
	11-20	48	68%	2,280	-	2,280	64%	n/a	64%
	21+	6	8%	183	-	183	5%	n/a	5%
	Total	71	100%	3,582	-	3,582	100%	n/a	100%
PL_CD	0-10	11	17%	1,858	1,162	3,020	27%	100%	38%
	11-20	38	58%	3,637	-	3,637	53%	0%	45%
	21+	17	26%	1,349	-	1,349	20%	0%	17%
	Total	66	100%	6,844	1,162	8,006	100%	100%	100%
SW_AB	0-10	15	25%	246	-	246	9%	n/a	9%
	11-20	27	46%	967	-	967	34%	n/a	34%
	21+	17	29%	1,649	-	1,649	58%	n/a	58%
	Total	59	100%	2,863	-	2,863	100%	n/a	100%
SW_CD	0-10	9	14%	227	1,432	1,659	4%	96%	25%
	11-20	16	25%	1,511	1	1,511	30%	0%	23%
	21+	38	60%	3,379	52	3,430	66%	3%	52%
	Total	63	100%	5,116	1,484	6,600	100%	100%	100%
Grand Total		576		77,744	9,625	87,369			

The number and percent of observations by DFMP yield stratum and age class for FMU W11 is shown in Table 4-4. The table also presents the landbase area and percent area by DFMP yield stratum, stand type and age class. Note that the goal of the 2004 volume sampling program was to obtain a relatively even spread of observations across merchantable age classes to anchor yield curves, rather than to obtain proportional representation relative to landbase areas.

Table 4-4. Number and percent of observations by age class relative to the amount (area in ha) and percent landbase, FMU W11.

DFMP Yield	Age	Observations		Landbase Area (ha)			Percent Landbase Area		
Stratum	Class (y)	Total	%	Natural	Managed	Total	Natural	Managed	Total
AW_AB	0-39	9	15%	2,959	-	2,959	36%	n/a	36%
	40-79	16	27%	972	-	972	12%	n/a	12%
	80-119	25	42%	3,799	-	3,799	47%	n/a	47%
	120+	10	17%	410	-	410	5%	n/a	5%
	Total	60	100%	8,140	-	8,140	100%	n/a	100%
AW_CD	0-39	32	30%	14,354	3,492	17,846	35%	100%	40%
	40-79	8	8%	4,482	-	4,482	11%	0%	10%
	80-119	49	47%	21,550	-	21,550	52%	0%	48%
	120+	16	15%	1,168	-	1,168	3%	0%	3%
	Total	105	100%	41,554	3,492	45,046	100%	100%	100%
BW	0-39	-	0%	7	-	7	5%	0%	5%
	40-79	-	0%	110	-	110	85%	0%	85%
	80-119	-	0%	14	-	14	10%	0%	10%
	120+	-	0%	-	-	-	0%	0%	0%
	Total	-	0%	130	-	130	100%	0%	100%
APAS_ABCD	0-39	4	6%	359	1,892	2,251	8%	100%	35%
	40-79	18	25%	500	-	500	11%	0%	8%
	80-119	24	33%	3,091	-	3,091	69%	0%	48%
	120+	26	36%	538	-	538	12%	0%	8%
	Total	72	100%	4,488	1,892	6,380	100%	100%	100%
PASA_ABCD	0-39	4	5%	166	1,594	1,760	3%	100%	27%
	40-79	21	26%	495	-	495	10%	0%	7%
	80-119	34	43%	3,132	-	3,132	62%	0%	47%
	120+	21	26%	1,234	-	1,234	25%	0%	19%
	Total	80	100%	5,027	1,594	6,621	100%	100%	100%
PL_AB	0-39	7	10%	765	-	765	21%	n/a	21%
	40-79	24	34%	1,054	-	1,054	29%	n/a	29%
	80-119	25	35%	1,618	-	1,618	45%	n/a	45%
	120+	15	21%	144	-	144	4%	n/a	4%
	Total	71	100%	3,582	-	3,582	100%	n/a	100%
PL_CD	0-39	5	8%	1,145	1,162	2,307	17%	100%	29%
	40-79	20	30%	1,570	-	1,570	23%	0%	20%
	80-119	20	30%	3,892	-	3,892	57%	0%	49%
	120+	21	32%	237	-	237	3%	0%	3%
	Total	66	100%	6,844	1,162	8,006	100%	100%	100%
SW_AB	0-39	0	0%	151	-	151	5%	n/a	5%
	40-79	19	32%	121	-	121	4%	n/a	4%
	80-119	19	32%	1,842	-	1,842	64%	n/a	64%
	120+	21	36%	749	-	749	26%	n/a	26%
	Total	59	100%	2,863	-	2,863	100%	n/a	100%
SW_CD	0-39	0	0%	87	1,484	1,572	2%	100%	24%
	40-79	17	27%	416	-	416	8%	0%	6%
	80-119	25	40%	3,082	-	3,082	60%	0%	47%
	120+	21	33%	1,531	-	1,531	30%	0%	23%
	Total	63	100%	5,116	1,484	6,600	100%	100%	100%
Grand Total		576		77,744	9,625	87,369			

The number and percent of observations by DFMP yield stratum and defining layer for FMU W11 is shown in Table 4-5. Note that for managed stands, AVI information is not necessarily the source of the DFMP yield stratum assignment, therefore those areas are not included here. Generally all strata were sampled in proportion to the area of composite stands; the exception is stratum SW_AB, which has slightly higher representation of plots with understory assignment relative to total landbase area.

Table 4-5. Number and percent of observations by defining layer class relative to the amount (area in ha) and percent natural stand landbase area, FMU W11.

DFMP Yield Stratum	Defining Layer	Observations		Landbase	
		Total	%	Area (ha)	% Area
AW_AB	Overstory	53	88%	7,649	94%
	Understory	4	7%	311	4%
	Composite	3	5%	180	2%
	Total	60	100%	8,140	100%
AW_CD	Overstory	102	97%	38,934	94%
	Understory	1	1%	852	2%
	Composite	2	2%	1,767	4%
	Total	105	100%	41,554	100%
BW	Overstory	-	0%	40	30%
	Understory	-	0%	87	67%
	Composite	-	0%	4	3%
	Total	-	0%	130	100%
APAS_ABCD	Overstory	62	86%	3,655	81%
	Understory	9	13%	215	5%
	Composite	1	1%	617	14%
	Total	72	100%	4,488	100%
PASA_ABCD	Overstory	63	79%	3,556	71%
	Understory	6	8%	202	4%
	Composite	11	14%	1,270	25%
	Total	80	100%	5,027	100%
PL_AB	Overstory	68	96%	3,512	98%
	Understory	3	4%	62	2%
	Composite	-	0%	8	0%
	Total	71	100%	3,582	100%
PL_CD	Overstory	66	100%	6,703	98%
	Understory	-	0%	13	0%
	Composite	-	0%	128	2%
	Total	66	100%	6,844	100%
SW_AB	Overstory	40	68%	2,547	89%
	Understory	16	27%	124	4%
	Composite	3	5%	191	7%
	Total	59	100%	2,863	100%
SW_CD	Overstory	51	81%	4,012	78%
	Understory	8	13%	207	4%
	Composite	4	6%	896	18%
	Total	63	100%	5,116	100%
Grand Total		576		77,744	

The number and percent of observations by DFMP yield stratum and site type for FMU W13 is shown in Table 4-6. The table also presents the landbase area and percent area by DFMP yield stratum, stand type and site type. The number of observations is generally in proportion with natural stands, with the exception of the SB DFMP yield stratum. The cause of this misalignment is uncertain, however, the method for development of yield curves in FMU W13 incorporates site into the yield function, and therefore the proportion of observations by site will not have an impact in overall model performance.

Table 4-6. Number and percent of observations by TPR class relative to the amount (area in ha) and percent landbase, FMU W13.

DFMP Yield Stratum	TPR Class	Observations		Landbase Area (ha)			Percent Landbase Area		
		Total	%	Natural	Managed[1]	Total	Natural	Managed	Total
AW	F	17	12%	9,079	1,384	10,463	17%	25%	18%
	M	109	79%	37,394	3,879	41,273	71%	71%	71%
	G	12	9%	5,925	186	6,110	11%	3%	11%
	Total	138	100%	52,397	5,449	57,846	100%	100%	100%
BW	Total	42	n/a	1,024	81	1,105	100%	100%	100%
AP	F	8	16%	873	48	922	16%	9%	15%
	M	44	78%	3,598	472	4,069	65%	87%	67%
	G	4	7%	1,028	24	1,051	19%	4%	17%
	Total	56	100%	5,498	544	6,042	100%	100%	100%
AS	F	22	23%	2,486	1,336	3,821	18%	24%	20%
	M	68	71%	9,369	3,802	13,171	69%	68%	69%
	G	6	6%	1,694	428	2,122	13%	8%	11%
	Total	96	100%	13,549	5,566	19,115	100%	100%	100%
PA	F	1	2%	457	549	1,006	6%	20%	10%
	M	33	53%	4,009	1,552	5,560	53%	56%	54%
	G	29	45%	3,136	652	3,788	41%	24%	37%
	Total	63	100%	7,602	2,753	10,354	100%	100%	100%
SA	F	6	9%	268	1,169	1,437	3%	16%	8%
	M	39	63%	6,872	5,583	12,455	67%	75%	70%
	G	15	28%	3,067	741	3,808	30%	10%	22%
	Total	60	100%	10,207	7,492	17,700	100%	100%	100%
PL	F	18	10%	4,687	2,075	6,762	10%	9%	10%
	M	99	54%	28,029	13,138	41,167	63%	60%	62%
	G	66	36%	11,991	6,720	18,711	27%	31%	28%
	Total	183	100%	44,707	21,934	66,641	100%	100%	100%
SB	F	19	31%	1,155	-	1,155	7%	0%	7%
	M	24	39%	11,580	205	11,785	70%	83%	70%
	G	18	30%	3,822	43	3,865	23%	17%	23%
	Total	61	100%	16,558	248	16,806	100%	100%	100%
SW	F	7	9%	541	1,159	1,700	5%	24%	10%
	M	47	62%	8,434	3,369	11,802	71%	69%	70%
	G	22	29%	2,954	351	3,305	25%	7%	20%
	Total	76	100%	11,929	4,879	16,808	100%	100%	100%
Grand Total		775		163,471	48,945	212,416			

[1] Thinning and selective logging were included with Managed Stand areas in order to simplify this table.

The number and percent of observations by DFMP yield stratum and height class for FMU W13 is shown in Table 4-7. The table also presents the landbase area and percent area by DFMP yield stratum, stand type and height class. Observations are generally in proportion to the distribution of natural stands, with the exception of the AP, PA and PL yield strata. This may be partly an artefact of the 1997/1998 TSP sampling program, where relatively equal numbers of stands were sampled within each of three height classes. Underrepresentation of plots at lower height classes may be related to the fact that either minimum height criteria and/or minimum age criteria have been applied to TSP sampling programs. Incorporation of site index into modelling may help mitigate issues with height class representation (site is related to age and height).

Table 4-7. Number and percent of observations by height class relative to the amount (area in ha) and percent landbase, FMU W13.

DFMP Yield	Height	Observations		Landbase Area (ha)			Percent Landbase Area		
Stratum	Class (m)	Total	%	Natural	Managed[1]	Total	Natural	Managed	Total
AW	0-10	22	16%	3,879	5,025	8,904	7%	92%	15%
	11-20	79	57%	29,079	336	29,415	55%	6%	51%
	21+	37	27%	19,440	88	19,527	37%	2%	34%
	Total	138	100%	52,397	5,449	57,846	100%	100%	100%
BW	0-10	12	29%	527	-	527	51%	0%	48%
	11-20	30	71%	497	81	578	49%	100%	52%
	21+	0	0%	-	-	-	0%	0%	0%
	Total	42	100%	1,024	81	1,105	100%	100%	100%
AP	0-10	3	5%	1,344	466	1,810	24%	86%	30%
	11-20	21	38%	2,531	11	2,542	46%	2%	42%
	21+	32	57%	1,624	66	1,690	30%	12%	28%
	Total	56	100%	5,498	544	6,042	100%	100%	100%
AS	0-10	11	11%	1,136	5,086	6,222	8%	91%	33%
	11-20	32	33%	4,803	94	4,897	35%	2%	26%
	21+	53	55%	7,611	385	7,996	56%	7%	42%
	Total	96	100%	13,549	5,566	19,115	100%	100%	100%
PA	0-10	10	16%	2,769	1,861	4,630	36%	68%	45%
	11-20	14	22%	2,597	252	2,849	34%	9%	28%
	21+	39	62%	2,236	640	2,876	29%	23%	28%
	Total	63	100%	7,602	2,753	10,354	100%	100%	100%
SA	0-10	9	15%	842	2,501	3,343	8%	33%	19%
	11-20	13	22%	3,020	795	3,814	30%	11%	22%
	21+	38	63%	6,346	4,196	10,542	62%	56%	60%
	Total	60	100%	10,207	7,492	17,700	100%	100%	100%
PL	0-10	44	24%	19,091	19,216	38,306	43%	88%	57%
	11-20	85	46%	19,036	1,511	20,547	43%	7%	31%
	21+	54	30%	6,580	1,207	7,787	15%	6%	12%
	Total	183	100%	44,707	21,934	66,641	100%	100%	100%
SB	0-10	28	46%	7,052	132	7,184	43%	53%	43%
	11-20	33	54%	9,396	87	9,484	57%	35%	56%
	21+	0	0%	109	28	137	1%	11%	1%
	Total	61	100%	16,558	248	16,806	100%	100%	100%
SW	0-10	15	20%	1,731	3,264	4,995	15%	67%	30%
	11-20	21	28%	3,401	486	3,887	29%	10%	23%
	21+	40	53%	6,797	1,128	7,926	57%	23%	47%
	Total	76	100%	11,929	4,879	16,808	100%	100%	100%
Grand Total		775		163,471	48,945	212,416			

[1] Thinning and selective logging were included with Managed Stand areas in order to simplify this table.

The number and percent of observations by DFMP yield stratum and age class for FMU W13 is shown in Table 4-8. The table also presents the landbase area and percent area by DFMP yield stratum, stand type and age class. Note that the goal of the 2004 volume sampling program was to obtain a relatively even spread of observations across merchantable age classes to anchor yield curves, rather than to obtain proportional representation relative to landbase areas.

Table 4-8. Number and percent of observations by age class relative to the amount (area in ha) and percent landbase, FMU W13.

DFMP Yield	Age	Observations		Landbase Area (ha)			Percent Landbase Area		
Stratum	Class (y)	Total	%	Natural	Managed[1]	Total	Natural	Managed	Total
AW	0-39	3	2%	2,225	5,447	7,671	4%	100%	13%
	40-79	86	62%	24,463	1	24,464	47%	0%	42%
	80-119	43	31%	22,052	1	22,054	42%	0%	38%
	120+	6	4%	3,657	-	3,657	7%	0%	6%
	Total	138	100%	52,397	5,449	57,846	100%	100%	100%
BW	0-39	0	0%	124	80	204	12%	99%	18%
	40-79	36	86%	881	1	882	86%	1%	80%
	80-119	6	14%	20	-	20	2%	0%	2%
	120+	0	0%	-	-	-	0%	0%	0%
	Total	42	100%	1,024	81	1,105	100%	100%	100%
AP	0-39	0	0%	856	516	1,372	16%	95%	23%
	40-79	24	43%	2,861	3	2,865	52%	1%	47%
	80-119	15	27%	1,529	24	1,553	28%	4%	26%
	120+	17	30%	252	-	252	5%	0%	4%
	Total	56	100%	5,498	544	6,042	100%	100%	100%
AS	0-39	0	0%	182	5,562	5,744	1%	100%	30%
	40-79	34	35%	3,838	0	3,838	28%	0%	20%
	80-119	40	42%	6,313	3	6,316	47%	0%	33%
	120+	22	23%	3,217	-	3,217	24%	0%	17%
	Total	96	100%	13,549	5,566	19,115	100%	100%	100%
PA	0-39	0	0%	1,953	2,634	4,587	26%	96%	44%
	40-79	22	35%	2,936	16	2,952	39%	1%	29%
	80-119	14	22%	1,571	96	1,667	21%	3%	16%
	120+	27	43%	1,141	7	1,149	15%	0%	11%
	Total	63	100%	7,602	2,753	10,354	100%	100%	100%
SA	0-39	0	0%	135	6,774	6,909	1%	90%	39%
	40-79	11	18%	1,846	53	1,900	18%	1%	11%
	80-119	21	35%	3,309	399	3,708	32%	5%	21%
	120+	28	47%	4,917	266	5,183	48%	4%	29%
	Total	60	100%	10,207	7,492	17,700	100%	100%	100%
PL	0-39	3	2%	6,047	20,743	26,791	14%	95%	40%
	40-79	117	64%	27,899	526	28,425	62%	2%	43%
	80-119	30	16%	6,609	646	7,255	15%	3%	11%
	120+	33	18%	4,152	19	4,170	9%	0%	6%
	Total	183	100%	44,707	21,934	66,641	100%	100%	100%
SB	0-39	0	0%	436	179	615	3%	72%	4%
	40-79	28	46%	6,430	0	6,430	39%	0%	38%
	80-119	8	13%	2,853	68	2,921	17%	28%	17%
	120+	25	41%	6,839	0	6,839	41%	0%	41%
	Total	61	100%	16,558	248	16,806	100%	100%	100%
SW	0-39	0	0%	77	4,767	4,843	1%	98%	29%
	40-79	23	30%	2,678	0	2,678	22%	0%	16%
	80-119	19	25%	3,357	112	3,469	28%	2%	21%
	120+	34	45%	5,817	-	5,817	49%	0%	35%
	Total	76	100%	11,929	4,879	16,808	100%	100%	100%
Grand Total		775		163,471	48,945	212,416			

[1] Thinning and selective logging were included with Managed Stand areas in order to simplify this table.

The number and percent of observations by DFMP yield stratum and defining layer for FMU W13 is shown in Table 4-9. Note that for managed stands, AVI information is not necessarily the source of the DFMP yield stratum assignment, therefore those areas are not included here. Generally all strata were sampled in proportion to the area of composite stands; the exceptions are the BW and SB strata.

Table 4-9. Number and percent of observations by defining layer class relative to the amount (area in ha) and percent natural stand landbase area, FMU W13.

DFMP Yield Stratum	Defining Layer	Observations		Landbase	
		Total	%	Area (ha)	% Area
AW	Overstory	105	76%	39,898	76%
	Understory	17	12%	3,448	7%
	Composite	16	12%	9,051	17%
	Total	138	100%	52,397	100%
BW	Overstory	18	43%	764	75%
	Understory	12	29%	202	20%
	Composite	12	29%	58	6%
	Total	42	100%	1,024	100%
AP	Overstory	56	100%	4,424	80%
	Understory	-	0%	612	11%
	Composite	-	0%	462	8%
	Total	56	100%	5,498	100%
AS	Overstory	73	76%	8,800	65%
	Understory	8	8%	1,465	11%
	Composite	15	16%	3,285	24%
	Total	96	100%	13,549	100%
PA	Overstory	63	100%	6,813	90%
	Understory	-	0%	305	4%
	Composite	-	0%	483	6%
	Total	63	100%	7,602	100%
SA	Overstory	42	70%	6,908	68%
	Understory	5	8%	831	8%
	Composite	13	22%	2,468	24%
	Total	60	100%	10,207	100%
PL	Overstory	176	96%	39,841	89%
	Understory	5	3%	1,849	4%
	Composite	2	1%	3,016	7%
	Total	183	100%	44,707	100%
SB	Overstory	13	21%	7,647	46%
	Understory	27	44%	4,397	27%
	Composite	21	34%	4,514	27%
	Total	61	100%	16,558	100%
SW	Overstory	52	68%	8,885	74%
	Understory	8	11%	1,229	10%
	Composite	16	21%	1,815	15%
	Total	76	100%	11,929	100%
Grand Total		775		163,471	

[1] Thinning and selective logging were included with Managed Stand areas in orde

4.4 Landbase Reconciliation

The differences in total landbase area between landbase version 9 (upon which yield curves were developed) and landbase version 12 (the final Millar Western landbase) are summarized in Table 4-10 and Table 4-11 for FMUs W11 and W13, respectively. There are very minor differences in natural stand landbase areas, upon which yield curves were developed. The largest difference is the reduction of 4,000 ha in the AW stratum for natural stands (a 7.8% change in stratum area) in FMU W13. This mainly represents A density aspen overstory stands which were remnant overstories and were subsequently redefined as managed stands.

Table 4-10. Area differences (ha) between landbase version 9 and landbase version 12 by DFMP yield stratum and stand type, FMU W11.

DFMP Yield	Stand Type					
	Natural			Managed		
Stratum	LB9	LB12	Diff.	LB9	LB12	Diff.
AW_AB	8,996	8,140	(856)	-	-	-
AW_CD	41,607	41,554	(54)	3,289	3,492	203
BW	124	130	6	-	-	-
APAS_ABCD	4,468	4,488	21	977	1,892	914
PASA_ABCD	5,165	5,027	(137)	1,476	1,594	118
PL_AB	3,597	3,582	(15)	-	-	-
PL_CD	6,962	6,844	(118)	806	1,162	356
SB	-	-	-	-	-	-
SW_AB	2,878	2,863	(15)	-	-	-
SW_CD	5,209	5,116	(93)	1,053	1,484	431
Total	79,006	77,744	(1,262)	7,601	9,625	2,024

Table 4-11. Area differences (ha) between landbase version 9 and landbase version 12 by DFMP yield stratum and stand type, FMU W13.

DFMP Yield	Stand Type											
	Natural			Managed			Thinning[1]			Selective Logging[2,3,4]		
Stratum	LB9	LB12	Diff.	LB9	LB12	Diff.	LB9	LB12	Diff.	LB9	LB12	Diff.
AW	56,458	52,397	(4,061)	5,427	5,447	19	2	2	(0)	-	-	-
BW	1,021	1,024	3	-	80	80	1	1	-	-	-	-
AP	5,288	5,498	210	192	527	335	17	17	(0)	-	-	-
AS	13,845	13,549	(295)	852	5,562	4,710	4	4	(0)	-	-	-
PA	7,522	7,602	79	2,995	2,647	(348)	45	45	0	61	61	(0)
SA	10,276	10,207	(69)	7,263	6,774	(490)	8	8	(0)	624	711	87
PL	44,385	44,707	322	20,646	20,802	156	1,132	1,132	1	-	-	-
SB	16,719	16,558	(162)	179	179	0	74	69	(6)	-	-	-
SW	12,029	11,929	(100)	4,789	4,876	87	3	3	(0)	-	-	-
Total	167,544	163,471	(4,073)	42,343	46,892	4,549	1,285	1,280	(5)	685	772	87

[1] Salvage and commercial thinning in natural stands; excludes selective logging.

[2] Selective logging took place in the Athabasca Flats vicinity of the Athabasca river using horse logging methods.

[3] Includes blocks classified as planned in 2004 but that have subsequently been harvested.

[4] DFMP yield strata are based on post-harvest assignment.

Specific yield curves were developed for the Athabasca Flats area in FMU W13. These involved the compositing of natural stand yield curves in order to create a single curve specific to the Athabasca Flats selective logging area. The differences in total landbase area between landbase version 9 and landbase version 12 are summarized in Table 4-12. Note that due to changes in definitions of isolated stands, the managed landbase area within the Athabasca Flats area increased by approximately 90 ha. However, the distribution of areas is very similar, as shown by the percent distribution of area.

Table 4-12. Area (ha) and percent differences between landbase version 9 and landbase version 12 by DFMP yield stratum and stand type, Athabasca Flats, FMU W13.

DFMP Yield	Area (ha)		% Area	
Stratum	LB9	LB12	% LB9	% LB12
AW	54	55	7.8%	7.2%
AS	154	177	22.4%	22.9%
SA	138	156	20.2%	20.2%
LT	-	12	0.0%	1.5%
PL	53	53	7.7%	6.8%
SB	18	18	2.7%	2.4%
SW	268	301	39.2%	39.0%
Total	685	772	100.0%	100.0%

4.5 Plot Reconciliation

Plots were intersected with landbase 12 and assigned characteristics in the same manner as described in Sections 3.3 to 3.5. Plot attributes based on landbase 9 and landbase 12 were then compared.

Eligibility for Yield Curve Development

Plots that were eligible for yield curve development based on landbase version 9 may not be eligible for yield curve development based on landbase version 12. Differences in plot eligibility are summarized in Table 4-13.

Table 4-13. Comparison between plot assignments based on landbase 9 versus landbase 12, FMUs W11 and W13 combined.

	Landbase 12				
Landbase 9	Natural Eligible	Ineligible	Sampling Pre-Fire	Seismic	Total
Natural Eligible	1,279	26	-	-	1,305
Ineligible	6	388	-	-	394
Sampling Pre-Fire	-	-	20	-	20
Seismic	-	-	-	59	59
Total	1,285	414	20	59	1,778

A total of 6 plots were ineligible for inclusion in yield curve development based on landbase 9, but are eligible based on landbase 12. These plots were access deletions, rather than deletions based on stand characteristics. Not including these plots when they could have been included in yield curve development will not have introduced any bias into the data set used for curve fitting.

A total of 26 plots that were initially eligible for yield curve development based on landbase 9 were deemed ineligible based on landbase 12. Table 4-14 summarizes the plots by FMU, DFMP yield stratum and reason for the change.

Table 4-14. Breakdown of plots used in yield curve development based on landbase 9 that are now ineligible based on landbase 12.

FMU	DFMP Yield Stratum	Location	Original Observations	Removed Observations	Removal Reason
W11	AW_AB	n/a	60	8	Managed
W13	AW	MC/VH	94	4	Managed
		W/BR	44	3	Managed
	PL	n/a	183	3	Managed
	SB		61	3	Managed
				5	Subj. Del.
Total			26	26	

A total of 21 of the 26 plots were removed because the stands are now defined as cutblocks rather than natural origin stands. These stands were primarily A density overstory stands which were in fact remnant stands left after harvesting. Including these plots should have negligible effect, or at least a conservative effect, given that the plots would be low volume plots relative to the remainder of the sample. Most of the yield strata have fairly high sample sizes, which should also ameliorate any effect the plots may have. The last five plots were removed due to subjective deletions. Again, assuming that these are low productivity stands (the reason for subjective deletion), any effect they would have on yield would be minimal. Volumes for the 26 plots were examined and the potential effects on yields are described here.

FMU W11

Eight AW_AB plots would be removed based on landbase 12 information. Seven out of the eight removed plots had a total volume of 0 m^3/ha, and the eighth had a total volume of 64 m^3/ha. Removing these plots would not lower yields.

FMU W13

Four AW_MC/VH plots would be removed based on landbase 12 information. In fact, these PSPs were subjectively removed from the PSP dataset before yield curve development, since these were identified as managed stand PSPs. Therefore no change would be made to existing curves.

Three AW_W/BR plots would be removed based on landbase 12 information; these have total volumes of 216, 50 and 168 m^3/ha, all at an age of 108 years. The average across these three plots is 144 m^3/ha, which is lower than volumes for all three yield curves (F, M and G) at the same age. Removal of these plots would not lower yields.

Three PL plots would also be removed; these have total volumes of 0, 17 and 0 m^3/ha at 42 years. Removing these plots would not lower yields.

Five SB plots would be removed based on subjective deletions applied in landbase 12. These plots represent fairly high volumes, all at 147 years of age (136, 152, 87, 131 and 306 m^3/ha). Average total volume is 162 m^3/ha, which is very similar to the medium TPR curve at the same age (151 m^3/ha). Most of the landbase area is comprised of medium TPR stands, with the second highest area comprised of good TPR stands. These volumes are in line with the volumes expected by an area-weighted yield curve across all TPRs, and therefore no net effect on volume is expected.

Three SB plots would be removed since these were harvested prior to the effective date of the landbase. These plots are all TPR good, high volume plots (299, 515 and 589 m^3/ha at 57 years of age). These plots have the potential to affect yield curves, since they are high volume plots. However, Millar Western has an agreement in place with Alberta SRD, in which Millar Western will be subjectively removing approximately 50% of SB stands from their managed landbase. These will be low productivity (*i.e.*, low volume) stands, leaving only high volume stands on the landbase. Use of the existing SB yield curves will likely be an underestimate of potential yields, and as such, it is felt that using the existing curves is reasonable.

DFMP Yield Stratum Assignment

All plots that were used for yield curve development had the same DFMP yield stratum and age assignment based on landbase12 attributes, with the exception of plot # 406542-1-0-2004. This TSP was initially assigned to the PL DFMP yield stratum; based on landbase 12, the plot was reassigned to the AW DFMP yield stratum.

This was in fact a plot sampled in a PL stand. The majority of the PL stand was part of the unmanaged landbase due to deletions. The plot itself was located in a residual polygon sliver that was part of the managed landbase. The sliver removal process resulted in the plot being reassigned to an adjacent AW polygon.

As such, the use of this plot in PL yield curve development was correct.

5. Base Yield Curves, FMU W11

5.1 Overview

FMU W11 has 11 DFMP Yield Strata defined for the 2007-2016 DFMP (Table 2-9). Two of these are specific to the unmanaged landbase (LT and SB) and have no associated yield curves.

For each of the nine remaining DFMP yield strata, one natural stand empirical yield curve was fit using data collected within the FMU. Volume was fit as a function of stand age using *nonlinear regression* techniques. These are the base natural stand yield curves for FMU W11 (Table 5-1).

There is an assumption that harvested stands will return as *fully stocked* under standard management practices, since current reforestation standards enforce strict stocking limits. Plots from natural stands with a C or D crown closure class (based on the defining layer) were used as a proxy to represent managed stands (referred to as the *fully stocked method*). Volume as a function of age was fit for the APAS_ABCD and PASA_ABCD DFMP yield strata using fully stocked data.

No managed stand yield curves were developed for the AW_AB, PL_AB or SW_AB DFMP yield strata, since these were based on AB crown closure data (not fully stocked). New curves were not fit for the AW_CD, PL_CD or SW_CD yield strata since these curves were already fully stocked.

Area-weighted *composite yield curves* were also developed for natural stands in FMU W11. Five area-weighted curves were developed for natural stands: four to represent each broad cover group (D, DC, CD, and C) and one overall composite for the coniferous landbase (DC, CD and C combined). Curves were based on natural stand yield curves, weighted by the proportion of area of natural stands that each DFMP yield stratum currently represents within the managed landbase.

There are only 124 ha of birch in FMU W11, therefore, while a natural stand yield curve was developed to represent both FMUs, it is described under FMU W13 yield curves.

A full list of base yield curves for FMU W11 is provided in Table 5-1.

Table 5-1. Base DFMP yield curves, FMU W11.

DFMP Yield Stratum	Broad Cover Group	Natural Stand Yield Curve Code	Managed Stand Yield Curve Code
AW_AB	D	W11_AW_AB_N	
AW_CD	D	W11_AW_CD_N	
BW	D	W11W13_BW_N[1]	
APAS_ABCD	DC	W11_APAS_ABCD_N	W11_APAS_CD_M
PASA_ABCD	CD	W11_PASA_ABCD_N	W11_PASA_CD_M
PL_AB	C	W11_PL_AB_N	
PL_CD	C	W11_PL_CD_N	
SW_AB	C	W11_SW_AB_N	
SW_CD	C	W11_SW_CD_N	
COMPOSITE	C	W11_COMP_C	
	CD	W11_COMP_CD	
	DC	W11_COMP_DC	
	D	W11_COMP_D	
	C/CD/DC	W11_COMP_C/CD/DC	

[1] Combined curve for FMU W11 and FMU W13.

5.2 Natural Stand Yield Curves

5.2.1 Background

In their Preliminary Forest Management Plan (PFMP) (Millar Western 2004e), Millar Western employed a limited number of yield strata and created a single set of yield curves to represent both natural and managed stands. Volume was modelled as a function of age, without incorporating the effects of site. As per the Terms of Reference, Millar Western followed the same process for the 2007-2016 DFMP, updated for new data and using new DFMP yield strata developed in consultation with SRD.

5.2.2 Yield Curve Development

Data from the base TSP/PSP dataset were used to fit natural stand yield curves (see Section 3.4 for information on data preparation). Only observations from with the FMU were used in curve development. Base natural stand yield curves for FMU W11 were fit using one of two models:

2-parameter model (2P):

$$Volume = a(Age)^{b} e^{(-a*Age)}$$

2-parameter model with constant (2P+k):

$$Volume = a(Age)^{b} e^{\left(-Age/k\right)}$$

Where: *Volume* = gross merchantable stand volume (m^3/ha)

Age = stand age at year of measurement

a, b, k = coefficients

Conifer and deciduous volume were modelled using one of the two equations. Where the constant k was required to achieve biologically reasonable curve form, values between 10 and 100 were tested to achieve the most biologically reasonable fit that also fit to the data. Total volume was calculated by summing conifer and deciduous volume. An exception to this process was the SW_CD stratum. Because the regression to fit deciduous volume would not *converge*, total volume was fit instead, and deciduous volume was calculated by subtracting coniferous volume from total volume. Where predicted coniferous volume was greater than predicted total volume, total volume was set equal to coniferous volume.

Model selection was qualitatively based on goodness-of-fit. Sample size, model form, coefficients and fit statistics (R^2) by yield curve are presented in Table 5-2. Yield curves are presented in Appendix IX.

Table 5-2. Model form and model coefficients, base natural stand yield curves, FMU W11.

DFMP Yield Stratum	Yield Curve Code	Number of Observations	Species Type	Model Form	Model Coefficients a	b	k	R^2
AW_AB	W11_AW_AB_N	60	Coniferous	2P+k	2.83232E-09	5.53555329	30	0.06
			Deciduous	2P	2.57673E-02	2.40058385	-	0.12
AW_CD	W11_AW_CD_N	105	Coniferous	2P	1.23556E-02	2.05417925	-	0.08
			Deciduous	2P+k	6.66574E-04	3.24732640	40	0.25
APAS_ABCD	W11_APAS_ABCD_N	72	Coniferous	2P	1.23341E-02	2.15452925	-	0.07
			Deciduous	2P	2.13211E-02	2.32670923	-	0.10
PASA_ABCD	W11_PASA_ABCD_N	80	Coniferous	2P	2.03845E-02	2.36346047	-	0.04
			Deciduous	2P+k	1.15284E-10	7.02653883	20	0.11
PL_AB	W11_PL_AB_N	71	Coniferous	2P	1.11728E-02	2.23105867	-	0.20
			Deciduous	2P	2.27518E-02	1.83364340	-	0.01
PL_CD	W11_PL_CD_N	66	Coniferous	2P+k	1.03153E-06	4.59982047	40	0.38
			Deciduous	2P+k	4.24007E-09	5.63029813	30	0.05
SW_AB	W11_SW_AB_N	59	Coniferous	2P+k	6.77130E-05	3.59195275	40	0.08
			Deciduous	2P+k	1.62897E-09	5.81812483	30	0.06
SW_CD	W11_SW_CD_N	63	Coniferous	2P	1.85245E-02	2.37244915	-	0.08
			Total[1]	2P+k	4.04860E-06	4.60041870	30	0.18
Total		576						

[1] Regression to fit deciduous volume would not converge; instead, total volume was fit and predicted deciduous volume was calculated using predicted total volume minus predicted coniferous volume (or zero, whichever was greater).

5.3 Managed Stand Yield Curves

5.3.1 Background

For the 2007-2016 DFMP, Millar Western developed fully stocked[9] yield curves to represent managed stands. Because most of the 2007-2016 DFMP yield strata in FMU W11 were split by

[9] Fully stocked yield curves were fit using plots with C and D crown closure classes only.

crown closure class, CD crown closure class yield curves could be used to represent both natural and managed stands. The APAS_ABCD and PASA_ABCD DFMP yield strata were comprised of all crown closure classes, therefore fully stocked yield curves were required for these two DFMP yield strata.

5.3.2 Yield Curve Development

Base managed stand yield curves were developed using data from fully stocked natural stands as a proxy for managed stands. A subset of the TSP/PSP data used to fit base natural stand yield curves for FMU W11 was selected. Only those plots with a defining layer crown closure class of C or D were used to fit managed stand yield curves[10]. Base managed stand yield curves for FMU W11 were fit using one of two models:

2-parameter model (2P):

$$Volume = a(age)^{b} e^{(-a*age)}$$

2-parameter model with constant (2P+k):

$$Volume = a(age)^{b} e^{\left(-age/k\right)}$$

Where: *Volume* = gross merchantable stand volume (m^3/ha)

Age = stand age at year of measurement

a, b, k = coefficients

Model selection was qualitatively based on goodness-of-fit. Sample size, model form, coefficients and fit statistics (R^2) by yield curve are presented in Table 5-3. Yield curves are presented in Appendix X.

Table 5-3. Model form and model coefficients, base managed stand yield curves, FMU W11.

DFMP Yield Stratum	Yield Curve Code	Number of Observations	Species Type	Model Form	Model Coefficients[1]			R^2
					a	b	k	
APAS_ABCD	W11_APAS_CD_M	49	Coniferous	2P+k	7.94450E-06	3.88852729	50	0.11
			Deciduous	2P	3.09425E-02	2.48418486	-	0.05
PASA_ABCD	W11_PASA_CD_M	59	Coniferous	2P	2.03590E-02	2.37291321	-	0.03
			Deciduous	2P+k	3.54558E-10	6.85285570	50	0.04
Total		108						

[10] This selection criterion differs from the one used for FMU W13 curves. For FMU W13, only stands with a C or D density overstory were selected, since the expectation is that managed stands will be single layer fully stocked stands. However, existing CD density natural stand curves were selected based on defining layer. Since these curves were being "reused" to represent managed stand curves, it was deemed reasonable to keep the same methodology within the suite of curves for FMU W11 rather than match with FMU W13.

5.4 Composite Yield Curves

5.4.1 Background

Composite yield curves provide an area-weighted estimate of volume over time across all natural stands within the FMU W11 managed landbase. These curves are necessary to provide comparisons from one DFMP to the next.

5.4.2 Yield Curve Development

Composite yield curves were created for natural stands within the FMU W11 managed landbase. Five area-weighted curves were developed for natural stands: four to represent each broad cover group (D, DC, CD, and C) and one overall composite for the coniferous landbase (DC, CD and C combined).

Each natural stand yield curve was weighted by the proportion of the total area of natural stands within the managed landbase. The total area of natural stands by DFMP yield stratum used for area-weighting was obtained from landbase version 12 and is provided in Table 5-4. Composite yield curves were developed by summing all area-weighted natural stand yield curves at each age.

Table 5-4. Total area (ha) of natural stands by DFMP yield stratum, FMU W11, for composite yield curve development (based on landbase version 12).

Landbase	Broad Cover Group	DFMP Yield Stratum	Area (ha)
Deciduous	D	AW_AB	8,140
		AW_CD	41,554
		BW	130
Coniferous	DC	APAS_ABCD	4,488
	CD	PASA_ABCD	5,027
	C	PL_AB	3,582
		PL_CD	6,844
		SB	-
		SW_AB	2,863
		SW_CD	5,116
Total			77,744

The composite yield curves for FMU W11 are presented in Appendix XI. Composite yield curves are shown against composite yield curves from previous plans in Appendix XIX.

6. Base Yield Curves, FMU W13

6.1 Overview

FMU W13 has 10 defined DFMP Yield Strata. One of these is specific to the unmanaged landbase (LT) and has no associated yield curves.

For each of the nine remaining DFMP yield strata, site-specific natural stand empirical yield curves were fit using data collected within the FMU area. Within each DFMP yield stratum, separate yield curves were developed for fair, medium and good site types. These are the base natural stand yield curves for FMU W13. An exception was the birch DFMP yield stratum, for which a single yield curve was fit (not site-specific). This yield curve is a combined yield curve for both FMU W11 and FMU W13, but since the majority of birch stands fall within FMU W13, curve development is included here.

There is an assumption that stands will return as fully stocked under standard management practices. Plots sampled in natural stands with an overstory C or D crown closure class were used as a proxy to represent fully stocked stands. These data were used to develop base managed stand yield curves for eight out of nine DFMP yield strata in FMU W13 using *site-specific methods* (there is no fully stocked managed stand yield curve for birch).

Composite natural stand yield curves were developed for natural stands in FMU W13. Five area-weighted curves were developed for natural stands: four to represent each broad cover group (D, DC, CD, and C) and one overall composite for the coniferous landbase (DC, CD and C combined). These curves were based on natural stand yield curves, weighted by the proportion of area of natural stands that each DFMP yield stratum currently represents within the managed landbase.

A complete list of base yield curves for FMU W13 is provided in Table 6-1.

Table 6-1. Base DFMP yield curves, FMU W13.

DFMP Yield Stratum	Broad Cover Group	Site	Natural Stand Yield Curve Code	Managed Stand Yield Curve Code
AW	D	Fair	W13_AW_F_N	W13_AW_F_M
		Medium	W13_AW_M_N	W13_AW_M_M
		Good	W13_AW_G_N	W13_AW_G_M
BW	D	All	W11W13_BW_N[1]	
AP	DC	Fair	W13_AP_F_N	W13_AP_F_M
		Medium	W13_AP_M_N	W13_AP_M_M
		Good	W13_AP_G_N	W13_AP_G_M
AS	DC	Fair	W13_AS_F_N	W13_AS_F_M
		Medium	W13_AS_M_N	W13_AS_M_M
		Good	W13_AS_G_N	W13_AS_G_M
PA	CD	Fair	W13_PA_F_N	W13_PA_F_M
		Medium	W13_PA_M_N	W13_PA_M_M
		Good	W13_PA_G_N	W13_PA_G_M
SA	CD	Fair	W13_SA_F_N	W13_SA_F_M
		Medium	W13_SA_M_N	W13_SA_M_M
		Good	W13_SA_G_N	W13_SA_G_M
PL	C	Fair	W13_PL_F_N	W13_PL_F_M
		Medium	W13_PL_M_N	W13_PL_M_M
		Good	W13_PL_G_N	W13_PL_G_M
SB	C	Fair	W13_SB_F_N	W13_SB_F_M
		Medium	W13_SB_M_N	W13_SB_M_M
		Good	W13_SB_G_N	W13_SB_G_M
SW	C	Fair	W13_SW_F_N	W13_SW_F_M
		Medium	W13_SW_M_N	W13_SW_M_M
		Good	W13_SW_G_N	W13_SW_G_M
COMPOSITE	C	All	W13_COMP_C	
	CD	All	W13_COMP_CD	
	DC	All	W13_COMP_DC	
	D	All	W13_COMP_D	
	C/CD/DC	All	W13_COMP_C/CD/DC	

[1] Combined curve for FMU W11 and FMU W13.

Note that in the 2007-2016 DFMP, there is no separate yield curve for Windfall Burn stands. An analysis of data collected inside and outside of the Windfall burn area indicated that stands within the Windfall burn boundary were similar enough to merit inclusion with the rest of the natural PL stands. Results from this analysis are presented in Appendix VI.

6.2 Natural Stand Yield Curves

6.2.1 Background

For the last DFMP, a single yield curve was fit for each DFMP yield stratum in FMU W13 using *nonlinear regression* methods (Millar Western 2000). Volume was fit as a function of stand age using nonlinear regression techniques. In order to develop site-specific natural stand yield curves that reflect the effect of site on productivity, *TPR scaling* was used.

The empirically-fit yield curve was assumed to represent medium TPR sites. Good TPR sites were assumed to have an increased volume, while fair TPR sites were assumed to have a decreased volume relative to the medium TPR curve. As such, TPR-scaled curves were

developed where the good TPR curve was created by scaling the medium curve upwards by 33%, and the fair TPR curve was created by decreasing the medium curve downwards by 25%.

For the 2007-2016 DFMP, curves representing the effects of site were again required. Data-based curve development was preferable over assumptions regarding the effect of site, providing that an appropriate method could be developed. A number of factors influenced the selection of a method for developing yield curves for natural stands in FMU W13:

1. There were insufficient data to fit individual yield curves for each TPR x DFMP yield stratum combination.

2. Ecosite maps exist for both FMUs. Although these maps provide a good representation of the distribution of ecosites across the landbase, accuracy in predicting ecosite for a specific polygon to the ecosite level was generally under 50% (Millar Western 2005d). Even if maps were more accurate, some ecosite types would likely be poorly represented by plot data, since sampling was not stratified to target ecosite types.

3. Equations for predicting site index based on inventory attributes were available in the AVI 2.1 manual (AFLW 1991). Predicting AVI-based site index and using this site index to develop yield projections by stand age and site type (fair, medium and good productivity site) would allow investigation of the effects of site index changes on volume predictions (*e.g.*, site index increase for pine), and to tie plot data to inventory attributes.

As such, the decision was made to develop empirical yield curve predictions as a function of both stand age and stand AVI-based site index. This is referred to as the site-specific method.

6.2.2 Yield Curve Development

Yield curve development consisted of two main components:

1. Fitting empirical yield curves (volume is a function of AVI-based site index and stand age);

2. Calculate average AVI-based site index[11] by site type (fair, medium and good) based on area of natural stands within the managed landbase; use these values as inputs into the empirical yield curves to create a set of site-specific yield curves.

Figure 6-1 provides an overview of the process, which is described in subsequent sections.

[11] Area-weighted AVI-based site index based on total area of natural stands by DFMP yield stratum and TPR.

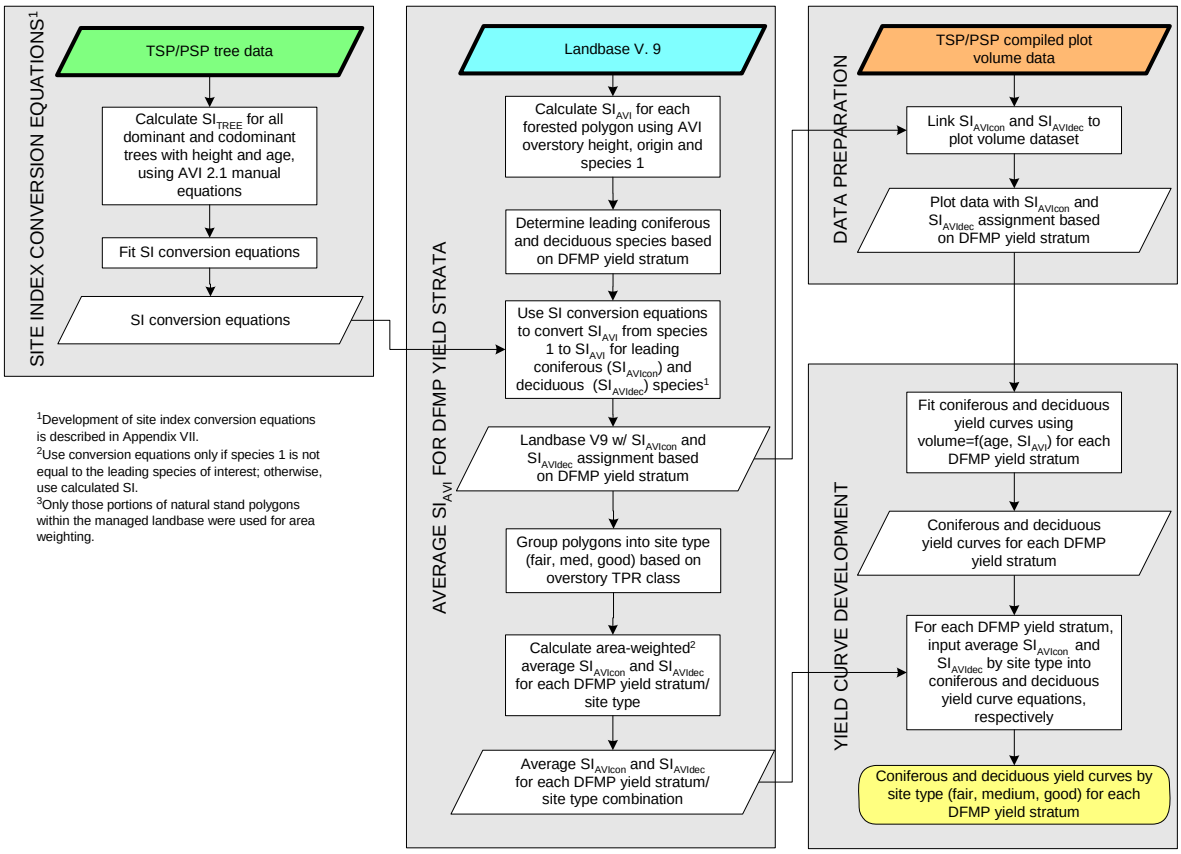


Figure 6-1. Flow chart for natural stand yield curve development, FMU W13.

STEP 1. Fitting Empirical Yield Curves Using Plot Data

Data from the base TSP/PSP dataset were used to fit natural stand yield curves (see Section 3.4 for more information). Only data collected within FMU W13 were used for empirical yield curve development, with the exception of the BW DFMP yield curve (BW is an FMU-wide yield curve, therefore plot data from FMU W11 were also included (6 plots)).

In order to fit empirical yield curves, the following were required for each observation: DFMP yield stratum, plot volume (m^3/ha), AVI-based site index for the leading coniferous species (SI_{AVIcon}), AVI-based site index for the leading deciduous species (SI_{AVIdec}), and stand age. All of this information, with the exception of the site index values, was obtained using the data compilation and plot attribute assignment methods described in Section 3.

AVI-based site index was calculated for the leading conifer and deciduous species as follows:

1. Site index for overstory species 1 (SI_{AVIsp1}) was calculated for each landbase polygon in FMU W13 using overstory AVI attributes (species 1, height, stand age)[12]. The equations provided in the AVI 2.1 manual (AFLW 1991) were used for calculating site index.

[12] Polygons with height ≤ 2 m and polygons with breast height age < 0 were excluded from calculations.

2. A leading conifer species and leading deciduous species was assigned to each landbase polygon based on its DFMP yield stratum assignment (Table 6-2). The leading deciduous species was assumed to be AW for all stands (whether deciduous species were present or not), since AVI-based site index does not differentiate deciduous by species. In deciduous stands with no conifer present, the leading conifer was assumed to be white spruce[13].

3. If the leading coniferous species was not the same as overstory species 1, site index conversion equations[14] were used to convert SI_{AVIsp1} to an AVI-based site index for the leading coniferous species (SI_{AVIcon}).

4. If the leading deciduous species was not the same as overstory species 1, site index conversion equations were used to convert SI_{AVIsp1} to an AVI-based site index for the leading deciduous species (SI_{AVIdec}).

5. The calculated site index values for each leading species (SI_{AVIcon}, SI_{AVIdec}) were linked to each observation using AVI polygon number.

Table 6-2. Leading coniferous and deciduous species as a function of DFMP yield stratum.

DFMP Yield Stratum	Leading Species	
	Coniferous	Deciduous
AW	SW	AW
AP	PL	AW
AS	SW or SB[1]	AW
PA	PL	AW
SA	SW or SB[1]	AW
PL	PL	AW
SB	SB	AW
SW	SW	AW

[1] Whichever occurs first in defining layer species composition.

Once all plot information was complete, a modified version of the 2-parameter model with constant was used to fit site-specific yield curves. In the modified form, parameter 'a' was replaced by ($a_0 + a_1$*SI) in order to represent site:

2-parameter model with constant (2P+k):

$$Volume_{con} = (a_0 + a_1 * SI_{AVIcon})(Age)^b e^{\left(-Age/k\right)}$$

$$Volume_{dec} = (a_0 + a_1 * SI_{AVIdec})(Age)^b e^{\left(-Age/k\right)}$$

[13] In pure C stands with no deciduous and pure D stands with no conifer, a site index must still be calculated. Zero volumes must be included in model fitting, and site index is required in order to be used in the model fitting process.

[14] Local site index conversion equations were developed using Millar Western data. A description of the development of site index conversion equations is provided in Appendix VII.

Where: $Volume_{con/dec}$ = gross merchantable coniferous/deciduous stand volume (m^3/ha)

Age = stand age at year of measurement

$SI_{AVIcon/dec}$ = AVI-based coniferous/deciduous site index for the leading species

a_0, a_1, b, k = coefficients

Results of model fitting are presented in Table 6-3. Note that for the birch yield curves and the deciduous component of the black spruce stratum, a_1 is set to zero. Under this condition, the yield curve equation reverts to its original form, which is a curve without site. Birch stands comprise a small area of the landbase, therefore site-specific curves were not required. Black spruce stands had very little deciduous volume and site-specific curves could not be obtained because the regression would not converge.

Table 6-3. Model form and model coefficients, base natural stand yield curves, FMU W13.

DFMP Yield Stratum	Yield Curve Code	Number of Observations	Species Type	Model Form	Model Coefficients				R^2
					a_0	a_1	b	k	
AW	W13_AW_FMG_N	138	Coniferous	2P+k	-2.33681E-04	1.08647E-04	2.72026827	50	0.07
			Deciduous	2P+k	-1.04241E-03	8.37622E-05	3.59637947	30	0.39
BW[1]	W11W13_BW_N	42	Coniferous	2P+k	1.32573E-05	0	4.16842888	30	0.10
			Deciduous	2P+k	2.09473E-13	0	9.53249021	10	0.24
AP	W13_AP_FMG_N	56	Coniferous	2P+k	-8.79661E-04	3.98352E-04	2.61493295	50	0.17
			Deciduous	2P+k	-9.13246E-06	7.65765E-07	4.59041438	30	0.43
AS	W13_AS_FMG_N	96	Coniferous	2P+k	5.49044E-03	1.88844E-04	2.51203700	50	0.12
			Deciduous	2P+k	7.43397E-06	6.83763E-07	4.19012503	30	0.05
PA	W13_PA_FMG_N	63	Coniferous	2P+k	-5.82439E-05	6.80554E-06	3.70901170	50	0.42
			Deciduous	2P+k	2.44348E-06	5.37161E-08	4.37683544	30	0.13
SA	W13_SA_FMG_N	60	Coniferous	2P+k	-1.25012E-02	2.31891E-03	2.36589878	50	0.15
			Deciduous	2P+k	2.36474E-06	2.87292E-07	4.30872600	30	0.08
PL	W13_PL_FMG_N	183	Coniferous	2P+k	-1.45575E-04	2.66634E-05	3.40972456	50	0.59
			Deciduous	2P+k	-1.18934E-06	1.42356E-07	4.52848785	30	0.17
SB	W13_SB_FMG_N	61	Coniferous	2P+k	-4.65772E-03	8.45847E-04	2.75853831	50	0.26
			Deciduous	2P+k	3.88572E-09	0	5.10489901	30	0.02
SW	W13_SW_FMG_N	76	Coniferous	2P+k	3.75340E-05	9.75111E-06	3.46887978	50	0.25
			Deciduous	2P+k	-5.87826E-07	4.68658E-08	4.97414266	30	0.17
Total		775							

[1] The BW curve is a combined curve for FMU W11 and FMU W13. The majority of existing stands are within FMU W13.

STEP 2. Determining Average Site Index By Site Type and Create Site-Specific Curves

The process in Step 1 developed a yield curve for each DFMP yield stratum as a function of AVI-based site index and stand age, however, the goal was to develop three separate yield curves for each DFMP yield stratum by site type: fair, medium and good. To do so, the average site index of natural stands by site type was required as an input to the model. This was calculated using:

1. Take all natural stands within the managed landbase from Step 1 (each will have a calculated SI_{AVIcon} and SI_{AVIdec}).

2. Assign stands into site types (fair, medium, good) based on overstory TPR.

3. For each DFMP yield stratum and site type, calculate the average area-weighted deciduous and coniferous site index for natural stands in the managed landbase. Average area-weighted site index values by DFMP yield stratum and site type are presented in Table 6-5.

4. For each DFMP yield stratum, input the average conifer site index for each site type into the fitted equation for coniferous volume, to obtain three site-specific curves for conifer volume. Repeat using average deciduous site index to obtain three site-specific curves for deciduous volume.

5. Total volume is equal to coniferous volume plus deciduous volume for each site type.

Table 6-4. Rules for assigning site type based on leading species site index.

Leading Species	Site Index Range (m) by Site Type		
	Fair	Medium	Good
AW	<14.05	14.05-18.05	>18.05
PL	<12.05	12.05-16.05	>16.05
SB	<7.05	7.05-10.05	>10.05
SW	<10.55	10.55-15.55	>15.55

Table 6-5. Average site index values used as inputs to the site-specific empirical yield curve model, base natural stand yield curves, FMU W13.

DFMP Yield Stratum	Site Type	Site Index (m)	
		Coniferous	Deciduous
AW	Fair	12.4	14.9
	Medium	14.5	17.4
	Good	17.3	20.5
BW	n/a	-	-
AP	Fair	14.2	14.8
	Medium	16.5	17.1
	Good	18.9	19.6
AS	Fair	11.9	14.6
	Medium	14.0	17.1
	Good	16.8	20.3
PA	Fair	10.8	11.1
	Medium	14.5	14.7
	Good	17.3	17.6
SA	Fair	11.4	13.9
	Medium	13.7	15.9
	Good	16.7	19.4
PL	Fair	10.9	11.1
	Medium	14.3	14.6
	Good	17.1	17.4
SB	Fair	7.6	11.0
	Medium	9.1	13.1
	Good	11.9	17.2
SW	Fair	10.3	12.0 [1]
	Medium	13.9	15.8
	Good	16.9	19.2

[1] A site index of 13.0 was used as an input since the model did not perform adequately with site index 12.0.

Site-specific natural stand yield curves for FMU W13 are presented in Appendix XII.

6.3 Managed Stand Yield Curves

6.3.1 Background

For the 1997-2006 DFMP, managed stand yield curves were developed by applying an 11% increase to natural stand yield curves to account for full stocking in managed stands (*percent increase method*): 15% to account for full stocking minus 4% to account for roads and landings.

For the 2007-2016 DFMP, the fully stocked method, was used. Managed stand base yield curves were developed using data from fully stocked natural stands as a proxy for mature managed stand data. Because site index was based on overstory attributes for modelling, plots with an overstory crown closure class of C or D, rather than plots with a defining layer crown closure class of C or D, were used in model development.

6.3.2 Yield Curve Development

The same two steps used in Section 6.2.2 to develop site-specific yield curves for natural stands were applied to develop site-specific yield curves for managed stands.

STEP 1. Fitting Empirical Yield Curves Using Plot Data

Fully stocked plots were used to fit site-specific yield curves in the same manner as described for natural stands. Only plots with an overstory AVI crown closure class of C or D were used to fit yield curves. Again, black spruce stands had very little deciduous volume and site-specific curves could not be obtained because the regression would not converge. As such, a_1 was set to zero, creating a non-site-specific version of the 2P+k equation. No managed stand yield curve was developed for the BW DFMP yield stratum. Model selection was based on goodness-of-fit. Sample size, model form and coefficients are presented in Table 6-6.

Table 6-6. Model form and coefficients, base managed stand yield curves, FMU W13.

DFMP Yield Stratum	Yield Curve Code	Number of Observations	Species Type	Model Form	Model Coefficients				R^2
					a_0	a_1	b	k	
AW	M_AW_FMG	91	Coniferous	2P+k	-7.80559E-06	2.38931E-05	3.03334163	50	0.10
			Deciduous	2P+k	-1.96632E-03	1.57908E-04	3.47141756	30	0.38
AP	M_AP_FMG	53	Coniferous	2P+k	-3.03495E-04	3.35352E-04	2.63470234	50	0.17
			Deciduous	2P+k	-2.90775E-06	2.97724E-07	4.72953880	30	0.49
AS	M_AS_FMG	72	Coniferous	2P+k	5.27349E-03	6.36027E-05	2.55903098	50	0.09
			Deciduous	2P+k	9.27203E-05	8.92729E-07	3.82756270	30	0.04
PA	M_PA_FMG	57	Coniferous	2P+k	-3.80271E-05	7.12497E-06	3.62777296	50	0.42
			Deciduous	2P+k	-9.34626E-08	7.01941E-08	4.59290202	30	0.14
SA	M_SA_FMG	35	Coniferous	2P+k	6.00585E-02	1.36720E-02	1.98113257	40	0.07
			Deciduous	2P+k	3.82389E-04	4.93347E-06	3.72718788	20	0.00
PL	M_PL_FMG	135	Coniferous	2P+k	-1.10564E-04	3.85675E-05	3.28229877	50	0.53
			Deciduous	2P+k	-1.28660E-06	1.34248E-07	4.60287037	30	0.18
SB	M_SB_FMG	11	Coniferous	2P+k	-2.10922E-04	2.90403E-05	3.64611426	40	0.43
			Deciduous	2P+k	8.50015E-17	0	2.10000000	30	n/a[1]
SW	M_SW_FMG	37	Coniferous	2P+k	5.15995E-04	6.18814E-06	3.21266782	50	0.07
			Deciduous	2P+k	-1.16603E-08	9.29119E-10	5.86111614	30	0.21
Total		491							

[1] All deciduous volumes are zeros; although convergence criteria were met when running the regression, CSS=0 was obtained. Since R^2=1-SSE/CSS, R^2 could not be obtained.

STEP 2. Determining Average Site Index By Site Type and Create Site-Specific Curves

Average site index for each site class (fair, medium and good) was calculated in the same manner as described in Section 6.2.2. Only stands in the managed landbase with an overstory AVI crown closure class of C or D were used to calculate average site indices by site type (presented in Table 6-7). These values were input into the fitted equations to create site-specific yield curves for each DFMP yield stratum.

Table 6-7. Average site index values used as inputs to the site-specific empirical yield curve model, base managed stand yield curves, FMU W13.

DFMP Yield Stratum	Site Type	Site Index (m)	
		Coniferous	Deciduous
AW	Fair	12.4	15.0
	Medium	14.7	17.5
	Good	17.2	20.4
BW	n/a	-	-
AP	Fair	14.3	14.9
	Medium	16.5	17.2
	Good	19.0	19.8
AS	Fair	12.0	14.7
	Medium	14.1	17.2
	Good	17.0	20.9
PA	Fair	10.5	10.8
	Medium	14.3	14.6
	Good	17.2	17.5
SA	Fair	11.8	14.2
	Medium	13.7	15.7
	Good	16.8	19.4
PL	Fair	10.7	10.9
	Medium	14.4	14.6
	Good	17.1	17.3
SB	Fair	6.8 [1]	9.9
	Medium	8.5	12.3
	Good	11.6	16.8
SW	Fair	10.0	11.3 [2]
	Medium	13.8	15.7
	Good	16.6	18.8

[1] A site index of 7.5 was used as an input since the model did not perform adequately with site index 6.8.

[2] A site index of 13.0 was used as an input since the model did not perform adequately with site index 11.3.

Many of the fitted base managed stand yield curves show volumes below natural stand yields (AP, AS, PA and SW good site types, and all SB site types), and the SA managed stand yield curve shows poor curve form (volume peaks and declines too early). The SA curve, and curves with predicted volumes below natural stand yield curve volumes, will not be used in timber supply analysis. Instead, the natural stand yield curves will be used (see Chapter 8). This is an "inverse capping" method to reflect the fact that, under managed stand conditions, volumes should be at least the same as natural stand volumes, if not higher.

Base managed stand yield curves for W13 are presented in Appendix XIII.

6.4 Composite Yield Curves

6.4.1 Background

Composite yield curves provide an area-weighted estimate of volume over time across all natural stands within the FMU W13 managed landbase. These curves are necessary to provide comparisons from one DFMP to the next.

6.4.2 Yield Curve Development

Composite yield curves were created for natural stands within the FMU W13 managed landbase. Five area-weighted curves were developed for natural stands: four to represent each broad cover group (D, DC, CD, and C) and one overall composite for the coniferous landbase (DC, CD and C combined).

Each natural stand yield curve by site type was weighted by the proportion of the total area of natural stands within the managed landbase. The total area of natural stands by DFMP yield stratum and TPR was obtained from landbase version 12 and is provided in Table 6-8. Composite yield curves were developed by summing all area-weighted natural stand yield curves at each age.

Table 6-8. Total area (ha) of natural stands by DFMP yield stratum and TPR, FMU W13, for composite yield curve development (based on landbase version 12).

Landbase	Broad Cover Group	DFMP Yield Stratum	TPR			Total
			Fair	Medium	Good	
Deciduous	D	AW-W/BR	4,074	16,402	239	20,714
		AW-MC/VH	5,005	20,992	5,686	31,683
		BW[1]	258	530	237	1,024
Coniferous	DC	AP	873	3,598	1,028	5,498
		AS	2,486	9,369	1,694	13,549
	CD	PA	457	4,009	3,136	7,602
		SA	268	6,872	3,067	10,207
	C	PL	4,687	28,029	11,991	44,707
		SB	1,155	11,580	3,822	16,558
		SW	541	8,434	2,954	11,929
Total		Total	19,804	109,814	33,853	163,471

[1] Total area, not area by TPR, was used for area-weighted BW volumes.

The composite yield curves for FMU W13 are presented in Appendix XIV. Composite yield curves are shown against composite yield curves from previous plans in Appendix XIX.

7. Modified Yield Curves, FMU W13

7.1 Overview

Base yield curves have been modified to reflect specific applied silvicultural treatments or to represent geographically localized areas within the DFA with recognized differences in stand composition and/or growth. For example:

1. The silvicultural treatment in question lacks suitable data for the development of empirical yield curves, yet there is sufficient research to indicate that adjustments are required. Treatments include site index increase in managed pine stands, commercial thinning, and *salvage thinning*).

2. The silvicultural treatment in question is a small area comprised of multiple DFMP strata; data collection by DFMP yield stratum to fit separate empirical yield curves is unrealistic. The Athabasca Flats selective thinning area is one such treatment.

3. A geographically localized area is recognized to exhibit different yields at harvest age from the rest of the FMU area. In aspen stands, there is a recognized difference in yields between the Whitecourt and Blue Ridge (W/BR) subunits and the McLeod and Virginia Hills (MC/VH) subunits.

Modified yield curves for FMU W13 are listed in Table 7-1.

Table 7-1. Modified DFMP yield curves, FMU W13.

Modifier	Curve Modified	DFMP Yield Stratum	Location	Site	Yield Curve Code
Site Index Increase	Base Managed	PL	W13	Fair	W13_PL_F_SI
				Medium	W13_PL_M_SI
				Good	W13_PL_G_SI
Commercial Thinning	Base Natural	PL	W13	Fair	W13_PL_F_CT
				Medium	W13_PL_M_CT
				Good	W13_PL_G_CT
		SB	W13	Fair	W13_SB_F_CT
				Medium	W13_SB_M_CT
				Good	W13_SB_G_CT
Salvage Thinning	Base Natural	PL	W13	Fair	W13_PL_F_ST
				Medium	W13_PL_M_ST
				Good	W13_PL_G_ST
		SB	W13	Fair	W13_SB_F_ST
				Medium	W13_SB_M_ST
				Good	W13_SB_G_ST
Athabasca Flats Pre-Treat	Base Natural	COMPOSITE	W13	All	W13_ALL_AF_Pre
Athabasca Flats Post-Treat	Base Natural	COMPOSITE	W13	All	W13_ALL_AF_Post
Subunit	Base Natural	AW	Whitecourt/ Blue Ridge	Fair	W13_AW_F_N_W/BR
				Medium	W13_AW_M_N_W/BR
				Good	W13_AW_G_N_W/BR
			McLeod/ Virginia Hills	Fair	W13_AW_F_N_MC/VH
				Medium	W13_AW_M_N_MC/VH
				Good	W13_AW_G_N_MC/VH

7.2 Pine Site Index Increase Yield Curves

Pine site index increase yield curves were developed to incorporate the anticipated increase in site productivity in managed over natural stands. Site index increase will represent yields in managed stands, replacing base managed stand yield curves for PL. A summary of relevant work in Alberta that supports pine site index increase in managed stands (Huang *et al.* 2004, Dempster 2004) is presented in Appendix VIII. A local study comparing natural and managed stand site index was undertaken by The Forestry Corp. on behalf of Millar Western in 1999 (The Forestry Corp. 1999) and is also summarized in this Appendix.

Based on the available information, site index in managed stands is expected to increase approximately 3.5 to 5 m above that of natural stands across all site types. Results of studies in Alberta (Dempster 2004, The Forestry Corp. 1999) indicate that the magnitude of increase varies based on site productivity, whether expressed in terms of pre-harvest site index or soil nutrient status. Initial use of a predictive equation developed in the 1999 TFC study resulted in site index increase values unacceptable to Alberta. As such, results from the study produced by the Foothills Growth and Yield Association (Dempster 2004), of which Millar Western is currently a member, were used.

Site index increase values were assessed by site type, with values of 6.7 m for poor sites, 2.8 m for medium sites, and 0.3 m for good sites. These values were added to average natural stand site index values calculated in Section 6.2 to produce managed stand site index values (Table 7-2).

Table 7-2. Average natural stand site index by site type, calculated FGYA site index increase, and new managed stand site index values for pine site index increase yield curves.

Site Type	Natural Stand Site Index (m) SI_f	Site Index Increase (m) (FGYA Values)	Managed Stand Site Index (m) SI_m
Fair	10.9	6.7	17.6
Medium	14.3	2.8	17.1
Good	17.1	0.3	17.4

These increased site index values were used as an input into the base natural stand yield curve equation for PL, creating site index increase yield curves for fair, medium and good sites in the PL stratum. Curves are presented in Appendix XV**.**

The total managed landbase area assignment is presented in Table 7-3. The majority of the PL stratum is comprised of medium TPR stands, which underwent a site index increase of 2.8 m. Because the final site index value was very similar across all site types, the medium TPR curve was selected to represent all managed pine stands. This is the most conservative of the three curves and is very similar to the natural stand "good" curve.

Table 7-3. Managed landbase area (ha) by TPR and stand type, PL stratum, FMU W13 (based on landbase version 12).

Stand Type	TPR			
	Fair	Medium	Good	Total
Natural	4,687	28,029	11,991	44,707
Cutblock	2,030	12,567	6,205	20,802
Thinning	45	572	516	1,132
Total	6,762	41,167	18,711	66,641

7.3 Thinning Yield Curves

Thinning yield curves were developed to provide volume estimates for 1,285 ha of existing thinned stands within FMU W13. The majority of stands are within the PL DFMP yield stratum, with a smaller proportion of stands within the SB DFMP yield stratum (see Table 4-2, Section 4.3). Minor areas belonging to other DFMP yield strata will be dealt with through timber supply analysis assumptions. For the PL and SB DFMP yield strata, thinning curves were developed by modifying the respective base natural stand yield curves for each stratum.

Two types of thinning curves were developed: commercial thinning yield curves and salvage thinning yield curves. Commercial thinning is the thinning of younger stands, where a recovery after harvest is expected. Commercial thinning allows Millar Western to utilize a portion of the standing timber without waiting for the entire stand to become merchantable. Salvage thinning is a thinning in older stands where the age of the stand reduces the likelihood of a positive growth response. Salvage thinning allows removal of overmature volume where stands are expected to begin to break up before final harvest.

For yield curve development, natural stand yield curves were modified to reflect volume removal at a specified average stand age, with or without stand recovery. Assumptions followed the 1997-2006 DFMP:

Commercial thinning:

- Thinning event at 45 years
- 35% removal
- Assume volume recovery to 90% of base natural stand yield curve volume in 15 years.

Salvage thinning:

- Thinning event at 90 years
- 33% removal
- No recovery (no assumption of volume recovery; volume remains at 67% of the base natural stand yield curve until final harvest)

These curves are intended to represent existing thinned stands (1,280 ha). No additional thinning is planned. Thinning yield curves are presented in Appendix XVI.

7.4 Athabasca Flats Selective Logging Yield Curves

Selective logging took place in the Athabasca Flats area (adjacent to the Athabasca River) using horse logging methods. Yield curves are required to represent standing volume before and after treatment. Sampling took place in 2005, to address data needs for yield curve development.

Data Processing

Data were processed in a similar manner to the TSP/PSP dataset. Spatial plot locations (***horse_logging_sampling_plots_320.shp***) were intersected with the Millar Western spatial landbase, version 9 (***mwfp_lb9a_model2.shp***) in order to obtain attribute information. Seven observations were removed because plots were not in the managed landbase. No additional deletions were required.

DFMP yield strata was reassigned after treatment, so in order to obtain DFMP yield stratum prior to treatment, an earlier version of DFMP yield stratum assignment was obtained based on the original (pre-treatment) AVI attributes[15]. Stand age at year of sampling was calculated as 2005 minus the origin year from the defining layer.

[15] F_YC is the final (post-treatment) DMFP yield stratum assignment. In order to obtain the pre-treatment DFMP yield stratum assignment, one of three fields was used, depending on which layer was identified as the defining layer: STRATA_YC (overstory), USTRATA_YC (understory) or CSTRATA_YC (composite).

Volumes were compiled as described in Section 3.6, with one notable difference. Stump diameters from felled trees were used to estimate diameter at breast height for harvested trees using equations from Huang (1994b). Estimated diameters were used to predict total tree height. Individual tree volumes were then calculated for each felled tree. These volumes were rolled up to the plot-level, representing the volume of timber removed from each plot. Thus, two volumes were calculated for each plot: pre-treatment volume and post-treatment volume (live trees only).

Landbase polygons identified as within Athabasca Flats areas were extracted from the landbase file and assigned an age and DFMP yield stratum in the same manner as described for plots on this page. Areas and number of plots by DFMP yield stratum are presented in Table 7-4.

Table 7-4. Total managed landbase area (ha) and number of plots within the Athabasca Flats selective logging area by pre-treatment DFMP yield stratum and eligibility (areas based on landbase version 9).

Eligibility	DFMP Yield Stratum	Area (ha)	Number of Plots
Managed (eligible)	AW	54	1
	AS	154	18
	SA	138	6
	PL	53	6
	SB	18	3
	SW	268	16
	Total	685	50
Unmanaged		229	7
Total		914	57

Yield Curve Development

A composite yield curve was developed for the Athabasca Flats selective logging area using area-weighting of base natural stand yield curves for FMU W13. Areas for area-weighting are those presented in Table 7-4 and are based on landbase version 9 (see Section 4.4 for reconciliation with landbase version 12).

Table 7-5. Areas (ha) used for creating a composite natural stand yield curve, Athabasca Flats selecting logging area, using landbase version 9.

DFMP Yield Stratum	TPR			Total
	Fair	Medium	Good	
AS	1	67	86	154
AW	1	31	22	54
PL	-	17	36	53
SA	-	68	70	138
SB	-	2	16	18
SW	-	163	106	268
Total	2	348	336	685

Pre-treatment plot volumes were then used to localize the composite yield curve. Percent difference was calculated for conifer and deciduous volume separately:

$$PctVolumeDiff = \frac{\sum\left(\frac{Volume_{ACTUAL,plot} - Volume_{PREDICTED,curve}}{Volume_{PREDICTED,curve}}\right)}{n_{plot}} * 100$$

Where: $PctVolumeDiff$ = average % difference between predicted and observed volume

$Volume_{Actual,plot}$ = observed gross merchantable stand volume (m^3/ha)

$Volume_{Pred,curve}$ = predicted gross merchantable volume (m^3/ha) at Age_j

Age_j = stand age at year of measurement

n_{plot} = number of sampled plots

The composite yield curve was localized for conifer and deciduous volume separately using:

$$VolumeComposite_{PRETREAT,Age_j} = VolumeComposite_{Age_j} * (1 + PctVolumeDiff)$$

Where: $VolumeComposite_{PRETREAT,Age_j}$ = pre-treatment composite volume (m^3/ha), Age_j

$VolumeComposite_{Age_j}$ = composite volume (m^3/ha), Age_j

$PctVolumeDiff$ = average % difference between predicted and observed volume

Post-harvest yield curves were then created to reflect volume removed. An average percent volume harvested was calculated using observed pre-treatment and post-treatment volumes calculated for each plot for deciduous and coniferous volumes, separately:

$$PctVolumeHarvested = \frac{\sum\left(\frac{Volume_{PRETREAT,plot} - Volume_{POSTTREAT,plot}}{Volume_{PRETREAT,plot}}\right)}{n_{plot}} * 100$$

Where: $PctVolumeHarvested$ = average percent volume removed

$Volume_{PRETREAT,plot}$ = gross merchantable stand volume (m^3/ha) before treatment

$Volume_{POSTTREAT,plot}$ = gross merchantable stand volume (m^3/ha) after treatment

n_{plot} = number of sampled plots

This percent removal was applied to reduce the localized composite yield curve, to reflect standing volumes in thinned stands, as follows:

$$VolumeComposite_{POSTTREAT,Age_j} = VolumeComposite_{PRETREAT,Age_j} * (1 - PctVolumeHarvested)$$

Where: $VolumeComposite_{POSTTREAT, Age_j}$ = post-treatment composite volume (m^3/ha), Age_j

$VolumeComposite_{PRETREAT, Age_j}$ = pre-treatment composite volume (m^3/ha), Age_j

Age_j = stand age

PctVolumeHarvested = average percent volume removed

No assumption of post-treatment volume recovery was applied to these curves.

Pre-treatment and post-treatment *Athabasca Flats selective logging yield curves* are presented in Appendix XVII.

7.5 Subunit-Specific Aspen Yield Curves

Within FMU W13, there are recognized differences in aspen stand volume by subunit. As a result, separate subunit-specific AW yield curves were developed for natural stands in the Whitecourt/Blue Ridge and McLeod/Virginia Hills subunits. Plot data and landbase areas were divided by subunit and used for empirical yield curve development.

Yield curves were fit using the same methods described for base natural stand yield curves (Section 6.2). Model form and coefficients are presented in Table 7-6. Coniferous volume would not converge using data split by location, therefore a single coniferous yield curve was fit using combined data. However, average site index by site type varies between locations (Table 7-7); these values were input into the single equation to create subunit-specific coniferous yield curves.

Table 7-6. Model form and model coefficients, subunit-specific aspen yield curves, FMU W13.

DFMP Yield Stratum	Yield Curve Code	Number of Observations	Species Type	Model Form	Model Coefficients a_0	a_1	b	k	R^2
AW	W13_AW_G_N_MC/VH	94	Coniferous	2P+k	-2.33681E-04	1.08647E-04	2.72026827	50	0.07
			Deciduous	2P+k	-5.76483E-04	4.55778E-05	3.75686635	30	0.48
	W13_AW_F_N_W/BR	44	Coniferous	2P+k	-2.33681E-04	1.08647E-04	2.72026827	50	0.07
			Deciduous	2P+k	5.98792E-03	1.63589E-04	2.81140685	30	0.14
Total		138							

Table 7-7. Average site index values used as inputs to the site-specific empirical yield curve model, subunit-specific aspen curves, FMU W13.

Subunit	Site Type	Site Index (m)	
		Coniferous	Deciduous
Whitecourt/ Blue Ridge	Fair	12.4	15.1
	Medium	14.2	17.4
	Good	16.2	19.8
McLeod/ Virginia Hills	Fair	12.4	14.7
	Medium	14.7	17.5
	Good	17.3	20.5

Yield curves developed for the Whitecourt/Blue Ridge subunits were appreciably lower than yield curves developed for the McLeod/Virginia Hills subunits, which parallels expectations based on knowledge of these areas. Differences in site productivity are also evident in TPR assignments by subunit. The total area of natural stands by subunit is summarized in Table 6-8, page 58. The majority of stands have a medium TPR; however, the Whitecourt/Blue Ridge subunit has appreciably less area with a good TPR.

Results are presented in Appendix XVIII.

8. Yield Curves for Timber Supply Analysis

This document has outlined the development of a number of yield curves. Not all yield curves were selected for use in timber supply analysis. The following sections list the curves used in timber supply analysis.

8.1 FMU W11

One natural stand yield curve was fit for each DFMP yield stratum in FMU W11. These yield curves will be used to represent natural stands in timber supply analysis.

Managed stand yield curves were only developed for the APAS_ABCD and PASA_ABCD DFMP yield strata, since there were already "fully stocked" base natural yield curves for aspen, pine and white spruce base natural yield curves (AW_CD, PL_CD, SW_CD) that could be used to represent managed stands.

The yield curves that will be used to represent each stand type in FMU W11 are listed by DFMP yield stratum in Table 8-1. Note that the AW_AB, PL_AB and SW_AB yield strata are not represented under the managed stand type. It is assumed that all regenerating conifer stands will be fully stocked, as required under Alberta regeneration surveys.

FMU W11 yield curves developed for the 2007-2016 DFMP yield strata are graphically presented by DFMP yield stratum in Appendix XIX, for ease of comparison.

Table 8-1. Yield curves used in timber supply analysis, FMU W11, by stand type and DFMP yield stratum.

Stand Type	DFMP Yield Stratum	Yield Curve Code	Curve Type
Natural	AW_AB	W11_AW_AB_N	Base natural
	AW_CD	W11_AW_CD_N	Base natural
	APAS_ABCD	W11_APAS_ABCD_N	Base natural
	PASA_ABCD	W11_PASA_ABCD_N	Base natural
	PL_AB	W11_PL_AB_N	Base natural
	PL_CD	W11_PL_CD_N	Base natural
	SW_AB	W11_SW_AB_N	Base natural
	SW_CD	W11_SW_CD_N	Base natural
Managed	AW_CD	W11_AW_CD_N	Base natural, fully stocked
	APAS_ABCD	W11_APAS_CD_M	Base managed, fully stocked
	PASA_ABCD	W11_PASA_CD_M	Base managed, fully stocked
	PL_AB	-	-
	PL_CD	W11_PL_CD_N	Base natural, fully stocked
	SW_AB	-	-
	SW_CD	W11_SW_CD_N	Base natural, fully stocked

8.2 FMU W13

In FMU W13, base natural and base managed stand yield curves were developed for each DFMP yield stratum by site type. In order to account for specific silvicultural and management treatments as well as areas with unique growth traits, modified yield curves were developed.

The yield curves used to represent each stand type in FMU W13 are listed by DFMP yield stratum in Table 8-2. Natural stands are represented by base natural stand yield curves except for the AW DFMP yield stratum, where subunit-specific aspen yield curves are used. Managed stands are represented by fully stocked base managed stand yield curves, with the following exceptions:

1. Base managed stand yield curves for AW were replaced by subunit-specific aspen yield curves (natural stands, all density);

2. Base managed stand yield curves for PL were replaced by site index increase yield curves;

3. Base managed stand yield curves for SA were replaced by base natural stand yield curves due to poor curve performance of managed curves (MAI achieved too quickly); and

4. In the remaining base managed stand yield curves, where the base natural stand yield curve was higher than the base managed stand curve at operable ages, the base natural curve was used. The base natural curve for good site types replaced the base managed stand curve in the AP, AS, PA and SW DFMP yield strata. All three site-specific base managed curves for were replaced by base natural curves in the SB DFMP yield stratum.

Other stand types (thinning and Athabasca Flats) are represented by their respective base/modified yield curves with no alterations or substitutions.

All FMU W13 yield curves developed for the 2007-2016 DFMP yield strata are presented graphically by DFMP yield stratum in Appendix XIX, for ease of comparison.

Table 8-2. Yield curves used in timber supply analysis, FMU W13, by stand type and DFMP yield stratum.

Stand Type	DFMP Yield Stratum	Subunit	Site Type	Yield Curve Code	Curve Type
Natural	AW	W/BR	Fair	W13_AW_F_N_W/BR	Subunit-specific aspen, all densities
			Medium	W13_AW_M_N_W/BR	Subunit-specific aspen, all densities
			Good	W13_AW_G_N_W/BR	Subunit-specific aspen, all densities
		MC/VH	Fair	W13_AW_F_N_MC/VH	Subunit-specific aspen, all densities
			Medium	W13_AW_M_N_MC/VH	Subunit-specific aspen, all densities
			Good	W13_AW_G_N_MC/VH	Subunit-specific aspen, all densities
	BW		All	W11W13_BW_N[1]	Base natural, all densities
	AP		Fair	W13_AP_F_N	Base natural, all densities
			Medium	W13_AP_M_N	Base natural, all densities
			Good	W13_AP_G_N	Base natural, all densities
	AS		Fair	W13_AS_F_N	Base natural, all densities
			Medium	W13_AS_M_N	Base natural, all densities
			Good	W13_AS_G_N	Base natural, all densities
	PA		Fair	W13_PA_F_N	Base natural, all densities
			Medium	W13_PA_M_N	Base natural, all densities
			Good	W13_PA_G_N	Base natural, all densities
	SA		Fair	W13_SA_F_N	Base natural, all densities
			Medium	W13_SA_M_N	Base natural, all densities
			Good	W13_SA_G_N	Base natural, all densities
	PL		Fair	W13_PL_F_N	Base natural, all densities
			Medium	W13_PL_M_N	Base natural, all densities
			Good	W13_PL_G_N	Base natural, all densities
	SB		Fair	W13_SB_F_N	Base natural, all densities
			Medium	W13_SB_M_N	Base natural, all densities
			Good	W13_SB_G_N	Base natural, all densities
	SW		Fair	W13_SW_F_N	Base natural, all densities
			Medium	W13_SW_M_N	Base natural, all densities
			Good	W13_SW_G_N	Base natural, all densities
Managed	AW	W/BR	Fair	W13_AW_F_N_W/BR	Subunit-specific aspen, all densities
			Medium	W13_AW_M_N_W/BR	Subunit-specific aspen, all densities
			Good	W13_AW_G_N_W/BR	Subunit-specific aspen, all densities
		MC/VH	Fair	W13_AW_F_N_MC/VH	Subunit-specific aspen, all densities
			Medium	W13_AW_M_N_MC/VH	Subunit-specific aspen, all densities
			Good	W13_AW_G_N_MC/VH	Subunit-specific aspen, all densities
	BW		All	W11W13_BW_N[1]	Base natural, all densities
	AP		Fair	W13_AP_F_M	Base managed, fully stocked
			Medium	W13_AP_M_M	Base managed, fully stocked
			Good	W13_AP_G_N	Base natural, all densities
	AS		Fair	W13_AS_F_M	Base managed, fully stocked
			Medium	W13_AS_M_M	Base managed, fully stocked
			Good	W13_AS_G_N	Base natural, all densities
	PA		Fair	W13_PA_F_M	Base managed, fully stocked
			Medium	W13_PA_M_M	Base managed, fully stocked
			Good	W13_PA_G_N	Base natural, all densities

Table 8-2 Cont'd. Yield curves used in timber supply analysis, FMU W13, by stand type and DFMP yield stratum.

Stand Type	DFMP Yield Stratum	Subunit	Site Type	Yield Curve Code	Curve Type
Managed	SA		Fair	W13_SA_F_N	Base natural, all densities
			Medium	W13_SA_M_N	Base natural, all densities
			Good	W13_SA_G_N	Base natural, all densities
	PL		Fair	W13_PL_F_SI[2]	Site index increase
			Medium	W13_PL_M_SI[2]	Site index increase
			Good	W13_PL_G_SI[2]	Site index increase
	SB		Fair	W13_SB_F_N	Base natural, all densities
			Medium	W13_SB_M_N	Base natural, all densities
			Good	W13_SB_G_N	Base natural, all densities
	SW		Fair	W13_SW_F_M	Base managed, fully stocked
			Medium	W13_SW_M_M	Base managed, fully stocked
			Good	W13_SW_G_N	Base natural, all densities
Commercial Thinning	PL		Fair	W13_PL_F_CT	Commercial thinning
			Medium	W13_PL_M_CT	Commercial thinning
			Good	W13_PL_G_CT	Commercial thinning
	SB		Fair	W13_SB_F_CT	Commercial thinning
			Medium	W13_SB_M_CT	Commercial thinning
			Good	W13_SB_G_CT	Commercial thinning
Salvage Thinning	PL		Fair	W13_PL_F_ST	Salvage thinning
			Medium	W13_PL_M_ST	Salvage thinning
			Good	W13_PL_G_ST	Salvage thinning
	SB		Fair	W13_SB_F_ST	Salvage thinning
			Medium	W13_SB_M_ST	Salvage thinning
			Good	W13_SB_G_ST	Salvage thinning
Athabasca Flats Pre-Treat	COMPOSITE		All	W13_ALL_AF_Pre	Athabasca Flats pre-treatment
Athabasca Flats Post-Treat	COMPOSITE		All	W13_ALL_AF_Post	Athabasca Flats post-treatment

[1] FMU-wide yield curve.

[2] Pine SI increase applied to natural stand curves.

9. Additional Growth and Yield Issues

Although this document's primary purpose is to describe the development of volume-age yield curves for the 2007-2016 DFMP, there are a number of related growth and yield issues that are also included herein. These are: cull, piece size curves, species composition curves and regeneration lag calculations.

9.1 Cull Deductions

Cull deductions are applied to yield curves to reflect losses to cull (trees or portions thereof that are merchantable but are removed because of defect). In the 1997-2006 DFMP, an 8% deciduous cull and a 2% coniferous cull were applied after timber supply analysis. An annual allowable cut (AAC) was determined for *gross volume*, and cull factors were applied to obtain the net AAC.

The new Alberta Forest Management Planning Standard (SRD 2006) requires that cull be applied as a percent reduction to yield curves, rather than as a reduction to the harvest level in timber supply analysis.

Updated cull factors are required for the 2007-2016 DFMP. This section describes the methods by which cull was derived.

9.1.1 Methods

Scaling data (number of logs, gross scaled volume, cull volume, and *net* volume) were used to determine cull. Millar Western cull data for the 2003 and 2004 timber years were used for analysis. Data were from both FMU W11 and FMU W13.

Coniferous scaling data were available from 64 cutblocks (186 species-specific records), and deciduous scaling data were available from 72 cutblocks (128 species-specific records). The number of blocks and records is broken down by FMU in Table 9-1.

Table 9-1. Number of cull records and associated number of cutblocks by species group and FMU.

Species Type	FMU	Number of Records	Number of Blocks
Deciduous	W11	112	64
	W13	16	8
Coniferous	W11	0	0
	W13	186	64

For each species type, cull was determined by calculating percent cull for each record. Each record was then weighted by gross scaled volume, so that records representing more scaled volume had a higher influence on the cull calculation. All records were then summed to obtain percent cull for the species group. The equation was:

$$PctCull = \sum_{i=1}^{n}\left(\left(\frac{CullVol_i}{GrossVol_i}\right)*\left(\frac{GrossVol_i}{GrossVol_{tot}}\right)\right)*100$$

which reduces to $$PctCull = \frac{\sum_{i=1}^{n} CullVol_i}{GrossVol_{tot}}*100$$

Where: *PctCull* = percent cull

CullVol = cull volume (m^3)

GrossVol = gross scaled volume (m^3)

9.1.2 Results

Results of calculations are presented in Table 9-2.

Table 9-2. Millar Western percent cull by species type, combined FMUs, for use in the 2007-2016 DFMP.

Species Type	Percent Cull
Deciduous	5.2
Coniferous	2.2

No Millar Western coniferous cull data were available from FMU W11, but information from SRD indicates that percentages are similar to those calculated using SRD data (Table 9-3) (Bill Cooper, SRD, via email). This information also provides independent verification that the proposed values for cull are reasonable.

Table 9-3. SRD percent cull by species type, FMU W11, for comparison purposes.

Species Type	Percent Cull
Deciduous	5.3
Coniferous	2.0

Millar Western's cull calculation was used for both FMUs. A 5.2 percent reduction was applied to the deciduous component of each yield curve, and a 2.2 percent reduction was applied to the coniferous component of each yield curve. However, cull was applied to yield curves during timber supply modelling and therefore *net* merchantable volume yield curves are not presented here.

9.2 Piece Size Curves

Piece size curves were required to provide an estimate of how piece size (number of trees per cubic meter of gross merchantable tree volume) changes over time. This information is used in timber supply modelling to assess the economics of stands selected for harvest.

9.2.1 Methods

Piece size curves were developed for both FMU W11 and FMU W13. The same method was used for both FMUs.

The base TSP/PSP dataset used in yield curve development was used for piece size curve development. Influential points that were removed from the dataset during yield curve development were included in piece size development. Plot attributes were the same as previously defined, and volumes compiled for yield curve development were retained for use in this analysis.

For each plot, trees per m^3 was calculated, by dividing total number of merchantable trees in the plot by the gross merchantable plot volume. An equation to predict trees per m^3 as a function of age was then fit directly using plot data:

$$PieceSize = a_0 + \frac{a_1}{Age}$$

Where: *PieceSize* = number of trees per m^3 of gross merchantable tree volume

Age = age at year of measurement

a_0, a_1 = coefficients

Observations with no merchantable volume were excluded from analysis, since piece size could not be calculated (dividing by zero). Several influential points were also removed. These were extreme values that affected curve fit. The final number of observations by DFMP yield stratum

was different for coniferous and deciduous curves, since there could be coniferous volume with no deciduous volume, or vice versa. The number of observations used in developing piece size curves is summarized in Table 9-4.

Table 9-4. Number of plots used for fitting coniferous and deciduous piece size curves.

			Coniferous Curves			Deciduous Curves		
FMU	DFMP Yield Stratum	Initial Number of Observations	Influential Points	Observations With Zero Volumes	Final Number of Observations	Influential Points	Observations With Zero Volumes	Final Number of Observations
W11	AW_AB	63	3	49	11	3	17	43
	AW_CD	105		71	34		26	79
	APAS_ABCD	72		22	50		25	47
	PASA_ABCD	80		17	63		29	51
	PL_AB	71		20	51	4	59	8
	PL_CD	66		14	52		47	19
	SW_AB	59		19	40		36	23
	SW_CD	63		8	55		31	32
	Total	579	3	220	356	7	270	302
W13	AW	138		60	78		17	121
	BW	42		21	21		12	30
	AP	58		6	52		8	50
	AS	96		26	70		22	74
	PA	64		11	53		27	37
	SA	64		9	55		19	45
	PL	183		29	154		132	51
	SB	61		14	47		57	4
	SW	76		13	63		43	33
	Total	782		189	593		337	445
Grand Total		1,361	3	409	949	7	607	747

9.2.2 Results

Model coefficients are presented in Table 9-5. Graphs showing piece size curves are provided in Appendix XX.

Certain piece size curves show poor performance, with values of zero before death age. For TSA purposes, piece size values greater than zero were required at older ages for proper model function. Therefore, a minimum piece size value was applied. Any curves that fell below the 10^{th} percentile of the plot data used for curve development were capped at that minimum value. This minimum was applied during timber supply modelling and therefore the adjusted curves are not presented here.

Table 9-5. Model coefficients for piece size curves, FMU W11 and FMU W13.

FMU	DFMP Yield Stratum	Species Type	Model Coefficients	
			a_0	a_1
W11	AW_AB	Coniferous	4.68291	83.96982
		Deciduous	-2.74769	522.82353
	AW_CD	Coniferous	4.00407	96.13856
		Deciduous	-0.55139	368.80043
	APAS_ABCD	Coniferous	0.61400	401.05774
		Deciduous	0.58903	344.69404
	PASA_ABCD	Coniferous	1.34493	186.47765
		Deciduous	-1.44842	479.46998
	PL_AB	Coniferous	3.63011	136.82045
		Deciduous	2.68631	117.32448
	PL_CD	Coniferous	-3.05070	822.00923
		Deciduous	-1.20960	518.41124
	SW_AB	Coniferous	5.16384	26.60796
		Deciduous	2.85493	287.66632
	SW_CD	Coniferous	1.31412	238.69963
		Deciduous	-1.26312	489.92987
W13	AW	Coniferous	3.35441	138.89566
		Deciduous	-0.89112	347.75294
	BW	Coniferous	0.73968	373.89008
		Deciduous	-0.30692	456.63616
	AP	Coniferous	-1.41872	434.09965
		Deciduous	-4.70026	694.47459
	AS	Coniferous	-0.19330	284.65316
		Deciduous	0.11112	273.06719
	PA	Coniferous	-0.86782	370.85279
		Deciduous	-1.46693	532.22920
	SA	Coniferous	0.58922	291.04339
		Deciduous	3.24711	78.79453
	PL	Coniferous	-1.60400	545.02440
		Deciduous	-1.73117	559.64027
	SB	Coniferous	6.03084	102.60456
		Deciduous	-2.65923	737.88434
	SW	Coniferous	1.47080	134.58594
		Deciduous	1.24279	239.91475

9.3 Species Composition Curves

Species composition by DFMP yield stratum was required so that volume harvested by species could be tracked within timber supply analysis.

9.3.1 Methods

Plot data were divided into age classes (using the defining layer stand age) by species type and species group (Table 9-6). 40-year age classes were used for both coniferous and deciduous species types, however, the coniferous age classes began and ended 20 years later to reflect the fact that coniferous species generally achieve merchantable volumes later than deciduous species.

Table 9-6. Age classes for percent species composition calculations by species type.

Species Type	Species Group	Age Class	Age Range
Deciduous	AW, BW, PB	20	<40
		60	40-79
		100	80-119
		140	120+
Coniferous	FB, FD, LT, PL, SB, SW	40	<60
		80	60-99
		120	100-139
		160	140+

For each observation, gross merchantable volume was summed by species. Mean gross merchantable volume was then calculated by species and in total within DFMP yield stratum and age class. Percent volume by species was calculated as:

$$\%Vol_{SPi} = \frac{AvgVol_{SPi}}{AvgVol_{TOT}} * 100$$

Where: $\%Vol_{SPi}$ = percent volume, species i

$AvgVol_{SPi}$ = average gross merchantable volume, species i

$AvgVol_{TOT}$ = average gross merchantable volume, for the species type

Total percent volume by species group was calculated for deciduous and coniferous species groups, respectively, using:

$$\%Vol_{DEC} = \sum \left(\%Vol_{AW} + \%Vol_{BW} + \%Vol_{PB} \right)$$

$$\%Vol_{CON} = \sum \left(\%Vol_{FB} + \%Vol_{FD} + \%Vol_{LT} + \%Vol_{PL} + \%Vol_{SB} + \%Vol_{SW} \right)$$

Where: $\%Vol_{DEC}$ = percent deciduous volume

$\%Vol_{CON}$ = percent coniferous volume

$\%Vol_{AW,BW,PB,FB,FD,LT,PL,SB,SW}$ = percent volume by species ($\%Vol_{SPi}$)

9.3.2 Results

Results of analyses for FMUs W11 and W13, respectively, are presented in Table 9-7 and Table 9-8. Note that total coniferous volume does not add together with total deciduous volume to 100%, since percent deciduous and percent coniferous volume were calculated using different age classes. Within timber supply analysis, deciduous percent volume was normalized to total to 100% at each age class. The deciduous portion of each yield curve was separated into AW, BW, and PB components using the proportion at each age class, and straight-line interpolation

between age classes. The same process was applied to coniferous percent volume. These results were applied to generate species-specific volumes within timber supply analysis.

Table 9-7. Percent species composition by DFMP yield stratum and age class, FMU W11.

DFMP Yield Stratum	Age Class	Deciduous Percent Volume				Coniferous Percent Volume					
		AW	BW	PB	Total	FB/FD	LT	PL	SB	SW	Total
AW_AB	60	61.1	4.1	31.5	96.7						
	80					0.4	0.0	0.0	2.2	3.7	6.3
	100	54.8	0.0	38.2	93.1						
	120					0.0	0.0	2.3	0.6	12.3	15.1
	140	63.9	7.1	3.6	74.6						
	160					-	-	-	-	-	-
AW_CD	60	61.2	9.7	14.0	84.8						
	80					0.0	0.0	1.1	0.7	13.5	15.3
	100	68.2	1.6	6.1	75.9						
	120					0.1	0.0	4.0	0.1	21.8	26.0
	140	72.5	0.2	10.4	83.1						
	160					-	-	-	-	-	-
APAS_ABCD	60	15.4	17.8	16.3	49.5						
	80					0.0	1.1	9.8	6.1	12.1	29.2
	100	60.2	0.0	7.7	67.9						
	120					0.1	0.4	4.9	6.3	29.2	40.9
	140	36.6	0.1	12.2	48.8						
	160					0.0	0.0	5.5	0.0	50.4	55.9
PASA_ABCD	60	39.3	6.2	3.7	49.2						
	80					0.0	1.4	12.8	7.0	30.4	51.5
	100	36.9	0.3	2.9	40.1						
	120					0.1	0.0	7.3	3.0	43.8	54.2
	140	42.0	2.7	9.8	54.6						
	160					-	-	-	-	-	-
PL_AB	60	17.3	0.0	5.1	22.4						
	80					0.0	0.0	70.8	2.2	6.6	79.6
	100	4.0	0.4	0.2	4.6						
	120					0.0	0.2	36.2	21.7	35.6	93.7
	140	7.7	0.2	0.0	7.9						
	160					-	-	-	-	-	-
PL_CD	60	10.3	0.0	3.2	13.4						
	80					0.0	0.0	78.2	9.6	1.2	89.1
	100	12.6	0.0	1.2	13.8						
	120					0.1	0.8	58.9	14.2	8.3	82.2
	140	23.9	0.1	0.0	24.0						
	160					0.0	0.0	47.4	9.6	0.0	57.0
SW_AB	60	15.5	0.8	4.8	21.1						
	80					0.0	0.0	2.0	20.8	68.9	91.7
	100	9.7	0.5	9.6	19.8						
	120					0.4	1.5	15.6	19.8	34.1	71.5
	140	23.1	2.3	4.6	30.0						
	160					-	-	-	-	-	-
SW_CD	60	10.0	1.5	7.9	19.4						
	80					0.0	3.0	7.2	22.9	50.1	83.1
	100	11.8	0.8	3.0	15.6						
	120					0.9	0.0	4.0	5.4	54.6	65.0
	140	37.3	0.9	11.2	49.4						
	160					-	-	-	-	-	-

Table 9-8. Percent species composition by DFMP yield stratum and age class, FMU W13.

DFMP Yield Stratum	Age Class	Deciduous Percent Volume				Coniferous Percent Volume					
		AW	BW	PB	Total	FB/FD	LT	PL	SB	SW	Total
AW	60	56.7	5.7	22.2	84.6						
	80					0.6	0.0	3.3	0.1	13.1	17.2
	100	54.3	1.1	23.5	78.9						
	120					0.3	0.0	0.0	0.0	18.8	19.1
	140	48.5	1.9	48.3	98.6						
	160					-	-	-	-	-	-
AP	60	33.1	1.7	3.0	37.8						
	80					0.0	0.0	15.5	4.4	15.4	35.3
	100	59.3	1.7	4.4	65.4						
	120					2.9	0.0	15.4	5.2	18.1	41.5
	140	54.4	0.1	3.5	58.1						
	160					-	-	-	-	-	-
AS	60	38.1	2.0	12.7	52.8						
	80					0.0	0.0	28.6	3.0	16.1	47.7
	100	35.0	4.1	11.7	50.8						
	120					1.1	0.0	6.7	1.2	32.2	41.2
	140	33.1	0.6	36.7	70.4						
	160					-	-	-	-	-	-
PA	60	22.2	3.3	0.6	26.1						
	80					0.0	0.0	60.2	6.1	12.9	79.2
	100	30.2	1.6	0.0	31.8						
	120					0.4	0.0	46.5	2.9	15.8	65.6
	140	18.8	0.7	5.2	24.8						
	160					0.8	0.0	37.8	7.2	34.6	80.3
SA	60	33.5	0.0	2.7	36.2						
	80					4.2	0.0	0.0	0.0	59.2	63.4
	100	18.4	2.7	13.1	34.2						
	120					2.6	0.0	8.1	2.0	44.3	57.0
	140	29.8	4.5	12.2	46.4						
	160					-	-	-	-	-	-
PL	60	6.5	1.2	1.8	9.6						
	80					0.4	0.0	72.8	6.3	7.6	87.1
	100	13.8	2.0	0.8	16.6						
	120					1.6	0.0	53.9	11.0	15.1	81.6
	140	10.7	0.3	0.0	11.0						
	160					3.1	0.0	34.9	11.7	45.3	95.0
SB	60	1.4	0.1	0.0	1.5						
	80					0.0	0.0	40.9	59.1	0.0	100.0
	100	0.0	0.0	0.0	0.0						
	120					3.5	0.9	10.9	63.3	18.5	97.1
	140	3.2	0.0	0.0	3.2						
	160					3.2	3.3	29.3	64.2	0.0	100.0
SW	60	13.4	1.3	1.2	16.0						
	80					0.5	0.0	39.8	5.1	34.4	79.8
	100	14.6	1.7	15.4	31.7						
	120					2.8	0.3	8.1	11.1	57.9	80.1
	140	0.7	1.0	10.0	11.7						
	160					1.1	0.0	0.0	25.5	73.5	100.0

9.4 Regeneration Lag

Regeneration lag (regen lag) is the time in years following harvesting that is required for the harvested area to become stocked with desirable tree species. Regeneration lag calculations employ historic data to project anticipated regeneration lag in forecasting.

Regeneration lag calculations were required for Millar Western's FMA area for the 2007-2016 DFMP. They have been completed in accordance with the Alberta Forest Management Planning Standard Version 3 – June 2005 and additional instructions provided by SRD (Regeneration Lag Assessment Version 8.0 (SRD 2005), received from Stephen Wills, April 28, 2006).

Regeneration lag was calculated separately for each FMU according to one of two broad cover group classes (pure conifer and mixedwoods grouped together, and pure deciduous). Regeneration lag was applied as a shift to all yield curves representing managed stands used in the Millar Western 2007-2016 DFMP during timber supply modelling (see Chapter 8).

9.4.1 Methods

Regeneration lag was determined in two stages: first, a regeneration lag was assigned to each existing cutblock using the rules provided by SRD, and then an area-weighted regeneration lag was calculated for each FMU and broad cover group class. Four area-weighted regeneration lags were calculated for the 2007-2016 DFMP:

- D broad cover groups in FMU W11;
- C, CD and DC broad cover groups in FMU W11;
- D broad cover groups in FMU W13; and
- C, CD and DC broad cover groups in FMU W13.

Millar Western's geodatabase system, which was used to develop the cutblock dataset for the landbase classification, contained all the information required for the regeneration lag calculations. The development of the cutblock dataset is described in Millar Western's *Cutblock Classification* (Millar Western 2006a). The relevant information for the regeneration lag calculations from this dataset included:

- Post-harvest broad cover group declaration;
- Status of regeneration surveys (completed or not completed);
- Result of the survey;
- Year of harvest (calculated using timber year (defined in the Alberta Forest Management Planning Standard as May 1 to April 30) of skid clearance date);

- Harvest type (clearcut or thinning);

- Silviculture activities (calculated as the dominant treatment occurring within 2 years of skid clearance date that was applied to at least 60% of the cutblock area; treatments in order of decreasing dominance were: planting, seeding – including drag scarification for pine, site preparation, and lastly leave-for-natural);

- Last treatment date (calculated as the year, from July 1 to June 30, of the most recent silvicultural activity that was applied to at least 20% of the cutblock area; tending was not considered a silvicultural activity for this analysis);

- Planting stock; and

- Cutblock area.

Assigning Regeneration Lag to Cutblocks

First, the cutblocks that were used in the regeneration lag calculations were selected from the cutblock dataset. The selected cutblocks met the following criteria:

- Clearcut harvest (not thinned or selectively logged);

- Harvested on or after March 1, 1991;

- Harvested before May 1, 1997 for C, CD and DC broad cover groups;

- Harvested before May 1, 2000 for D broad cover groups; and

- Not an existing cutblock in the Virginia Hills area that was burnt in the 1998 fire where Millar Western committed to reforesting and accepted regeneration liability.

Based on SRD's rules, cutblocks harvested before May 1, 1996 (C, CD and DC broad cover groups) and May 1, 1999 (D broad cover groups) were to be included in the regeneration lag calculation. Additional years could also be included if all blocks within that year had been declared SR or NSR. For these calculations, one additional year met this criterion and was included for both the C, CD, and DC broad cover groups and the D broad cover group.

Status and management strategy were then assigned to all cutblocks using the hierarchy in Table 9-9.

Table 9-9. Hierarchy and criteria for assigning regeneration status and management strategy.

Status	Management Strategy	Assignment Criteria
SR	Plant or Seed	Regeneration survey completed, result was SR, planting or seeding activities[1] occurred within 2 years of harvest
SR	Site Preparation	Regeneration survey completed, result was SR, site preparation activities occurred within 2 years of harvest
SR	LFN	Regeneration survey completed, result was SR, and LFN strategy was identified
CSR	-	Regeneration survey completed, result was CSR
NSR	-	Regeneration survey completed, result was NSR
Overdue	-	No regeneration survey completed

[1]Activities must cover 60% or more of the cutblock area.

Once status and management strategy was assigned, the regeneration lag was calculated for each cutblock using the rules provided in Table 9-10.

Table 9-10. Rules for assigning regeneration lag to cutblocks.

Broad Cover Group	Management Strategy				
	SR Plant or Seed	SR Site Preparation	SR LFN	CSR	Overdue or NSR[1]
C	If planting stock was 2+0, then last treatment date minus year of harvest minus 1 year, otherwise last treatment date minus year of harvest	Last treatment date minus year of harvest plus 2 years	Maximum of: 5 years or last treatment date minus year of harvest		Maximum of: 10 years or 2004 minus year of harvest
CD			Maximum of: 4 years or last treatment date minus year of harvest		Maximum of: 10 years or 2004 minus year of harvest
DC			Maximum of: 2 years or last treatment date minus year of harvest		Maximum of: 10 years or 2004 minus year of harvest
D			Maximum of: 1 year or last treatment date minus year of harvest	3 years	Maximum of: 7 years or 2004 minus year of harvest

[1] The regeneration lag assessment year was the same as the effective date of the landbase classification (2004).

Calculating an Area-Weighted Regeneration Lag

The regeneration lag assigned to each cutblock was averaged for FMU and broad cover group class using cutblock areas.

9.4.2 Results

The area-weighted regeneration lag was calculated, and then rounded up to the nearest year, which was used in timber supply modelling (Table 9-11).

Table 9-11. Calculated regeneration lag by FMU and broad cover group.

FMU	Broad Cover Group	Non-Rounded Regeneration Lag (years)	Rounded Regeneration Lag (years)
W11	C, CD, DC	5.6698	6
	D	2.2435	3
W13	C, CD, DC	3.9320	4
	D	2.8742	3

The number and area of cutblocks by management strategy and broad cover group is presented in Table 9-12 and Table 9-13 for each FMU respectively.

Table 9-12. Number and area (ha) of cutblocks by management strategy and broad cover group, FMU W11.

Broad Cover Group	Number of Blocks by Management Strategy: SR Plant or Seed Site Preparation	SR	LFN	Unspecified[1]	CSR	NSR	Overdue	Total
Number of Blocks								
C	11	12	2	56		4	1	86
CD	6	13	-	36		2	-	57
DC	2	6	-	24		4	-	36
D	2	1	63	20	-	2	1	89
Total	21	32	65	136	0	12	2	268
Area (ha) of Blocks								
C	118	151	25	721		29	14	1,058
CD	109	219	-	739		28	-	1,095
DC	32	96	-	457		84	-	669
D	39	20	1,638	437	-	14	28	2,177
Total	298	487	1,663	2,355	0	156	42	5,000

[1] Treated as "SR-LFN" management strategy for classification.

Table 9-13. Number and area (ha) of cutblocks by management strategy and broad cover group, FMU W13.

Broad Cover Group	Number of Blocks by Management Strategy: SR Plant or Seed Site Preparation	SR	LFN	Unspecified[1]	CSR	NSR	Overdue	Total
Number of Blocks								
C	182	66	1	86		23	2	360
CD	5	2	-	1		-	-	8
DC	1	1	-	-		1	-	3
D	-	2	130	2	56	8	2	200
Total	188	71	131	89	56	32	4	571
Area (ha) of Blocks								
C	4,020	1,726	15	2,059		548	30	8,398
CD	107	41	-	7		-	-	155
DC	11	33	-	-		15	-	58
D	-	16	2,666	26	1,067	144	534	4,454
Total	4,138	1,816	2,681	2,092	1,067	707	565	13,065

[1] Treated as "SR-LFN" management strategy for classification.

The minimum acceptable standards for regeneration have evolved over time, from simply ensuring that a new stand has been established to ensuring that new stands meet minimum performance standards. This has increased silvicultural intensity requirements (planting of larger stock, herbicide treatments, *etc.*). As a result, regeneration lag has steadily decreased since 1991.

However, SRD guidelines require that all cutblocks harvested after March 1, 1991 be included in regeneration lag calculations. Figure 9-1 and Figure 9-2 present the regeneration lag by year of harvest and management strategy for the C, CD and DC broad cover groups and D broad cover group, respectively.

The regen lag calculation was applied to all managed stand yield curves used in the Millar Western 2007-2016 DFMP. Regeneration lag was applied during timber supply analysis, therefore lagged curves are not presented here.

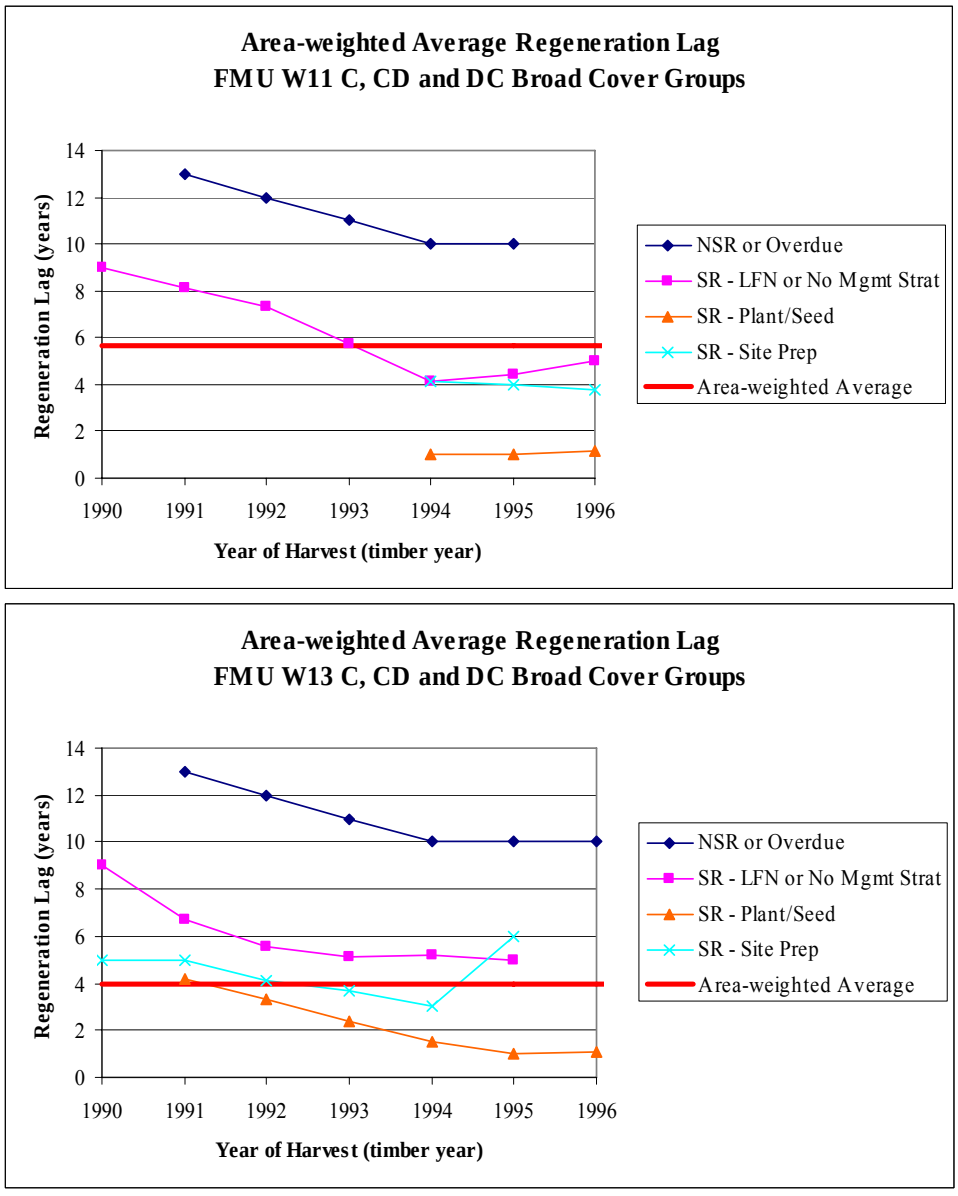
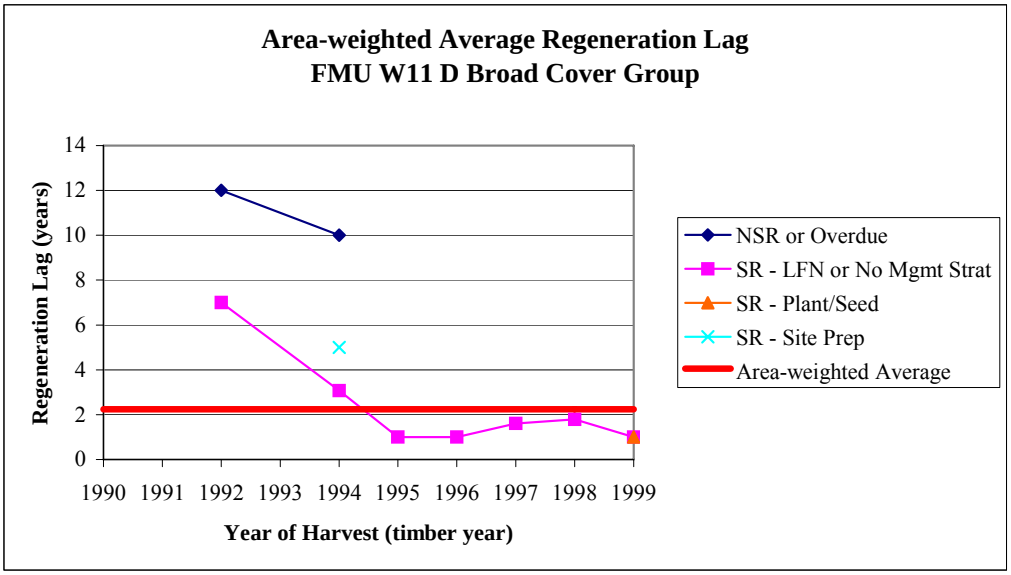


Figure 9-1. Regeneration lag by management strategy and year of harvest for the conifer and mixedwood (C, CD, and DC) broad cover groups.



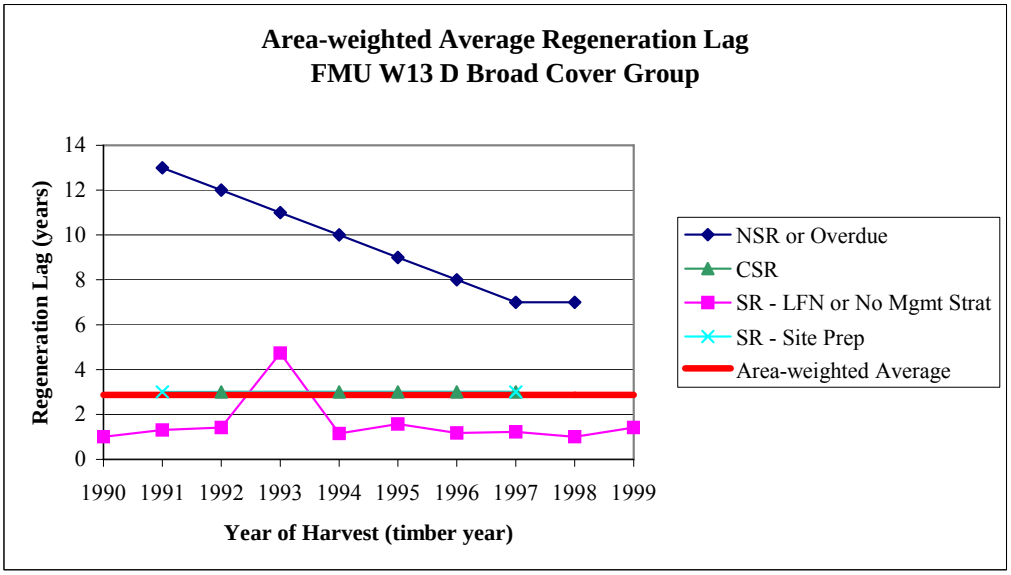


Figure 9-2. Regeneration lag by management strategy and year of harvest for the deciduous (D) broad cover group.

10. References

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APPENDICES

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Appendix I. Glossary

Glossary Term	Definition
Athabasca Flats	An area along the Athabasca River in Millar Western's FMA that has been managed since 1997 for wildlife habitat and aesthetic values using a horse logging operation.
Athabasca Flats selective logging yield curve	Modified composite yield curve developed to represent the small (under 700 ha) area harvested using selective thinning. Yield curve has been localized using plot data to represent pre- and post-thinning volumes.
AVI polygon	A polygon delineated based on aerial photography using Alberta Vegetation Inventory rules (AFLW 1991, Nesby 1996). For vegetated areas, areas must be sufficiently similar in terms of structure, moisture regime, crown closure, height, species composition, and origin year to be considered a single unit, or polygon. For nonvegetated areas, areas must have a similar nonvegetated classification.
BAP strata	A stratification assigned to all stands in the gross landbase. Based upon extended strata (broad cover group and species composition) for forested stands and AVI or anthropogenic stand disturbances for non-forested stands. BAP strata are independent of FMU.
Base yield curve	The "standard" set of yield curves developed for the DFMP yield strata, representing the main stand types within the FMA area. Base yield curves may or may not be used to represent these stand types in the final timber supply analysis.
Broad cover group	A classification of forest types based on coniferous and deciduous components of the AVI species composition. The broad cover groups are coniferous (C), coniferous-leading mixedwood (CD), deciduous-leading mixedwood (DC) and deciduous (D).
Clearcut	A regeneration system where all or most of the merchantable trees in a defined area are harvested in one cutting with reproduction obtained through artificial or natural means. [SRD 2006]
Commercial thinning	A partial cut where trees of a merchantable size and value are removed to provide an interim harvest while maintaining a high rate of growth on the remaining, well-spaced, final crop trees. Used to capture volume likely to succumb to competition pressures and be lost to disease, insect, or dieback. [SRD 2006]
Commercial thinning yield curve	A modified yield curve for the PL and SB DFMP yield strata, whereby 35% of the natural stand volume is removed at 45 years. There is an assumption of recovery to 90% of natural stand volumes after 15 years.
Composite layer	A single AVI attribute string created by merging attributes from both the overstory and understory. Used as the defining layer for certain multi-storied stands.
Composite yield curve	Area-weighted composite yield curves developed from empirically-fit natural stand yield curves; a single composite curve was developed for each FMU.
Convergence	Nonlinear regression involves an iterative process in SAS™. An initial set of parameters is provided for the model, and the program attempts to improve the fit of the model to the data by modifying these values. Once the model can no longer be improved by changing these values, the model is said to have achieved convergence. Occasionally, convergence cannot be achieved, often due to the presence of influential points.
Crop plan	A silvicultural plan designed to assist in growing a forest stand or crop at densities that improve or maximize the quantity or value of the timber produced.
Crop plan yield curve	Yield curves developed to represent volume over time in stands managed under a specific crop plan. Includes representation of volume removal via thinning.
Cull	Trees or portions thereof that are merchantable but are removed because of defect.
Cutblock	A specified area that is either designated for harvest or has already been harvested.
Defined forest area	A specified area of forest, including land and water (regardless of ownership or tenure) to which the requirements of the Alberta Forest Management Planning Standard apply. The DFA may or may not consist of one or more contiguous blocks or parcels. (The total area of analysis for use in TSA before any deletions are made for parks, landuse, operability, etc.) [CSA, cited in SRD 2006]
Defining layer	The inventory layer used to assign strata. The defining layer may be the overstory, the understory or a composite of the two (composite layer).

Glossary Term	Definition
DFMP yield strata	A stratification applied to the forested landscape. Assignment is based upon species strata and/or crown closure class. DFMP Yield strata form the basis for the development of yield curves; each DFMP yield stratum has one or more associated yield curves. For example: Aspen open (AW_AB).
Extended strata	One of the three levels of yield stratification rules outlined in the Alberta Forest Management Planning Standard, intended to provide a standardized stratification scheme acceptable to Alberta. Extended stratification is a detailed level used to address specific local issues. Rolls up into Recommended stratification (moderate level of detail) and then to the Minimum stratification (basic level of detail). For the Millar Western 2007-2016 DFMP, extended strata are converted to DFMP yield strata.
Forested landscape	Areas within the gross landbase currently supporting, or being regenerated to, forested tree species.
Fully stocked	All potential growing space is effectively occupied by merchantable tree species.
Fully stocked method	A method for developing managed stand yield curves. Yield curves are empirically fit using plots from natural stands with a C or D density crown closure class; these curves are used as a proxy to represent fully stocked managed stands.
Gross landbase	Entire area in ha within the boundaries of both Millar Western FMUs. Includes areas within the outer boundaries of the FMUs that are normally excluded from the FMU area, such as parks.
Gross volume	Indicates that no defect/cull deduction has been applied; this term can be applied to tree-level, plot-level or stand-level volumes (e.g., gross total tree volume, gross merchantable tree volume, gross total plot volume, gross merchantable plot volume, gross total stand volume, gross merchantable stand volume).
Influential point	An extreme data point that negatively influences model performance, resulting in failure to converge or an unacceptable curve shape.
Landbase polygon	A polygon within the (classified, TSA, or modelling) landbase derived during spatial processing to incorporate various spatial layers and attributes of interest.
Managed landbase	Areas that are available for forest management activities. Comprised of the combined coniferous and deciduous landbases. Also referred to as the timber harvesting landbase, net landbase, contributing landbase, active landbase.
Managed stand	Stand initiation is caused by anthropogenic disturbance such as harvesting.
Managed stand yield curve	Empirical yield curves fit using C and D crown closure class data from natural stands as a proxy for managed stands within the managed landbase. In W13, individual curves were developed by DFMP yield stratum site type (fair, medium or good). In FMU W11, individual yield curves were developed by DFMP yield stratum only.
Mean annual increment	The average annual increase in volume of individual trees or stands up to the specified point in time. The MAI changes with different growth phases in a tree's life, being highest in the middle years and then slowly decreasing with age. The point at which the MAI peaks is commonly used to identify the biological maturity of the stand and its readiness for harvesting. [SRD 2006]
Merchantable stand volume	Merchantable tree volume summed to represent volume on a per hectare basis.
Merchantable tree volume	A tree-level term; the volume of those portions of a tree bole that meet utilization requirements (stump height, top and bottom diameter limits, log length).
Modified yield curve	Base yield curves modified to reflect specific applied silvicultural treatments or to represent geographically localized areas within the DFA with recognized differences in stand composition and/or growth.
Natural stand	Natural stands developed under natural (non-anthropogenic) disturbance regimes. Stand initiation was due to natural disturbances such as fire, pest or pathogen outbreak, etc.
Natural stand yield curve	Empirical yield curves fit using data from all sampled natural stands within the managed landbase. In W13, individual curves were developed by DFMP yield stratum site type (fair, medium or good). In FMU W11, individual yield curves were developed by DFMP yield stratum only.
Net	Indicates that a defect/cull deduction has been applied; this term can be applied to tree-level, plot-level or stand-level volumes (e.g., net total tree volume, net merchantable tree volume, net total plot volume, net merchantable plot volume, net total stand volume, net merchantable stand volume).
Non-forested landscape	Areas within the gross landbase currently not supporting or being regenerated to forested tree species.

Glossary Term	Definition
Nonlinear regression/nonlinear models	The practice of fitting a model where the dependant variable is a nonlinear function of one or more independent variables. Nonlinear regression is differentiated from curvilinear regression by the fact that derivatives of a nonlinear regression equation with respect to a given parameter depend on more than one parameter. One benefit of nonlinear models is that they are often derived on the basis of physical and/or biological considerations.
Observation	One plot measurement at a specific point in time. All temporary sample plots have only one associated observation. Permanent sample plots may have one or more observations (remeasured data) for a single plot.
Partial harvest	A treatment where significantly less than 100% of the trees are harvested from a stand or area. It includes commercial thinning, even when the intention is leading to a final clearcut. [SRD 2006]
Percent increase method	A method for developing managed stand yield curves. Natural stand yield curves are increased by a fixed percentage in order to represent fully stocked managed stands.
Piece size	The number of trees required to obtain one cubic meter of gross merchantable tree volume.
Plot	Unit of measurement, within which variables of interest are assessed. May be variable or fixed radius.
Plot volume	Gross merchantable tree volume within a plot, converted to a per hectare basis (m^3/ha).
Polygon	A closed geometric entity used to spatially represent area features with associated attributes.
Regeneration lag	The period of time between harvest and establishment of the regenerated stand.
Salvage thinning	A type of thinning in older, natural stands where the age of the stand reduces the likelihood of a positive growth response.
Salvage thinning yield curve	A modified yield curve for the PL and SB DFMP yield strata, whereby 33% of the natural stand volume is removed at 90 years. There is an assumption of no recovery over time, therefore volumes remain at 67% of natural stand volumes until final harvest.
Site index	A relative measure of forest site quality based on the height of top height trees at a specific age (usually 50 years).
Site index increase yield curve	Modified yield curve; managed stand yield curve is increased based on calculated site index increase by site class (fair, medium or good); applied to PL stands in FMU W13 only.
Site-specific method	Yield curves developed by explicitly incorporating site index as a variable in predictive equations, in order to represent the effects of site on productivity.
Site type	A term used to describe the productivity of a polygon (fair, medium, good). Site type is not equivalent to TPR. TPR is assigned using site index calculated for the first listed species in the AVI; SI and first species are then used to assign TPR class. Site type is derived by converting the site index of the first listed species to the site index for the leading conifer and deciduous species as defined by the polygon's DFMP yield stratum classification; SI and leading species are then used to assign site type.
Species group	A single species code used to represent one or more AVI species. For example, the AW species group is comprised of AVI species A and Aw; the LT species group is comprised of La, Lt, and Lw.
Species strata	Used to classify the forested landscape only; includes both the managed landbase and the unmanaged landbase. Forested landscape BAP strata roll into species strata either directly or via grouping; the same set of species strata are used for both FMU W11 and FMU W13.
Species type	There are two species types: deciduous and coniferous. Species belonging to the deciduous type include aspen, birch and poplar; species belonging to the coniferous type include fir, pine, larch and spruce.
Stand	A community of trees sufficiently uniform in species, age, arrangement or condition as to be distinguishable as a group in the forest or other growth in the area. A stand may also be that polygon as defined in the AVI or Phase III inventory. [SRD 2006]
Stand type	Stand type is not equivalent to stand origin. Stand type reflects stand origin and any silvicultural modifiers applied to that stand. For example, a natural stand that has been thinned is considered a thinned stand type.
Stand volume	Gross merchantable volume within a stand on a per hectare basis (m^3/ha); aka gross merchantable stand volume.
Strata/Stratification	A classification scheme for defining polygons within the gross landbase. There are four types of strata referenced in the Millar Western 2007-2016 DFMP: extended strata, BAP strata, species strata, and DFMP yield strata.

Glossary Term	Definition
Subunit	An area within a Forest Management Unit that is of interest for management purposes. Subunits are comprised of a series of contiguous compartments.
Subunit-specific aspen yield curves	Modified yield curves; separate empirically-fit natural stand yield curves were developed for two geographically distinct areas of FMU W13, referred to as the Whitecourt/Blue Ridge and McLeod/Virginia Hills subunits; curve fitting methods were the same as for base yield curves.
Thinning	Removal of trees to enhance the availability of resources for the remaining trees.
Timber productivity rating	The potential timber productivity of a stand based on the height and age of the first listed species in the AVI overstory string. TPR reflects factors affecting tree growth including soil, topography, climate, elevation, moisture, etc. [AFLW 1991]. TPR is assigned by 1) calculating the site index for the first listed species based on stand-level SI equations and 2) using species and SI to assign a TPR class.
Timber supply analysis	Calculations/computer models with built-in assumptions regarding forest growth patterns, used to determine the annual allowable cut. (Also calculates the spatial harvest sequence and other non-timber values.) [SRD 2006]
Total stand volume	Total tree volume summed to represent volume on a per ha basis.
Total tree volume	A tree-level term; the volume of the entire bole (excluding branches, roots, leaves) of a tree.
TPR scaling method	At a given age, the volume yield is increased by a percentage (proportion) relative to a base curve.
Unmanaged landbase	Areas that are unavailable for forest management activities. Also referred to as the passive or non-contributing landbase.
Yield curve	A graphical representation of a predictive yield equation. One yield curve is in fact comprised of three curves: a conifer curve, a deciduous curve and a total curve.
Yield equation	Mathematically describes the relationship between predictor variables (e.g., age, site index) and the response variable (e.g., yield in terms of volume or piece size).
Yield table	A summary table showing yield (e.g., volume, piece size) as a function of varying levels of predictor variables (e.g., age, site index) and classification criteria (e.g., DFMP yield stratum, site type).
Yield strata	A set of strata with associated yield projections (yield curves and/or yield tables). See DFMP yield strata.

Appendix II. Structure of Terminology

Volumes

- Tree Volume
  - Total Tree Volume
    - Gross Total Tree Volume
    - Net Total Tree Volume
  - Merchantable Tree Volume
    - Gross Merchantable Tree Volume
    - Net Merchantable Tree Volume
- Stand Volume
  - Total Stand Volume
    - Gross Total Stand Volume
    - Net Total Stand Volume
  - Merchantable Stand Volume
    - Gross Merchantable Stand Volume
    - Net Merchantable Stand Volume

Areas

- Gross Landbase
  - Managed Landbase
    - Forested Landscape
      - Stand Types
        - Managed Stands
        - Natural Stands
  - Unmanaged Landbase
    - Forested Landscape
      - Stand Types
        - Managed Stands (pre-existing W11 SB clearcuts only)
        - Natural Stands
    - Non-forested Landscape

Strata and Yield Curves

- Yield Strata
  - Extended Strata
  - BAP Strata
  - Species Strata
  - DFMP Yield Strata
    - Yield Curves
      - Base
        - Natural Stand
        - Managed Stand
        - Composite
      - Modified
        - Site Index Increase
        - Thinning (Commercial, Salvage)
        - Athabasca Flats
        - Subunit-Specific Aspen

Appendix III. Sampling Designs: TSPs

The objectives of the Temporary Sample Plot Programs were to 1) collect data on merchantable trees within natural stands in the managed landbase, for the purposes of developing volume estimates for empirical yield curve development, and 2) collect additional data on small trees, shrubs, vegetation, snags and woody debris for the Biodiversity Assessment Project (BAP).

Millar Western (MW) Temporary Sample Plots

Millar Western TSP data collection was undertaken in 1997, 1998, and 2004. Data collection in 1997 and 1998 was restricted to FMU W13 (prior to incorporation of FMU W11); data collection in 2004 was undertaken in both FMUs (for more information, see Millar Western 2004c, 2004d). Various MWFP data collection protocols have been used. Information for all programs is summarized in Table III-1. A total of 584 TSPs were established in the 1997/1998 field seasons and a total of 598 TSPs were established in the 2004/2005 field seasons.

Table III-1. Summary of Millar Western TSP programs to date.

	Program Type			
	TSP 1997	**TSP 1998**	**TSP 2004**	**TSP 'BAP ONLY' 2004**
Sampling Frame	Natural stands in the managed landbase; minimum stand height = 8 m	Natural stands in the managed landbase; minimum stand height = 8 m	Natural stands in the managed landbase; minimum age=40 years (no minimum height)	All forested stands; all ages
Sampling Location	W9 (subset of W13)	W5 (subset of W13)	W13 and W11	W13 and W11
Stand Selection	Random, area-weighted, by height class and yield stratum	Random, area-weighted, by height class and yield stratum	Random, area-weighted, by age class and yield stratum	Random, area-weighted, by BAP habitat type
Plot Selection	Random within stand; 15 m buffer along edge of stand to prevent straddle plots	Random within stand; 15 m buffer along edge of stand to prevent straddle plots	Random within stand; buffer width set to plot radius to ensure entire plot within stand	Random within stand; buffer width set to plot radius to ensure entire plot within stand
Number of Plots	3/stand	3/stand	3/stand	1-3/stand (varies)
Plot Design	Tree and snag plot: 5.64/7.98/11.28 m radius depending on AVI crown closure and stand height	Tree and snag plot: 5.64/7.98/11.28 m radius depending on AVI crown closure and stand height	Tree and snag plot: 5.64/7.98/11.28 m radius depending on AVI crown closure and stand height	Tree and snag plot: 5.64/7.98/11.28 m radius depending on AVI crown closure and stand height
	Sapling plot = 2.82 m radius	Sapling plot = 2.82 m radius	Sapling plot = 3.99 m radius	Sapling plot = 3.99 m radius
	Shrub and ground vegetation plot = 1.78 m radius	Shrub and ground vegetation plot = 1.78 m radius	Shrub and ground vegetation plot = 1.78 m radius	Shrub and ground vegetation plot = 1.78 m radius
	Coarse woody debris = 2 x 10 m transects	Coarse woody debris = 2 x 10 m transects	Coarse woody debris = 3 x 30 m transects	Coarse woody debris = 3 x 30 m transects
			Snag cruise = 100 m transect	Snag cruise = 100 m transect
Data Collection: All Plots	Trees - species, DBH, height, height to live crown, height to dead crown, crown class, number of dead limbs, presence of bark crevice cavities, lichen cover class, quality codes, subsample of breast height ages	Trees - species, DBH, height, height to live crown, height to dead crown, crown class, number of dead limbs, presence of bark crevice cavities, lichen cover class, quality codes, subsample of breast height ages	Trees - species, DBH, height, height to live crown, crown class, lichen cover class, quality codes, number of coppice suckers, crown development code	Trees - species, DBH, estimated height, estimated height to live crown, crown class, lichen cover class, quality codes, number of coppice suckers, crown development code
Data Collection: Additional BAP	Snags - species, DBH, height, decay class, bark class	Snags - species, DBH, height, decay class, bark class	Snags - species, DBH, height, decay class, bark class	Snags - species, DBH, height, decay class, bark class
	Saplings - same as for trees	Saplings - same as for trees	Saplings - same as for trees	Saplings - same as for trees
	Shrubs - species/species class, percent cover class, average height	Shrubs - species/species class, percent cover class, average height	Shrubs - species/species class, percent cover class, average height, total shrub percent cover, total shrub average height	Shrubs - species/species class, percent cover class, average height, total shrub percent cover, total shrub average height
	Ground vegetation - species group, percent cover class	Ground vegetation - species group, percent cover class	Ground vegetation - species group, percent cover class, total percent herb cover, total percent moss cover	Ground vegetation - species group, percent cover class, total percent herb cover, total percent moss cover
	Coarse woody debris - species group, diameter at intersection, decay class, inclination, stump top diameter, stump height, height above ground	Coarse woody debris - species group, diameter at intersection, decay class, inclination, stump top diameter, stump height, height above ground	Coarse woody debris - species group, diameter at intersection, decay class, inclination	Coarse woody debris - species group, diameter at intersection, decay class, inclination
			Snag cruise - species group, DBH, estimated height, decay class, bark class, lichen cover class	Snag cruise - species group, DBH, estimated height, decay class, bark class, lichen cover class
Year(s) Collection	1997	1998	2004, 2005	2004
Important Notes		1) BAP data not collected on all plots	1) BAP data not collected on all plots; 2) Minor additional birch stand sampling occurred in 2005 under the 2004 TSP protocols	1) Stand selection within W11 not completely random: selected random stands, then discarded those in NW corner of the FMU in order to improve access for sampling
Overall Notes	Yield stratum was used as a stratification category for each sampling design; however, yield strata were different in each of the three sample years.			

Alberta Sustainable Resources Development (SRD) Temporary Sample Plots

Initial TSP sampling in FMU W11 was undertaken by Alberta SRD in 2000 (SRD 1999). The objective of this sampling was to obtain data sufficient for development of empirical yield curves.

Stands were selected proportionally to the occurrence of crown density, species and age classes. Three volume sampling plots were placed within each selected stand. The center of the stand was located, and each plot was located 50 m from plot center at bearings of 0, 120 and 240 degrees. Plots were offset to avoid all anthropogenic disturbances (*e.g.*, roads, seismic lines, well sites) and naturally non-vegetated areas (*e.g.*, lakes, rivers, rock outcroppings). Plots were circular, with a fixed, 5.64 m radius (0.01 ha) main plot and a 2.82 m radius (0.0025 ha) circular subplot nested within the main plot.

Within the main plot, all trees greater than or equal to 9.1 cm DBH were measured. Species, height, height to live crown, DBH, stump diameter, crown class and condition codes were recorded for each tree. On selected trees, breast height age and increment width (0-10 years and 11-20 years) were recorded. Within the subplot, the same data were collected on trees under 9.1 cm DBH and greater than 1.3 m in height. Presence of slash, arboreal lichen, fire scars, stand structure, fuel continuity, woody shrub density class, average woody shrub height and dominant shrub species were recorded for each plot.

A total of 359 TSPs were established in 2000.

Appendix IV. Sampling Designs: Special Area TSPs

Special Area Temporary Sample Plot Programs are one-time sampling programs used to address specific research questions or data needs. There is no ongoing sampling component to these programs, although similar sampling may occur in the future if new questions arise.

Windfall Burn (WB) Temporary Sample Plots

The objective of the Windfall Burn sampling program was to gather data sufficient to determine if pine stands within the Windfall Burn were exhibiting signs of repression, and to develop an empirical yield curve within the Windfall Burn if necessary (Millar Western 2005c).

The sampling population was comprised of all single story pine-dominated conifer stands with 50% crown closure or greater (higher crown closures were presumed to be the stand types with potential for repression) within the Windfall Burn fire boundary (fire year = 1956). The population was stratified into crown closure class (5, 6, 7 or 8) and TPR class (F, M, G). The desired sample size was determined for each crown closure class/TPR combination based upon total area, knowledge of stand variability and number of stands available for sampling, with a minimum of 10 plots per combination.

Sampling occurred in 2003. Within each selected stand, one plot was established. Each plot had three separate point counts arranged in an equilateral triangle with 20 m sides. At each point, all trees ≥ 6 cm DBH were tallied using a BAF 2 prism, and DBH was measured for each. At each plot, height, DBH and age at stump height (30 cm) was recorded for an average DBH tree.

A total of 498 points (166 plots) were sampled.

Athabasca Flats Selective Logging (AFSL) Temporary Sample Plots

The Athabasca Flats selective logging area is a contiguous area of high productivity, generally white spruce leading, stands located along the southern edge of the Athabasca river. The area is approximately 920 ha in size. Roughly 2/3 of this area has already undergone selective logging (current to 2005). The objective of this sampling program was to gather data sufficient to develop a yield projection specific to these areas (Millar Western 2004a).

Data collection was undertaken in 2005. All areas in which selective logging had been completed (approximately 645 ha) were sampled. A grid of 57 points was established across this area, irrespective of polygon boundaries.

At each grid point, a 5.64 m radius (100 m^2) plot was established. For all live trees ≥ 10 cm DBH, species, DBH, height, response increment (diameter increment since harvesting) and preharvest increment (diameter increment prior to harvesting) were recorded. For all live trees ≥ 1.3 m in height and < 10 cm DBH, species and DBH were recorded. Species and stump diameter were recorded for all stumps with a diameter of ≥ 15 cm at stump height (30 cm).

Appendix V. Sampling Designs: PSPs

The objective of the Millar Western PSP program is to provide long-term, forest-wide, unbiased estimates of forest vegetation change, both in terms of timber and non-timber values (Millar Western 2004b).

Permanent sample plot establishment began in 1995. In 1995 and 1996, PSPs were established using a combination of systematic and stratified random sampling. After 1996, a 3000 m x 3000 m grid (oriented N-S and E-W) was established across the Millar Western FMA area, and all subsequent PSPs have been established on this grid, with the exception of Enhanced Forest Management PSPs.

There are four types of permanent sample plots within the PSP program: Standard Permanent Sample Plots (SPSPs), Plantation Permanent Sample Plots (PPSPs), Non-Productive Permanent Sample Plots (NPSPs) and Enhanced Forest Management Permanent Sample Plots (EFMPSPs). Currently, all PSPs are on a five to ten year remeasurement schedule.

PSP data collection protocols vary slightly depending on the type of stand the grid point falls in, or whether or not it is an EFMPSP. Data collection protocols are described in the following sections. For more information, refer to Millar Western (2004b).

Standard Permanent Sample Plots (SPSPs)

Standard PSPs are established when a grid point falls on a natural stand within the managed landbase.

An 11.28 m radius (0.04 ha) main plot is established with a 20 m buffer. Within this plot, all trees ≥ 1.3 m in height are tagged, stem mapped and measured (species, DBH, height, height to live crown, crown class, crown development, quality codes, number of coppice suckers, and lichen class). Breast height age is collected from four top height trees of the main species; in mixedwood stands, both the leading conifer and deciduous species are sampled. A 30.9 m radius (0.3 ha) snag plot is centered at the main plot, within which all snags ≥ 30 cm DBH are measured (species class, DBH, height, decay class and bark class).

A 1.78 m radius (10 m2) high shrub plot is used to sample all shrubs ≥ 3.0 m in height (percent cover and average height by species, total percent shrub cover). Eight 1 m2 plots (four pairs placed 10 m from plot center at 45˚, 135˚, 225˚ and 315˚) are established for sampling lower vegetation: shrubs ≥ 0.5 m and < 3 m in height (percent cover, average height and count by species), trees ≥ 0.2 m and ≤ 1.3 m in height (percent cover, average height and count by species), and herbaceous/short shrubs (< 0.5 m)/short trees (< 0.2 m)/other nonwoody plants (percent cover by species group, total percent moss cover, total percent herbaceous cover). Three 30 m transects are used to sample woody debris ≥ 7.5 cm at the point of intersection (diameter, position, decay class).

Plantation Permanent Sample Plots (PPSPs)

Plantation PSPs are established when a grid point falls on a managed stand within the managed landbase, or when a Standard PSP is harvested and the PSP is subsequently re-established. Reestablishment will occur immediately after planting in order to track seedling growth and survival; in leave for natural (LFN) stands, reestablishment will occur as soon as possible after harvesting in order to capture vegetation and site dynamics.

All protocols outlined for SPSPs will be followed for PPSPs, with the following exceptions:

1. In addition to tagging all seedlings ≥ 1.3 m in height, all planted seedlings under 1.3 m in height will be tagged. Unlike other tagged seedlings, these seedlings will not be assessed for height to live crown, DBH, crown class, lichen class or breast height age.

2. Regeneration type (natural, planted, advance, unknown) will be assigned to all tagged stems.

Non-Productive Permanent Sample Plots (NPSPs)

Non-Productive PSPs are established when a grid point falls on a natural stand within the unmanaged landbase. All protocols outlined for SPSPs will be followed, although for certain NPSP types (*e.g.*, shrubs or grasses), the plot will be devoid of trees.

Enhanced Forest Management Permanent Sample Plots (EFMPSPs)

EFMPSPs are established to monitor the growth response to enhanced forest management activities. Currently, these activities are restricted to thinning. EFMPSPs are not established on a grid; rather, plots are located within stands selected for thinning treatments. In addition, rather than a single PSP, four EFMPSPs are established in selected stands. One EFMPSP is randomly located within a control (unaltered) portion of the stand. Three additional EFMPSPs are established within the thinned portion of the stand: the first plot is randomly located prior to harvest within the treated area, and the remaining two plots are established following harvest to create a triangular layout within the treated area.

All protocols outlined for SSPs will be followed for EFMPSPs, with the addition of crown width measurements on all tagged stems.

There are currently seven sets of EFMPSPs in thinned stands, five of which have five-year remeasurement data and two of which have establishment data only. Four of these sets are located within salvage thinned stands and three of these sets are located within commercially thinned stands. There are five additional sets of EFMPSPs established as plot pairs (five plot pairs - one control PSP and one treated PSP – total 10 EFMPSPs); the plot pair EFMPSPs are comprised of one pair of plots in commercially thinned stands and four pairs of plots in salvage thinned stands. All plot pairs have five-year remeasurement data. There is also a single EFMPSP (treated – no control) located within a salvage thinned stand.

Appendix VI. Windfall Burn Pine Stand Analysis

In order to proceed with yield curve development, an assessment was required to determine whether pure pine stands growing within the Windfall Burn were exhibiting different growth patterns from pure pine stands outside of the Windfall Burn area. Although the burn area was fairly dense in some areas, Millar Western foresters felt that these stands were capable of producing yields similar to pine stands in the rest of the FMA area.

In order to proceed with yield curve development, an assessment was required to determine whether pure pine stands growing within the Windfall Burn were exhibiting different growth patterns from pure pine stands outside of the Windfall Burn area.

Data Sources

Three sources of data were used in this analysis.

TSP plots had been sampled both inside and outside the Windfall Burn, as had PSP plots. TSPs were established in the 1997/1998 field seasons using stratified random sampling. PSP plots were established from 1996 onwards, on a fixed grid system. Both TSPs and PSPs were sampled using fixed radius plots. Sampling protocols for TSP and PSP plots are described in Appendix III and Appendix V, respectively.

Additional plots have been sampled exclusively within the Windfall Burn boundaries. These plots are referred to as KBM plots and are variable radius plots. Plots were established in 2003, in stands with ≥ 50% crown closure using stratified random sampling. These stand types were targeted as they were the stand types most likely to exhibit repression, if repression was occurring.

Within each selected stand, one central plot was established. Each plot had three separate point counts arranged in an equilateral triangle with 20 m sides. At each point, all trees ≥ 6 cm DBH were tallied using a BAF 2 prism, and DBH was measured for each. At each plot, height, DBH and age at stump height (30 cm) was recorded for an average DBH tree. A total of 166 KBM plots were established, with 498 associated sampling points.

Data Screening

Since the landbase had not been fully developed, pine stands for comparison were identified using AVI attributes. TSP, PSP and KBM plot locations were intersected with the FMU W13 AVI in order to do so.

Only stands within the McLeod subunit were considered for inclusion in the analysis, to ensure that geographic influence on between-plot variability was limited.

Plots with AVI species1 equal to 100% pine, with an overstory crown closure class of C or D, a blank understory species layer, a blank understory nonforested layer, and a productive TPR (fair, medium or good) were selected. Based on a preliminary landbase (Version 4), any plots in the unmanaged landbase were removed. Plots with no pine age information were also discarded.

From the remaining plots, any plots with a burn modifier and a burn year or origin of 1956 were deemed Windfall Burn plots. All other plots were deemed non-Windfall Burn plots.

Methods

TSP and PSP data were pooled for analysis. After data screening, a total of 19 TSP/PSP plots were available for analysis. A total of 81 KBM plots were available for analysis (Table VI-1).

Table VI-1. Number of plots used in GYPSY runs by plot and stand type.

Stand Type	Data Type	Plot Type	Number of Plots
Windfall	KBM	Variable Radius	81
	PSP/TSP	Fixed Radius	8
non-Windfall	PSP/TSP	Fixed Radius	11

Direct comparisons of plot volumes inside and outside the Windfall Burn area were not possible, since all plots outside of the Windfall Burn area were at least 20 years older than those inside the burn area. As such, GYSPY simulations were employed to create volume-age trajectories for comparison.

GYPSY simulations were run in two manners:

1) Individual plot simulations

    a. Measured age and height from pine trees in plots were used to determine site index for the plot.

    b. Plot density at measurement age was used to obtain the *stand density factor* (stand density at a reference breast height age of 50 years) for the plot. Stand density factor was used to obtain initial density (sph) for GYPSY simulation by using known age-mortality relationships.

    c. GYPSY was used to simulate pine volume over age for each plot using site index and initial stand density as inputs.

2) Average plot simulations

    a. Measured height and age from pine trees in plots were used to determine site index for the plot.

    b. Plot density at measurement age was used to obtain the stand density factor (stand density at a reference breast height age of 50 years) for the plot. Stand density

factor was used to obtain initial density (sph) for GYPSY simulation by using known age-mortality relationships.

c. Average site index and average initial density was calculated for each group of plots: PSP/TSP Windfall, PSP/TSP Non-Windfall, and KBM Windfall.

d. GYPSY was used to simulate a single pine volume over age curve for each group of plots using average site index and average initial stand density as inputs.

Results

Simulations based on individual plot data (TSP and PSP plots) from both inside and outside the Windfall Burn area are shown in Figure VI-1. Note that although Windfall Burn areas begin to accumulate volume later than some non-Windfall stands, volumes at maturity are very similar, given the small sample size.

The difference in onset of volume accumulation may reflect accuracy in AVI ages: while Windfall Burn stands have a known year of disturbance, non-Windfall Burn stands have an estimated year of origin.

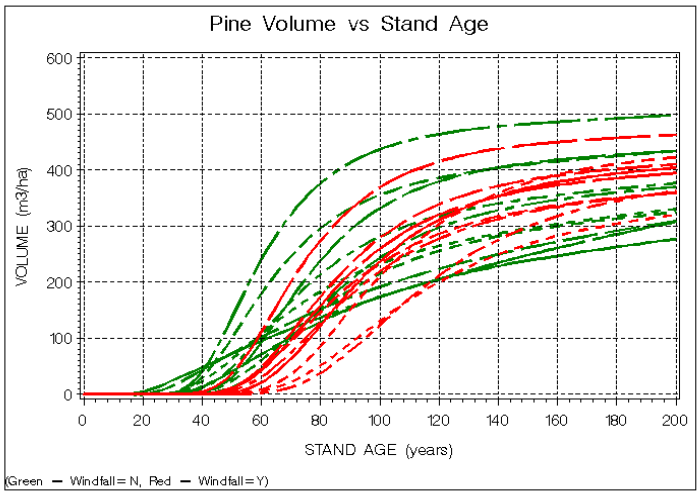


Figure VI-1. GYPSY simulations of individual TSP/PSP plots, Windfall (red) vs. non-Windfall (green).

A single GYPSY simulation for averages by plot type (Windfall TSP/PSP, non-Windfall TSP/PSP and KBM Windfall) is shown in Figure VI-2. Volume over age is similar for all three curves, although differences do exist. Keeping in mind that the sample size for non-Windfall plots is quite small, there does not appear to be sufficient evidence to support the use of a 50% reduction in volume in Windfall Burn stands. As such, Windfall Burn plots were used in pine yield curve development and no separate yield curves were created for the 2007-2016 DFMP.

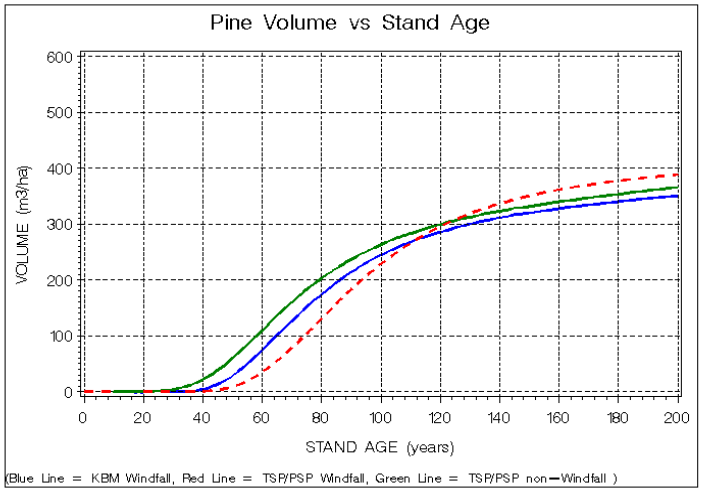


Figure VI-2. GYPSY simulations based on average plot data, Windfall PSP/TSP (red), non-Windfall PSP/TSP (green), KBM Windfall (blue).

Appendix VII. Site Index Conversion Equations

For site-specific yield curve development, AVI-based site index estimates were required for the leading conifer and deciduous species as defined by a polygon's DFMP yield stratum assignment. However, AVI-based site index could only be calculated for overstory species 1, which may or may not have been either of the two species. For this reason, site index conversion equations were required, so that the AVI-based SI from the first listed species could be converted to an AVI-based SI for the species of interest.

Site index conversion equations were developed as follows:

1. Site index was calculated for all dominant and codominant trees in the base TSP/PSP dataset that had measured ages and heights. Site index was predicted for each tree using equations from the AVI 2.1 manual, in order to be consistent with how site index was assigned to natural stands within the managed landbase.

2. Trees were grouped into four classes:

   - AW (aspen, birch and poplar)
   - PL (all pines)
   - SW (white spruce and firs)
   - SB (black spruce and larches)

3. Plots with more than one of the above species classes present in the plot were used to fit site index conversion equations. A conversion equation was fit for all possible group combinations using linear regression. For example, plots with both PL and SW were used to fit PL -> SW conversion equations as well as SW -> PL conversion equations (results will differ depending on which is the dependant and which is the independent variable, since the regression always attempts to minimize the variability in one direction only). The equation form was (Nigh 1995):

$$SI_i = m * SI_j$$

Where: SI_i = site index of species i

SI_j = site index of species j

m = slope parameter

Coefficients for the models are presented in Table VII-1. Site index conversion tables are provided in Table VII-2 to Table VII-5.

Table VII-1. Coefficients for site index conversion equations.

Leading Species Group (Convert To)	Species 1 Species Group (Convert From)	Slope Coefficient
AW	PL	1.0142321
	SB	1.4511591
	SW	1.1318216
PL	AW	0.9592976
	SB	1.3297274
	SW	1.1513887
SB	AW	0.6524253
	PL	0.7071435
	SW	0.8332316
SW	AW	0.8168247
	PL	0.7858179
	SB	1.1352982

Table VII-2. AW site index conversion table.

AW Site Index (m)	Predicted Site Index (m)		
	PL	SB	SW
5	4.80	3.26	4.08
6	5.76	3.91	4.90
7	6.72	4.57	5.72
8	7.67	5.22	6.53
9	8.63	5.87	7.35
10	9.59	6.52	8.17
11	10.55	7.18	8.99
12	11.51	7.83	9.80
13	12.47	8.48	10.62
14	13.43	9.13	11.44
15	14.39	9.79	12.25
16	15.35	10.44	13.07
17	16.31	11.09	13.89
18	17.27	11.74	14.70
19	18.23	12.40	15.52
20	19.19	13.05	16.34
21	20.15	13.70	17.15
22	21.10	14.35	17.97
23	22.06	15.01	18.79
24	23.02	15.66	19.60
25	23.98	16.31	20.42

Table VII-3. PL site index conversion table.

PL Site Index (m)	Predicted Site Index (m)		
	AW	SB	SW
5	5.07	3.54	3.93
6	6.09	4.24	4.71
7	7.10	4.95	5.50
8	8.11	5.66	6.29
9	9.13	6.36	7.07
10	10.14	7.07	7.86
11	11.16	7.78	8.64
12	12.17	8.49	9.43
13	13.19	9.19	10.22
14	14.20	9.90	11.00
15	15.21	10.61	11.79
16	16.23	11.31	12.57
17	17.24	12.02	13.36
18	18.26	12.73	14.14
19	19.27	13.44	14.93
20	20.28	14.14	15.72
21	21.30	14.85	16.50
22	22.31	15.56	17.29
23	23.33	16.26	18.07
24	24.34	16.97	18.86
25	25.36	17.68	19.65

Table VII-4. SB site index conversion table.

SB Site Index (m)	Predicted Site Index (m)		
	AW	PL	SW
5	7.26	6.65	5.68
6	8.71	7.98	6.81
7	10.16	9.31	7.95
8	11.61	10.64	9.08
9	13.06	11.97	10.22
10	14.51	13.30	11.35
11	15.96	14.63	12.49
12	17.41	15.96	13.62
13	18.87	17.29	14.76
14	20.32	18.62	15.89
15	21.77	19.95	17.03
16	23.22	21.28	18.16
17	24.67	22.61	19.30
18	26.12	23.94	20.44
19	27.57	25.26	21.57
20	29.02	26.59	22.71
21	30.47	27.92	23.84
22	31.93	29.25	24.98
23	33.38	30.58	26.11
24	34.83	31.91	27.25
25	36.28	33.24	28.38

Table VII-5. SW site index conversion table.

SW Site Index (m)	Predicted Site Index (m)		
	AW	PL	SB
5	5.66	5.76	4.17
6	6.79	6.91	5.00
7	7.92	8.06	5.83
8	9.05	9.21	6.67
9	10.19	10.36	7.50
10	11.32	11.51	8.33
11	12.45	12.67	9.17
12	13.58	13.82	10.00
13	14.71	14.97	10.83
14	15.85	16.12	11.67
15	16.98	17.27	12.50
16	18.11	18.42	13.33
17	19.24	19.57	14.16
18	20.37	20.72	15.00
19	21.50	21.88	15.83
20	22.64	23.03	16.66
21	23.77	24.18	17.50
22	24.90	25.33	18.33
23	26.03	26.48	19.16
24	27.16	27.63	20.00
25	28.30	28.78	20.83

Appendix VIII. Pine Site Index Increase Discussion

There are few existing studies of the differences between pre-harvest and post-harvest site indices for pine stands in Alberta. Two key documents are those of Huang *et al.* (2004) and Dempster (2004). A study by The Forestry Corp. was undertaken in the Millar Western FMA area and is also summarized here.

Huang, S., R.A. Monserud, T. Braun, H. Lougheed and O. Bakowsky. 2004. Comparing site productivity of mature fire-origin and post-harvest juvenile Lodgepole pine stands in Alberta. Can. J. For. Res. 34: 1181-1191.

This article compared site indices of 22 mature fire-origin stands to adjacent post-harvest juvenile stands using paired plot methods.

The original study was carried out by Udell and Dempster in 1987, who found site index increases of 25-30% between mature fire-origin and post-harvest stands in Weldwood's FMA area (now West Fraser Hinton).

The sites were revisited over 10 years later by Huang *et al.*, when post-harvest stands were (on average) 31 years of age, to determine whether site index increases were maintained over time.

Based on their analysis, the site index of post-harvest juvenile stands was found to be 27-35% higher than mature fire-origin stands. Average site index in post-harvest stands was between 18.09 and 18.89 m (depending on SI equation used), while average site index in mature pre-harvest stands was between 13.36 and 14.01 m using the same equations. This represents a site index increase of 4.73-4.88 m across all site types.

Similar studies in BC are also cited in this article. Authors cited site index increases ranging from 2.96 to 6.12 m. Again, these represent average increases across all site types.

Dempster, W.R. 2004. Comparison of pre-harvest and post-harvest site indices. Foothills growth and yield association regenerated Lodgepole pine project. Hinton, Alberta. http://www.fmf.ca/publications.html#GrowthAndYield

This study assessed pine site index using paired plot and PSP data from Weldwood's FMA area (now West Fraser Hinton).

50 stands were sampled using paired plot methods, with 3 plots pairs per stand. Breast height age ranged from 5 to 29 years and spanned 5 ecosite "categories".

Based on paired plot data, the overall average site index increase was 3.65 m, well within the ranges cited in Huang *et al.* for BC sites, and calculated by Huang *et al.* in their study. By site

type, average site index increases were 6.7 m for poor sites, 2.8 m for medium sites, and 0.3 m for rich sites.

43 PSPs with pre-and post harvest information were also assessed. Overall average site index increase was higher than using paired plot data, at 4.4 m across all site types.

The Forestry Corp. 1999. Managed stand site index study, Lodgepole pine. Unpublished report prepared for Millar Western Forest Products Ltd. Edmonton, Alberta.

The study used paired plot data collected within Millar Western's FMA area (20 stands) and Blue Ridge Lumber's FMA area (4 stands), with three plot pairs per stand.

Based on the paired plot data, the overall site index increase was 4.86 m, which is in line with Huang *et al.*'s findings and similar to results from the Foothills Model Forest data. This also fits within the range cited by Huang *et al.* from studies in BC. Recall that this is an average across all site types.

A regression equation was generated to estimate site index increase for pine relative to "parent stand" site index, as follows:

$$SI_m = -0.0685SI_f^2 + 1.5332SI_f - 0.7465$$

Where: SI_m = site index of managed stand (m)

SI_f = site index of fire origin parent stand (m)

This was used to estimate managed stand site index as a function of parent stand site index:

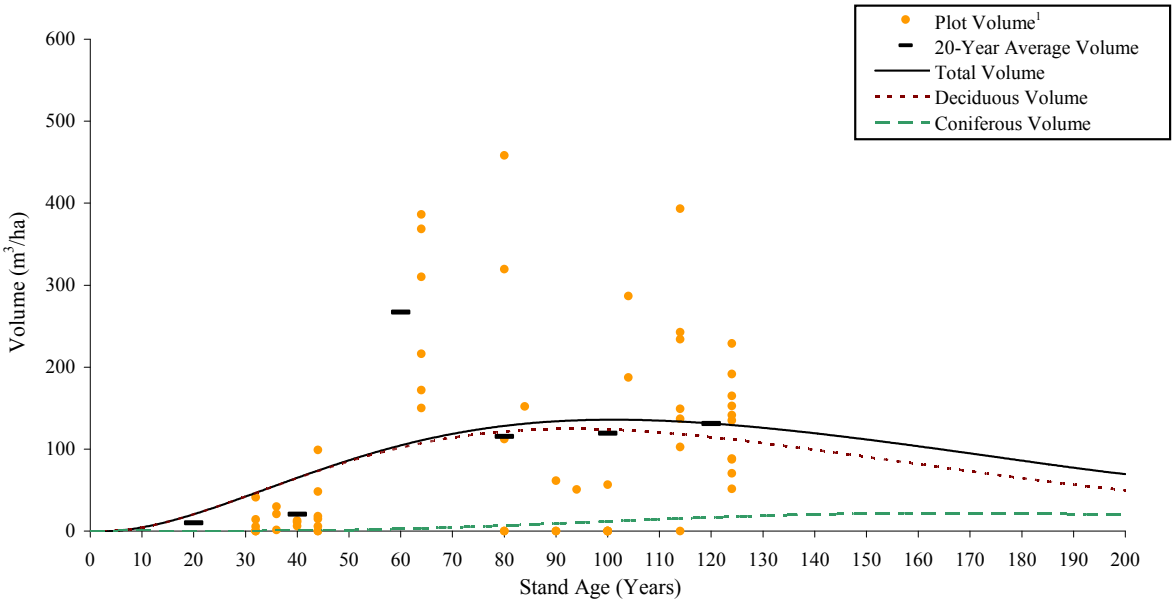
Table VIII-1. Estimates of managed stand site index for Lodgepole pine based on fire origin site index.

Fire Origin Site Index	Increase/ Decrease	Regenerating Site Index
10	7.7	18
12	7.7	20
14	7.3	21
16	6.2	22
18	4.7	23
20	2.5	23
22	-0.2	22

The results from the Millar Western study are not outside of the range of values determined by Dempster or Huang *et al.*

Appendix IX. FMU W11 Base Natural Stand Yield Curves

FMU W11 / AW_AB STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

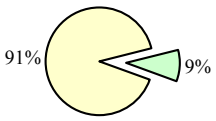
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	2.832E-09
Eqn: 2P+k	b	5.5355533
	k	30
Deciduous	a	2.577E-02
Eqn: 2P	b	2.4005839
	k	0

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	60
Stratum Area (ha) :	8,140

Stratum as a proportion of total managed landbase, FMU W11:



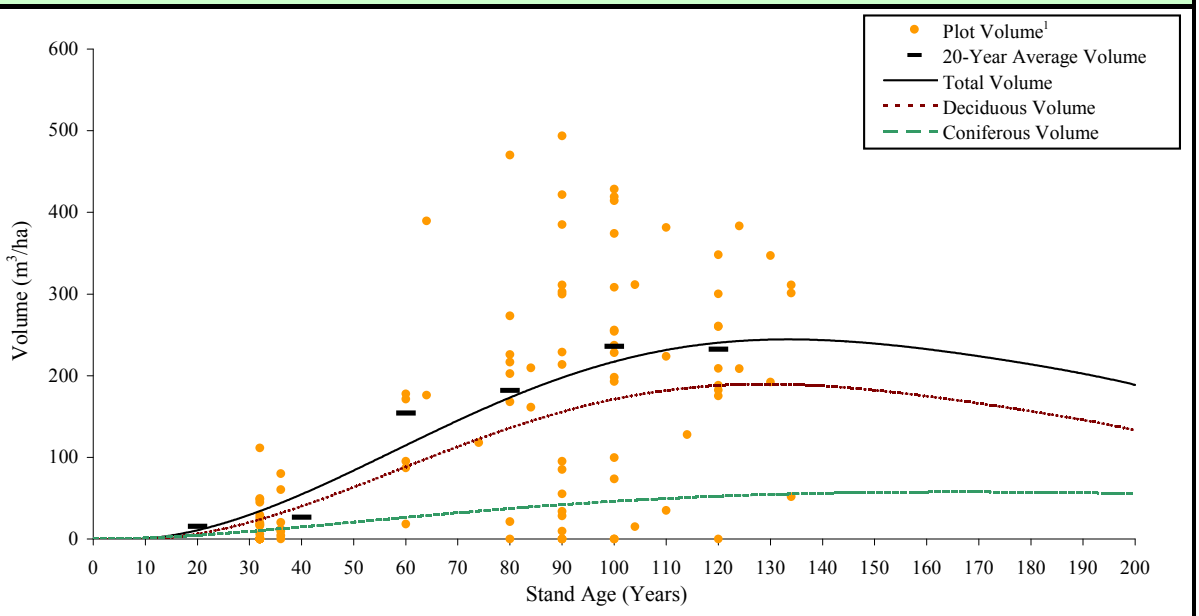
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	5.0	5.0	0.000	0.501	0.501
20		0.0	20.4	20.5	0.001	1.022	1.023
30	9	0.2	41.8	42.0	0.005	1.394	1.399
40	10	0.6	64.5	65.0	0.014	1.612	1.625
50		1.4	85.1	86.5	0.027	1.703	1.730
60	6	2.7	101.9	104.6	0.045	1.699	1.743
70		4.5	114.0	118.5	0.064	1.629	1.693
80	6	6.7	121.4	128.2	0.084	1.518	1.602
90	4	9.3	124.5	133.8	0.103	1.384	1.487
100	8	11.9	123.9	135.8	0.119	1.239	1.358
110	7	14.5	120.4	134.9	0.131	1.095	1.226
120	10	16.8	114.7	131.4	0.140	0.956	1.095
130		18.7	107.4	126.1	0.144	0.826	0.970
140		20.2	99.2	119.4	0.144	0.708	0.853
150		21.2	90.4	111.7	0.141	0.603	0.744
160		21.7	81.6	103.3	0.136	0.510	0.646
170		21.8	73.0	94.7	0.128	0.429	0.557
180		21.4	64.7	86.1	0.119	0.359	0.478
190		20.7	56.9	77.6	0.109	0.300	0.408
200		19.7	49.7	69.4	0.098	0.249	0.347

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

FMU W11 / AW_CD STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

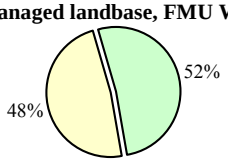
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	1.236E-02
Eqn: 2P	b	2.0541793
	k	0
Deciduous	a	6.666E-04
Eqn: 2P+k	b	3.2473264
	k	40

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	105
Stratum Area (ha) Nat:	41,554
Stratum Area (ha) Mgd:	3,492

Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.2	0.9	2.2	0.124	0.092	0.215
20		4.5	6.8	11.3	0.227	0.339	0.566
30	32	9.2	19.7	28.9	0.308	0.657	0.965
40		14.7	39.1	53.8	0.368	0.977	1.345
50		20.6	62.8	83.4	0.412	1.256	1.668
60	7	26.5	88.4	114.9	0.441	1.474	1.915
70	1	32.1	113.6	145.7	0.458	1.623	2.082
80	10	37.3	136.5	173.8	0.466	1.707	2.173
90	17	42.0	155.9	197.9	0.467	1.732	2.199
100	17	46.1	170.9	217.0	0.461	1.709	2.170
110	5	49.5	181.4	230.9	0.450	1.649	2.099
120	11	52.4	187.4	239.7	0.436	1.562	1.998
130	5	54.5	189.3	243.8	0.420	1.456	1.875
140		56.1	187.5	243.6	0.401	1.339	1.740
150		57.2	182.7	239.8	0.381	1.218	1.599
160		57.7	175.5	233.1	0.360	1.097	1.457
170		57.7	166.4	224.1	0.340	0.979	1.318
180		57.4	156.0	213.4	0.319	0.867	1.185
190		56.7	144.8	201.5	0.298	0.762	1.060
200		55.6	133.2	188.9	0.278	0.666	0.944

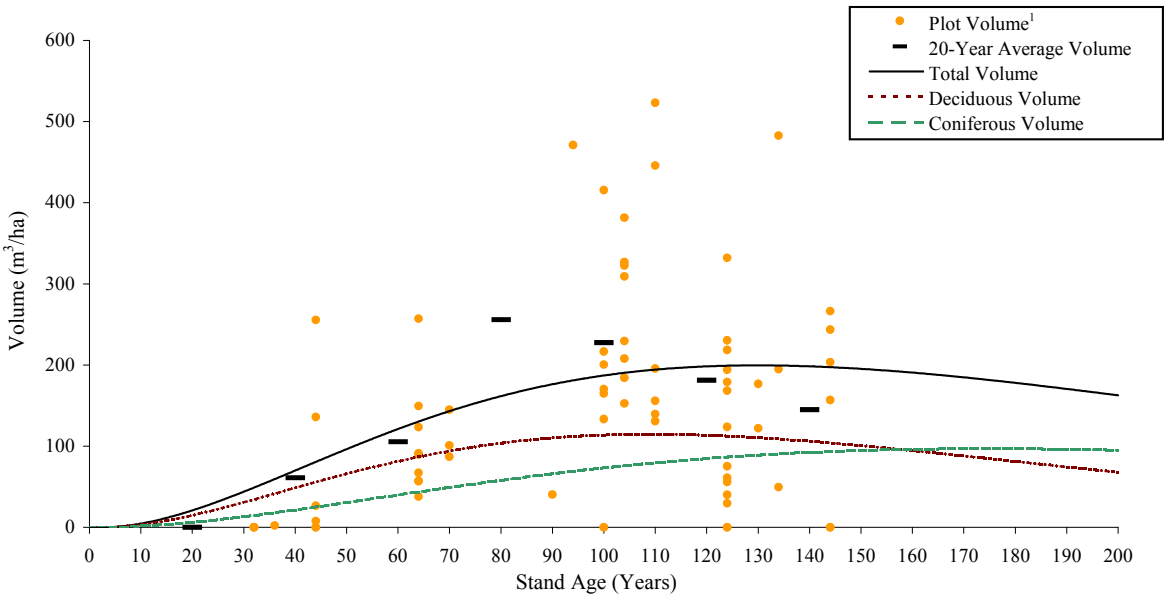
[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

[4] Natural stand yield curve will also represent managed stands, therefore managed stand areas are included here.

FMU W11 / APAS_ABCD STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

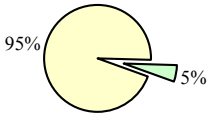
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	1.233E-02
Eqn: 2P	b	2.1545293
	k	0
Deciduous	a	2.132E-02
Eqn: 2P	b	2.3267092
	k	0

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	72
Stratum Area (ha) :	4,488

Stratum as a proportion of total managed landbase, FMU W11:



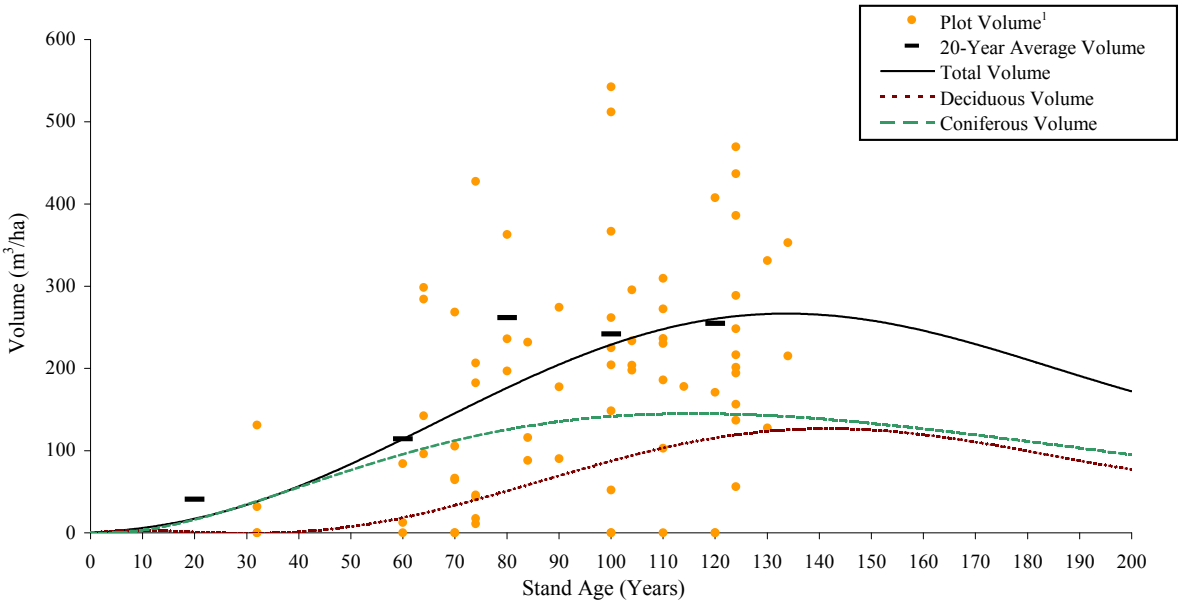
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.6	3.7	5.2	0.156	0.366	0.521
20		6.1	14.8	20.9	0.306	0.741	1.047
30	4	13.0	30.8	43.7	0.432	1.025	1.457
40	6	21.3	48.5	69.8	0.533	1.213	1.746
50		30.5	65.9	96.4	0.609	1.318	1.927
60	9	39.9	81.4	121.3	0.665	1.356	2.021
70	3	49.1	94.1	143.3	0.702	1.344	2.046
80		57.9	103.7	161.7	0.724	1.297	2.021
90	2	66.0	110.3	176.2	0.733	1.225	1.958
100	16	73.2	113.8	187.0	0.732	1.138	1.870
110	6	79.5	114.8	194.3	0.722	1.044	1.766
120	15	84.7	113.6	198.3	0.706	0.947	1.652
130	5	89.0	110.6	199.5	0.684	0.850	1.535
140	6	92.3	106.1	198.4	0.659	0.758	1.417
150		94.6	100.7	195.3	0.631	0.671	1.302
160		96.1	94.5	190.7	0.601	0.591	1.192
170		96.8	88.0	184.8	0.570	0.517	1.087
180		96.8	81.2	178.0	0.538	0.451	0.989
190		96.2	74.4	170.5	0.506	0.391	0.898
200		94.9	67.7	162.7	0.475	0.339	0.813

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

FMU W11 / PASA_ABCD STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

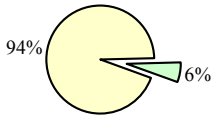
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	2.038E-02
Eqn: 2P	b	2.3634605
	k	0
Deciduous	a	1.153E-10
Eqn: 2P+k	b	7.0265388
	k	20

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	80
Stratum Area (ha) :	5,027

Stratum as a proportion of total managed landbase, FMU W11:



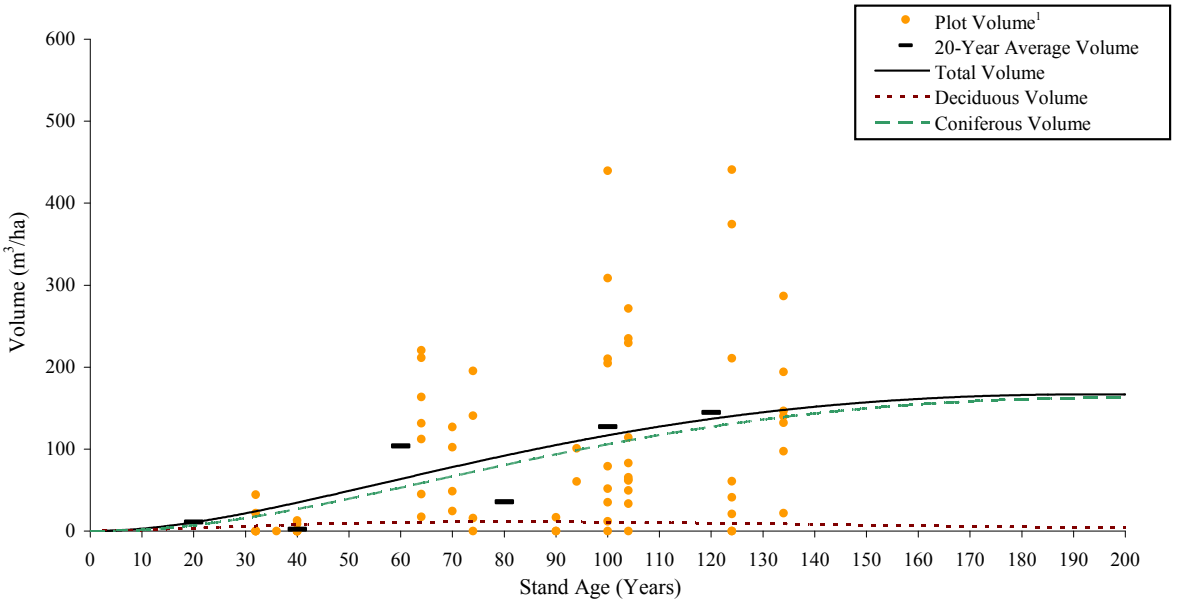
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		3.8	0.0	3.8	0.384	0.000	0.384
20		16.1	0.1	16.2	0.806	0.003	0.809
30	4	34.3	0.6	34.9	1.142	0.021	1.163
40		55.2	2.8	58.0	1.379	0.070	1.449
50		76.2	8.2	84.4	1.525	0.164	1.689
60	8	95.7	17.9	113.6	1.594	0.299	1.893
70	13	112.3	32.1	144.4	1.604	0.458	2.063
80	7	125.6	49.7	175.3	1.570	0.622	2.192
90	3	135.3	69.0	204.3	1.503	0.767	2.270
100	16	141.6	87.8	229.3	1.416	0.878	2.293
110	8	144.6	104.0	248.6	1.315	0.946	2.260
120	15	144.9	116.3	261.1	1.207	0.969	2.176
130	6	142.8	123.8	266.5	1.098	0.952	2.050
140		138.7	126.3	265.1	0.991	0.902	1.893
150		133.2	124.4	257.6	0.888	0.830	1.718
160		126.5	118.8	245.3	0.791	0.742	1.533
170		119.1	110.3	229.4	0.701	0.649	1.349
180		111.2	100.0	211.2	0.618	0.555	1.173
190		103.0	88.7	191.7	0.542	0.467	1.009
200		94.9	77.1	172.0	0.474	0.386	0.860

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

FMU W11 / PL_AB STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

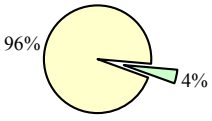
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	1.117E-02
Eqn: 2P	b	2.2310587
	k	0
Deciduous	a	2.275E-02
Eqn: 2P	b	1.8336434
	k	0

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	71
Stratum Area (ha) :	3,582

Stratum as a proportion of total managed landbase, FMU W11:



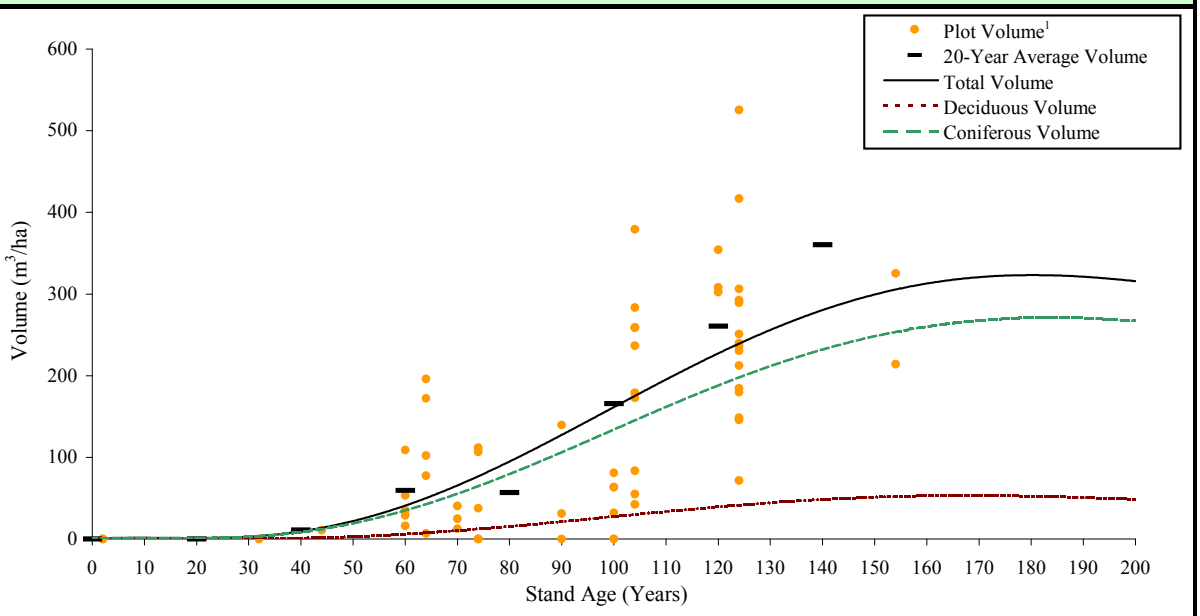
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.7	1.2	2.9	0.170	0.124	0.294
20		7.1	3.5	10.6	0.357	0.175	0.532
30	7	15.8	5.9	21.7	0.526	0.196	0.722
40	9	26.8	7.9	34.7	0.670	0.198	0.869
50		39.5	9.5	49.0	0.789	0.190	0.979
60	7	53.0	10.6	63.6	0.883	0.176	1.060
70	8	66.8	11.2	78.0	0.955	0.160	1.115
80		80.5	11.4	91.9	1.006	0.142	1.149
90	5	93.6	11.2	104.9	1.041	0.125	1.165
100	20	105.9	10.9	116.8	1.059	0.109	1.168
110		117.2	10.3	127.5	1.065	0.094	1.159
120	8	127.3	9.6	136.9	1.060	0.080	1.141
130	7	136.0	8.9	144.9	1.047	0.068	1.115
140		143.5	8.1	151.7	1.025	0.058	1.083
150		149.7	7.3	157.1	0.998	0.049	1.047
160		154.6	6.6	161.2	0.966	0.041	1.008
170		158.3	5.8	164.2	0.931	0.034	0.966
180		160.8	5.2	166.0	0.894	0.029	0.922
190		162.3	4.6	166.8	0.854	0.024	0.878
200		162.7	4.0	166.7	0.814	0.020	0.834

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

FMU W11 / PL_CD STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

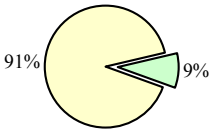
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	1.032E-06
Eqn: 2P+k	b	4.5998205
	k	40
Deciduous	a	4.240E-09
Eqn: 2P+k	b	5.6302981
	k	30

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	66
Stratum Area (ha) Nat :	6,844
Stratum Area (ha) Mgd[4]:	1,162

Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m³/ha/year) Conifer	Deciduous	Total
0	3	0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.003	0.000	0.003
20		0.6	0.0	0.6	0.030	0.002	0.032
30	2	3.0	0.3	3.4	0.101	0.011	0.112
40	1	8.9	1.2	10.0	0.222	0.029	0.251
50		19.3	2.9	22.2	0.386	0.059	0.445
60	10	34.8	5.9	40.7	0.580	0.098	0.678
70	9	55.0	10.1	65.1	0.786	0.144	0.930
80		79.2	15.3	94.5	0.990	0.191	1.181
90	3	106.0	21.3	127.3	1.178	0.236	1.414
100	17	134.1	27.6	161.6	1.341	0.276	1.616
110		161.9	33.8	195.7	1.472	0.307	1.779
120	18	188.1	39.5	227.6	1.568	0.329	1.897
130		211.7	44.4	256.1	1.629	0.342	1.970
140		231.9	48.3	280.2	1.656	0.345	2.001
150	3	248.0	51.0	299.1	1.654	0.340	1.994
160		259.9	52.6	312.5	1.625	0.329	1.953
170		267.5	53.0	320.6	1.574	0.312	1.886
180		271.0	52.4	323.4	1.506	0.291	1.797
190		270.7	50.9	321.6	1.425	0.268	1.693
200		266.9	48.7	315.6	1.334	0.244	1.578

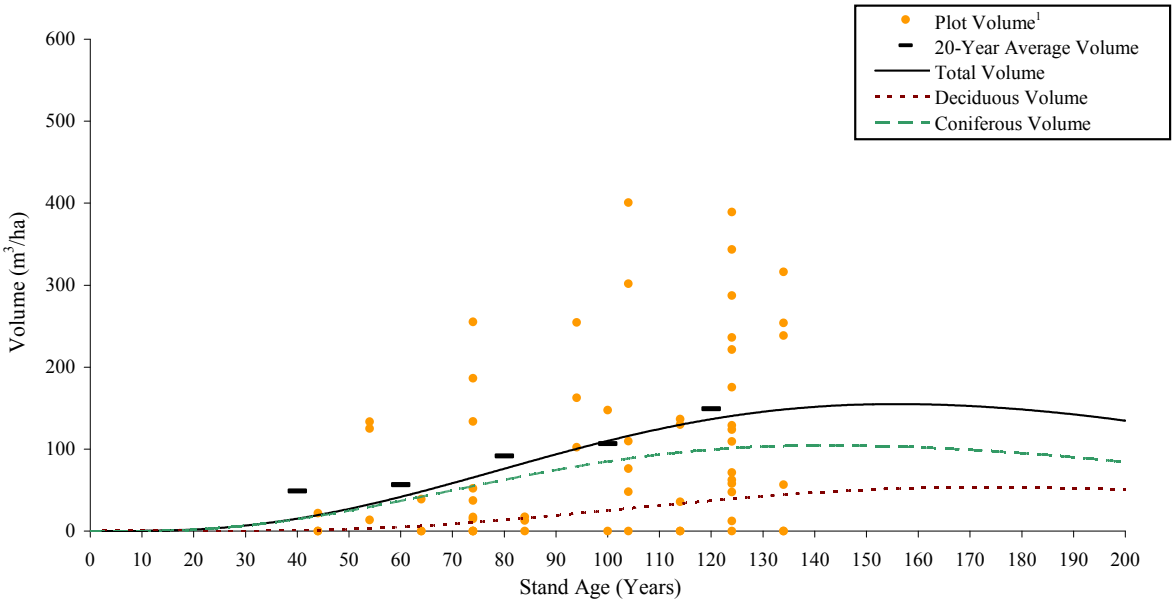
[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

[4] Natural stand yield curve will also represent managed stands, therefore managed stand areas are included here.

FMU W11 / SW_AB STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

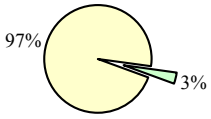
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	6.771E-05
Eqn: 2P+k	b	3.5919527
	k	40
Deciduous	a	1.629E-09
Eqn: 2P+k	b	5.8181248
	k	30

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	59
Stratum Area (ha) :	2,863

Stratum as a proportion of total managed landbase, FMU W11:



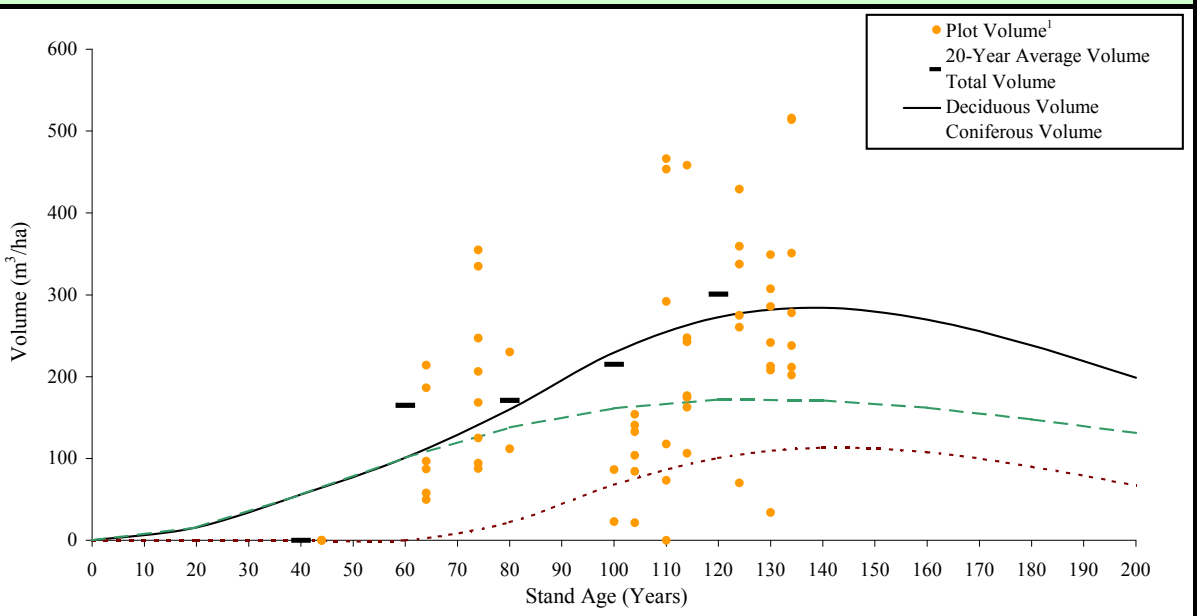
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.2	0.0	0.2	0.021	0.000	0.021
20		1.9	0.0	2.0	0.097	0.002	0.098
30		6.5	0.2	6.7	0.216	0.008	0.223
40	3	14.2	0.9	15.1	0.354	0.022	0.376
50	3	24.6	2.4	26.9	0.491	0.047	0.539
60	3	36.8	4.9	41.7	0.614	0.081	0.695
70	10	49.9	8.6	58.5	0.713	0.123	0.836
80	3	62.8	13.4	76.2	0.785	0.167	0.952
90	3	74.7	19.0	93.7	0.829	0.211	1.041
100	8	84.9	25.1	110.0	0.849	0.251	1.100
110	5	93.1	31.4	124.5	0.846	0.285	1.132
120	15	99.1	37.3	136.4	0.826	0.311	1.137
130	6	102.9	42.6	145.5	0.792	0.328	1.119
140		104.6	47.0	151.5	0.747	0.335	1.082
150		104.3	50.3	154.6	0.696	0.335	1.031
160		102.5	52.4	154.9	0.640	0.328	0.968
170		99.2	53.4	152.7	0.584	0.314	0.898
180		94.9	53.4	148.3	0.527	0.297	0.824
190		89.7	52.4	142.1	0.472	0.276	0.748
200		84.0	50.6	134.6	0.420	0.253	0.673

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

FMU W11 / SW_CD STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

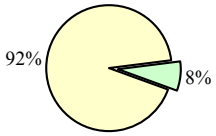
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	1.852E-02
Eqn: 2P	b	2.3724492
	k	0
Total[3]	a	4.049E-06
Eqn: 2P+k	b	4.6004187
	k	30

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	63
Stratum Area (ha) Nat:	5,116
Stratum Area (ha) Mgd[5]:	1,484

Stratum as a proportion of total managed landbase, FMU W11:

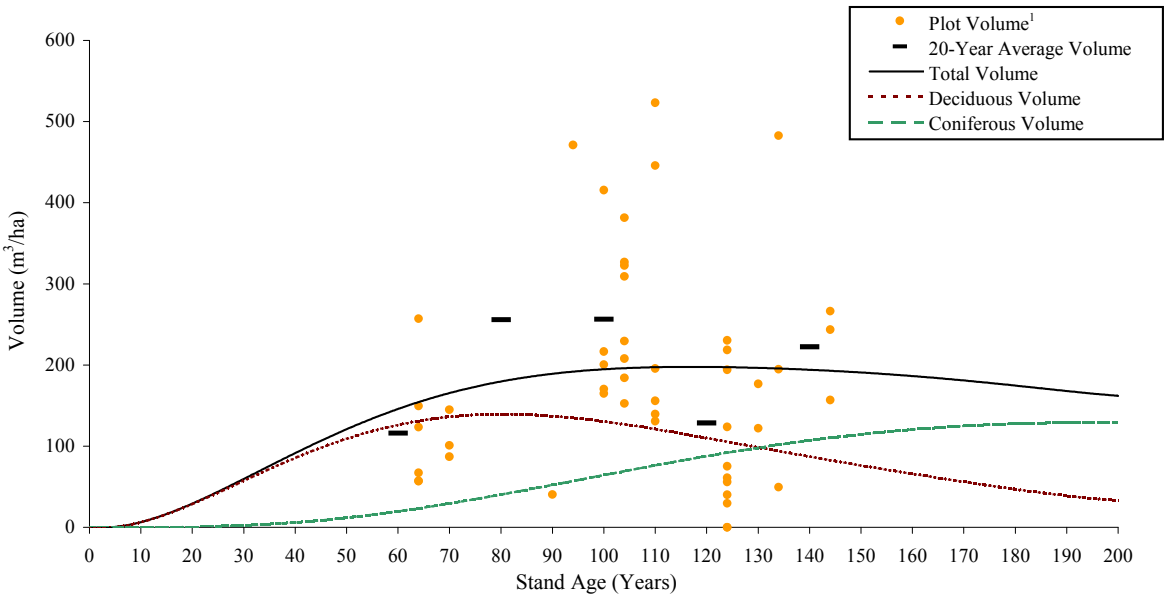


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous[4]	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		3.6	0.0	3.6	0.363	0.000	0.363
20		15.6	0.0	15.6	0.781	0.000	0.781
30		33.9	0.0	33.9	1.132	0.000	1.132
40	3	55.8	0.0	55.8	1.395	0.000	1.395
50		78.7	0.0	78.7	1.575	0.000	1.575
60	6	100.8	0.0	100.8	1.681	0.000	1.681
70	8	120.8	0.1	120.8	1.725	0.001	1.726
80	2	137.8	22.3	160.0	1.722	0.278	2.000
90		151.4	45.8	197.1	1.682	0.508	2.190
100	9	161.5	67.9	229.3	1.615	0.679	2.293
110	14	168.2	86.5	254.8	1.529	0.787	2.316
120	6	171.8	100.6	272.4	1.432	0.838	2.270
130	15	172.6	109.5	282.1	1.328	0.842	2.170
140		171.0	113.2	284.2	1.221	0.809	2.030
150		167.4	112.4	279.7	1.116	0.749	1.865
160		162.1	107.7	269.7	1.013	0.673	1.686
170		155.5	100.0	255.4	0.915	0.588	1.503
180		148.0	90.1	238.1	0.822	0.501	1.323
190		139.8	79.0	218.8	0.736	0.416	1.151
200		131.2	67.3	198.5	0.656	0.337	0.992

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.
[4] Deciduous curve did not converge; total volume was fit and predicted conifer was subtracted from predicted total to obtain deciduous volume.
[4] Natural stand yield curve will also represent managed stands, therefore managed stand areas are included here.

Appendix X. FMU W11 Base Managed Stand Yield Curves

FMU W11 / APAS_CD STRATUM / Base Managed Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

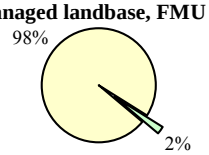
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	7.945E-06
Eqn: 2P+k	b	3.8885273
	k	50
Deciduous	a	3.094E-02
Eqn: 2P	b	2.4841849
	k	0

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	49
Stratum Area (ha) :	1,892

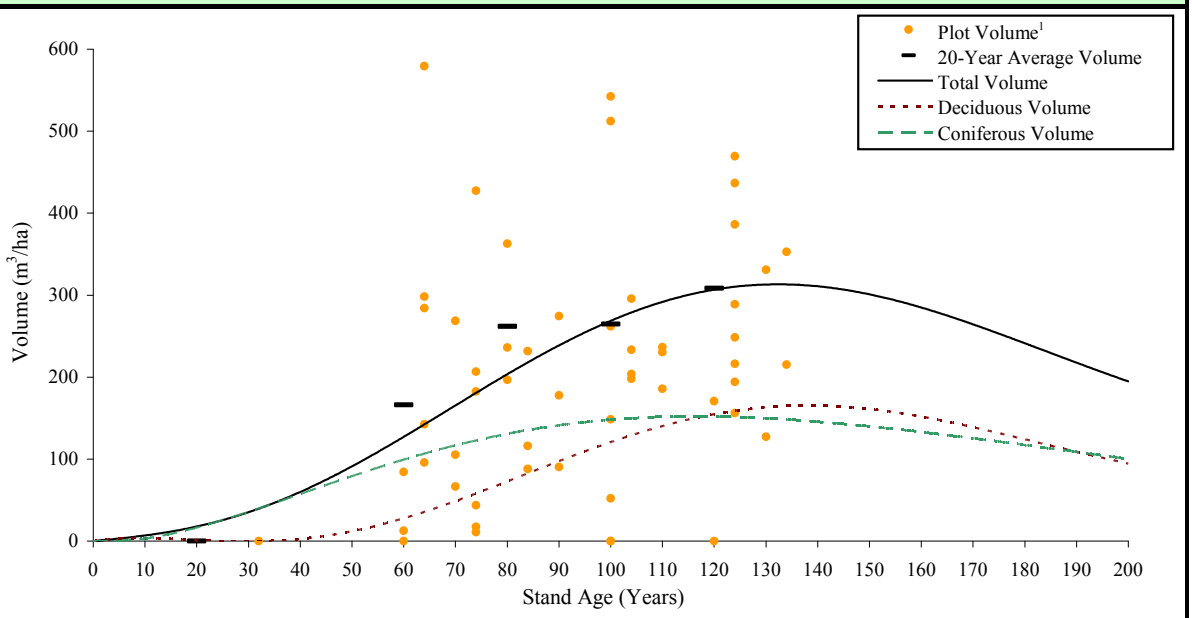
Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	6.9	7.0	0.005	0.692	0.697
20		0.6	28.4	29.0	0.031	1.422	1.452
30		2.4	57.1	59.5	0.081	1.904	1.985
40		6.1	85.7	91.7	0.151	2.142	2.293
50		11.8	109.4	121.3	0.236	2.189	2.425
60	6	19.6	126.3	146.0	0.327	2.106	2.433
70	3	29.3	136.0	165.3	0.418	1.942	2.361
80		40.3	139.0	179.3	0.504	1.738	2.242
90	2	52.2	136.7	188.9	0.580	1.519	2.099
100	13	64.3	130.3	194.7	0.643	1.303	1.947
110	6	76.3	121.2	197.5	0.694	1.102	1.796
120	11	87.6	110.4	198.1	0.730	0.920	1.651
130	5	98.0	98.9	196.8	0.754	0.760	1.514
140	3	107.0	87.2	194.2	0.764	0.623	1.387
150		114.5	76.0	190.5	0.764	0.506	1.270
160		120.5	65.4	186.0	0.753	0.409	1.162
170		124.9	55.8	180.8	0.735	0.328	1.063
180		127.7	47.2	175.0	0.710	0.262	0.972
190		129.0	39.6	168.7	0.679	0.209	0.888
200		129.0	33.0	162.0	0.645	0.165	0.810

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W11 / PASA_CD STRATUM / Base Managed Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

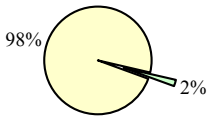
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	2.036E-02
Eqn: 2P	b	2.3729132
	k	0
Deciduous	a	3.546E-10
Eqn: 2P+k	b	6.8528557
	k	20

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	59
Stratum Area (ha) :	1,594

Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m^3/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		3.9	0.0	3.9	0.392	0.000	0.392
20		16.6	0.1	16.7	0.828	0.005	0.834
30	1	35.4	1.0	36.4	1.179	0.035	1.214
40		57.1	4.6	61.7	1.427	0.114	1.542
50		79.1	12.8	91.9	1.582	0.256	1.838
60	8	99.5	27.1	126.5	1.658	0.451	2.109
70	9	117.0	47.2	164.2	1.671	0.674	2.345
80	7	131.0	71.5	202.5	1.638	0.893	2.531
90	3	141.3	97.2	238.5	1.570	1.080	2.650
100	12	148.0	121.3	269.4	1.480	1.213	2.694
110	3	151.4	141.4	292.8	1.377	1.285	2.662
120	10	151.9	155.7	307.6	1.266	1.297	2.563
130	6	149.8	163.4	313.2	1.152	1.257	2.409
140		145.7	164.7	310.4	1.041	1.177	2.217
150		140.0	160.3	300.3	0.933	1.069	2.002
160		133.1	151.3	284.4	0.832	0.946	1.778
170		125.4	139.0	264.4	0.738	0.818	1.556
180		117.2	124.8	241.9	0.651	0.693	1.344
190		108.7	109.6	218.3	0.572	0.577	1.149
200		100.1	94.5	194.6	0.501	0.472	0.973

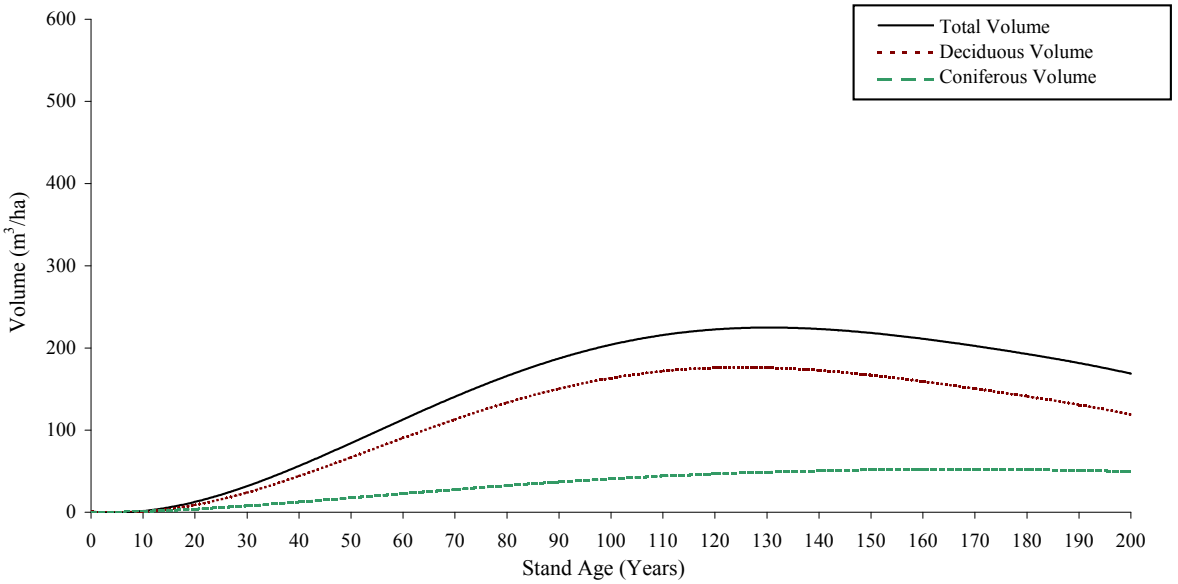
[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

Appendix XI. FMU W11 Base Composite Yield Curves

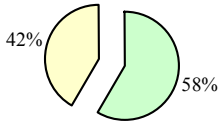
FMU W11 / Base Composite Yield Curve for Natural Stands, D Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	49,824

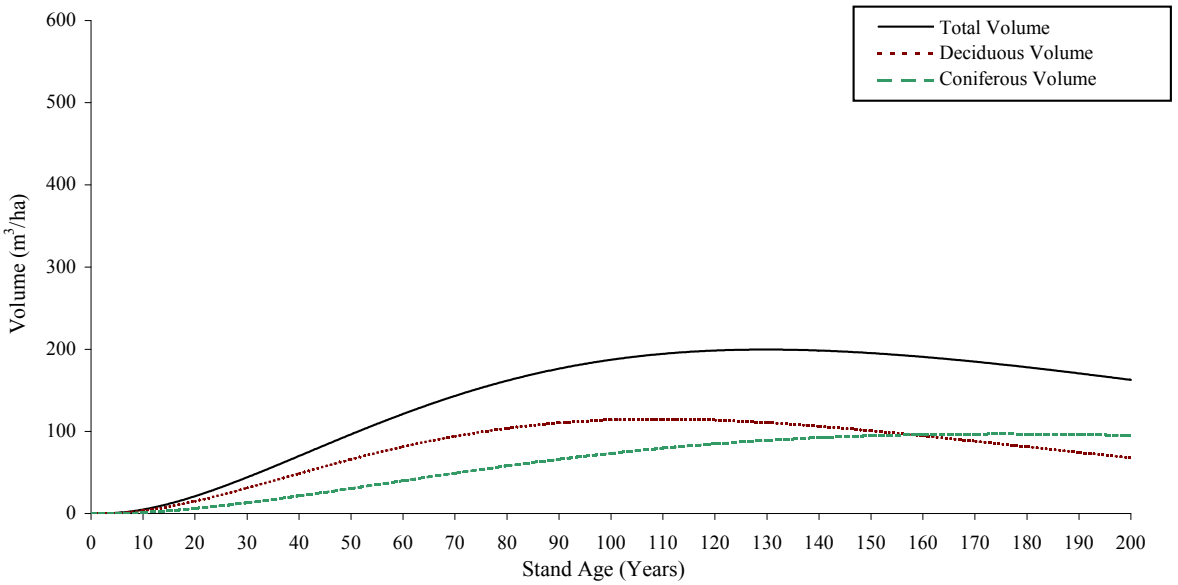
Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	1.0	1.6	2.6	0.103	0.158	0.262
20	3.8	9.0	12.8	0.190	0.450	0.640
30	7.7	23.3	31.0	0.258	0.776	1.034
40	12.4	43.1	55.6	0.310	1.079	1.389
50	17.5	66.4	83.8	0.349	1.327	1.677
60	22.6	90.5	113.2	0.377	1.509	1.886
70	27.7	113.6	141.3	0.395	1.623	2.018
80	32.4	134.0	166.4	0.405	1.674	2.080
90	36.8	150.6	187.4	0.409	1.674	2.082
100	40.7	163.1	203.7	0.407	1.631	2.037
110	44.0	171.2	215.2	0.400	1.556	1.956
120	46.7	175.2	221.9	0.389	1.460	1.849
130	48.8	175.6	224.4	0.376	1.350	1.726
140	50.4	172.7	223.1	0.360	1.234	1.594
150	51.4	167.2	218.6	0.343	1.115	1.458
160	51.9	159.7	211.6	0.324	0.998	1.323
170	51.9	150.7	202.7	0.306	0.887	1.192
180	51.6	140.7	192.3	0.286	0.782	1.068
190	50.8	130.1	180.9	0.268	0.685	0.952
200	49.8	119.2	169.0	0.249	0.596	0.845

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

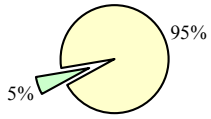
FMU W11 / Base Composite Yield Curve for Natural Stands, DC Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	4,488

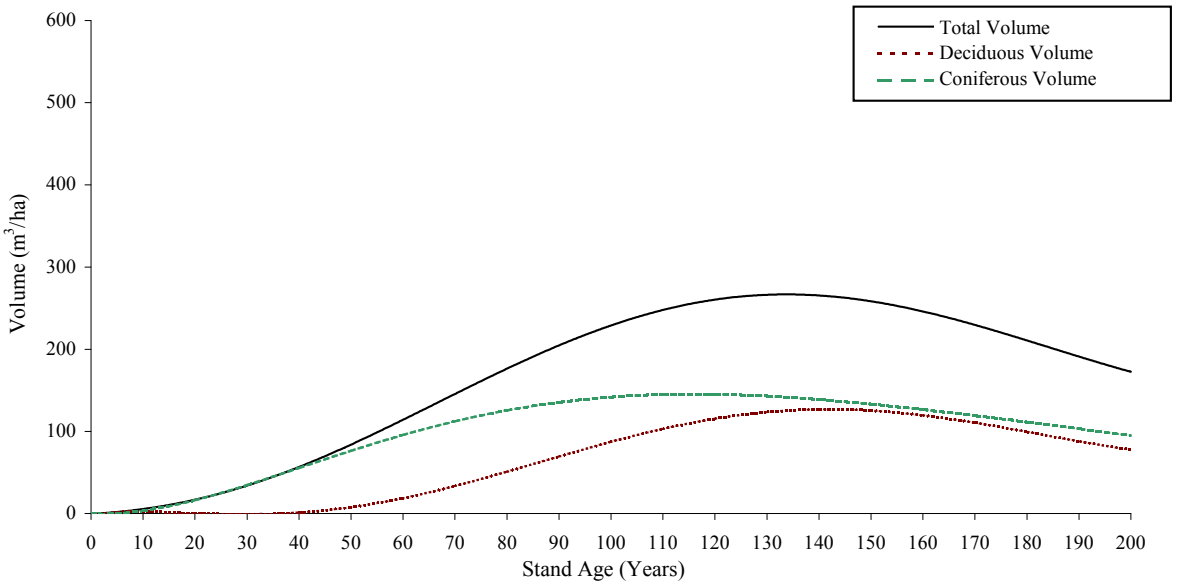
Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	1.6	3.7	5.2	0.156	0.366	0.521
20	6.1	14.8	20.9	0.306	0.741	1.047
30	13.0	30.8	43.7	0.432	1.025	1.457
40	21.3	48.5	69.8	0.533	1.213	1.746
50	30.5	65.9	96.4	0.609	1.318	1.927
60	39.9	81.4	121.3	0.665	1.356	2.021
70	49.1	94.1	143.3	0.702	1.344	2.046
80	57.9	103.7	161.7	0.724	1.297	2.021
90	66.0	110.3	176.2	0.733	1.225	1.958
100	73.2	113.8	187.0	0.732	1.138	1.870
110	79.5	114.8	194.3	0.722	1.044	1.766
120	84.7	113.6	198.3	0.706	0.947	1.652
130	89.0	110.6	199.5	0.684	0.850	1.535
140	92.3	106.1	198.4	0.659	0.758	1.417
150	94.6	100.7	195.3	0.631	0.671	1.302
160	96.1	94.5	190.7	0.601	0.591	1.192
170	96.8	88.0	184.8	0.570	0.517	1.087
180	96.8	81.2	178.0	0.538	0.451	0.989
190	96.2	74.4	170.5	0.506	0.391	0.898
200	94.9	67.7	162.7	0.475	0.339	0.813

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

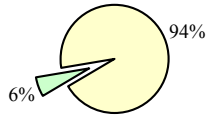
FMU W11 / Base Composite Yield Curve for Natural Stands, CD Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	5,027

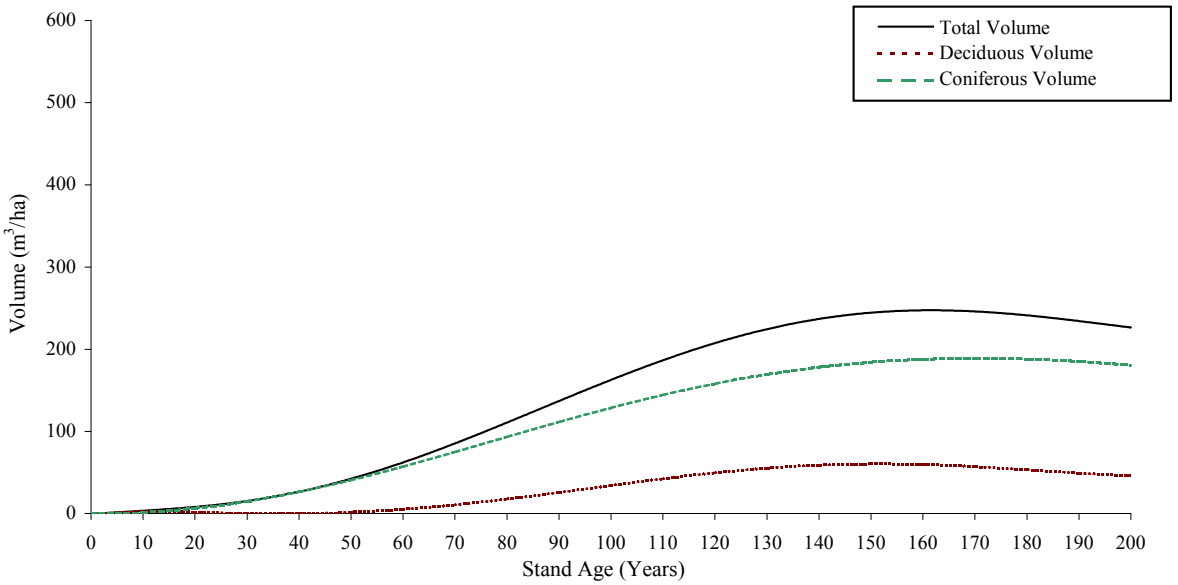
Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	3.8	0.0	3.8	0.384	0.000	0.384
20	16.1	0.1	16.2	0.806	0.003	0.809
30	34.3	0.6	34.9	1.142	0.021	1.163
40	55.2	2.8	58.0	1.379	0.070	1.449
50	76.2	8.2	84.4	1.525	0.164	1.689
60	95.7	17.9	113.6	1.594	0.299	1.893
70	112.3	32.1	144.4	1.604	0.458	2.063
80	125.6	49.7	175.3	1.570	0.622	2.192
90	135.3	69.0	204.3	1.503	0.767	2.270
100	141.6	87.8	229.3	1.416	0.878	2.293
110	144.6	104.0	248.6	1.315	0.946	2.260
120	144.9	116.3	261.1	1.207	0.969	2.176
130	142.8	123.8	266.5	1.098	0.952	2.050
140	138.7	126.3	265.1	0.991	0.902	1.893
150	133.2	124.4	257.6	0.888	0.830	1.718
160	126.5	118.8	245.3	0.791	0.742	1.533
170	119.1	110.3	229.4	0.701	0.649	1.349
180	111.2	100.0	211.2	0.618	0.555	1.173
190	103.0	88.7	191.7	0.542	0.467	1.009
200	94.9	77.1	172.0	0.474	0.386	0.860

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

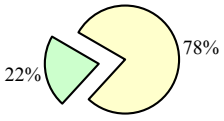
FMU W11 / Base Composite Yield Curve for Natural Stands, C Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	18,405

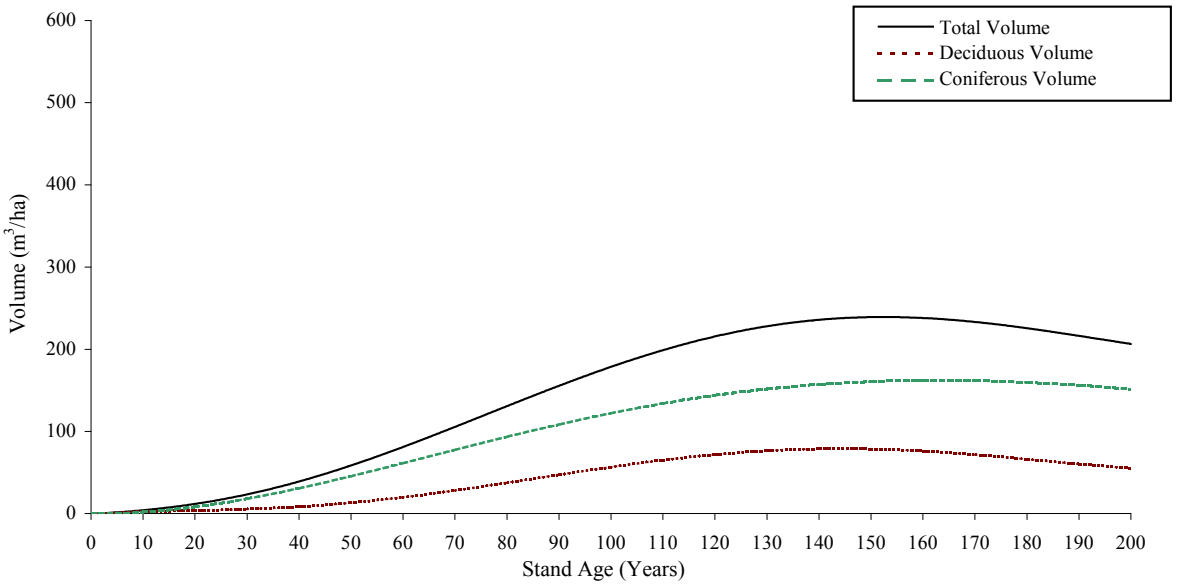
Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	1.4	0.2	1.6	0.138	0.024	0.162
20	6.3	0.7	7.0	0.313	0.035	0.348
30	14.6	1.3	15.9	0.488	0.043	0.531
40	26.2	2.1	28.4	0.656	0.053	0.709
50	40.6	3.3	43.9	0.811	0.066	0.878
60	57.0	5.0	62.0	0.950	0.084	1.034
70	74.8	7.3	82.1	1.069	0.104	1.172
80	93.2	16.2	109.4	1.165	0.202	1.367
90	111.3	25.8	137.1	1.237	0.286	1.524
100	128.6	35.1	163.7	1.286	0.351	1.637
110	144.2	43.5	187.8	1.311	0.395	1.707
120	157.9	50.3	208.2	1.316	0.419	1.735
130	169.2	55.3	224.5	1.302	0.425	1.727
140	178.0	58.3	236.3	1.271	0.417	1.688
150	184.1	59.5	243.6	1.227	0.396	1.624
160	187.7	58.9	246.7	1.173	0.368	1.542
170	189.0	57.0	245.9	1.112	0.335	1.447
180	188.0	53.9	241.8	1.044	0.299	1.343
190	185.0	49.9	235.0	0.974	0.263	1.237
200	180.4	45.5	225.9	0.902	0.227	1.130

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

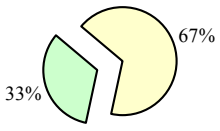
FMU W11 / Base Composite Yield Curve for Natural Stands, C/CD/DC Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	27,920

Stratum as a proportion of total managed landbase, FMU W11:



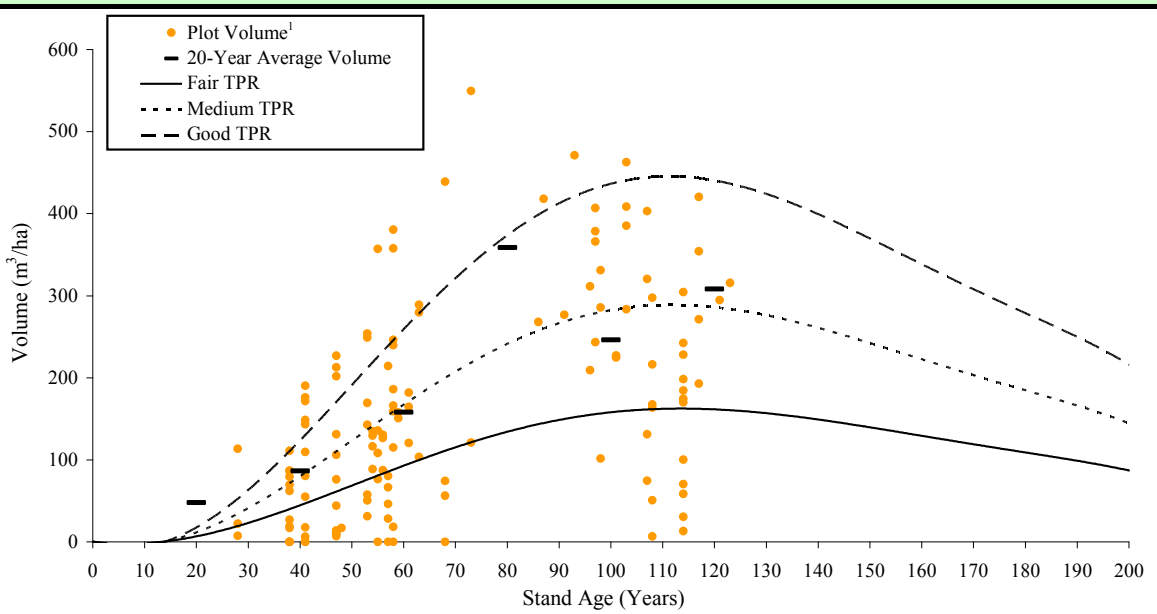
Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	1.9	0.7	2.6	0.185	0.075	0.260
20	8.0	2.9	10.9	0.400	0.143	0.543
30	17.9	5.9	23.8	0.597	0.197	0.794
40	30.7	9.7	40.4	0.766	0.243	1.009
50	45.4	14.3	59.6	0.907	0.285	1.192
60	61.2	19.6	80.8	1.020	0.327	1.347
70	77.4	25.7	103.1	1.106	0.367	1.473
80	93.4	36.3	129.6	1.167	0.454	1.621
90	108.4	47.1	155.5	1.204	0.524	1.728
100	122.0	57.3	179.3	1.220	0.573	1.793
110	133.9	65.9	199.8	1.217	0.599	1.816
120	143.8	72.4	216.2	1.198	0.603	1.801
130	151.5	76.5	228.1	1.166	0.589	1.754
140	157.1	78.3	235.4	1.122	0.559	1.681
150	160.6	77.8	238.4	1.070	0.519	1.589
160	162.0	75.4	237.4	1.012	0.471	1.484
170	161.6	71.5	233.1	0.950	0.421	1.371
180	159.5	66.6	226.0	0.886	0.370	1.256
190	156.0	60.8	216.8	0.821	0.320	1.141
200	151.3	54.7	206.0	0.756	0.274	1.030

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

Appendix XII. FMU W13 Base Natural Stand Yield Curves

AW Stratum Base Natural Stand Yield Curves

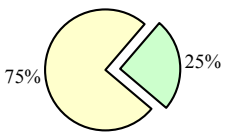
FMU W13 / AW STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	138
Stratum Area (ha) :	52,397

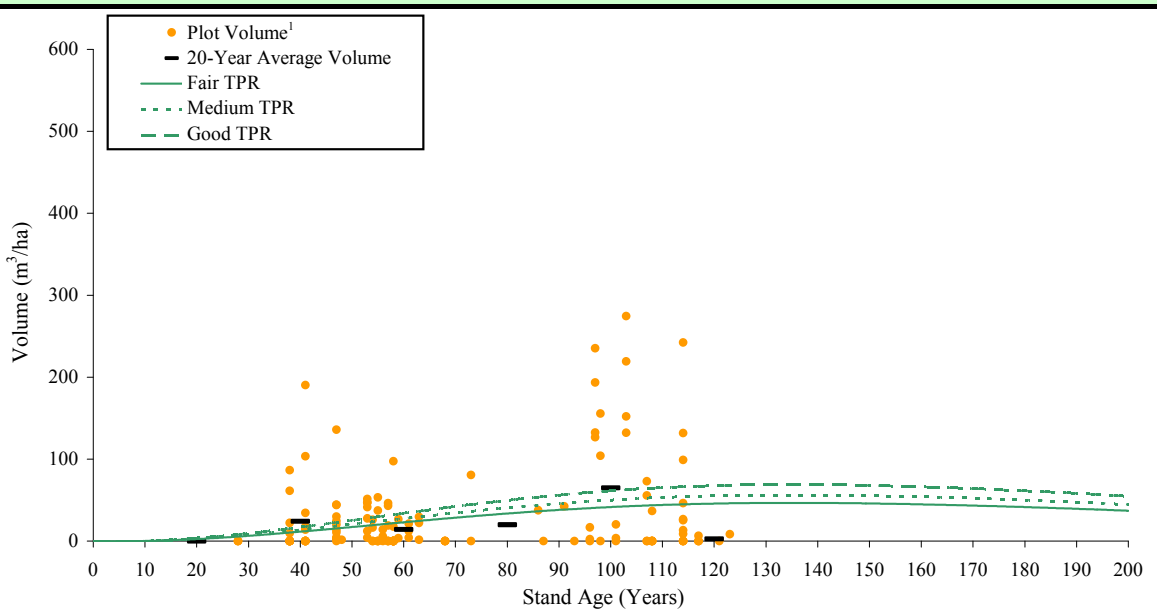
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.1	1.8	2.6	0.107	0.176	0.261
20	3	7.7	13.3	20.3	0.385	0.667	1.016
30	12	22.2	39.2	60.2	0.738	1.305	2.008
40	25	43.2	77.2	119.3	1.081	1.931	2.984
50	37	68.0	122.1	189.2	1.360	2.443	3.783
60	10	93.3	167.9	260.2	1.554	2.798	4.337
70	2	116.3	209.3	324.5	1.661	2.990	4.636
80	2	135.2	243.1	376.7	1.690	3.039	4.708
90	12	149.1	267.4	413.9	1.657	2.972	4.599
100	17	157.8	281.9	435.7	1.578	2.819	4.357
110	16	161.4	287.2	443.0	1.467	2.611	4.027
120	2	160.7	284.5	437.8	1.339	2.370	3.648
130		156.4	275.3	422.5	1.203	2.117	3.250
140		149.4	261.2	399.8	1.067	1.866	2.856
150		140.4	243.8	371.9	0.936	1.625	2.479
160		130.2	224.3	341.0	0.814	1.402	2.131
170		119.4	203.9	308.8	0.702	1.199	1.817
180		108.4	183.4	276.7	0.602	1.019	1.537
190		97.6	163.6	245.6	0.513	0.861	1.293
200		87.2	144.7	216.2	0.436	0.724	1.081

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



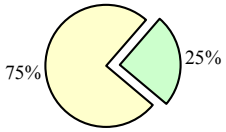
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-2.337E-04
Eqn: 2P+k	a_1	1.086E-04
	b	2.7202683
	k	50
Site Index Inputs	F	12.4
	M	14.5
	G	17.3

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	138
Stratum Area (ha) :	52,397

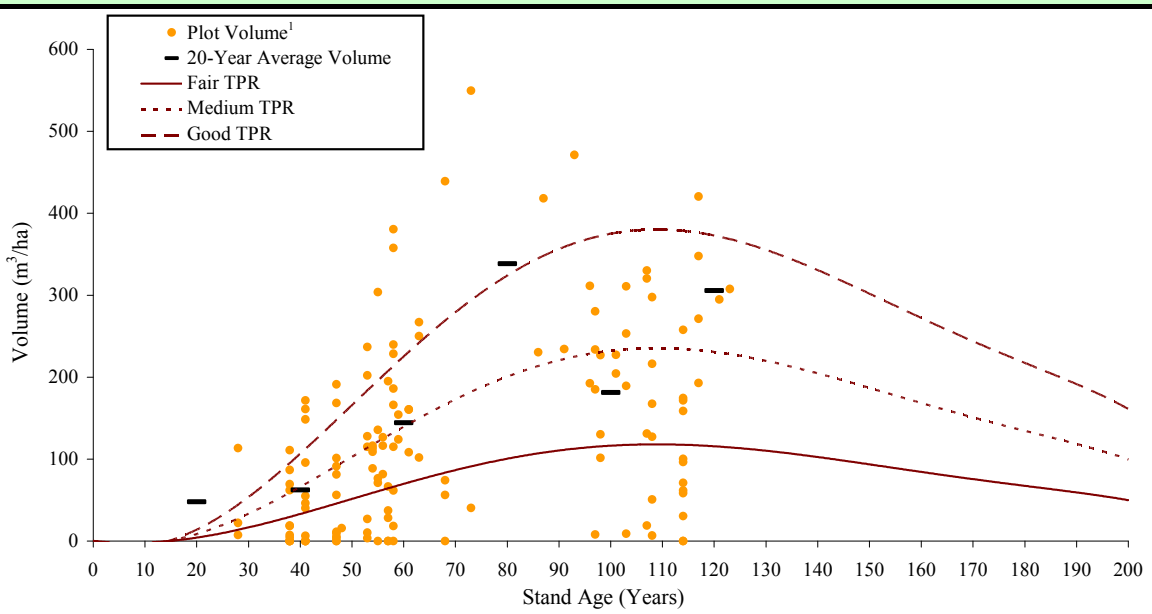
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.5	0.6	0.7	0.048	0.058	0.071
20	3	2.6	3.1	3.8	0.129	0.156	0.191
30	12	6.4	7.7	9.4	0.212	0.256	0.314
40	25	11.4	13.8	16.8	0.285	0.344	0.421
50	37	17.1	20.7	25.3	0.343	0.414	0.506
60	10	23.0	27.8	34.0	0.384	0.463	0.567
70	2	28.7	34.6	42.4	0.410	0.495	0.605
80	2	33.8	40.8	49.9	0.422	0.509	0.623
90	12	38.1	46.0	56.3	0.423	0.511	0.625
100	17	41.5	50.1	61.4	0.415	0.501	0.614
110	16	44.1	53.2	65.1	0.401	0.484	0.592
120	2	45.7	55.2	67.5	0.381	0.460	0.563
130		46.6	56.2	68.7	0.358	0.432	0.529
140		46.6	56.3	68.8	0.333	0.402	0.492
150		46.1	55.6	68.0	0.307	0.370	0.453
160		44.9	54.2	66.4	0.281	0.339	0.415
170		43.4	52.4	64.1	0.255	0.308	0.377
180		41.5	50.1	61.3	0.231	0.278	0.340
190		39.4	47.5	58.1	0.207	0.250	0.306
200		37.1	44.7	54.7	0.185	0.224	0.274

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



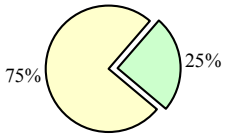
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.042E-03
Eqn: 2P+k	a_1	8.376E-05
	b	3.5963795
	k	30
Site Index Inputs	F	14.9
	M	17.4
	G	20.5

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	138
Stratum Area (ha) :	52,397

Stratum as a proportion of total managed landbase, FMU W13:

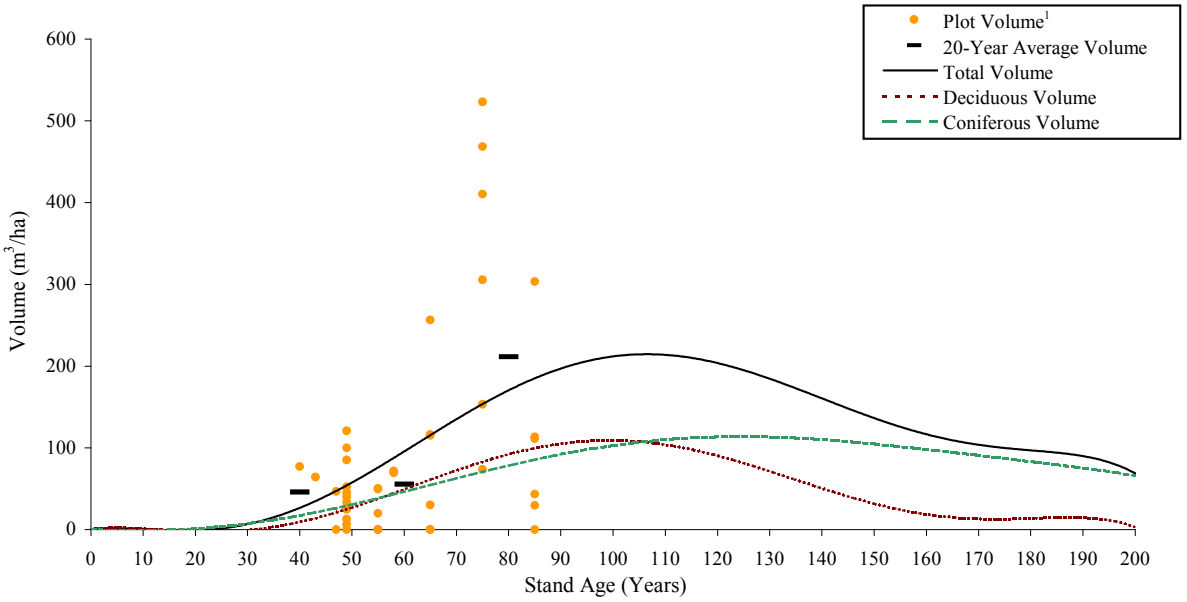


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.6	1.2	1.9	0.059	0.118	0.190
20	3	5.1	10.2	16.5	0.256	0.511	0.825
30	12	15.8	31.5	50.8	0.526	1.049	1.694
40	25	31.8	63.5	102.5	0.795	1.587	2.562
50	37	50.9	101.5	163.9	1.017	2.029	3.277
60	10	70.2	140.1	226.2	1.170	2.334	3.770
70	2	87.6	174.7	282.1	1.251	2.496	4.031
80	2	101.4	202.4	326.8	1.268	2.530	4.085
90	12	111.0	221.5	357.7	1.234	2.461	3.974
100	17	116.2	231.8	374.3	1.162	2.318	3.743
110	16	117.3	234.0	377.9	1.066	2.127	3.435
120	2	114.9	229.3	370.3	0.958	1.911	3.085
130		109.8	219.1	353.8	0.845	1.685	2.722
140		102.7	204.9	330.9	0.734	1.464	2.364
150		94.3	188.2	303.9	0.629	1.255	2.026
160		85.3	170.1	274.6	0.533	1.063	1.717
170		76.0	151.5	244.7	0.447	0.891	1.440
180		66.9	133.4	215.4	0.371	0.741	1.197
190		58.2	116.1	187.4	0.306	0.611	0.987
200		50.1	100.0	161.5	0.251	0.500	0.808

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

BW Stratum Base Natural Stand Yield Curves

FMU W11 and W13 / BW STRATUM / Base Natural Stand Yield Curve



2-PARAMETER EQUATION (2P): volume = $a(age)^b e^{(-a*age)}$

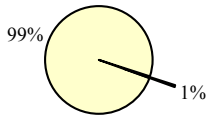
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Parameter Estimates:		
Coniferous	a	1.326E-05
Eqn: 2P+k	b	4.1684289
	k	30
Deciduous	a	2.095E-13
Eqn: 2P+k	b	9.5324902
	k	10

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-All (cm):	30.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	42
Stratum Area (ha) W11:	130
Stratum Area (ha) W13:	1,024

Stratum as a proportion of total managed landbase, both FMUs:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) Conifer	Deciduous	Total	Mean Annual Increment[3] (m³/ha/year) Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.0	0.1	0.014	0.000	0.014
20		1.8	0.1	1.9	0.090	0.004	0.094
30		7.0	1.3	8.3	0.234	0.042	0.275
40	16	16.7	7.2	23.8	0.416	0.179	0.596
50	8	30.2	22.1	52.4	0.605	0.443	1.048
60	6	46.3	46.3	92.6	0.772	0.772	1.544
70	6	63.1	74.0	137.2	0.902	1.058	1.960
80	6	78.9	97.3	176.2	0.987	1.216	2.202
90		92.4	110.0	202.4	1.027	1.222	2.249
100		102.7	110.4	213.2	1.027	1.104	2.132
110		109.5	100.8	210.3	0.996	0.916	1.912
120		112.8	85.0	197.8	0.940	0.708	1.648
130		112.8	67.1	179.9	0.868	0.516	1.384
140		110.1	50.0	160.1	0.786	0.357	1.143
150		105.2	35.5	140.7	0.701	0.237	0.938
160		98.6	24.2	122.8	0.616	0.151	0.767
170		91.0	15.8	106.8	0.535	0.093	0.628
180		82.7	10.1	92.8	0.460	0.056	0.515
190		74.3	6.2	80.4	0.391	0.033	0.423
200		65.9	3.7	69.6	0.329	0.019	0.348

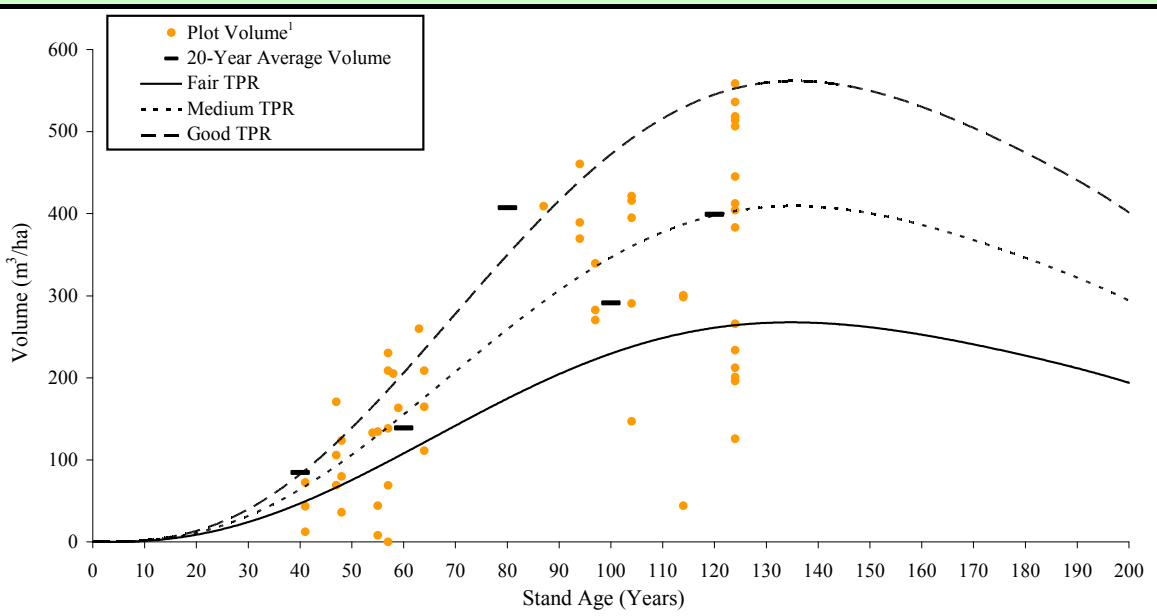
[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

[3] Maximum MAI highlighted in blue.

AP Stratum Base Natural Stand Yield Curves

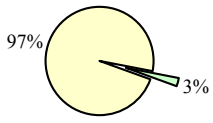
FMU W13 / AP STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	56
Stratum Area (ha) :	5,498

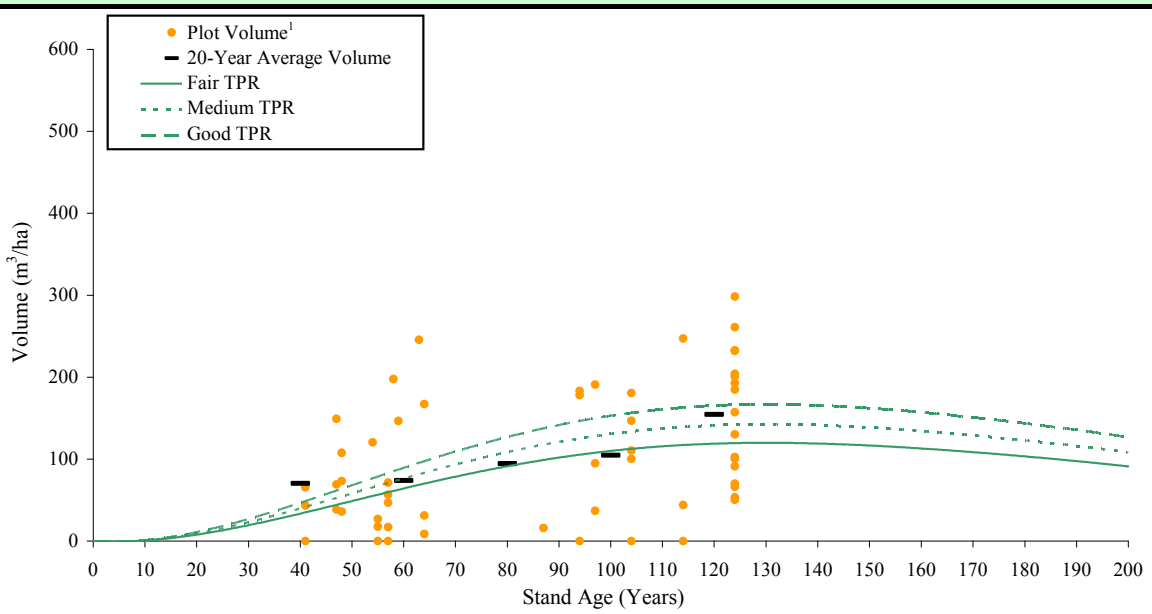
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.7	2.0	2.4	0.168	0.203	0.241
20		9.2	11.5	14.1	0.458	0.577	0.705
30		24.0	31.6	39.7	0.802	1.054	1.324
40	9	46.4	63.3	81.4	1.161	1.583	2.036
50	11	75.1	105.5	138.1	1.501	2.109	2.762
60	4	107.8	155.0	205.7	1.797	2.584	3.428
70		142.1	207.9	278.6	2.029	2.970	3.980
80	1	175.1	259.8	350.7	2.189	3.248	4.384
90	6	204.8	307.0	416.8	2.276	3.411	4.631
100	5	229.5	346.7	472.5	2.295	3.467	4.725
110	3	248.2	377.0	515.3	2.256	3.427	4.684
120	17	260.5	397.2	544.0	2.171	3.310	4.533
130		266.5	407.4	558.7	2.050	3.134	4.298
140		266.8	408.3	560.3	1.906	2.916	4.002
150		262.0	401.2	550.6	1.747	2.674	3.671
160		253.2	387.3	531.5	1.582	2.421	3.322
170		241.1	368.3	505.1	1.418	2.167	2.971
180		226.6	345.6	473.4	1.259	1.920	2.630
190		210.7	320.4	438.3	1.109	1.686	2.307
200		193.9	294.0	401.4	0.970	1.470	2.007

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AP STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



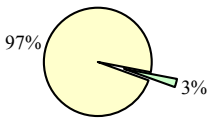
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-8.797E-04
Eqn: 2P+k	a_1	3.984E-04
	b	2.6149329
	k	50
Site Index Inputs	F	14.2
	M	16.5
	G	18.9

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	56
Stratum Area (ha) :	5,498

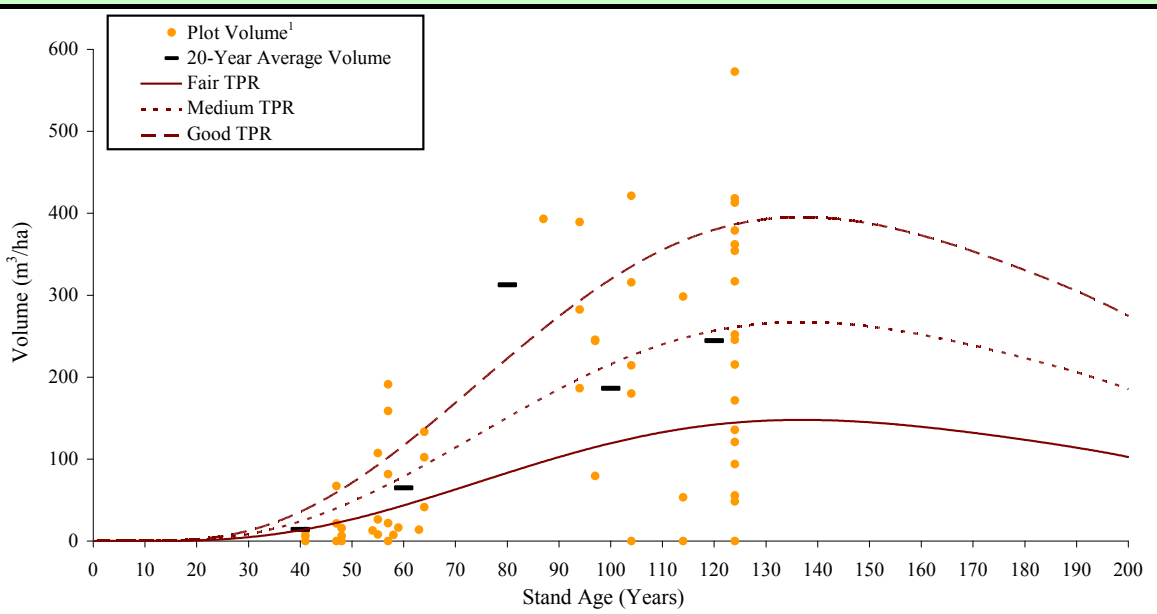
Stratum as a proportion of total managed landbase, FMU W11:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.6	1.9	2.2	0.161	0.192	0.224
20		8.1	9.6	11.3	0.405	0.481	0.563
30		19.1	22.8	26.6	0.638	0.758	0.887
40	9	33.3	39.5	46.2	0.831	0.988	1.156
50	11	48.8	58.0	67.8	0.976	1.160	1.357
60	4	64.4	76.5	89.5	1.073	1.275	1.491
70		78.9	93.7	109.6	1.126	1.339	1.566
80	1	91.5	108.8	127.3	1.144	1.360	1.591
90	6	102.0	121.2	141.8	1.133	1.347	1.575
100	5	110.0	130.7	152.9	1.100	1.307	1.529
110	3	115.5	137.3	160.6	1.050	1.248	1.460
120	17	118.7	141.1	165.1	0.990	1.176	1.376
130		119.9	142.5	166.6	0.922	1.096	1.282
140		119.1	141.6	165.6	0.851	1.011	1.183
150		116.8	138.8	162.4	0.779	0.926	1.083
160		113.2	134.6	157.4	0.708	0.841	0.984
170		108.6	129.1	151.0	0.639	0.759	0.888
180		103.3	122.7	143.6	0.574	0.682	0.798
190		97.4	115.7	135.4	0.513	0.609	0.713
200		91.2	108.4	126.8	0.456	0.542	0.634

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AP STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



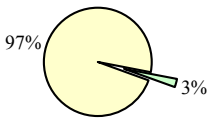
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-9.132E-06
Eqn: 2P+k	a_1	7.658E-07
	b	4.5904144
	k	30
Site Index Inputs	F	14.8
	M	17.1
	G	19.6

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	56
Stratum Area (ha) :	5,498

Stratum as a proportion of total managed landbase, FMU W13:

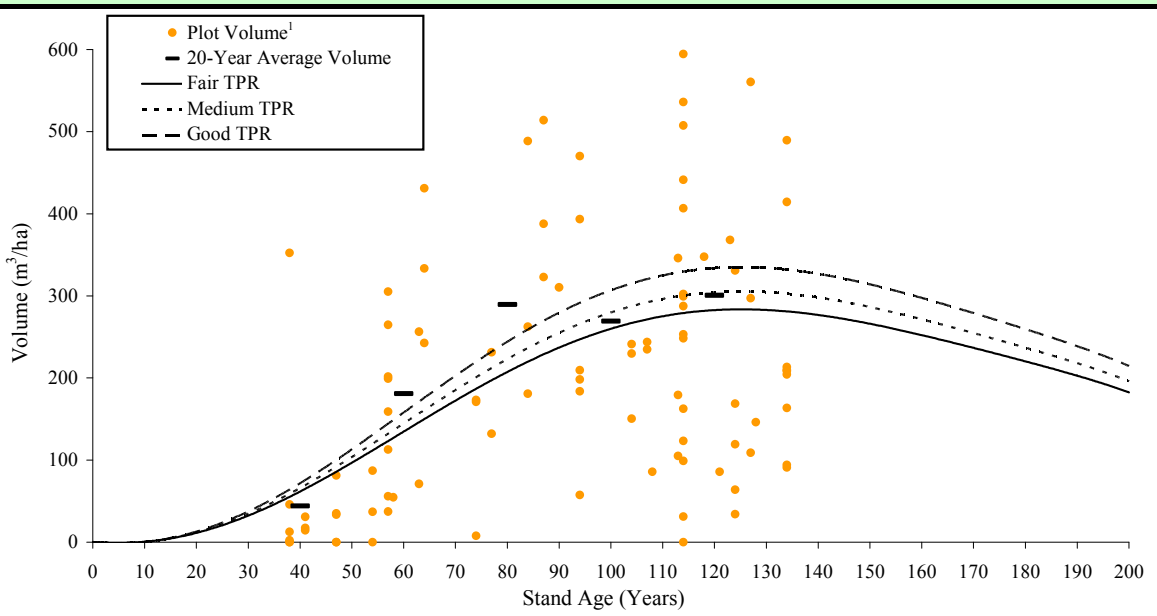


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.1	0.2	0.006	0.011	0.016
20		1.1	1.9	2.8	0.053	0.096	0.142
30		4.9	8.9	13.1	0.164	0.295	0.437
40	9	13.2	23.8	35.2	0.329	0.595	0.880
50	11	26.3	47.5	70.2	0.525	0.949	1.405
60	4	43.5	78.5	116.2	0.725	1.309	1.937
70		63.2	114.2	169.0	0.903	1.631	2.414
80	1	83.6	151.0	223.5	1.045	1.888	2.794
90	6	102.9	185.8	275.0	1.143	2.065	3.055
100	5	119.5	215.9	319.6	1.195	2.159	3.196
110	3	132.7	239.7	354.7	1.206	2.179	3.224
120	17	141.7	256.0	378.9	1.181	2.134	3.158
130		146.7	264.9	392.0	1.128	2.038	3.016
140		147.7	266.7	394.7	1.055	1.905	2.820
150		145.2	262.3	388.2	0.968	1.749	2.588
160		139.9	252.8	374.1	0.875	1.580	2.338
170		132.4	239.2	354.1	0.779	1.407	2.083
180		123.4	222.9	329.8	0.685	1.238	1.832
190		113.3	204.7	302.9	0.596	1.077	1.594
200		102.7	185.6	274.7	0.514	0.928	1.373

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

AS Stratum Base Natural Stand Yield Curves

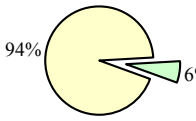
FMU W13 / AS STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	96
Stratum Area (ha) :	13,549

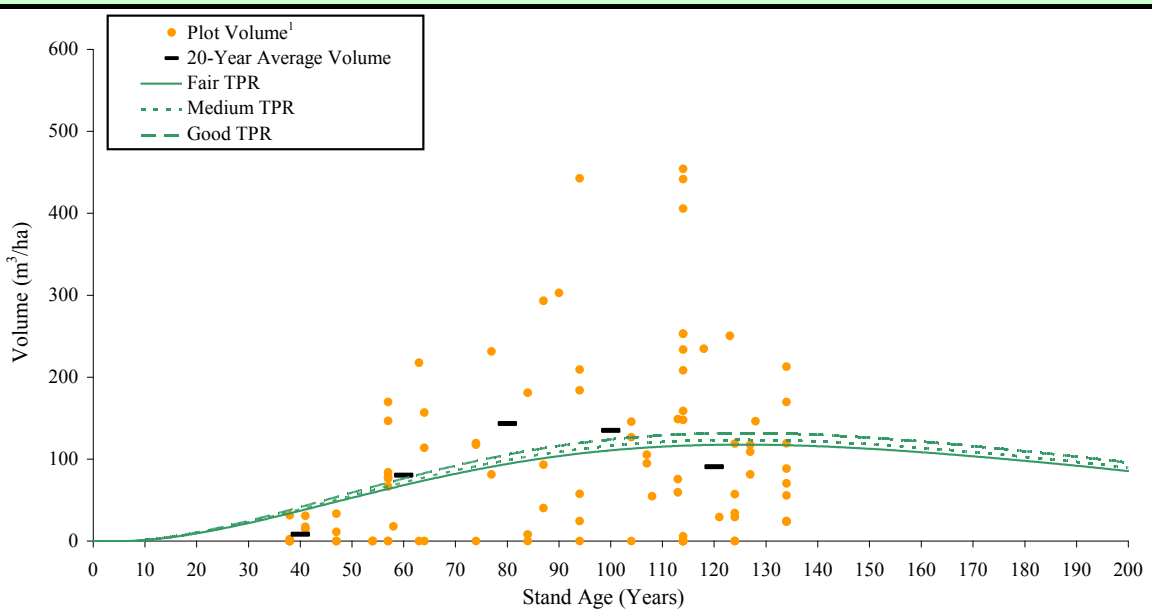
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		2.3	2.4	2.5	0.225	0.237	0.254
20		12.2	12.9	13.9	0.608	0.644	0.694
30	6	31.7	33.8	36.6	1.057	1.125	1.219
40	8	60.5	64.6	70.2	1.512	1.615	1.756
50	12	96.0	102.8	112.1	1.920	2.056	2.241
60	5	134.8	144.6	158.0	2.247	2.411	2.633
70	5	173.3	186.2	203.6	2.476	2.659	2.909
80	6	208.3	224.0	245.3	2.604	2.800	3.066
90	7	237.6	255.7	280.2	2.640	2.841	3.113
100	6	259.9	279.7	306.6	2.599	2.797	3.066
110	20	274.5	295.6	324.1	2.495	2.687	2.946
120	12	281.7	303.4	332.7	2.348	2.528	2.773
130	9	282.2	303.9	333.3	2.171	2.337	2.564
140		276.8	298.1	326.9	1.977	2.129	2.335
150		266.8	287.3	315.0	1.779	1.915	2.100
160		253.2	272.6	298.8	1.583	1.704	1.867
170		237.2	255.2	279.6	1.395	1.501	1.645
180		219.5	236.1	258.6	1.219	1.312	1.437
190		201.1	216.2	236.7	1.058	1.138	1.246
200		182.6	196.2	214.7	0.913	0.981	1.073

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AS STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



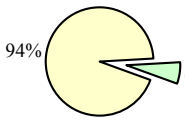
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	5.490E-03
Eqn: 2P+k	a_1	1.888E-04
	b	2.5120370
	k	50
Site Index Inputs	F	11.9
	M	14.0
	G	16.8

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	96
Stratum Area (ha) :	13,549

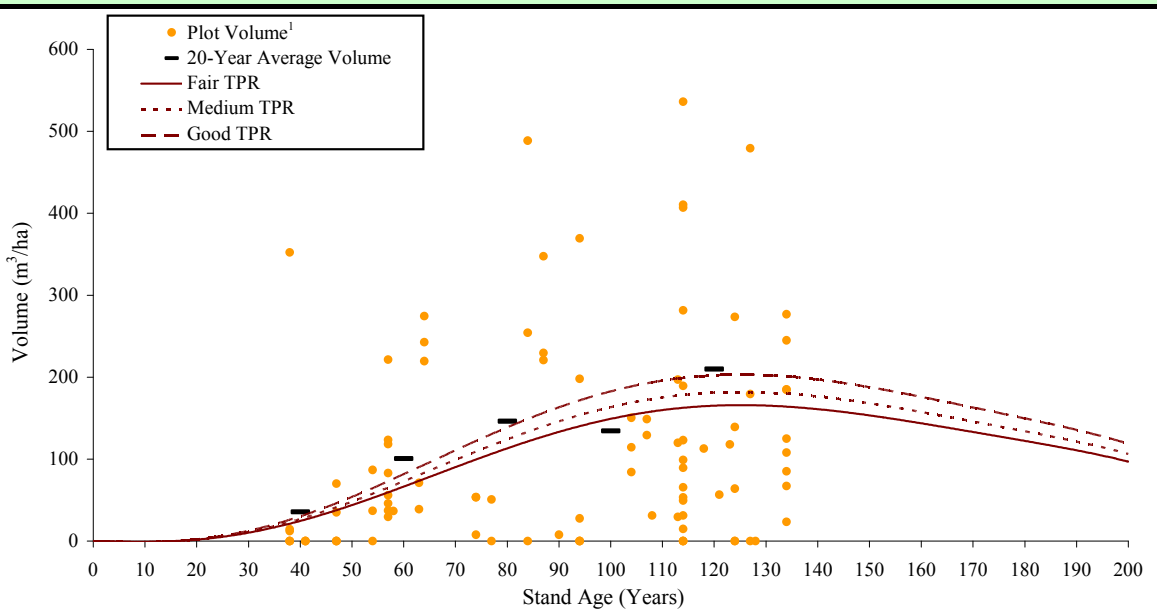
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		2.1	2.2	2.3	0.206	0.216	0.231
20		9.6	10.1	10.8	0.481	0.505	0.539
30	6	21.8	22.9	24.4	0.727	0.763	0.814
40	8	36.8	38.6	41.2	0.920	0.966	1.030
50	12	52.8	55.4	59.1	1.055	1.108	1.182
60	5	68.3	71.7	76.5	1.138	1.195	1.275
70	5	82.3	86.5	92.2	1.176	1.235	1.318
80	6	94.3	99.0	105.6	1.179	1.237	1.320
90	7	103.8	109.0	116.2	1.153	1.211	1.291
100	6	110.7	116.2	124.0	1.107	1.162	1.240
110	20	115.2	120.9	129.0	1.047	1.099	1.173
120	12	117.3	123.2	131.4	0.978	1.026	1.095
130	9	117.4	123.3	131.5	0.903	0.948	1.012
140		115.8	121.6	129.7	0.827	0.869	0.927
150		112.8	118.4	126.3	0.752	0.789	0.842
160		108.6	114.0	121.6	0.679	0.713	0.760
170		103.5	108.7	116.0	0.609	0.639	0.682
180		97.9	102.7	109.6	0.544	0.571	0.609
190		91.8	96.3	102.8	0.483	0.507	0.541
200		85.5	89.7	95.7	0.427	0.449	0.479

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AS STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



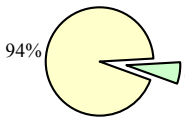
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	7.434E-06
Eqn: 2P+k	a_1	6.838E-07
	b	4.1901250
	k	30
Site Index Inputs	F	14.6
	M	17.1
	G	20.3

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	96
Stratum Area (ha) :	13,549

Stratum as a proportion of total managed landbase, FMU W13:

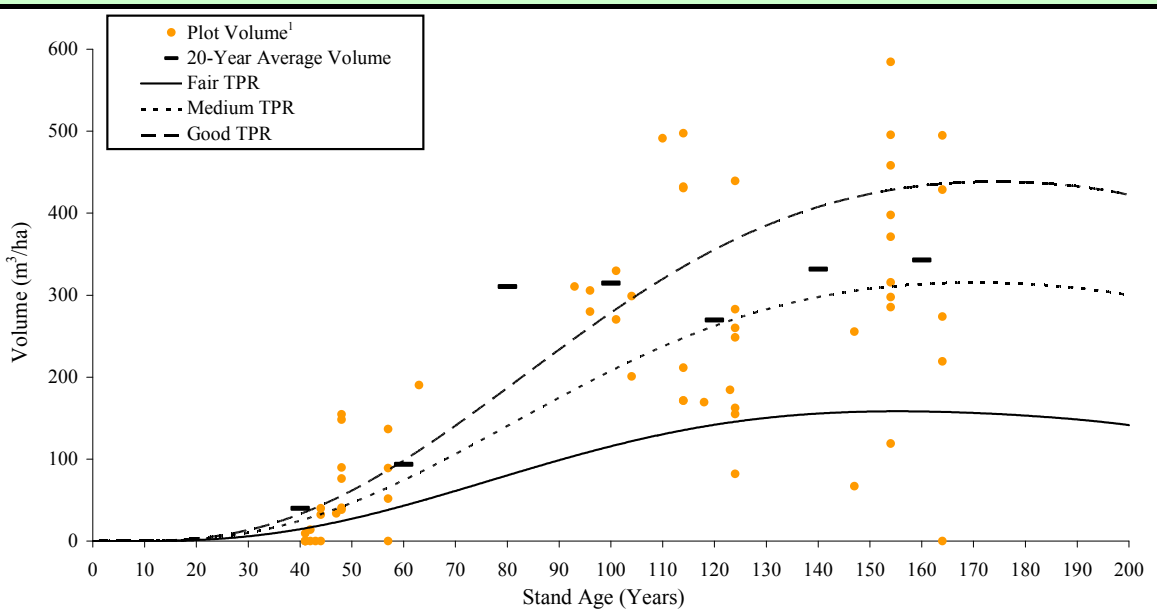


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.2	0.2	0.2	0.019	0.021	0.024
20		2.5	2.8	3.1	0.126	0.139	0.155
30	6	9.9	10.9	12.1	0.330	0.362	0.405
40	8	23.7	26.0	29.0	0.593	0.650	0.726
50	12	43.3	47.4	53.0	0.865	0.948	1.060
60	5	66.5	72.9	81.5	1.109	1.216	1.358
70	5	91.0	99.7	111.4	1.299	1.424	1.591
80	6	114.0	125.0	139.7	1.426	1.563	1.746
90	7	133.9	146.7	163.9	1.487	1.630	1.821
100	6	149.2	163.5	182.7	1.492	1.635	1.827
110	20	159.3	174.7	195.1	1.448	1.588	1.774
120	12	164.4	180.2	201.3	1.370	1.502	1.678
130	9	164.7	180.6	201.7	1.267	1.389	1.552
140		161.0	176.5	197.2	1.150	1.261	1.408
150		154.0	168.9	188.6	1.027	1.126	1.258
160		144.7	158.6	177.1	0.904	0.991	1.107
170		133.6	146.5	163.6	0.786	0.862	0.963
180		121.7	133.4	149.0	0.676	0.741	0.828
190		109.3	119.8	133.9	0.575	0.631	0.705
200		97.1	106.5	118.9	0.486	0.532	0.595

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

PA Stratum Base Natural Stand Yield Curves

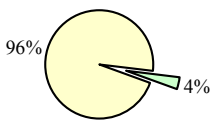
FMU W13 / PA STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	63
Stratum Area (ha) :	7,602

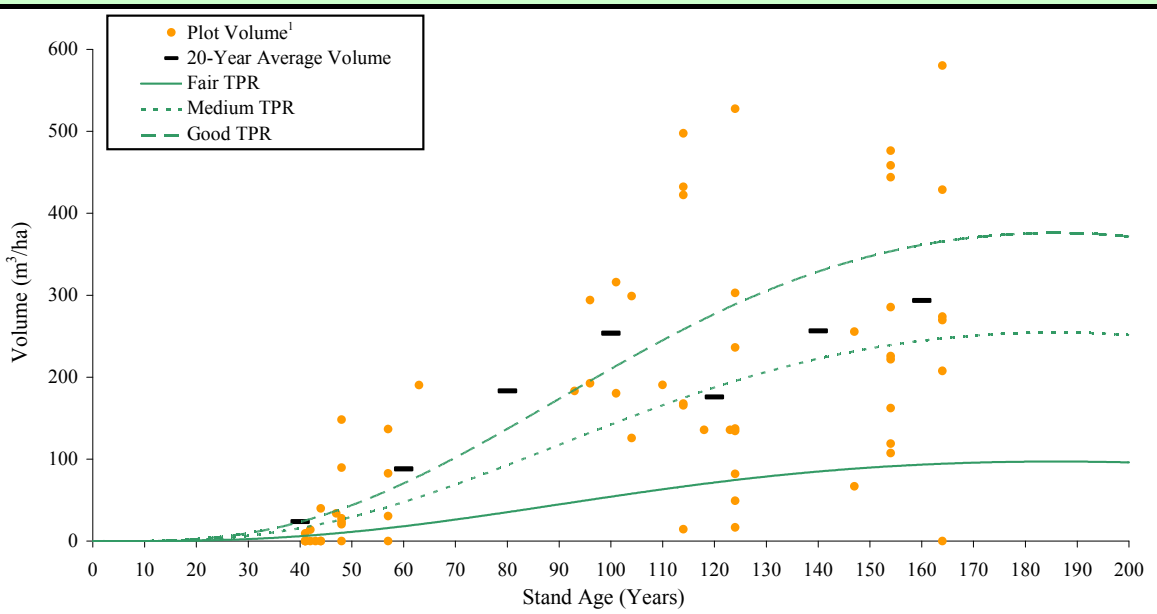
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.2	0.3	0.012	0.022	0.031
20		1.5	2.6	3.5	0.073	0.131	0.176
30		5.8	10.1	13.4	0.193	0.337	0.448
40	17	14.3	24.5	32.5	0.356	0.613	0.812
50	4	26.9	46.2	61.1	0.539	0.924	1.222
60	1	43.1	74.1	98.1	0.718	1.235	1.635
70		61.4	106.3	141.0	0.877	1.519	2.015
80		80.5	140.7	187.2	1.006	1.758	2.340
90	3	98.9	175.0	233.9	1.099	1.945	2.598
100	4	115.7	207.6	278.6	1.157	2.076	2.786
110	8	130.1	236.9	319.4	1.183	2.153	2.904
120	9	141.6	262.0	355.0	1.180	2.183	2.958
130		150.1	282.3	384.5	1.154	2.171	2.958
140	2	155.6	297.7	407.5	1.111	2.126	2.911
150	9	158.2	308.1	424.0	1.055	2.054	2.826
160	6	158.5	313.9	434.1	0.990	1.962	2.713
170		156.5	315.5	438.5	0.921	1.856	2.579
180		152.8	313.4	437.5	0.849	1.741	2.431
190		147.7	308.1	432.0	0.778	1.621	2.274
200		141.6	300.0	422.5	0.708	1.500	2.112

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / PA STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



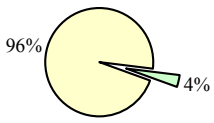
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-5.824E-05
Eqn: 2P+k	a_1	6.806E-06
	b	3.7090117
	k	50
Site Index Inputs	F	10.8
	M	14.5
	G	17.3

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	63
Stratum Area (ha) :	7,602

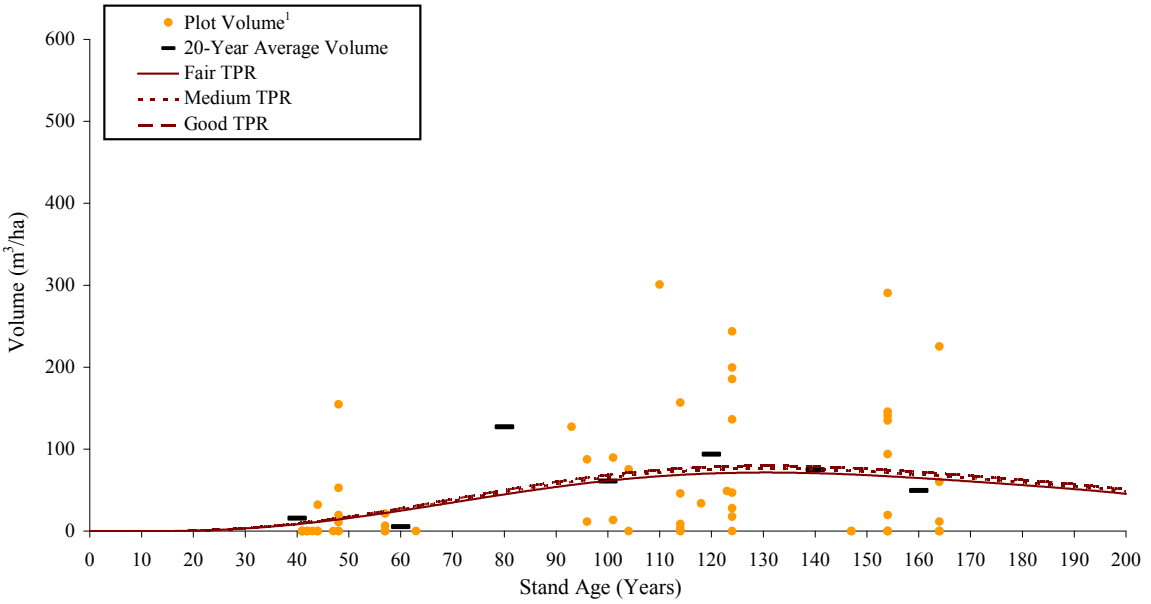
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.2	0.2	0.006	0.017	0.025
20		0.7	1.8	2.7	0.034	0.090	0.133
30		2.5	6.6	9.8	0.084	0.221	0.326
40	17	6.0	15.8	23.3	0.150	0.394	0.583
50	4	11.3	29.5	43.7	0.225	0.591	0.873
60	1	18.2	47.6	70.3	0.303	0.793	1.171
70		26.3	69.0	101.9	0.376	0.985	1.456
80		35.4	92.7	136.9	0.442	1.158	1.712
90	3	44.8	117.4	173.5	0.498	1.305	1.928
100	4	54.2	142.1	210.0	0.542	1.421	2.100
110	8	63.2	165.7	244.8	0.575	1.506	2.226
120	9	71.5	187.3	276.8	0.596	1.561	2.307
130		78.8	206.4	305.0	0.606	1.587	2.346
140	2	84.9	222.4	328.7	0.606	1.589	2.348
150	9	89.8	235.2	347.6	0.598	1.568	2.317
160	6	93.4	244.6	361.5	0.584	1.529	2.260
170		95.7	250.8	370.6	0.563	1.475	2.180
180		96.9	253.8	375.1	0.538	1.410	2.084
190		96.9	254.0	375.3	0.510	1.337	1.975
200		96.0	251.5	371.7	0.480	1.257	1.858

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / PA STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



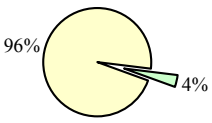
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	2.443E-06
Eqn: 2P+k	a_1	5.372E-08
	b	4.3768354
	k	30
Site Index Inputs	F	11.1
	M	14.7
	G	17.6

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	63
Stratum Area (ha) :	7,602

Stratum as a proportion of total managed landbase, FMU W13:

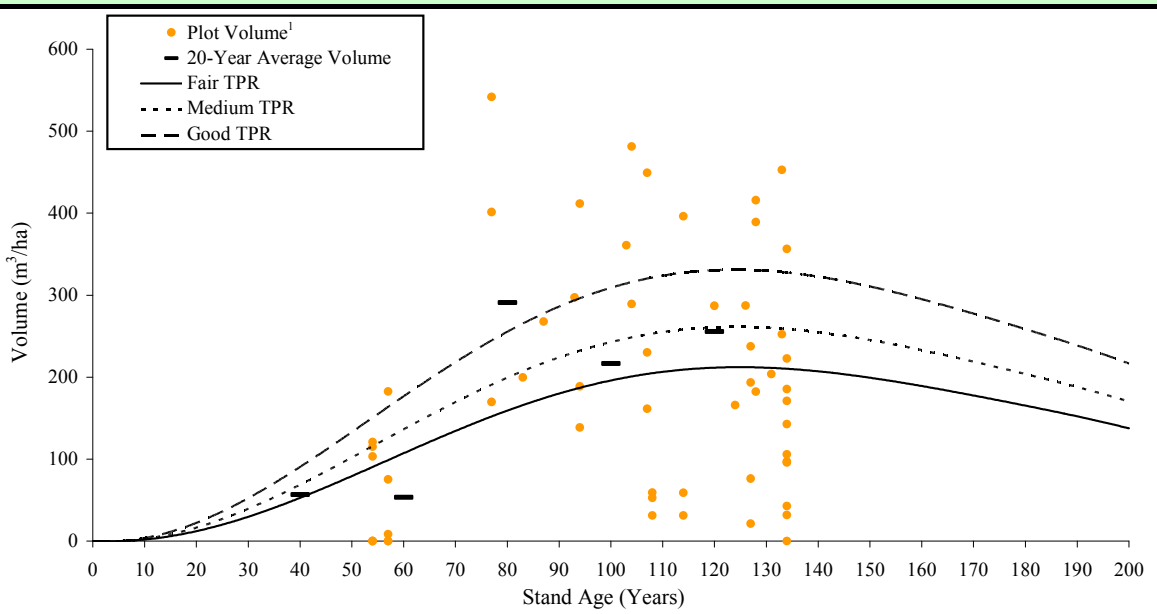


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.1	0.1	0.005	0.006	0.006
20		0.8	0.8	0.9	0.039	0.041	0.043
30		3.3	3.5	3.6	0.109	0.116	0.121
40	17	8.2	8.8	9.2	0.206	0.219	0.230
50	4	15.7	16.7	17.5	0.313	0.334	0.349
60	1	24.9	26.5	27.8	0.416	0.442	0.463
70		35.1	37.4	39.1	0.501	0.534	0.559
80		45.1	48.0	50.3	0.564	0.600	0.629
90	3	54.1	57.6	60.3	0.601	0.640	0.670
100	4	61.5	65.5	68.6	0.615	0.655	0.686
110	8	66.8	71.2	74.6	0.608	0.647	0.678
120	9	70.1	74.7	78.2	0.584	0.622	0.651
130		71.3	75.9	79.5	0.548	0.584	0.612
140	2	70.7	75.3	78.8	0.505	0.538	0.563
150	9	68.5	72.9	76.4	0.457	0.486	0.509
160	6	65.1	69.3	72.6	0.407	0.433	0.454
170		60.8	64.8	67.8	0.358	0.381	0.399
180		56.0	59.6	62.4	0.311	0.331	0.347
190		50.8	54.1	56.7	0.267	0.285	0.298
200		45.6	48.5	50.8	0.228	0.243	0.254

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

SA Stratum Base Natural Stand Yield Curves

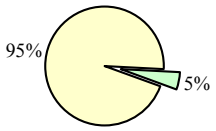
FMU W13 / SA STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	60
Stratum Area (ha) :	10,207

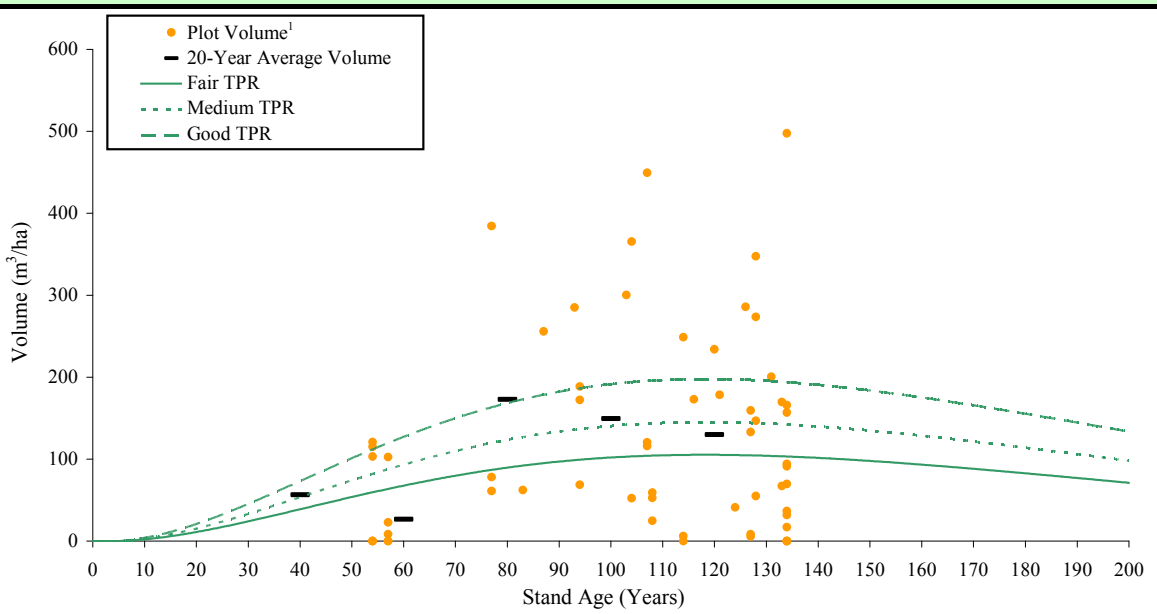
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		2.7	3.8	5.1	0.275	0.376	0.511
20		12.5	16.9	22.7	0.626	0.844	1.135
30		29.4	38.9	51.8	0.979	1.296	1.725
40		52.1	68.0	89.5	1.303	1.699	2.238
50	11	78.9	101.4	132.4	1.578	2.028	2.647
60		107.2	136.3	176.6	1.787	2.272	2.943
70	3	134.8	169.9	218.7	1.926	2.427	3.125
80	2	159.7	199.8	256.0	1.996	2.497	3.200
90	4	180.3	224.4	286.4	2.004	2.493	3.182
100	9	195.9	242.8	309.0	1.959	2.428	3.090
110	4	206.1	254.6	323.4	1.874	2.315	2.940
120	12	211.0	260.2	329.9	1.759	2.168	2.749
130	15	211.1	260.0	329.3	1.624	2.000	2.533
140		207.1	254.9	322.7	1.479	1.821	2.305
150		199.7	245.8	311.2	1.331	1.638	2.074
160		189.7	233.6	295.8	1.186	1.460	1.849
170		177.9	219.2	277.8	1.046	1.289	1.634
180		164.9	203.4	258.1	0.916	1.130	1.434
190		151.3	187.0	237.4	0.796	0.984	1.250
200		137.6	170.3	216.6	0.688	0.852	1.083

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / SA STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



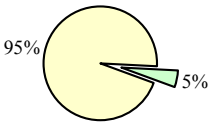
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.250E-02
Eqn: 2P+k	a_1	2.319E-03
	b	2.3658988
	k	50
Site Index Inputs	F	11.4
	M	13.7
	G	16.7

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	60
Stratum Area (ha) :	10,207

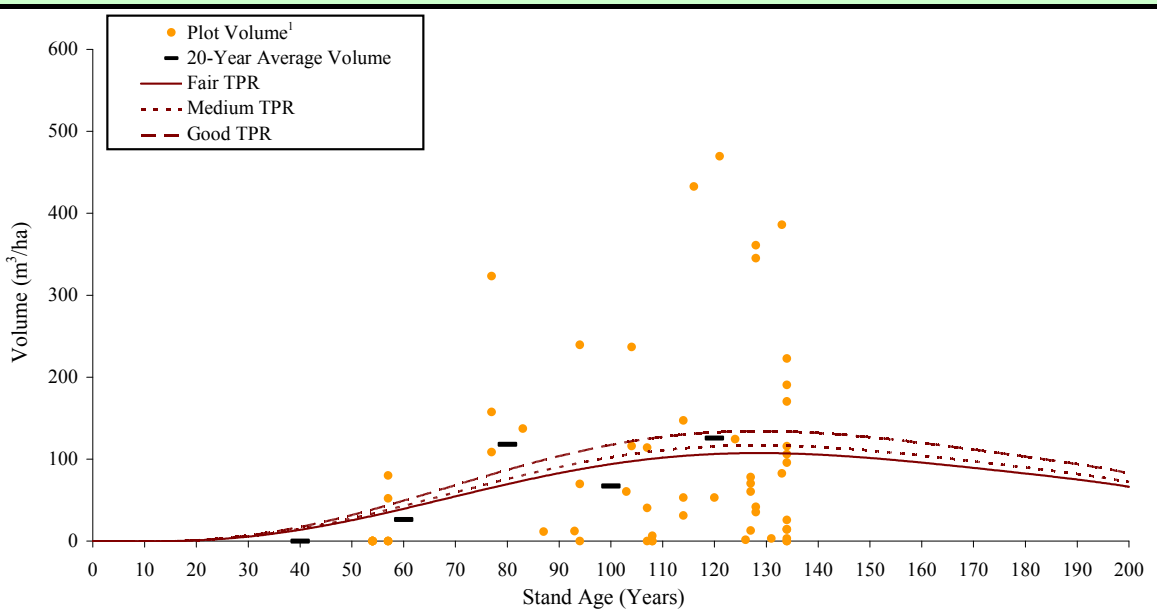
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		2.7	3.7	5.0	0.266	0.366	0.499
20		11.2	15.4	21.1	0.561	0.772	1.053
30		24.0	33.0	45.0	0.799	1.100	1.500
40		38.7	53.4	72.8	0.969	1.334	1.819
50	11	53.8	74.1	101.0	1.076	1.482	2.020
60		67.8	93.4	127.3	1.130	1.556	2.121
70	3	79.9	110.1	150.1	1.142	1.573	2.144
80	2	89.7	123.6	168.5	1.122	1.545	2.107
90	4	97.1	133.7	182.3	1.079	1.486	2.026
100	9	102.0	140.5	191.5	1.020	1.405	1.915
110	4	104.6	144.1	196.5	0.951	1.310	1.786
120	12	105.2	144.9	197.6	0.877	1.208	1.647
130	15	104.1	143.4	195.5	0.801	1.103	1.504
140		101.6	139.9	190.8	0.726	0.999	1.363
150		97.9	134.9	183.9	0.653	0.899	1.226
160		93.4	128.6	175.4	0.584	0.804	1.096
170		88.3	121.6	165.7	0.519	0.715	0.975
180		82.7	113.9	155.3	0.460	0.633	0.863
190		77.0	106.0	144.5	0.405	0.558	0.761
200		71.1	98.0	133.6	0.356	0.490	0.668

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / SA STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



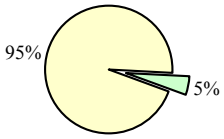
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	2.365E-06
Eqn: 2P+k	a_1	2.873E-07
	b	4.3087260
	k	30
Site Index Inputs	F	13.9
	M	15.9
	G	19.4

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	60
Stratum Area (ha) :	10,207

Stratum as a proportion of total managed landbase, FMU W13:

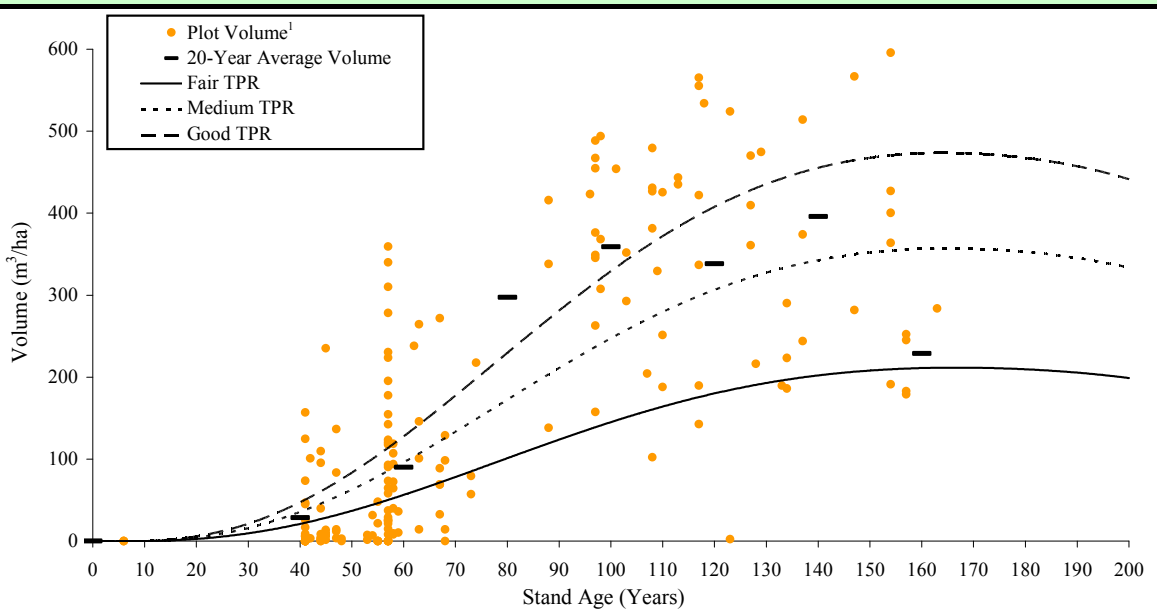


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.1	0.1	0.009	0.010	0.012
20		1.3	1.4	1.6	0.066	0.072	0.082
30		5.4	5.9	6.8	0.180	0.196	0.225
40		13.4	14.6	16.7	0.335	0.365	0.419
50	11	25.1	27.3	31.4	0.502	0.547	0.628
60		39.4	43.0	49.3	0.657	0.716	0.822
70	3	54.9	59.8	68.7	0.784	0.855	0.981
80	2	70.0	76.2	87.5	0.874	0.952	1.093
90	4	83.3	90.7	104.1	0.925	1.008	1.157
100	9	93.9	102.3	117.4	0.939	1.023	1.174
110	4	101.5	110.5	126.9	0.923	1.005	1.154
120	12	105.8	115.2	132.3	0.882	0.960	1.102
130	15	107.0	116.6	133.8	0.823	0.897	1.029
140		105.5	115.0	132.0	0.754	0.821	0.943
150		101.8	110.9	127.3	0.679	0.739	0.849
160		96.3	104.9	120.4	0.602	0.656	0.753
170		89.6	97.6	112.1	0.527	0.574	0.659
180		82.1	89.5	102.7	0.456	0.497	0.571
190		74.3	80.9	92.9	0.391	0.426	0.489
200		66.4	72.3	83.0	0.332	0.362	0.415

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

PL Stratum Base Natural Stand Yield Curves

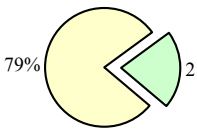
FMU W13 / PL STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	183
Stratum Area (ha) :	44,707

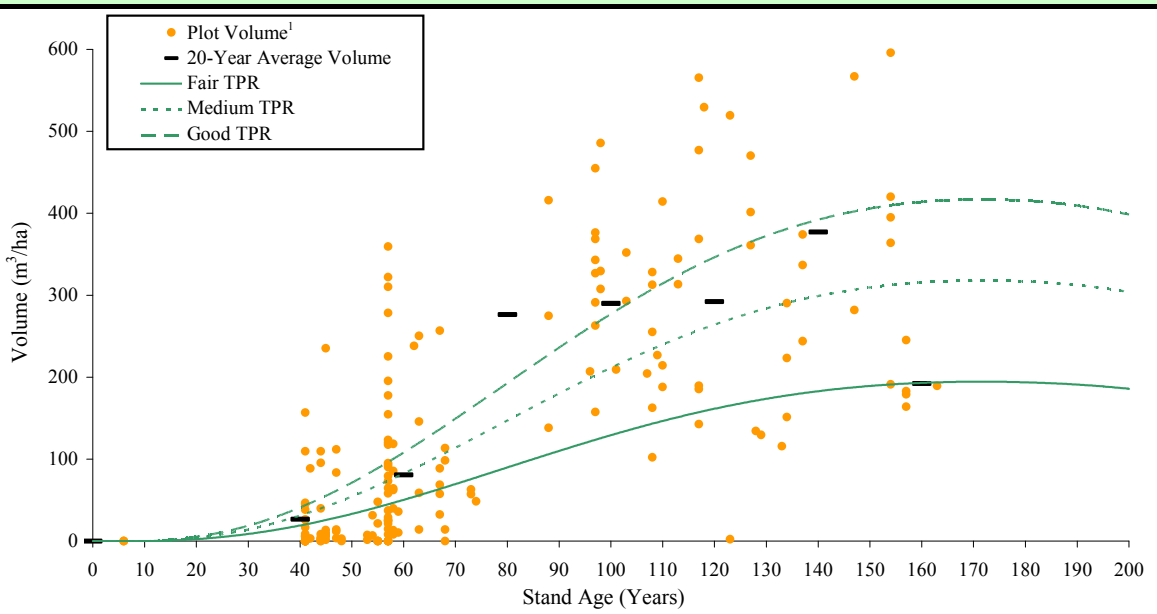
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	3	0.0	0.0	0.0	0.000	0.000	0.000
10		0.3	0.5	0.7	0.031	0.052	0.068
20		2.8	4.7	6.2	0.140	0.234	0.310
30		9.3	15.7	20.8	0.311	0.524	0.694
40	48	20.7	35.0	46.5	0.518	0.876	1.163
50	52	36.7	62.3	82.9	0.734	1.246	1.657
60	14	56.4	95.9	127.6	0.939	1.599	2.127
70	3	78.4	133.6	177.9	1.120	1.908	2.541
80	3	101.3	172.8	230.2	1.267	2.160	2.877
90	12	124.0	211.4	281.5	1.377	2.349	3.128
100	10	145.1	247.3	329.3	1.451	2.473	3.293
110	12	164.0	279.2	371.6	1.490	2.538	3.378
120	7	179.9	306.0	407.1	1.499	2.550	3.392
130	7	192.7	327.2	435.0	1.482	2.517	3.346
140	2	202.1	342.6	455.3	1.444	2.447	3.252
150	9	208.3	352.4	468.1	1.388	2.350	3.120
160	1	211.3	357.0	473.8	1.321	2.231	2.961
170		211.6	356.8	473.2	1.245	2.099	2.783
180		209.4	352.4	467.0	1.163	1.958	2.595
190		205.1	344.5	456.2	1.079	1.813	2.401
200		198.9	333.6	441.5	0.995	1.668	2.207

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / PL STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



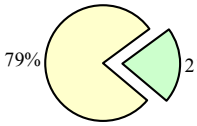
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.456E-04
Eqn: 2P+k	a_1	2.666E-05
	b	3.4097246
	k	50
Site Index Inputs	F	10.9
	M	14.3
	G	17.1

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	183
Stratum Area (ha) :	44,707

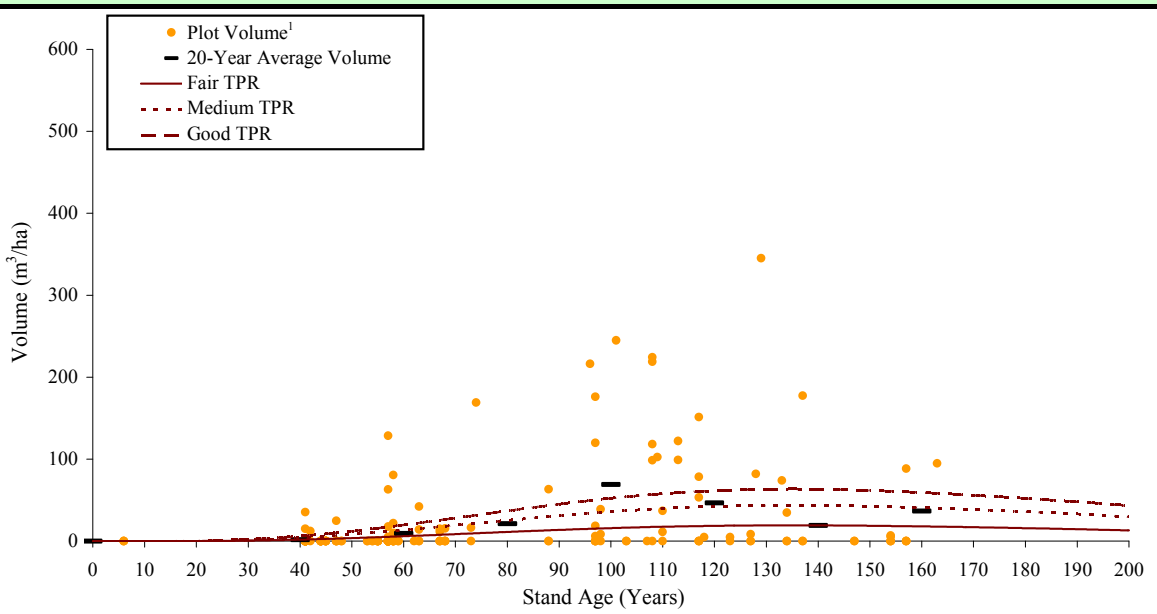
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0	3	0.0	0.0	0.0	0.000	0.000	0.000
10		0.3	0.5	0.7	0.030	0.050	0.065
20		2.6	4.3	5.7	0.132	0.217	0.284
30		8.6	14.1	18.5	0.288	0.471	0.617
40	48	18.9	30.8	40.4	0.472	0.771	1.011
50	52	33.1	54.1	70.9	0.661	1.081	1.417
60	14	50.4	82.4	108.0	0.840	1.373	1.800
70	3	69.8	114.1	149.6	0.997	1.630	2.137
80	3	90.1	147.3	193.1	1.126	1.841	2.414
90	12	110.2	180.2	236.2	1.225	2.002	2.625
100	10	129.2	211.3	277.0	1.292	2.113	2.770
110	12	146.4	239.5	313.9	1.331	2.177	2.854
120	7	161.3	263.8	345.8	1.344	2.198	2.881
130	7	173.5	283.7	371.9	1.335	2.182	2.861
140	2	182.9	299.1	392.1	1.306	2.136	2.800
150	9	189.5	309.8	406.1	1.263	2.065	2.707
160	1	193.3	316.1	414.3	1.208	1.975	2.590
170		194.6	318.2	417.1	1.145	1.872	2.454
180		193.6	316.6	415.0	1.076	1.759	2.306
190		190.6	311.7	408.6	1.003	1.640	2.150
200		185.9	303.9	398.4	0.929	1.520	1.992

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / PL STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



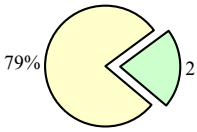
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.189E-06
Eqn: 2P+k	a_1	1.424E-07
	b	4.5284879
	k	30
Site Index Inputs	F	11.1
	M	14.6
	G	17.4

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	183
Stratum Area (ha) :	44,707

Stratum as a proportion of total managed landbase, FMU W13:

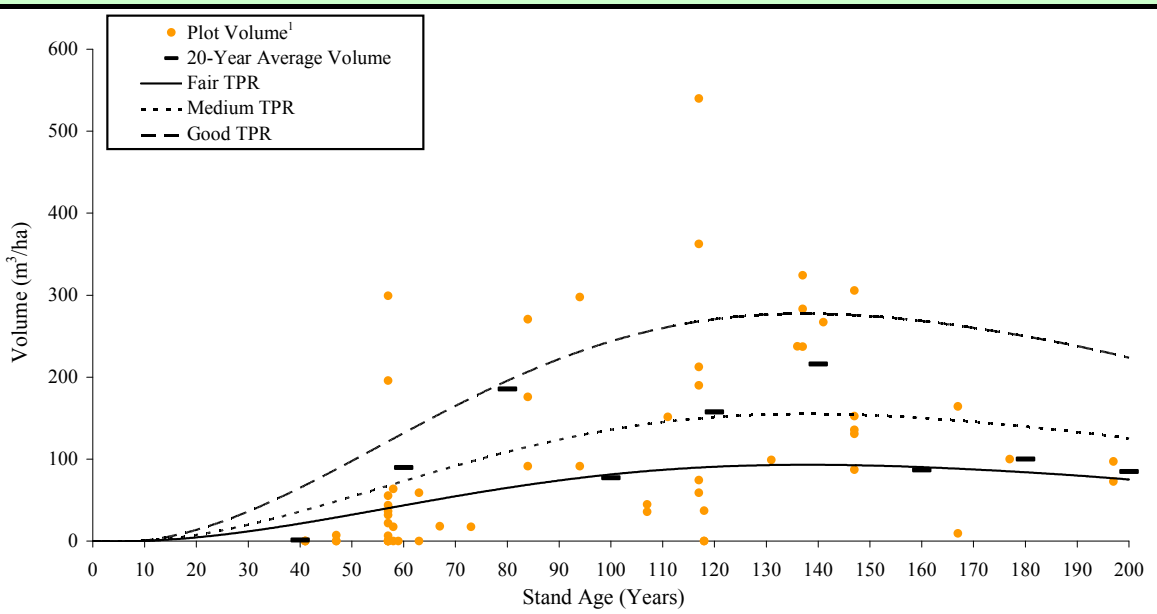


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0	3	0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.001	0.002	0.003
20		0.2	0.4	0.5	0.008	0.018	0.026
30		0.7	1.6	2.3	0.023	0.053	0.077
40	48	1.8	4.2	6.1	0.046	0.105	0.152
50	52	3.6	8.3	12.0	0.073	0.165	0.240
60	14	6.0	13.5	19.6	0.099	0.225	0.327
70	3	8.6	19.5	28.3	0.123	0.278	0.404
80	3	11.3	25.5	37.1	0.141	0.319	0.463
90	12	13.7	31.2	45.3	0.153	0.346	0.503
100	10	15.9	36.0	52.3	0.159	0.360	0.523
110	12	17.5	39.7	57.7	0.159	0.361	0.524
120	7	18.6	42.2	61.3	0.155	0.352	0.511
130	7	19.2	43.5	63.1	0.147	0.334	0.485
140	2	19.2	43.6	63.2	0.137	0.311	0.452
150	9	18.8	42.7	61.9	0.125	0.284	0.413
160	1	18.0	40.9	59.4	0.113	0.256	0.372
170		17.0	38.6	56.1	0.100	0.227	0.330
180		15.8	35.8	52.0	0.088	0.199	0.289
190		14.5	32.8	47.6	0.076	0.173	0.251
200		13.1	29.6	43.0	0.065	0.148	0.215

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

SB Stratum Base Natural Stand Yield Curves

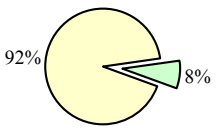
FMU W13 / SB STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	61
Stratum Area (ha) :	16,558

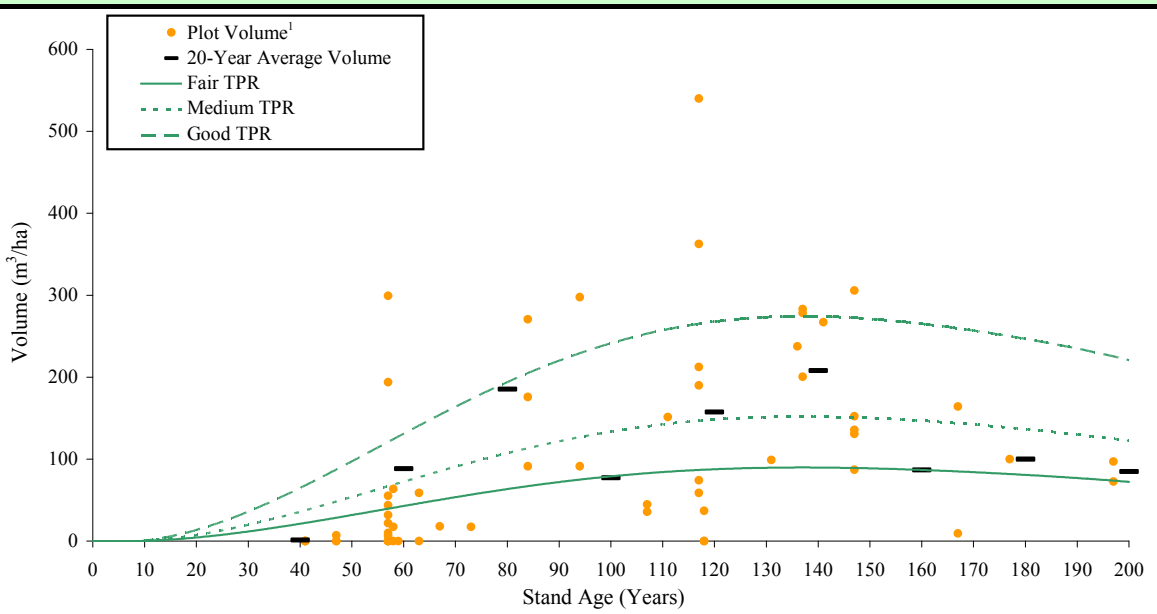
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.8	1.4	2.5	0.083	0.141	0.254
20		4.6	7.8	14.1	0.231	0.391	0.705
30		11.6	19.6	35.4	0.387	0.654	1.179
40	6	21.1	35.6	64.1	0.527	0.889	1.602
50	18	32.1	54.0	97.2	0.642	1.080	1.945
60	3	43.6	73.3	131.8	0.727	1.221	2.197
70	1	54.8	92.0	165.3	0.783	1.314	2.361
80	3	65.1	109.1	195.8	0.814	1.363	2.448
90	2	74.0	123.8	222.1	0.822	1.376	2.468
100	2	81.2	135.8	243.4	0.812	1.358	2.434
110	10	86.8	144.9	259.5	0.789	1.317	2.359
120		90.5	151.0	270.3	0.754	1.258	2.252
130	5	92.6	154.3	276.1	0.712	1.187	2.124
140	6	93.1	155.1	277.5	0.665	1.108	1.982
150		92.3	153.7	274.9	0.615	1.025	1.833
160	2	90.4	150.5	269.0	0.565	0.940	1.681
170	1	87.5	145.6	260.3	0.515	0.857	1.531
180		83.9	139.6	249.6	0.466	0.776	1.386
190	2	79.7	132.7	237.2	0.419	0.698	1.248
200		75.1	125.1	223.7	0.376	0.625	1.118

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / SB STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



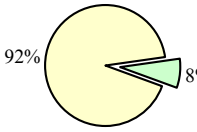
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-4.658E-03
Eqn: 2P+k	a_1	8.458E-04
	b	2.7585383
	k	50
Site Index Inputs	F	7.6
	M	9.1
	G	11.9

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	61
Stratum Area (ha) :	16,558

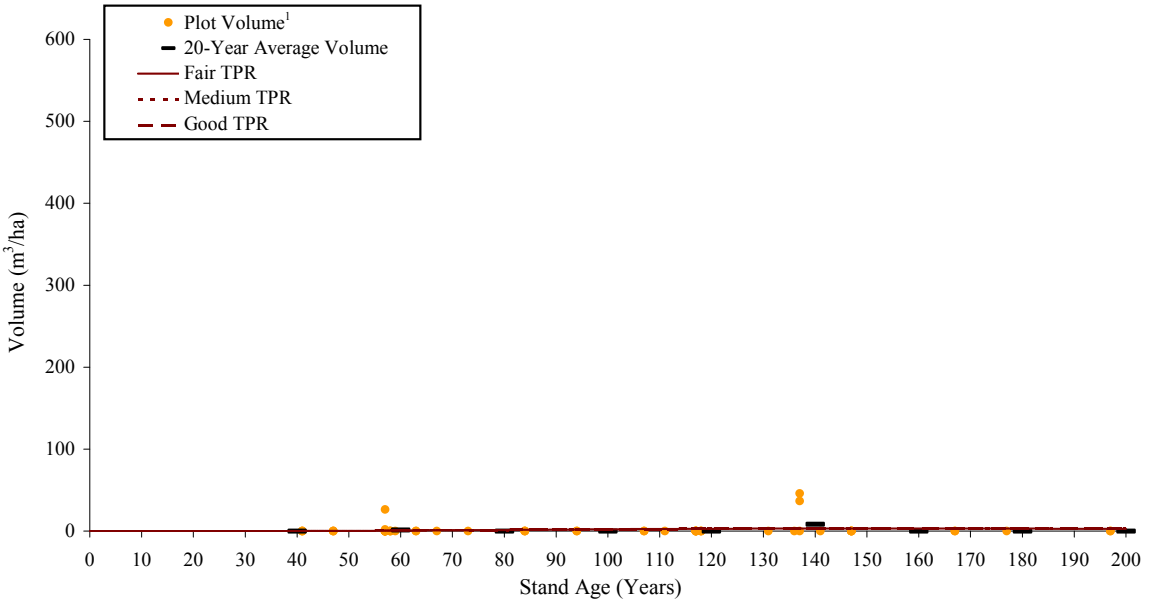
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.8	1.4	2.5	0.083	0.141	0.254
20		4.6	7.8	14.1	0.231	0.390	0.705
30		11.6	19.6	35.3	0.386	0.652	1.177
40	6	20.9	35.4	63.9	0.524	0.885	1.599
50	18	31.7	53.7	96.9	0.635	1.073	1.938
60	3	43.0	72.6	131.2	0.716	1.211	2.186
70	1	53.8	91.0	164.3	0.769	1.300	2.347
80	3	63.7	107.7	194.4	0.796	1.346	2.430
90	2	72.2	122.0	220.3	0.802	1.356	2.448
100	2	79.0	133.6	241.2	0.790	1.336	2.412
110	10	84.1	142.2	256.9	0.765	1.293	2.335
120		87.6	148.1	267.3	0.730	1.234	2.228
130	5	89.4	151.2	273.0	0.688	1.163	2.100
140	6	89.8	151.8	274.2	0.641	1.085	1.958
150		88.9	150.4	271.5	0.593	1.003	1.810
160	2	87.0	147.1	265.6	0.544	0.919	1.660
170	1	84.2	142.4	257.1	0.495	0.837	1.512
180		80.7	136.5	246.4	0.448	0.758	1.369
190	2	76.7	129.7	234.2	0.404	0.683	1.233
200		72.4	122.3	220.9	0.362	0.612	1.104

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / SB STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



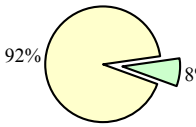
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a	3.886E-09
Eqn: 2P+k	b	5.1048990
	k	30
Site Index Inputs	F	n/a
One deciduous	M	n/a
curve for all TPR	G	n/a

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	61
Stratum Area (ha) :	16,558

Stratum as a proportion of total managed landbase, FMU W13:

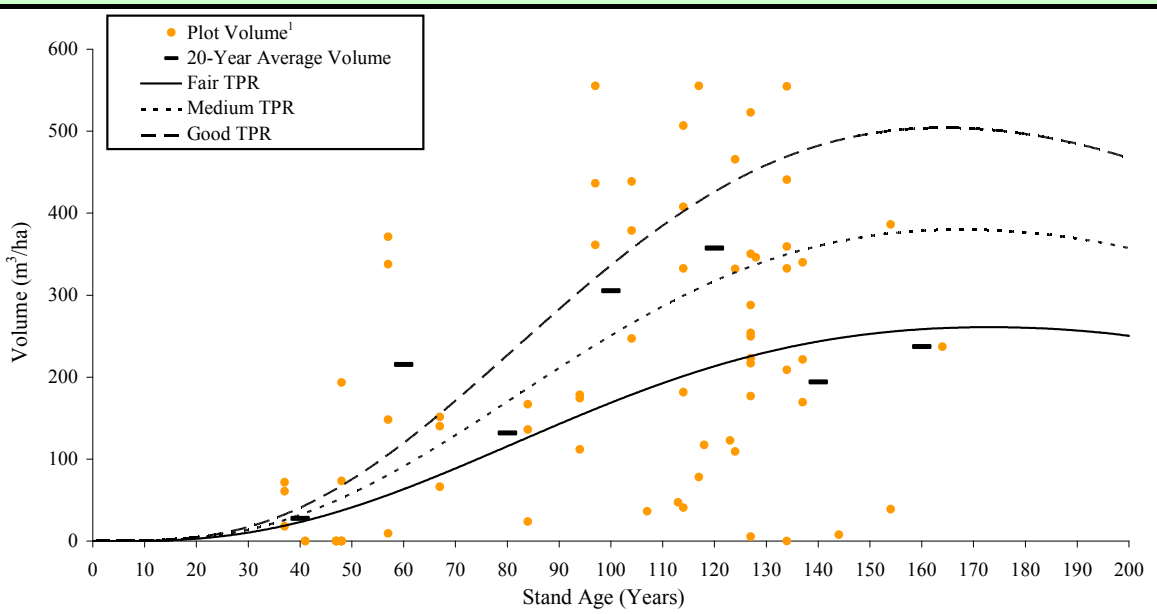


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.000	0.000	0.000
20		0.0	0.0	0.0	0.000	0.000	0.000
30		0.0	0.0	0.0	0.002	0.002	0.002
40	6	0.2	0.2	0.2	0.004	0.004	0.004
50	18	0.3	0.3	0.3	0.007	0.007	0.007
60	3	0.6	0.6	0.6	0.010	0.010	0.010
70	1	1.0	1.0	1.0	0.014	0.014	0.014
80	3	1.4	1.4	1.4	0.018	0.018	0.018
90	2	1.8	1.8	1.8	0.020	0.020	0.020
100	2	2.2	2.2	2.2	0.022	0.022	0.022
110	10	2.6	2.6	2.6	0.024	0.024	0.024
120		2.9	2.9	2.9	0.024	0.024	0.024
130	5	3.2	3.2	3.2	0.024	0.024	0.024
140	6	3.3	3.3	3.3	0.024	0.024	0.024
150		3.4	3.4	3.4	0.022	0.022	0.022
160	2	3.3	3.3	3.3	0.021	0.021	0.021
170	1	3.3	3.3	3.3	0.019	0.019	0.019
180		3.1	3.1	3.1	0.017	0.017	0.017
190	2	3.0	3.0	3.0	0.016	0.016	0.016
200		2.8	2.8	2.8	0.014	0.014	0.014

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

SW Stratum Base Natural Stand Yield Curves

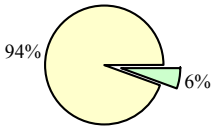
FMU W13 / SW STRATUM / Base Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	76
Stratum Area (ha) :	11,929

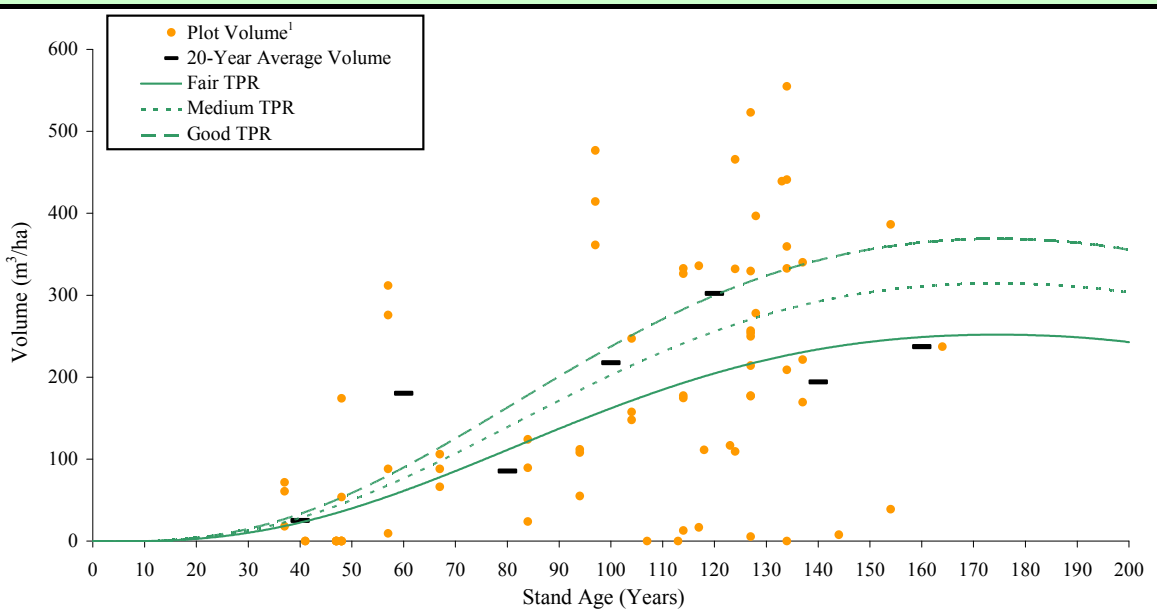
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.3	0.4	0.5	0.033	0.043	0.051
20		3.1	4.0	4.9	0.153	0.200	0.245
30	3	10.3	13.8	17.3	0.342	0.462	0.578
40	12	22.9	31.7	40.5	0.573	0.793	1.013
50	5	40.9	57.8	75.0	0.819	1.156	1.500
60	3	63.3	91.0	119.5	1.056	1.517	1.991
70		88.8	129.3	171.3	1.269	1.847	2.447
80	3	115.8	170.2	227.0	1.448	2.128	2.838
90	6	142.9	211.4	283.2	1.588	2.349	3.146
100	4	168.8	250.7	336.6	1.688	2.507	3.366
110	9	192.5	286.2	384.7	1.750	2.602	3.498
120	17	213.1	316.7	425.7	1.776	2.639	3.547
130	10	230.2	341.4	458.3	1.771	2.627	3.526
140	1	243.5	360.0	482.2	1.739	2.572	3.444
150	2	253.0	372.4	497.3	1.686	2.483	3.315
160	1	258.7	378.9	504.2	1.617	2.368	3.151
170		261.0	380.0	503.6	1.535	2.235	2.962
180		260.1	376.3	496.5	1.445	2.091	2.758
190		256.5	368.6	483.9	1.350	1.940	2.547
200		250.4	357.4	466.9	1.252	1.787	2.335

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / SW STRATUM / Base Natural Stand Yield Curve / Coniferous Volume



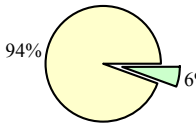
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	3.753E-05
Eqn: 2P+k	a_1	9.751E-06
	b	3.4688798
	k	50
Site Index Inputs	F	10.3
	M	13.9
	G	16.9

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	76
Stratum Area (ha) :	11,929

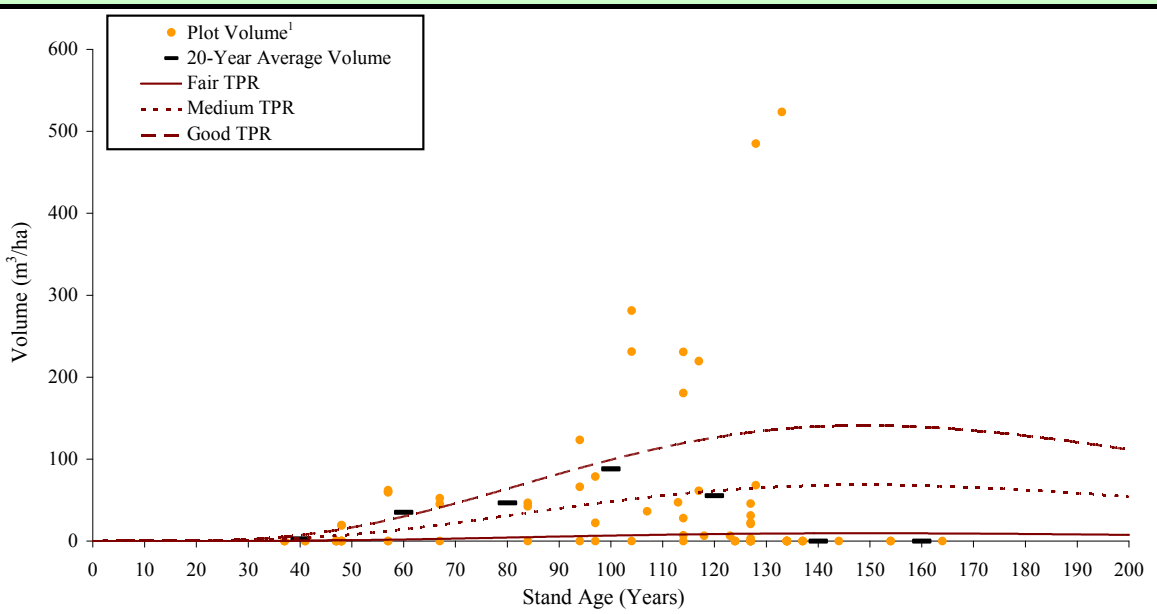
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.3	0.4	0.5	0.033	0.042	0.049
20		3.0	3.8	4.4	0.151	0.189	0.221
30	3	10.1	12.6	14.8	0.336	0.420	0.492
40	12	22.4	28.0	32.8	0.560	0.700	0.820
50	5	39.8	49.7	58.2	0.796	0.994	1.165
60	3	61.3	76.6	89.7	1.022	1.276	1.496
70		85.7	107.0	125.4	1.224	1.529	1.792
80	3	111.5	139.2	163.2	1.393	1.740	2.040
90	6	137.3	171.5	201.0	1.526	1.906	2.234
100	4	162.0	202.4	237.2	1.620	2.024	2.372
110	9	184.7	230.6	270.3	1.679	2.097	2.457
120	17	204.4	255.4	299.3	1.704	2.128	2.494
130	10	221.0	276.0	323.5	1.700	2.123	2.488
140	1	233.9	292.2	342.5	1.671	2.087	2.446
150	2	243.3	303.9	356.2	1.622	2.026	2.375
160	1	249.2	311.3	364.8	1.558	1.945	2.280
170		251.8	314.5	368.6	1.481	1.850	2.168
180		251.3	313.9	368.0	1.396	1.744	2.044
190		248.2	310.1	363.4	1.307	1.632	1.913
200		242.8	303.3	355.5	1.214	1.516	1.777

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / SW STRATUM / Base Natural Stand Yield Curve / Deciduous Volume



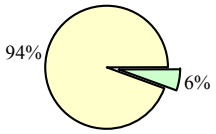
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-5.878E-07
Eqn: 2P+k	a_1	4.687E-08
	b	4.9741427
	k	30
Site Index Inputs	F	13.0
	M	15.8
	G	19.2

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	76
Stratum Area (ha) :	11,929

Stratum as a proportion of total managed landbase, FMU W13:



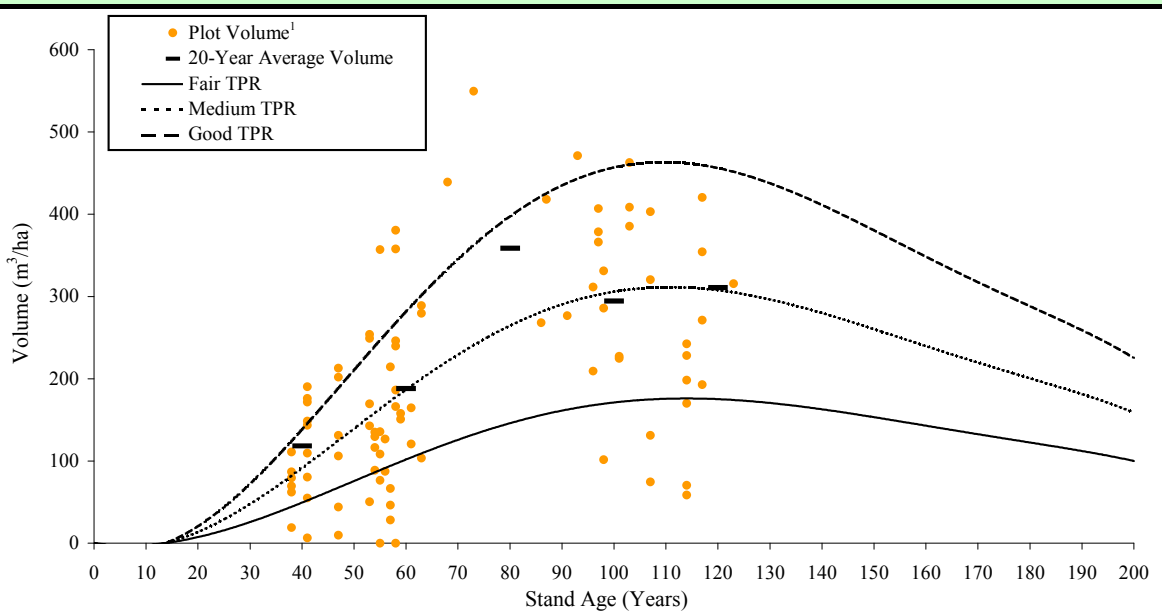
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.000	0.001	0.002
20		0.0	0.2	0.5	0.002	0.012	0.024
30	3	0.2	1.2	2.6	0.006	0.042	0.086
40	12	0.5	3.7	7.7	0.013	0.093	0.193
50	5	1.1	8.1	16.7	0.023	0.163	0.335
60	3	2.0	14.4	29.7	0.034	0.240	0.495
70		3.1	22.2	45.8	0.045	0.318	0.655
80	3	4.4	31.0	63.8	0.054	0.387	0.798
90	6	5.6	39.9	82.1	0.062	0.443	0.913
100	4	6.8	48.3	99.4	0.068	0.483	0.994
110	9	7.8	55.5	114.4	0.071	0.505	1.040
120	17	8.6	61.4	126.4	0.072	0.511	1.053
130	10	9.2	65.5	134.9	0.071	0.504	1.037
140	1	9.5	67.8	139.7	0.068	0.484	0.998
150	2	9.6	68.5	141.1	0.064	0.457	0.941
160	1	9.5	67.6	139.4	0.059	0.423	0.871
170		9.2	65.5	135.0	0.054	0.385	0.794
180		8.8	62.4	128.5	0.049	0.347	0.714
190		8.2	58.5	120.5	0.043	0.308	0.634
200		7.6	54.1	111.5	0.038	0.271	0.557

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

Appendix XIII. FMU W13 Base Managed Stand Yield Curves

AW Stratum Base Managed Stand Yield Curves

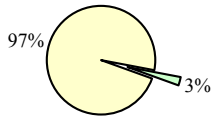
FMU W13 / AW STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	91
Stratum Area (ha) :	5,447

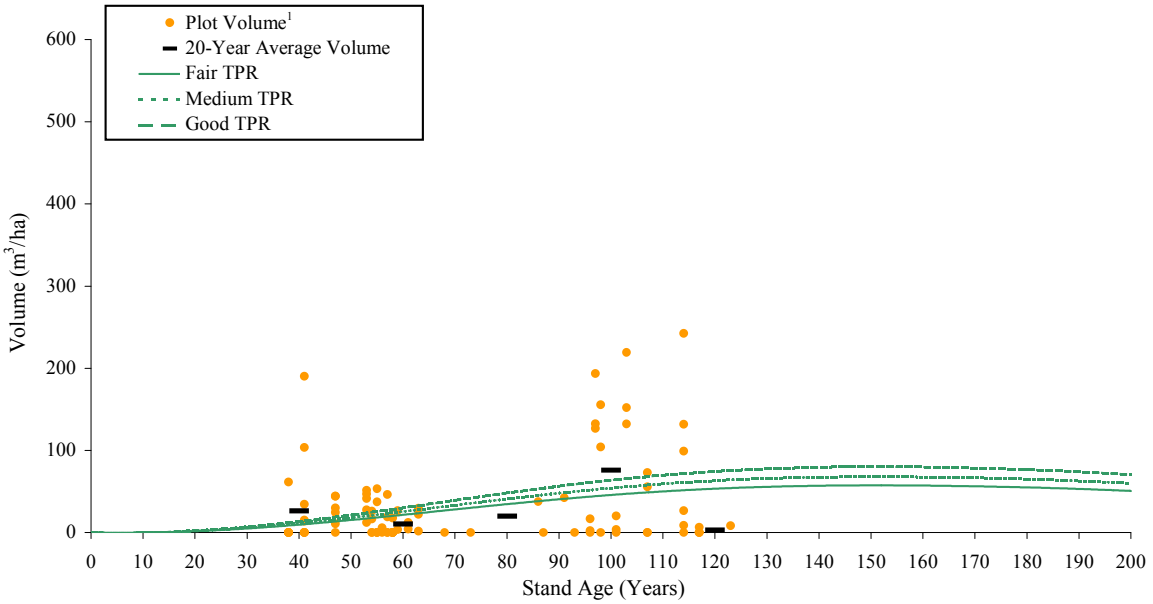
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.1	2.0	3.0	0.110	0.201	0.302
20		8.5	15.6	23.5	0.423	0.779	1.177
30	6	24.6	45.3	68.6	0.819	1.511	2.287
40	15	47.8	88.3	133.6	1.196	2.207	3.339
50	29	74.9	137.9	208.4	1.498	2.757	4.168
60	6	102.2	187.3	282.7	1.703	3.122	4.712
70	1	126.8	231.3	348.5	1.812	3.305	4.978
80	2	147.0	266.5	400.4	1.837	3.331	5.005
90	11	161.7	291.1	436.2	1.796	3.235	4.847
100	10	170.8	305.2	455.9	1.708	3.052	4.559
110	10	174.8	309.7	460.9	1.589	2.815	4.190
120	1	174.2	305.8	453.4	1.452	2.549	3.779
130		170.0	295.5	436.2	1.308	2.273	3.355
140		163.0	280.3	411.9	1.165	2.002	2.942
150		154.1	261.9	382.8	1.027	1.746	2.552
160		143.8	241.5	351.1	0.899	1.509	2.195
170		132.9	220.3	318.5	0.782	1.296	1.873
180		121.7	199.2	286.1	0.676	1.106	1.590
190		110.7	178.7	255.0	0.583	0.940	1.342
200		100.1	159.3	225.7	0.501	0.796	1.129

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



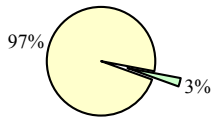
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-7.806E-06
Eqn: 2P+k	a_1	2.389E-05
	b	3.0333416
	k	50
Site Index Inputs	F	12.4
	M	14.7
	G	17.2

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	91
Stratum Area (ha) :	5,447

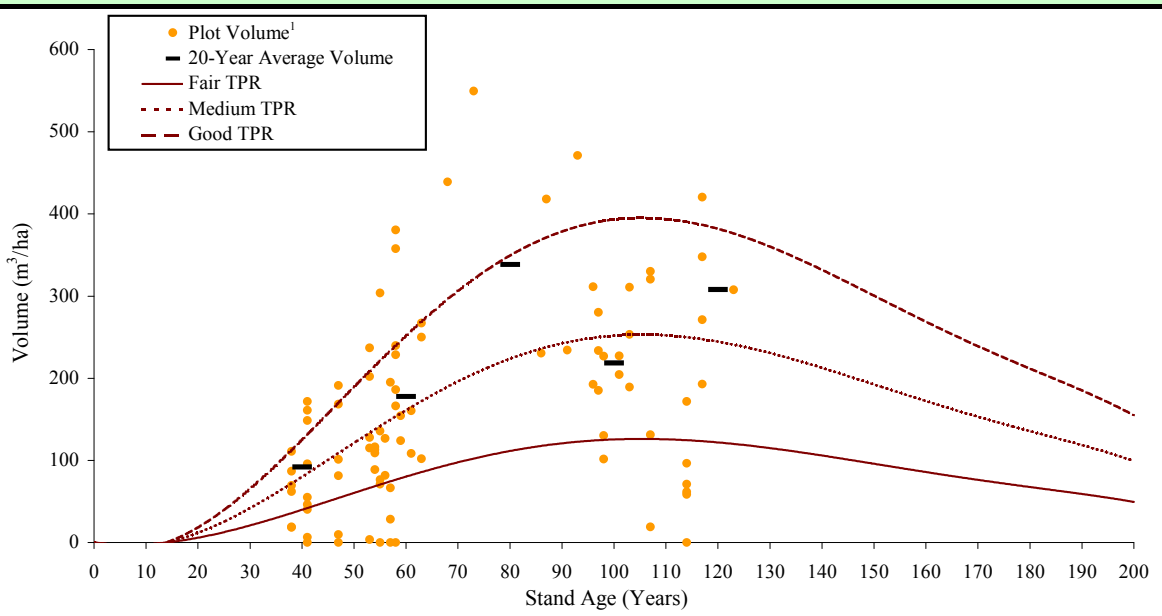
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.3	0.3	0.4	0.026	0.030	0.036
20		1.7	2.0	2.4	0.086	0.101	0.119
30	6	4.8	5.7	6.7	0.160	0.189	0.223
40	15	9.4	11.1	13.1	0.235	0.278	0.328
50	29	15.2	17.9	21.1	0.303	0.359	0.422
60	6	21.6	25.5	30.1	0.360	0.425	0.501
70	1	28.2	33.4	39.3	0.403	0.477	0.561
80	2	34.6	41.0	48.2	0.433	0.512	0.603
90	11	40.5	47.9	56.4	0.450	0.533	0.627
100	10	45.7	54.0	63.6	0.457	0.540	0.636
110	10	49.9	59.0	69.5	0.454	0.537	0.632
120	1	53.2	62.9	74.1	0.444	0.525	0.618
130		55.6	65.7	77.4	0.427	0.505	0.595
140		56.9	67.3	79.3	0.407	0.481	0.566
150		57.5	68.0	80.0	0.383	0.453	0.534
160		57.2	67.7	79.7	0.358	0.423	0.498
170		56.3	66.6	78.4	0.331	0.392	0.461
180		54.8	64.9	76.4	0.305	0.360	0.424
190		52.9	62.6	73.7	0.278	0.329	0.388
200		50.6	59.8	70.5	0.253	0.299	0.352

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



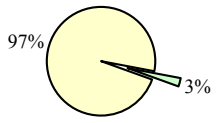
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.966E-03
Eqn: 2P+k	a_1	1.579E-04
	b	3.4714176
	k	30
Site Index Inputs	F	15.0
	M	17.5
	G	20.4

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	91
Stratum Area (ha) :	5,447

Stratum as a proportion of total managed landbase, FMU W13:

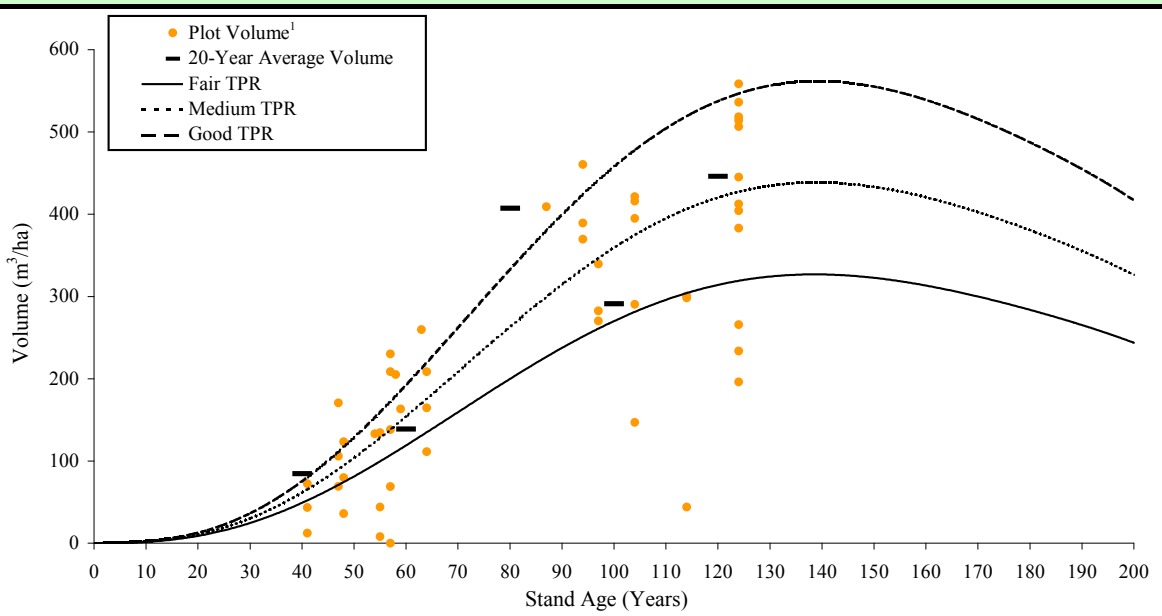


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.8	1.7	2.7	0.085	0.170	0.266
20		6.7	13.5	21.2	0.337	0.677	1.058
30	6	19.8	39.7	61.9	0.658	1.322	2.064
40	15	38.4	77.1	120.5	0.961	1.928	3.011
50	29	59.7	119.9	187.3	1.195	2.398	3.745
60	6	80.6	161.8	252.7	1.343	2.697	4.211
70	1	98.6	198.0	309.2	1.409	2.828	4.417
80	2	112.3	225.5	352.2	1.404	2.819	4.402
90	11	121.2	243.2	379.8	1.346	2.702	4.220
100	10	125.2	251.2	392.3	1.252	2.512	3.923
110	10	124.8	250.6	391.4	1.135	2.278	3.558
120	1	121.0	242.9	379.3	1.008	2.024	3.161
130		114.5	229.8	358.8	0.881	1.768	2.760
140		106.1	212.9	332.6	0.758	1.521	2.375
150		96.6	193.9	302.8	0.644	1.293	2.018
160		86.6	173.8	271.4	0.541	1.086	1.696
170		76.6	153.7	240.0	0.450	0.904	1.412
180		66.9	134.3	209.7	0.372	0.746	1.165
190		57.8	116.1	181.3	0.304	0.611	0.954
200		49.5	99.4	155.2	0.248	0.497	0.776

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

AP Stratum Base Managed Stand Yield Curves

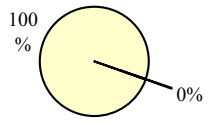
FMU W13 / AP STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	53
Stratum Area (ha) :	527

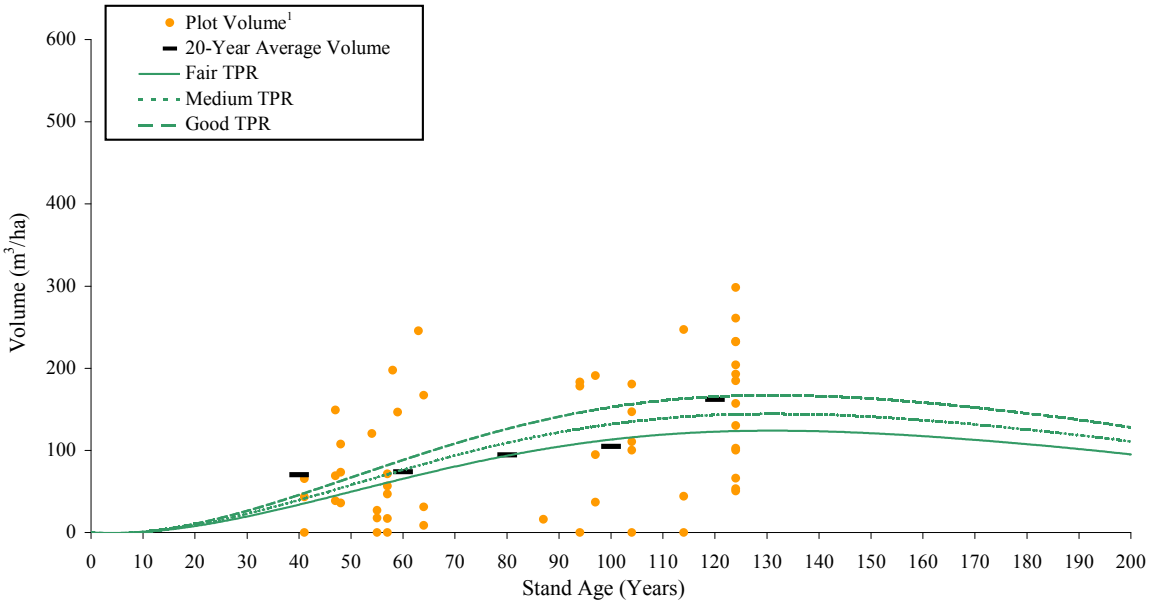
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.6	1.9	2.3	0.164	0.193	0.225
20		9.2	11.0	13.0	0.459	0.551	0.652
30		24.7	30.3	36.5	0.822	1.010	1.217
40	9	48.8	61.2	74.9	1.220	1.530	1.872
50	11	80.8	103.1	127.7	1.617	2.062	2.554
60	4	118.7	153.5	191.8	1.979	2.558	3.196
70		159.6	208.4	262.2	2.279	2.977	3.746
80	1	200.2	263.5	333.4	2.503	3.294	4.167
90	6	237.9	315.0	400.0	2.643	3.500	4.445
100	5	270.2	359.4	457.9	2.702	3.594	4.579
110	3	295.7	394.7	503.9	2.688	3.588	4.581
120	14	313.6	419.6	536.6	2.614	3.497	4.472
130		323.8	434.0	555.6	2.491	3.339	4.274
140		326.7	438.4	561.6	2.333	3.131	4.011
150		323.0	433.7	555.8	2.154	2.891	3.705
160		313.9	421.4	540.1	1.962	2.634	3.376
170		300.3	403.1	516.5	1.766	2.371	3.038
180		283.4	380.1	486.9	1.574	2.112	2.705
190		264.2	354.1	453.2	1.391	1.864	2.385
200		243.8	326.2	417.2	1.219	1.631	2.086

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AP STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



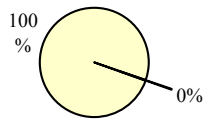
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-3.035E-04
Eqn: 2P+k	a_1	3.354E-04
	b	2.6347023
	k	50
Site Index Inputs	F	14.3
	M	16.5
	G	19.0

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	53
Stratum Area (ha) :	527

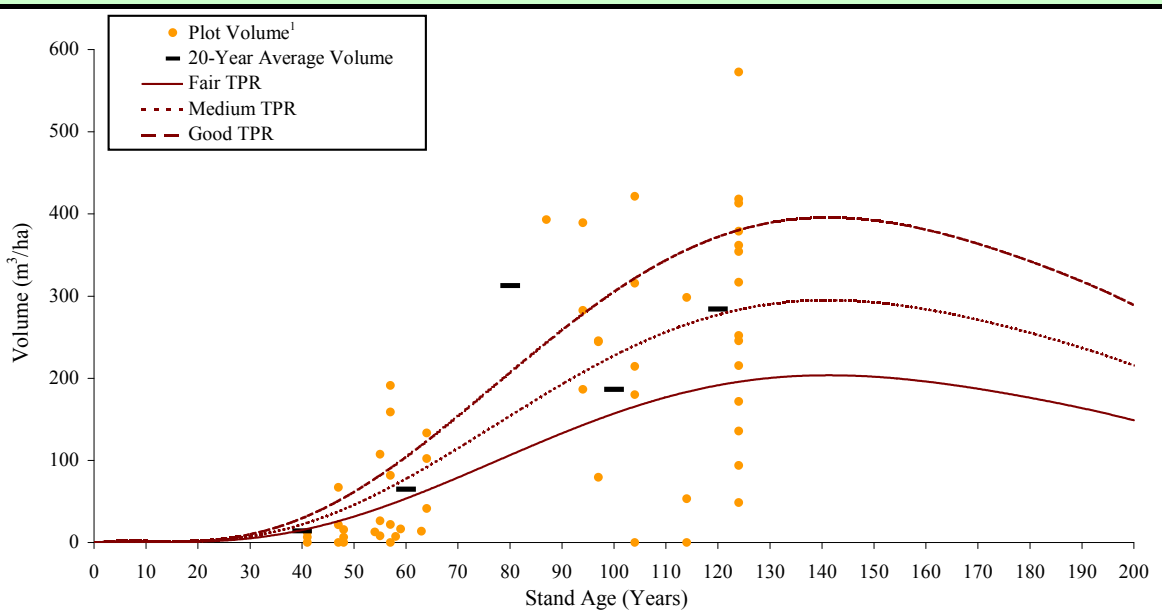
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.6	1.8	2.1	0.159	0.185	0.214
20		8.1	9.4	10.9	0.403	0.470	0.544
30		19.2	22.4	25.9	0.641	0.747	0.864
40	9	33.6	39.1	45.3	0.839	0.978	1.132
50	11	49.5	57.7	66.7	0.990	1.154	1.334
60	4	65.5	76.4	88.3	1.092	1.273	1.472
70		80.5	93.8	108.5	1.150	1.340	1.550
80	1	93.7	109.2	126.3	1.171	1.365	1.579
90	6	104.6	122.0	141.1	1.162	1.355	1.567
100	5	113.1	131.8	152.4	1.131	1.318	1.524
110	3	119.0	138.7	160.4	1.082	1.261	1.459
120	14	122.5	142.8	165.2	1.021	1.190	1.377
130		123.9	144.4	167.0	0.953	1.111	1.285
140		123.3	143.7	166.2	0.881	1.026	1.187
150		121.0	141.1	163.2	0.807	0.941	1.088
160		117.5	136.9	158.4	0.734	0.856	0.990
170		112.8	131.5	152.1	0.664	0.774	0.895
180		107.4	125.2	144.8	0.597	0.696	0.805
190		101.4	118.2	136.7	0.534	0.622	0.720
200		95.0	110.8	128.1	0.475	0.554	0.641

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AP STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



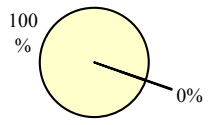
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-2.908E-06
Eqn: 2P+k	a_1	2.977E-07
	b	4.7295388
	k	30
Site Index Inputs	F	14.9
	M	17.2
	G	19.8

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	53
Stratum Area (ha) :	527

Stratum as a proportion of total managed landbase, FMU W13:

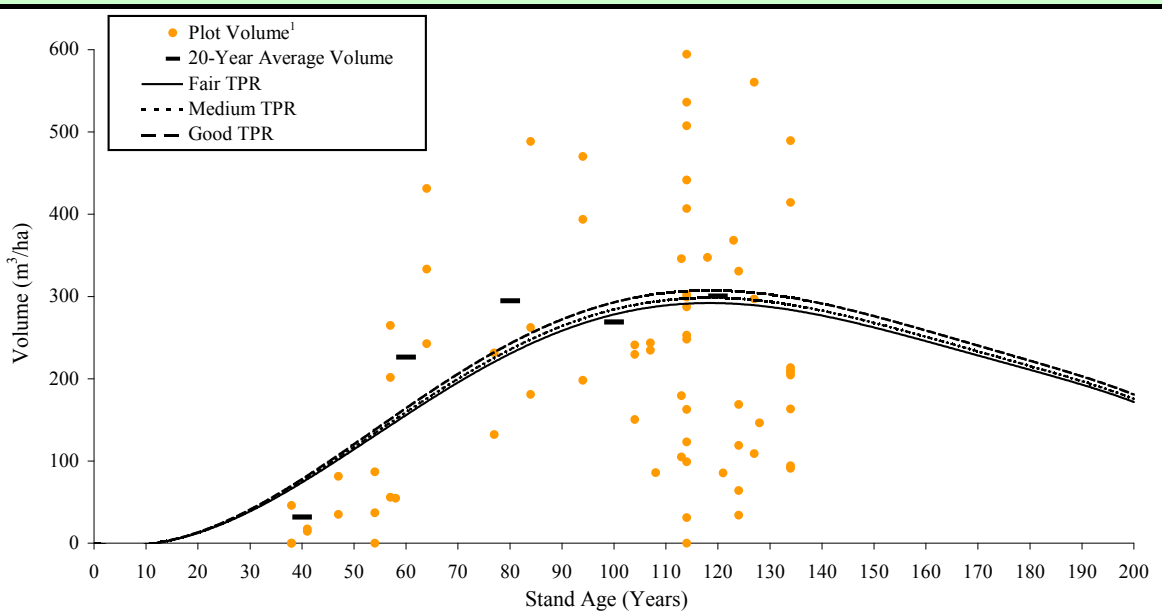


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.1	0.1	0.006	0.009	0.011
20		1.1	1.6	2.2	0.056	0.081	0.109
30		5.5	7.9	10.6	0.182	0.263	0.353
40	9	15.2	22.1	29.6	0.381	0.552	0.740
50	11	31.4	45.4	61.0	0.627	0.909	1.219
60	4	53.2	77.1	103.4	0.887	1.285	1.724
70		79.1	114.5	153.7	1.130	1.636	2.195
80	1	106.5	154.3	207.1	1.332	1.929	2.588
90	6	133.3	193.0	259.0	1.481	2.145	2.878
100	5	157.2	227.6	305.4	1.572	2.276	3.054
110	3	176.7	256.0	343.5	1.607	2.327	3.123
120	14	191.1	276.8	371.4	1.593	2.307	3.095
130		199.9	289.6	388.6	1.538	2.228	2.989
140		203.4	294.6	395.3	1.453	2.105	2.824
150		202.0	292.6	392.6	1.347	1.951	2.617
160		196.4	284.5	381.7	1.227	1.778	2.386
170		187.4	271.5	364.3	1.103	1.597	2.143
180		176.0	254.9	342.1	0.978	1.416	1.900
190		162.9	235.9	316.5	0.857	1.242	1.666
200		148.7	215.4	289.1	0.744	1.077	1.445

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

AS Stratum Base Managed Stand Yield Curves

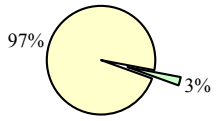
FMU W13 / AS STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	72
Stratum Area (ha) :	5,562

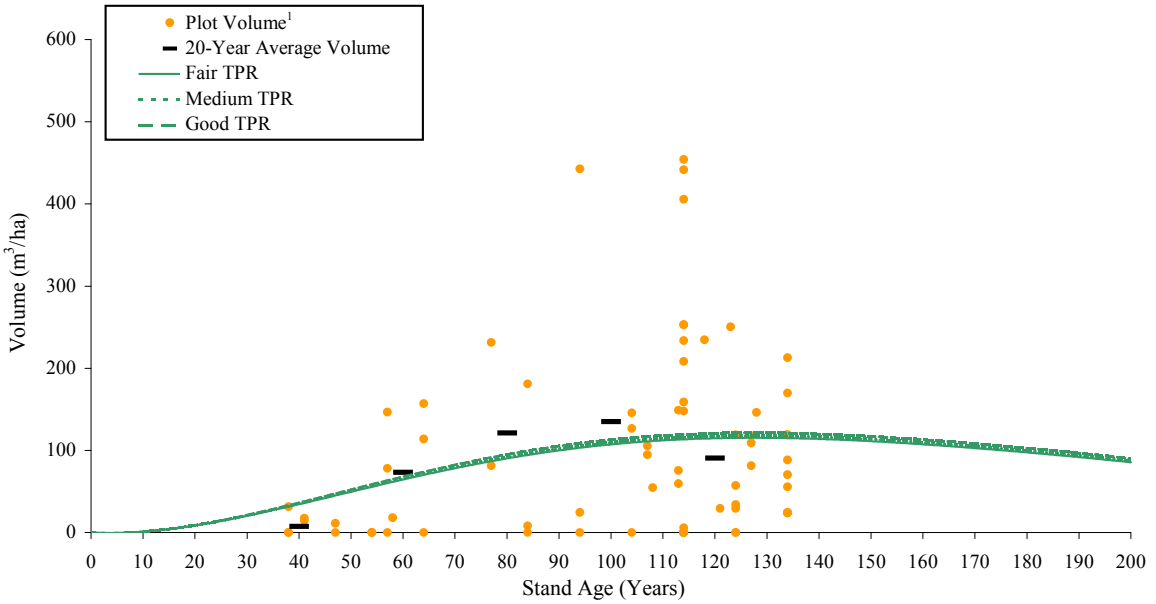
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		2.3	2.4	2.4	0.230	0.235	0.242
20		13.8	14.1	14.6	0.691	0.706	0.728
30	3	37.5	38.3	39.5	1.250	1.277	1.316
40	4	71.9	73.5	75.7	1.798	1.837	1.893
50	7	113.1	115.5	119.0	2.261	2.311	2.381
60	3	156.2	159.6	164.4	2.603	2.660	2.740
70	2	196.8	201.1	207.2	2.812	2.873	2.960
80	3	231.8	236.9	244.0	2.897	2.961	3.050
90	3	259.1	264.7	272.8	2.879	2.942	3.031
100	6	277.8	283.9	292.5	2.778	2.839	2.925
110	20	288.1	294.4	303.3	2.619	2.676	2.757
120	12	290.6	297.0	305.9	2.422	2.475	2.549
130	9	286.5	292.7	301.6	2.204	2.252	2.320
140		277.0	283.0	291.6	1.978	2.022	2.083
150		263.4	269.2	277.3	1.756	1.795	1.849
160		247.0	252.4	260.1	1.544	1.578	1.625
170		228.9	233.9	241.0	1.346	1.376	1.417
180		209.8	214.4	220.9	1.166	1.191	1.227
190		190.7	194.9	200.7	1.004	1.026	1.057
200		171.9	175.7	181.0	0.859	0.878	0.905

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AS STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



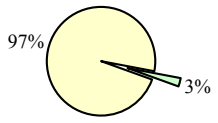
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	5.273E-03
Eqn: 2P+k	a_1	6.360E-05
	b	2.5590310
	k	50
Site Index Inputs	F	12.0
	M	14.1
	G	17.0

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	72
Stratum Area (ha) :	5,562

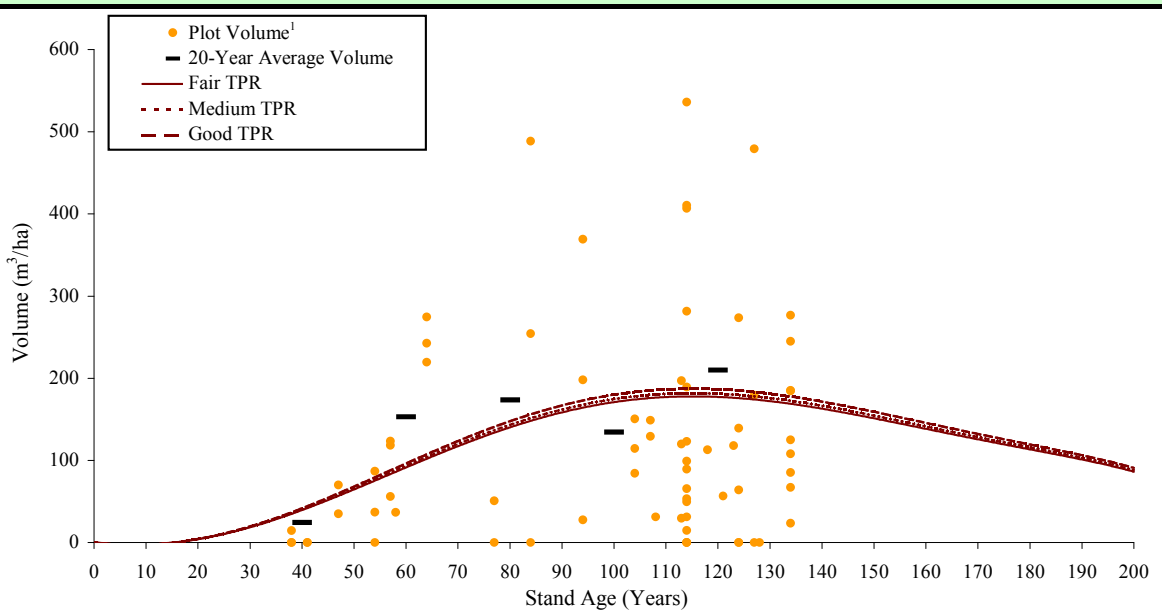
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.8	1.8	1.9	0.179	0.183	0.188
20		8.6	8.8	9.1	0.432	0.441	0.455
30	3	20.0	20.4	21.0	0.665	0.680	0.700
40	4	34.1	34.9	35.9	0.853	0.872	0.898
50	7	49.4	50.5	52.1	0.989	1.011	1.041
60	3	64.5	66.0	68.0	1.076	1.100	1.133
70	2	78.4	80.1	82.5	1.120	1.145	1.179
80	3	90.3	92.3	95.1	1.129	1.154	1.189
90	3	100.0	102.2	105.3	1.111	1.135	1.170
100	6	107.2	109.6	112.9	1.072	1.096	1.129
110	20	112.0	114.5	117.9	1.018	1.041	1.072
120	12	114.5	117.1	120.6	0.955	0.976	1.005
130	9	115.1	117.7	121.2	0.885	0.905	0.932
140		113.9	116.5	120.0	0.814	0.832	0.857
150		111.3	113.8	117.2	0.742	0.758	0.781
160		107.5	109.9	113.2	0.672	0.687	0.707
170		102.8	105.0	108.2	0.604	0.618	0.636
180		97.4	99.5	102.5	0.541	0.553	0.570
190		91.6	93.6	96.4	0.482	0.493	0.507
200		85.5	87.4	90.0	0.427	0.437	0.450

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AS STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



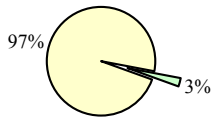
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	9.272E-05
Eqn: 2P+k	a_1	8.927E-07
	b	3.8275627
	k	30
Site Index Inputs	F	14.7
	M	17.2
	G	20.9

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	72
Stratum Area (ha) :	5,562

Stratum as a proportion of total managed landbase, FMU W13:

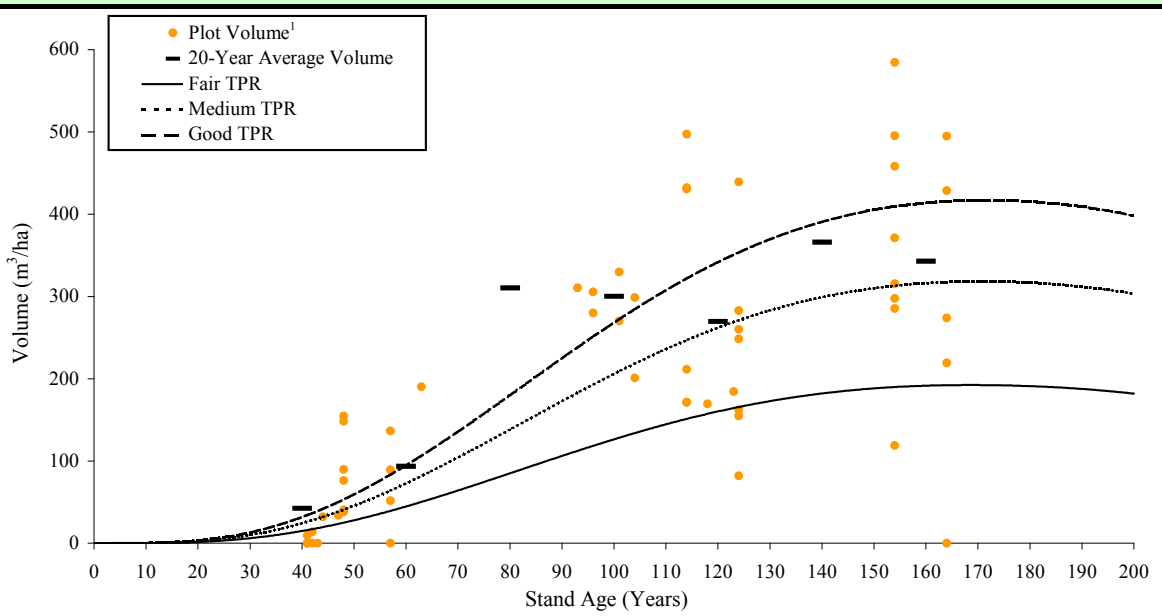


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.5	0.5	0.5	0.051	0.052	0.054
20		5.2	5.3	5.5	0.259	0.265	0.273
30	3	17.5	17.9	18.5	0.585	0.597	0.616
40	4	37.8	38.6	39.8	0.945	0.966	0.995
50	7	63.6	65.0	67.0	1.273	1.300	1.340
60	3	91.6	93.6	96.4	1.527	1.560	1.607
70	2	118.4	121.0	124.7	1.692	1.729	1.781
80	3	141.5	144.5	148.9	1.768	1.807	1.861
90	3	159.1	162.6	167.5	1.768	1.806	1.861
100	6	170.6	174.3	179.6	1.706	1.743	1.796
110	20	176.1	179.9	185.4	1.601	1.635	1.685
120	12	176.0	179.9	185.3	1.467	1.499	1.544
130	9	171.4	175.1	180.4	1.318	1.347	1.388
140		163.1	166.6	171.6	1.165	1.190	1.226
150		152.1	155.4	160.2	1.014	1.036	1.068
160		139.6	142.6	146.9	0.872	0.891	0.918
170		126.1	128.8	132.8	0.742	0.758	0.781
180		112.5	114.9	118.4	0.625	0.638	0.658
190		99.1	101.3	104.3	0.522	0.533	0.549
200		86.4	88.3	91.0	0.432	0.441	0.455

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

PA Stratum Base Managed Stand Yield Curves

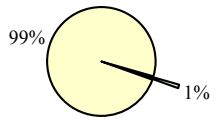
FMU W13 / PA STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	57
Stratum Area (ha) :	2,647

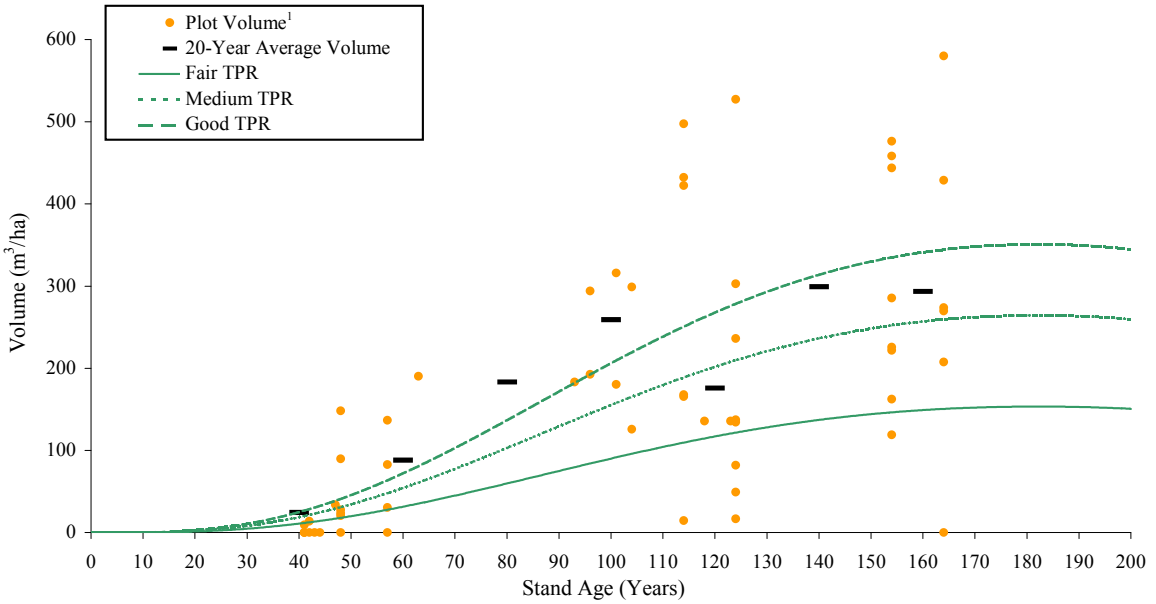
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.2	0.3	0.015	0.025	0.033
20		1.6	2.7	3.5	0.081	0.134	0.176
30		6.1	10.1	13.1	0.204	0.335	0.438
40	15	14.8	24.1	31.5	0.369	0.603	0.786
50	4	27.8	45.3	58.9	0.555	0.905	1.179
60	1	44.6	72.6	94.4	0.743	1.209	1.574
70		64.2	104.3	135.8	0.917	1.490	1.939
80		85.2	138.5	180.2	1.065	1.731	2.253
90	3	106.3	173.0	225.1	1.181	1.922	2.502
100	4	126.4	205.9	268.2	1.264	2.059	2.682
110	7	144.5	235.8	307.3	1.314	2.144	2.794
120	9	160.0	261.7	341.3	1.334	2.181	2.844
130		172.6	282.9	369.1	1.328	2.176	2.840
140		182.0	299.0	390.5	1.300	2.136	2.790
150	8	188.4	310.2	405.5	1.256	2.068	2.703
160	6	191.8	316.6	414.2	1.199	1.979	2.589
170		192.5	318.6	417.1	1.132	1.874	2.454
180		190.9	316.7	415.0	1.060	1.759	2.306
190		187.2	311.4	408.4	0.985	1.639	2.150
200		181.9	303.2	398.1	0.909	1.516	1.990

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / PA STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



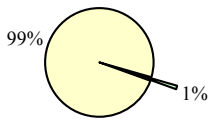
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-3.803E-05
Eqn: 2P+k	a_1	7.125E-06
	b	3.6277730
	k	50
Site Index Inputs	F	10.5
	M	14.3
	G	17.2

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	57
Stratum Area (ha) :	2,647

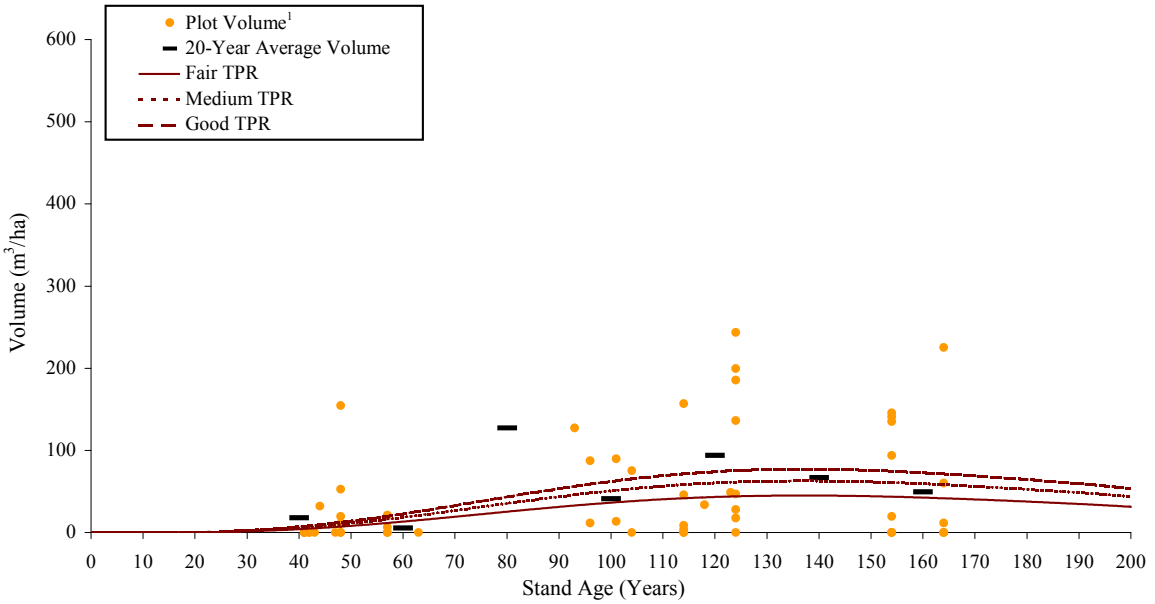
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.1	0.2	0.3	0.013	0.022	0.029
20		1.3	2.2	3.0	0.065	0.112	0.149
30		4.6	8.0	10.6	0.154	0.266	0.353
40	15	10.8	18.5	24.6	0.269	0.464	0.615
50	4	19.8	34.1	45.3	0.396	0.682	0.906
60	1	31.4	54.1	71.8	0.523	0.902	1.197
70		45.0	77.5	102.9	0.642	1.107	1.470
80		59.8	103.0	136.7	0.747	1.288	1.709
90	3	75.0	129.3	171.6	0.833	1.437	1.907
100	4	90.0	155.1	205.9	0.900	1.551	2.059
110	7	104.1	179.5	238.3	0.946	1.632	2.166
120	9	116.9	201.5	267.5	0.974	1.679	2.229
130		127.9	220.5	292.8	0.984	1.696	2.252
140		137.0	236.3	313.6	0.979	1.688	2.240
150	8	144.1	248.4	329.8	0.961	1.656	2.199
160	6	149.1	257.1	341.3	0.932	1.607	2.133
170		152.1	262.2	348.1	0.895	1.543	2.048
180		153.2	264.2	350.7	0.851	1.468	1.948
190		152.7	263.2	349.4	0.803	1.385	1.839
200		150.5	259.5	344.5	0.753	1.298	1.723

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / PA STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



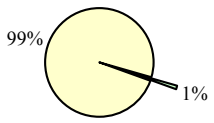
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-9.346E-08
Eqn: 2P+k	a_1	7.019E-08
	b	4.5929020
	k	30
Site Index Inputs	F	10.8
	M	14.6
	G	17.5

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	57
Stratum Area (ha) :	2,647

Stratum as a proportion of total managed landbase, FMU W13:

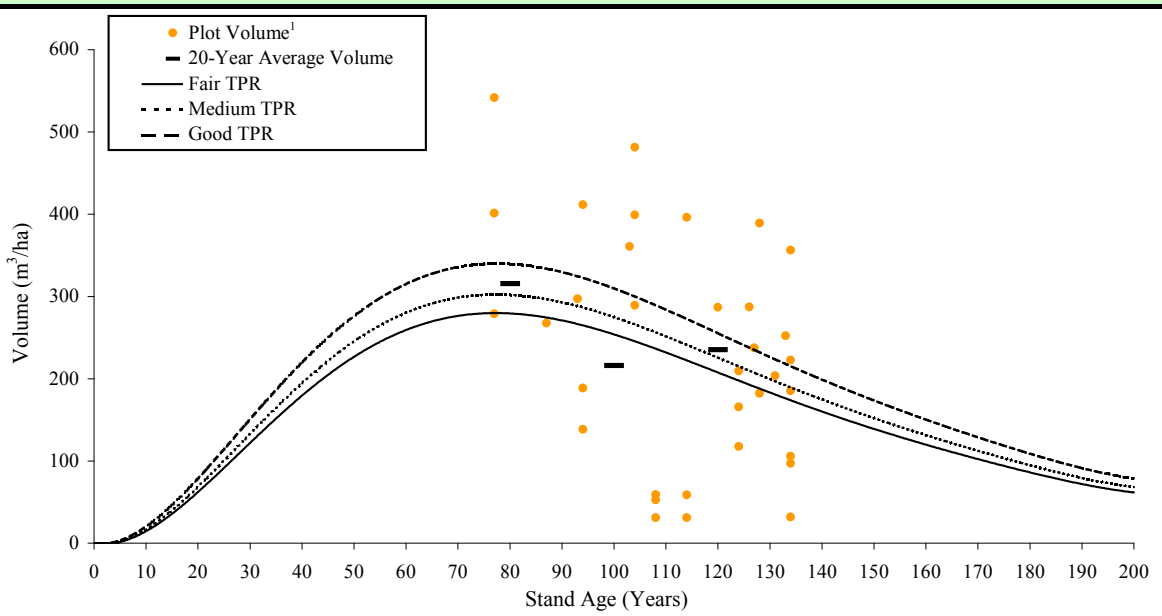


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.002	0.003	0.003
20		0.3	0.5	0.6	0.016	0.023	0.028
30		1.5	2.1	2.5	0.050	0.069	0.085
40	15	4.0	5.6	6.8	0.100	0.139	0.171
50	4	8.0	11.1	13.6	0.160	0.223	0.273
60	1	13.2	18.4	22.6	0.220	0.307	0.377
70		19.2	26.8	32.9	0.275	0.383	0.469
80		25.4	35.5	43.5	0.318	0.444	0.544
90	3	31.3	43.7	53.5	0.348	0.485	0.595
100	4	36.4	50.8	62.2	0.364	0.508	0.622
110	7	40.4	56.4	69.1	0.367	0.512	0.628
120	9	43.2	60.2	73.8	0.360	0.502	0.615
130		44.7	62.3	76.4	0.344	0.479	0.587
140		45.0	62.8	76.9	0.321	0.448	0.549
150	8	44.2	61.8	75.7	0.295	0.412	0.504
160	6	42.6	59.5	72.9	0.267	0.372	0.456
170		40.4	56.3	69.0	0.237	0.331	0.406
180		37.6	52.5	64.3	0.209	0.292	0.357
190		34.5	48.2	59.1	0.182	0.254	0.311
200		31.3	43.7	53.6	0.157	0.219	0.268

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

SA Stratum Base Managed Stand Yield Curves

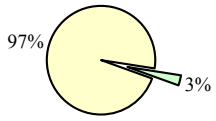
FMU W13 / SA STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	35
Stratum Area (ha) :	6,774

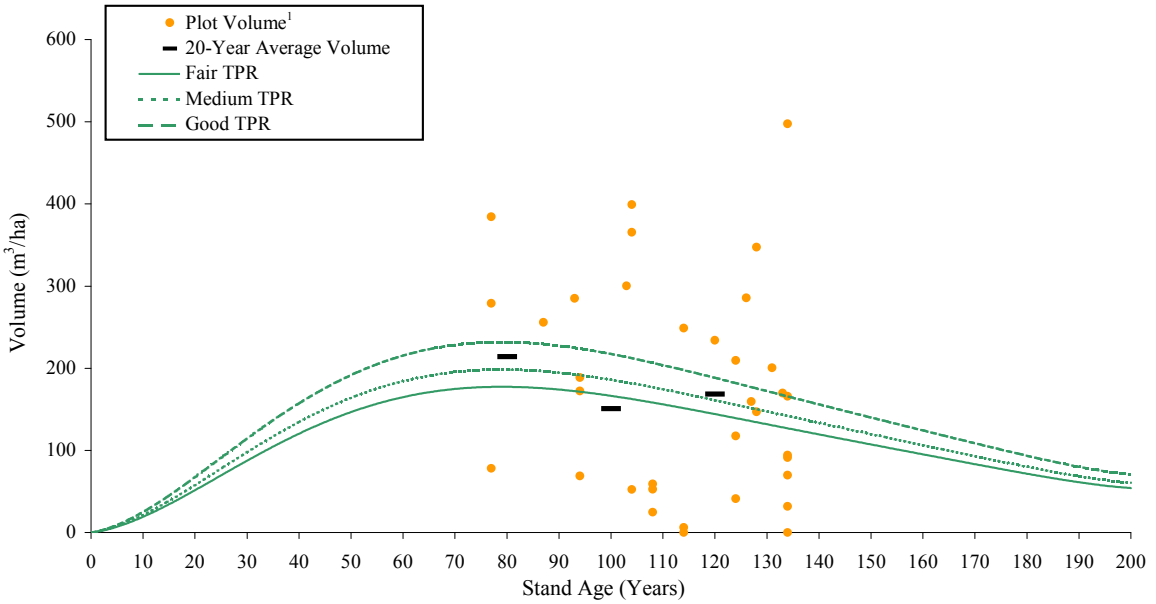
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		18.0	19.9	23.1	1.797	1.994	2.311
20		62.5	68.7	78.7	3.125	3.434	3.936
30		120.6	131.5	149.4	4.019	4.383	4.981
40		178.8	194.1	219.3	4.470	4.852	5.482
50		227.1	245.7	276.7	4.542	4.915	5.534
60		260.1	281.1	315.9	4.335	4.685	5.266
70	3	276.9	299.1	336.0	3.955	4.272	4.800
80	1	279.2	301.7	339.1	3.490	3.771	4.238
90	4	270.2	292.2	328.8	3.002	3.247	3.654
100	7	253.3	274.4	309.3	2.533	2.744	3.093
110	3	231.8	251.5	284.0	2.107	2.286	2.582
120	8	208.0	226.1	255.9	1.733	1.884	2.133
130	9	183.8	200.2	227.2	1.414	1.540	1.748
140		160.5	175.2	199.4	1.146	1.252	1.424
150		138.8	151.9	173.3	0.926	1.013	1.155
160		119.2	130.7	149.5	0.745	0.817	0.934
170		101.7	111.8	128.2	0.598	0.658	0.754
180		86.4	95.2	109.4	0.480	0.529	0.608
190		73.1	80.7	92.9	0.385	0.425	0.489
200		61.7	68.2	78.7	0.309	0.341	0.393

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / SA STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



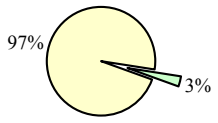
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	6.006E-02
Eqn: 2P+k	a_1	1.367E-02
	b	1.9811326
	k	40
Site Index Inputs	F	11.8
	M	13.7
	G	16.8

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	35
Stratum Area (ha) :	6,774

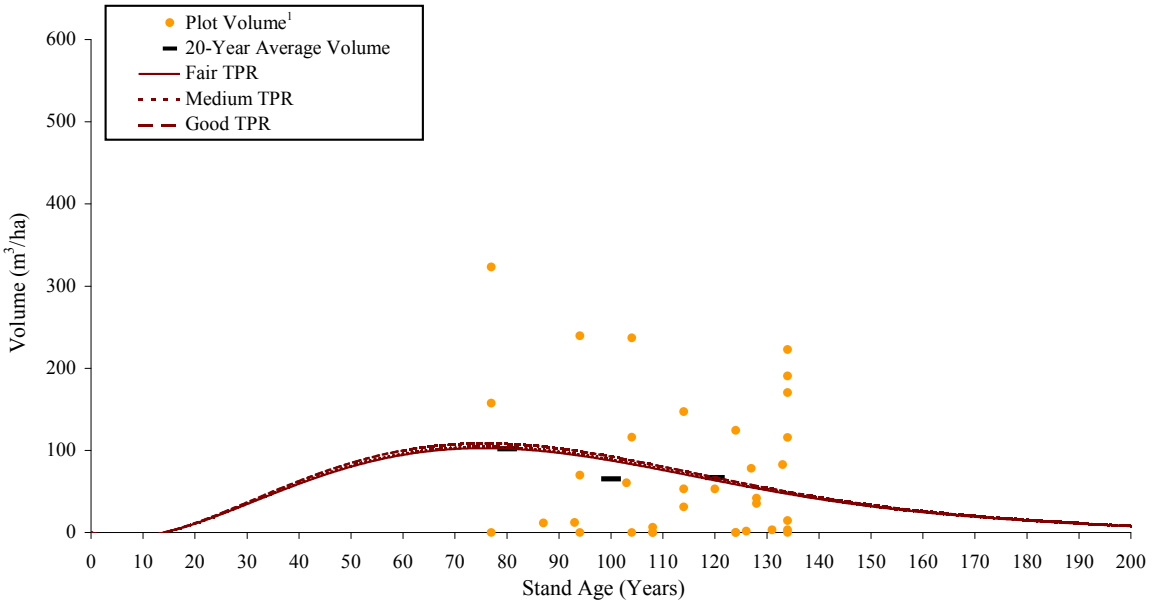
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		16.5	18.4	21.6	1.650	1.845	2.156
20		50.7	56.7	66.3	2.537	2.836	3.314
30		88.2	98.6	115.3	2.941	3.288	3.842
40		121.5	135.8	158.7	3.037	3.396	3.968
50		147.2	164.6	192.4	2.945	3.292	3.847
60		164.5	183.9	215.0	2.742	3.066	3.583
70	3	173.9	194.4	227.2	2.484	2.777	3.246
80	1	176.5	197.3	230.6	2.206	2.466	2.882
90	4	173.5	194.0	226.7	1.928	2.156	2.519
100	7	166.5	186.2	217.6	1.665	1.862	2.176
110	3	156.6	175.1	204.7	1.424	1.592	1.861
120	8	144.9	162.0	189.4	1.208	1.350	1.578
130	9	132.3	147.9	172.8	1.018	1.138	1.329
140		119.3	133.4	155.9	0.852	0.953	1.113
150		106.5	119.1	139.2	0.710	0.794	0.928
160		94.3	105.4	123.2	0.589	0.659	0.770
170		82.8	92.6	108.2	0.487	0.544	0.636
180		72.2	80.7	94.4	0.401	0.449	0.524
190		62.6	70.0	81.8	0.329	0.368	0.430
200		54.0	60.3	70.5	0.270	0.302	0.353

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / SA STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



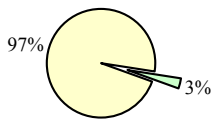
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	3.824E-04
Eqn: 2P+k	a_1	4.933E-06
	b	3.7271879
	k	20
Site Index Inputs	F	14.2
	M	15.7
	G	19.4

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	35
Stratum Area (ha) :	6,774

Stratum as a proportion of total managed landbase, FMU W13:

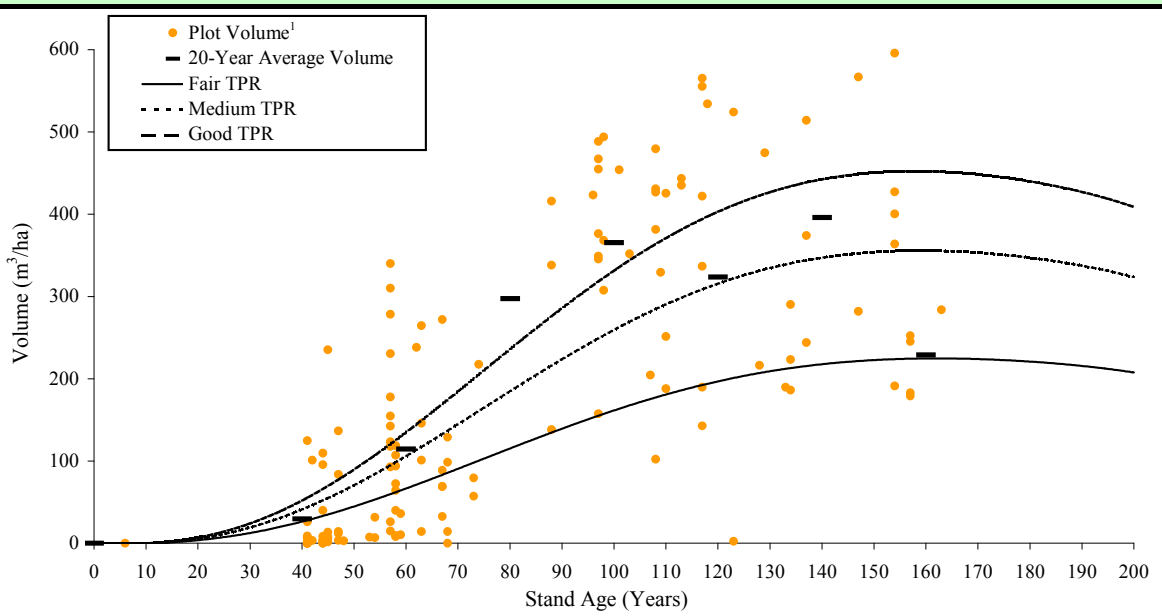


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.5	1.5	1.5	0.146	0.149	0.155
20		11.8	12.0	12.4	0.588	0.598	0.621
30		32.3	32.9	34.2	1.078	1.096	1.139
40		57.3	58.3	60.6	1.433	1.456	1.514
50		79.9	81.2	84.4	1.597	1.623	1.687
60		95.6	97.1	101.0	1.593	1.619	1.683
70	3	103.0	104.6	108.8	1.471	1.495	1.554
80	1	102.7	104.4	108.5	1.284	1.305	1.357
90	4	96.6	98.2	102.1	1.074	1.091	1.134
100	7	86.8	88.2	91.7	0.868	0.882	0.917
110	3	75.1	76.3	79.4	0.683	0.694	0.721
120	8	63.0	64.0	66.6	0.525	0.534	0.555
130	9	51.5	52.3	54.4	0.396	0.403	0.419
140		41.2	41.8	43.5	0.294	0.299	0.311
150		32.3	32.8	34.1	0.215	0.219	0.227
160		24.9	25.3	26.3	0.156	0.158	0.165
170		18.9	19.3	20.0	0.111	0.113	0.118
180		14.2	14.5	15.0	0.079	0.080	0.083
190		10.5	10.7	11.1	0.056	0.056	0.059
200		7.7	7.9	8.2	0.039	0.039	0.041

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

PL Stratum Base Managed Stand Yield Curves

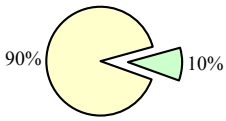
FMU W13 / PL STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	135
Stratum Area (ha) :	20,802

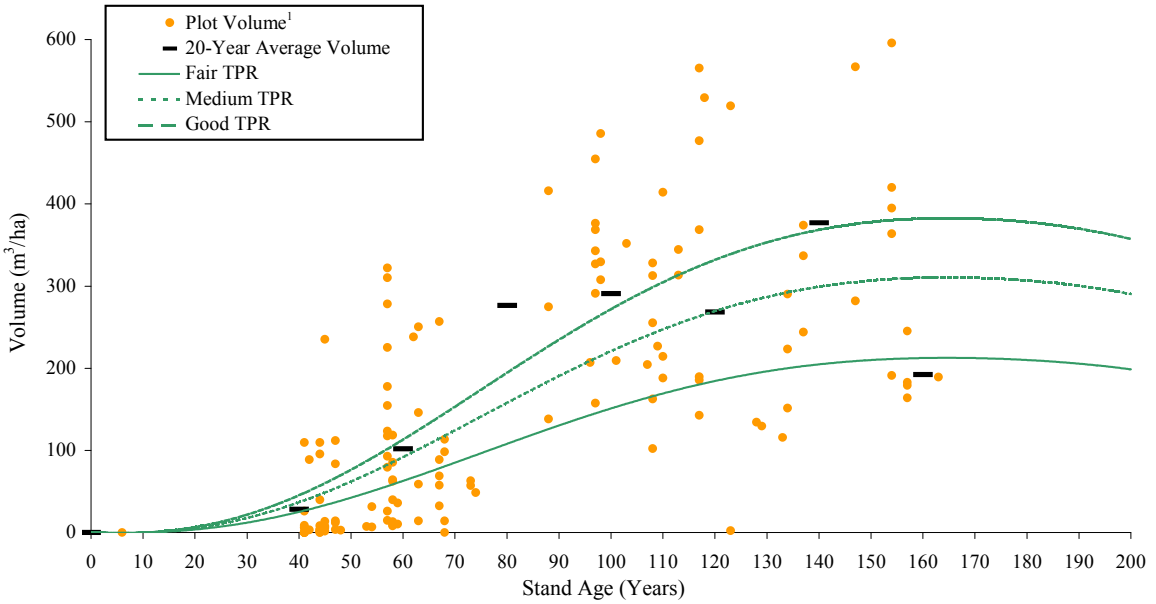
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	1	0.0	0.0	0.0	0.000	0.000	0.000
10		0.5	0.7	0.9	0.048	0.072	0.089
20		3.9	5.9	7.4	0.194	0.294	0.368
30		12.2	18.8	23.6	0.406	0.625	0.786
40	34	25.9	40.4	51.1	0.648	1.010	1.277
50	25	44.5	70.1	88.9	0.889	1.401	1.778
60	14	66.6	105.8	134.6	1.110	1.763	2.244
70	3	90.8	145.0	184.9	1.297	2.072	2.642
80	3	115.5	185.2	236.5	1.444	2.315	2.956
90	11	139.4	223.9	286.1	1.549	2.488	3.179
100	9	161.4	259.3	331.3	1.614	2.593	3.313
110	12	180.6	289.9	370.4	1.642	2.636	3.368
120	4	196.5	315.0	402.2	1.637	2.625	3.352
130	7	208.9	334.0	426.2	1.607	2.570	3.278
140	2	217.6	347.1	442.4	1.554	2.479	3.160
150	9	222.9	354.3	451.1	1.486	2.362	3.007
160	1	224.9	356.3	453.0	1.406	2.227	2.831
170		224.1	353.6	448.9	1.318	2.080	2.640
180		220.7	346.8	439.7	1.226	1.927	2.443
190		215.1	336.7	426.2	1.132	1.772	2.243
200		207.8	324.0	409.4	1.039	1.620	2.047

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / PL STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



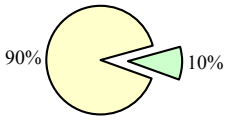
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.106E-04
Eqn: 2P+k	a_1	3.857E-05
	b	3.2822988
	k	50
Site Index Inputs	F	10.7
	M	14.4
	G	17.1

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	135
Stratum Area (ha) :	20,802

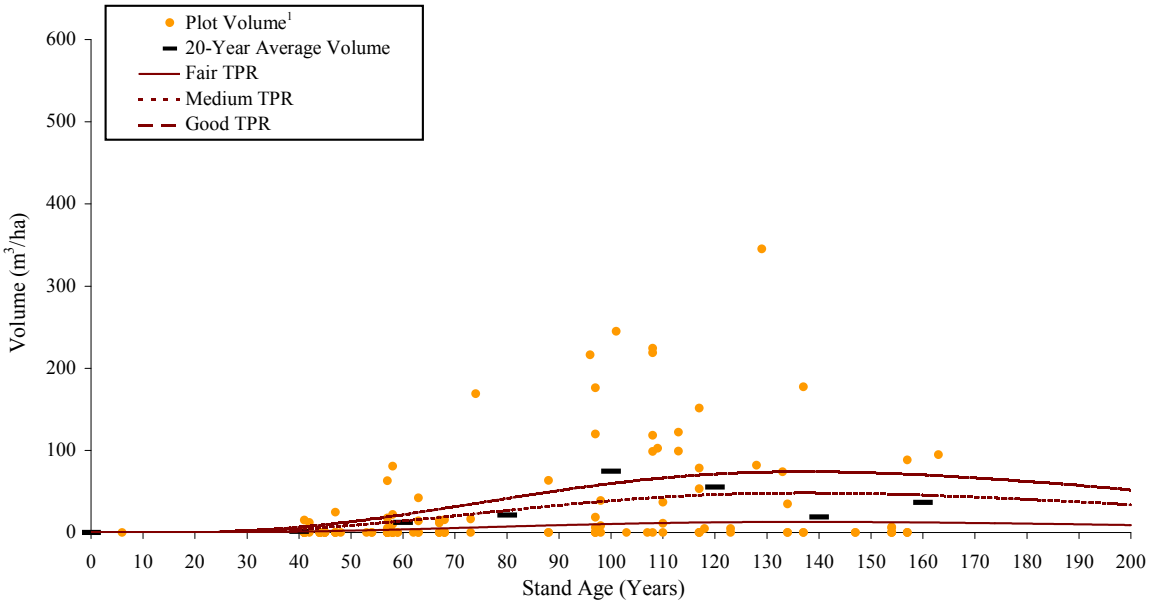
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0	1	0.0	0.0	0.0	0.000	0.000	0.000
10		0.5	0.7	0.9	0.048	0.070	0.086
20		3.8	5.5	6.8	0.190	0.277	0.342
30		11.8	17.2	21.2	0.392	0.573	0.706
40	34	24.8	36.2	44.6	0.619	0.905	1.114
50	25	42.2	61.6	75.9	0.844	1.233	1.518
60	14	62.8	91.8	113.1	1.047	1.530	1.884
70	3	85.3	124.7	153.5	1.219	1.781	2.193
80	3	108.3	158.2	194.8	1.353	1.977	2.436
90	11	130.5	190.7	234.8	1.450	2.118	2.609
100	9	151.0	220.6	271.7	1.510	2.206	2.717
110	12	169.0	246.9	304.1	1.536	2.245	2.765
120	4	184.1	269.0	331.3	1.534	2.242	2.761
130	7	196.0	286.4	352.8	1.508	2.203	2.713
140	2	204.7	299.1	368.3	1.462	2.136	2.631
150	9	210.2	307.1	378.2	1.401	2.047	2.521
160	1	212.7	310.7	382.7	1.329	1.942	2.392
170		212.5	310.4	382.3	1.250	1.826	2.249
180		209.8	306.6	377.6	1.166	1.703	2.098
190		205.2	299.8	369.2	1.080	1.578	1.943
200		198.8	290.4	357.7	0.994	1.452	1.789

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / PL STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



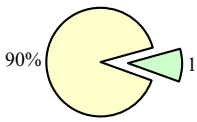
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.287E-06
Eqn: 2P+k	a_1	1.342E-07
	b	4.6028704
	k	30
Site Index Inputs	F	10.9
	M	14.6
	G	17.3

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	135
Stratum Area (ha) :	20,802

Stratum as a proportion of total managed landbase, FMU W13:

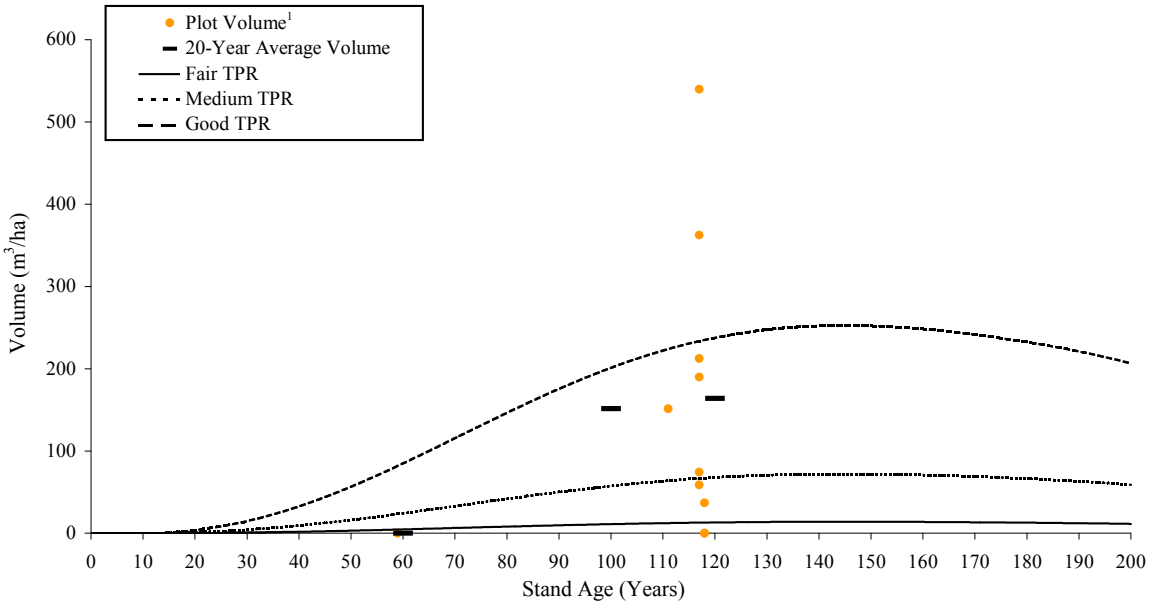


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0	1	0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.001	0.002	0.003
20		0.1	0.3	0.5	0.005	0.017	0.026
30		0.4	1.6	2.4	0.014	0.052	0.080
40	34	1.1	4.2	6.5	0.028	0.105	0.162
50	25	2.3	8.4	13.0	0.045	0.169	0.260
60	14	3.8	14.0	21.6	0.063	0.233	0.359
70	3	5.5	20.4	31.4	0.078	0.291	0.449
80	3	7.3	27.0	41.6	0.091	0.337	0.520
90	11	9.0	33.3	51.3	0.100	0.369	0.570
100	9	10.4	38.7	59.7	0.104	0.387	0.597
110	12	11.6	43.0	66.3	0.105	0.391	0.603
120	4	12.4	46.0	70.9	0.103	0.383	0.591
130	7	12.8	47.6	73.4	0.099	0.366	0.565
140	2	12.9	48.0	74.0	0.092	0.343	0.529
150	9	12.7	47.2	72.9	0.085	0.315	0.486
160	1	12.3	45.6	70.3	0.077	0.285	0.439
170		11.6	43.2	66.5	0.068	0.254	0.391
180		10.8	40.2	62.0	0.060	0.223	0.345
190		10.0	37.0	57.0	0.052	0.195	0.300
200		9.0	33.5	51.7	0.045	0.168	0.259

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

SB Stratum Base Managed Stand Yield Curves

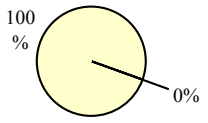
FMU W13 / SB STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	11
Stratum Area (ha) :	179

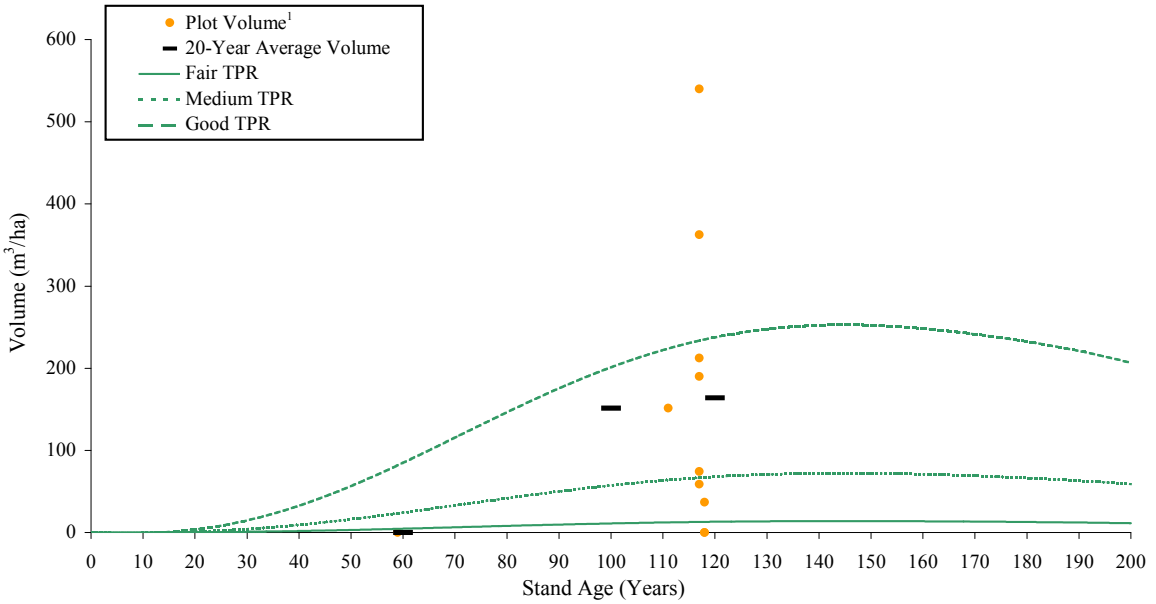
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.1	0.4	0.002	0.012	0.043
20		0.2	1.2	4.2	0.012	0.060	0.210
30		0.8	4.1	14.3	0.026	0.137	0.478
40		1.8	9.1	31.9	0.044	0.228	0.797
50	1	3.1	16.0	56.0	0.062	0.320	1.121
60		4.7	24.2	84.9	0.078	0.404	1.414
70		6.4	33.1	115.9	0.091	0.473	1.656
80		8.1	41.9	146.9	0.101	0.524	1.836
90		9.7	50.2	175.8	0.108	0.557	1.953
100		11.1	57.4	201.0	0.111	0.574	2.010
110	10	12.2	63.3	221.6	0.111	0.575	2.015
120		13.1	67.7	237.0	0.109	0.564	1.975
130		13.6	70.5	247.2	0.105	0.543	1.901
140		13.9	72.0	252.2	0.099	0.514	1.802
150		13.9	72.1	252.6	0.093	0.481	1.684
160		13.7	71.0	248.9	0.086	0.444	1.556
170		13.3	69.0	241.8	0.078	0.406	1.422
180		12.8	66.2	232.0	0.071	0.368	1.289
190		12.1	62.8	220.0	0.064	0.331	1.158
200		11.4	59.0	206.6	0.057	0.295	1.033

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / SB STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



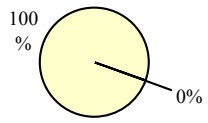
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-2.109E-04
Eqn: 2P+k	a_1	2.904E-05
	b	3.6461143
	k	40
Site Index Inputs	F	7.5
	M	8.5
	G	11.6

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	11
Stratum Area (ha) :	179

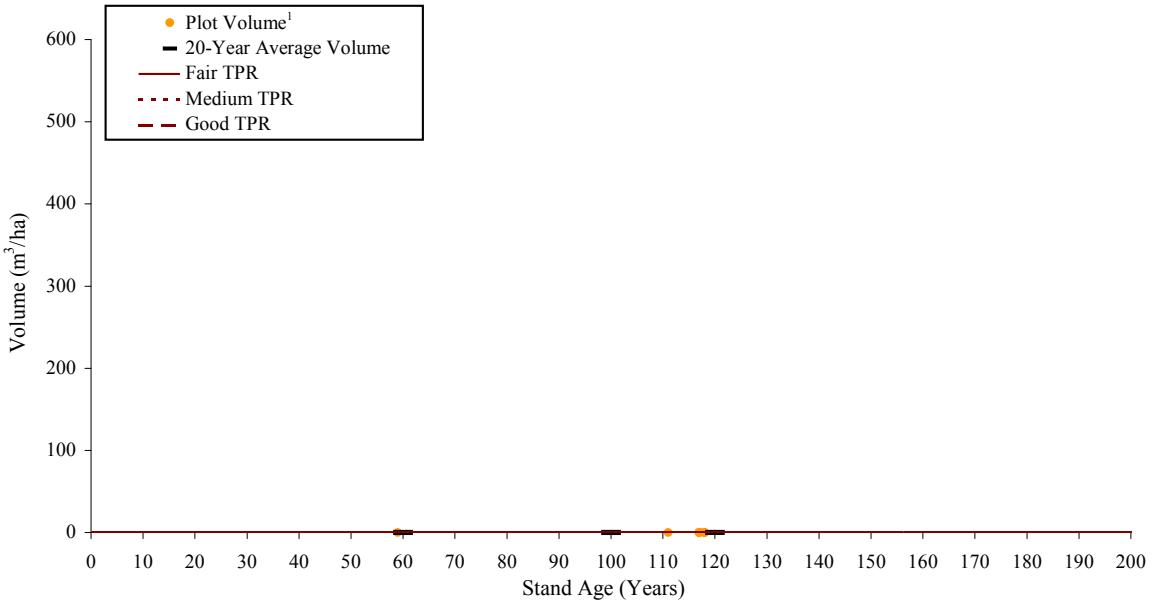
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.1	0.4	0.002	0.012	0.043
20		0.2	1.2	4.2	0.012	0.060	0.210
30		0.8	4.1	14.3	0.026	0.137	0.478
40		1.8	9.1	31.9	0.044	0.228	0.797
50	1	3.1	16.0	56.0	0.062	0.320	1.121
60		4.7	24.2	84.9	0.078	0.404	1.414
70		6.4	33.1	115.9	0.091	0.473	1.656
80		8.1	41.9	146.9	0.101	0.524	1.836
90		9.7	50.2	175.8	0.108	0.557	1.953
100		11.1	57.4	201.0	0.111	0.574	2.010
110	10	12.2	63.3	221.6	0.111	0.575	2.015
120		13.1	67.7	237.0	0.109	0.564	1.975
130		13.6	70.5	247.2	0.105	0.543	1.901
140		13.9	72.0	252.2	0.099	0.514	1.802
150		13.9	72.1	252.6	0.093	0.481	1.684
160		13.7	71.0	248.9	0.086	0.444	1.556
170		13.3	69.0	241.8	0.078	0.406	1.422
180		12.8	66.2	232.0	0.071	0.368	1.289
190		12.1	62.8	220.0	0.064	0.331	1.158
200		11.4	59.0	206.6	0.057	0.295	1.033

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / SB STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



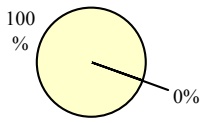
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a	8.500E-17
Eqn: 2P+k	b	2.1000000
	k	30
Site Index Inputs	F	n/a
One deciduous	M	n/a
curve for all TPR	G	n/a

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	11
Stratum Area (ha) :	179

Stratum as a proportion of total managed landbase, FMU W13:

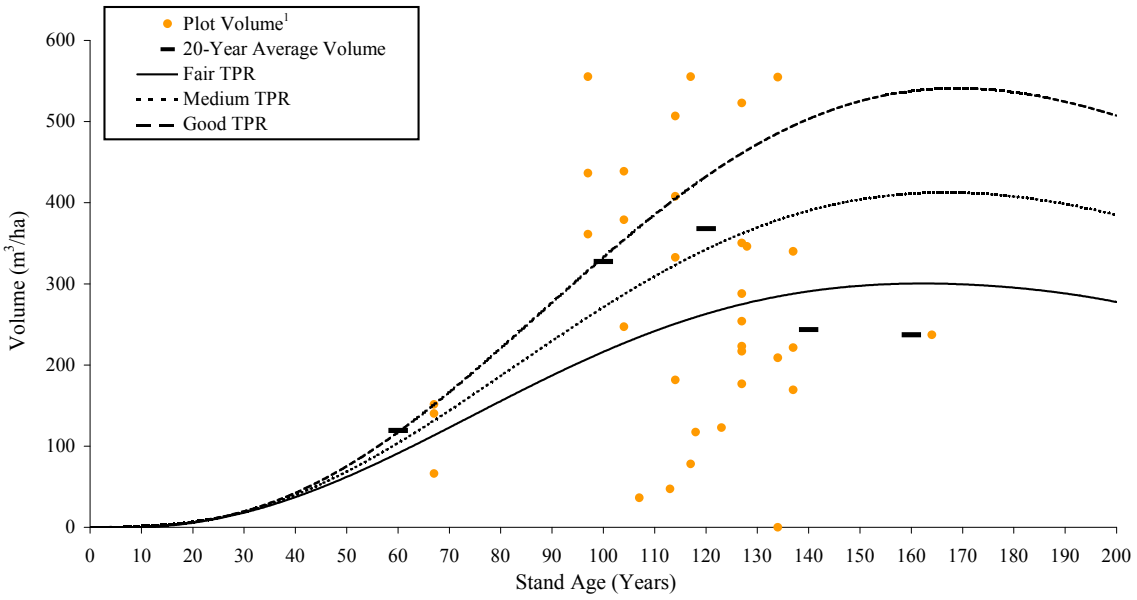


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.000	0.000	0.000
20		0.0	0.0	0.0	0.000	0.000	0.000
30		0.0	0.0	0.0	0.000	0.000	0.000
40		0.0	0.0	0.0	0.000	0.000	0.000
50	1	0.0	0.0	0.0	0.000	0.000	0.000
60		0.0	0.0	0.0	0.000	0.000	0.000
70		0.0	0.0	0.0	0.000	0.000	0.000
80		0.0	0.0	0.0	0.000	0.000	0.000
90		0.0	0.0	0.0	0.000	0.000	0.000
100		0.0	0.0	0.0	0.000	0.000	0.000
110	10	0.0	0.0	0.0	0.000	0.000	0.000
120		0.0	0.0	0.0	0.000	0.000	0.000
130		0.0	0.0	0.0	0.000	0.000	0.000
140		0.0	0.0	0.0	0.000	0.000	0.000
150		0.0	0.0	0.0	0.000	0.000	0.000
160		0.0	0.0	0.0	0.000	0.000	0.000
170		0.0	0.0	0.0	0.000	0.000	0.000
180		0.0	0.0	0.0	0.000	0.000	0.000
190		0.0	0.0	0.0	0.000	0.000	0.000
200		0.0	0.0	0.0	0.000	0.000	0.000

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] MAI was 0 in all cases; thus no maximum MAI has been highlighted.

SW Stratum Base Managed Stand Yield Curves

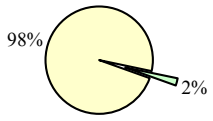
FMU W13 / SW STRATUM / Base Managed Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	37
Stratum Area (ha) :	4,876

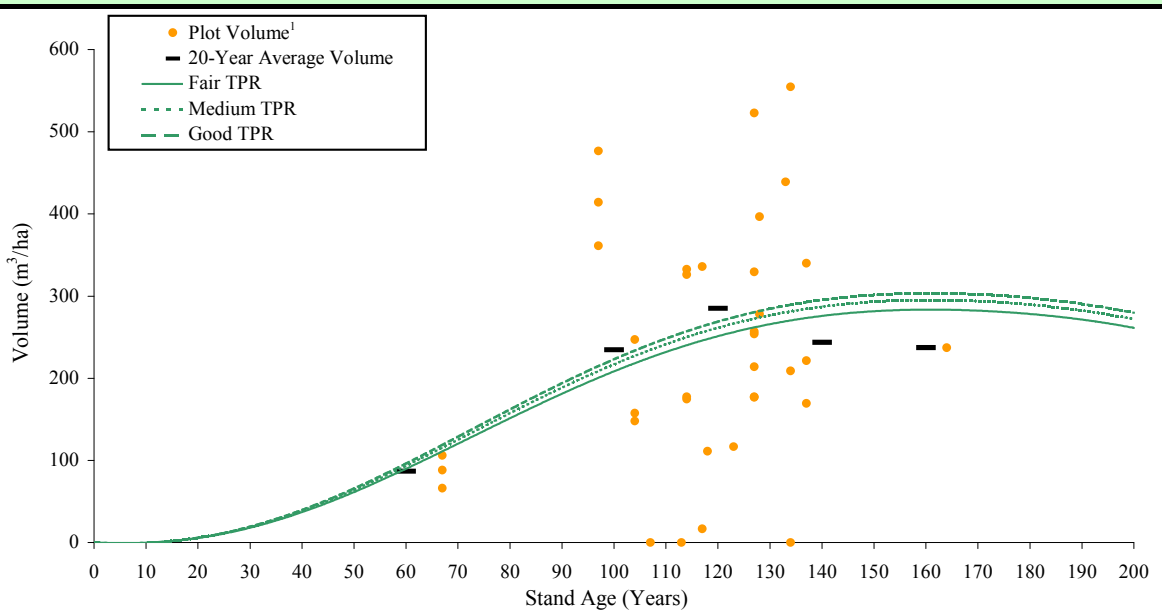
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.8	0.8	0.8	0.077	0.081	0.083
20		5.9	6.2	6.4	0.293	0.308	0.320
30		17.7	18.9	19.9	0.591	0.628	0.662
40		36.7	39.8	42.8	0.917	0.994	1.069
50		61.8	68.5	75.4	1.236	1.370	1.507
60	3	91.3	103.8	117.0	1.522	1.730	1.950
70		123.3	143.8	166.0	1.761	2.055	2.372
80		155.9	186.5	220.2	1.948	2.332	2.752
90	3	187.3	229.6	276.7	2.081	2.552	3.074
100	4	216.1	271.1	332.6	2.161	2.711	3.326
110	8	241.5	309.2	385.3	2.195	2.810	3.503
120	11	262.5	342.3	432.4	2.188	2.852	3.603
130	7	279.0	369.4	472.0	2.146	2.842	3.631
140		290.7	390.1	503.0	2.077	2.786	3.593
150		297.9	403.9	524.8	1.986	2.693	3.499
160	1	300.7	411.2	537.3	1.879	2.570	3.358
170		299.6	412.2	540.9	1.762	2.425	3.182
180		295.0	407.6	536.4	1.639	2.265	2.980
190		287.5	398.2	524.8	1.513	2.096	2.762
200		277.6	384.7	507.2	1.388	1.923	2.536

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / SW STRATUM / Base Managed Stand Yield Curve / Coniferous Volume



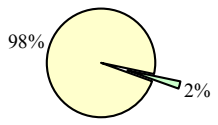
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	5.160E-04
Eqn: 2P+k	a_1	6.188E-06
	b	3.2126678
	k	50
Site Index Inputs	F	10.0
	M	13.8
	G	16.6

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	37
Stratum Area (ha) :	4,876

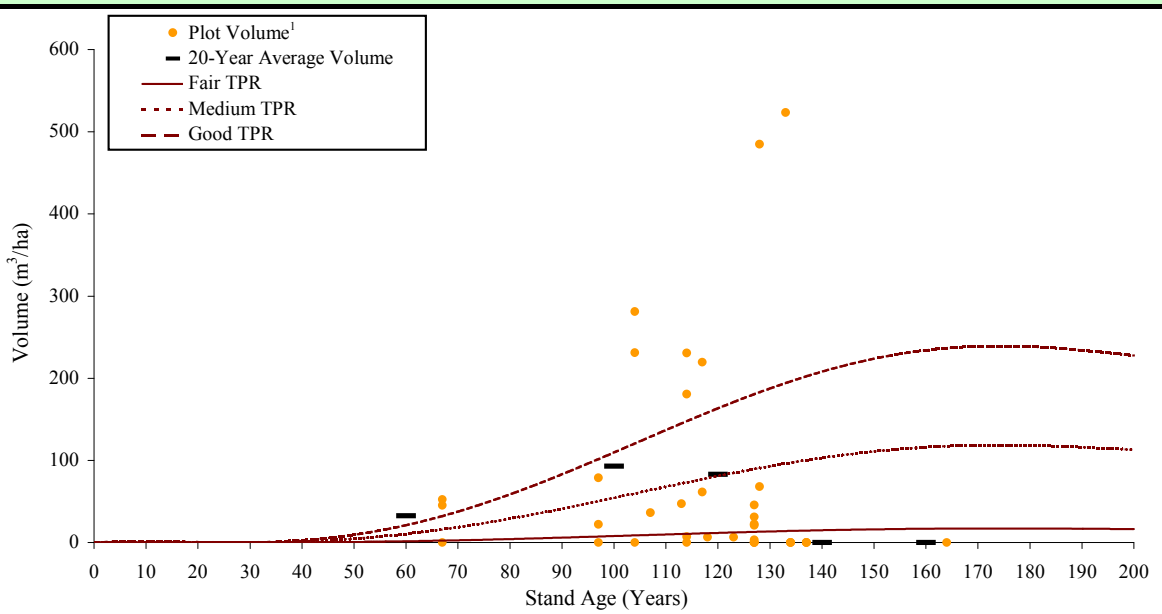
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.8	0.8	0.8	0.077	0.080	0.083
20		5.9	6.1	6.3	0.293	0.305	0.314
30		17.7	18.4	18.9	0.588	0.612	0.630
40		36.4	37.9	39.0	0.910	0.948	0.974
50		61.1	63.6	65.4	1.221	1.271	1.307
60	3	89.8	93.5	96.1	1.497	1.558	1.602
70		120.7	125.6	129.1	1.724	1.794	1.845
80		151.7	157.9	162.4	1.896	1.974	2.030
90	3	181.3	188.7	194.1	2.015	2.097	2.156
100	4	208.3	216.8	222.9	2.083	2.168	2.229
110	8	231.6	241.0	247.9	2.105	2.191	2.254
120	11	250.8	261.0	268.4	2.090	2.175	2.237
130	7	265.5	276.3	284.2	2.043	2.126	2.186
140		275.8	287.1	295.2	1.970	2.051	2.109
150		281.9	293.4	301.7	1.879	1.956	2.011
160	1	283.9	295.5	303.9	1.775	1.847	1.899
170		282.5	294.0	302.3	1.662	1.729	1.778
180		277.9	289.2	297.4	1.544	1.607	1.652
190		270.7	281.7	289.7	1.425	1.483	1.525
200		261.3	271.9	279.7	1.307	1.360	1.398

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / SW STRATUM / Base Managed Stand Yield Curve / Deciduous Volume



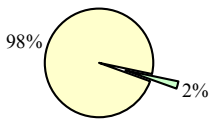
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $(a_0+a_1*SI)(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-1.166E-08
Eqn: 2P+k	a_1	9.291E-10
	b	5.8611161
	k	30
Site Index Inputs	F	13.0
	M	15.7
	G	18.8

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	37
Stratum Area (ha) :	4,876

Stratum as a proportion of total managed landbase, FMU W13:

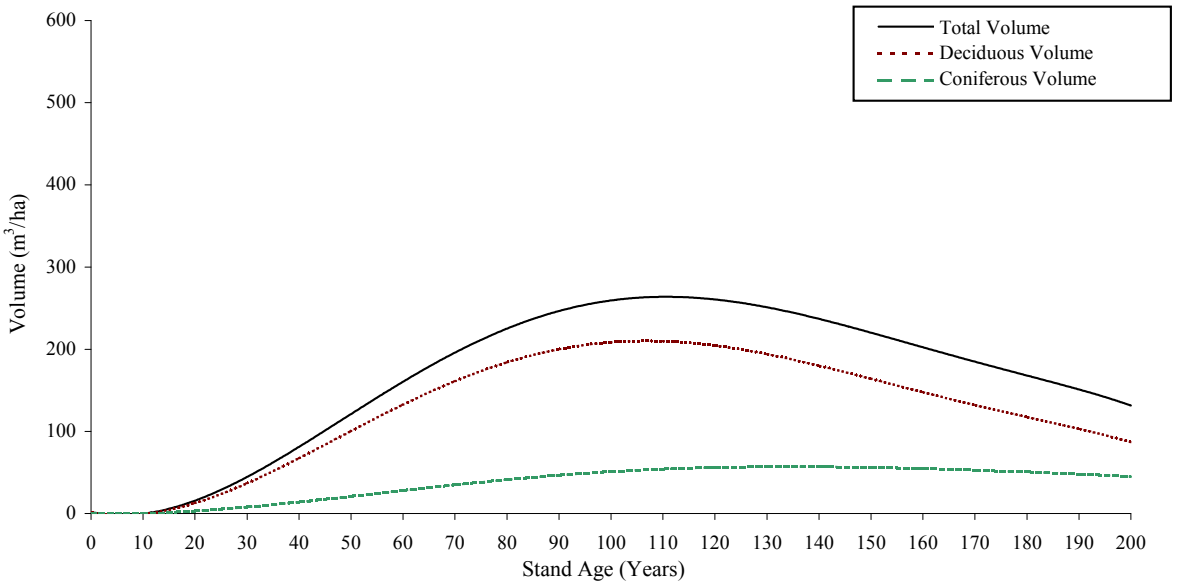


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.0	0.0	0.0	0.000	0.000	0.000
20		0.0	0.1	0.1	0.000	0.003	0.006
30		0.1	0.5	1.0	0.002	0.016	0.032
40		0.3	1.9	3.8	0.007	0.047	0.094
50		0.7	5.0	10.0	0.014	0.099	0.200
60	3	1.5	10.3	20.8	0.025	0.172	0.347
70		2.6	18.3	36.9	0.038	0.261	0.527
80		4.1	28.6	57.8	0.052	0.358	0.722
90	3	5.9	40.9	82.6	0.066	0.455	0.917
100	4	7.9	54.4	109.7	0.079	0.544	1.097
110	8	9.9	68.1	137.4	0.090	0.619	1.249
120	11	11.8	81.3	164.0	0.098	0.677	1.367
130	7	13.5	93.1	187.8	0.104	0.716	1.445
140		14.9	103.0	207.8	0.106	0.736	1.484
150		16.0	110.6	223.1	0.107	0.737	1.487
160	1	16.7	115.7	233.4	0.105	0.723	1.459
170		17.1	118.2	238.6	0.101	0.695	1.403
180		17.1	118.4	239.0	0.095	0.658	1.328
190		16.9	116.5	235.1	0.089	0.613	1.237
200		16.3	112.7	227.5	0.082	0.564	1.137

[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

Appendix XIV. FMU W13 Base Composite Yield Curves

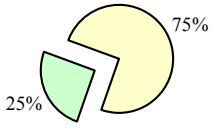
FMU W13 / Base Composite Yield Curve for Natural Stands, D Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	53,421

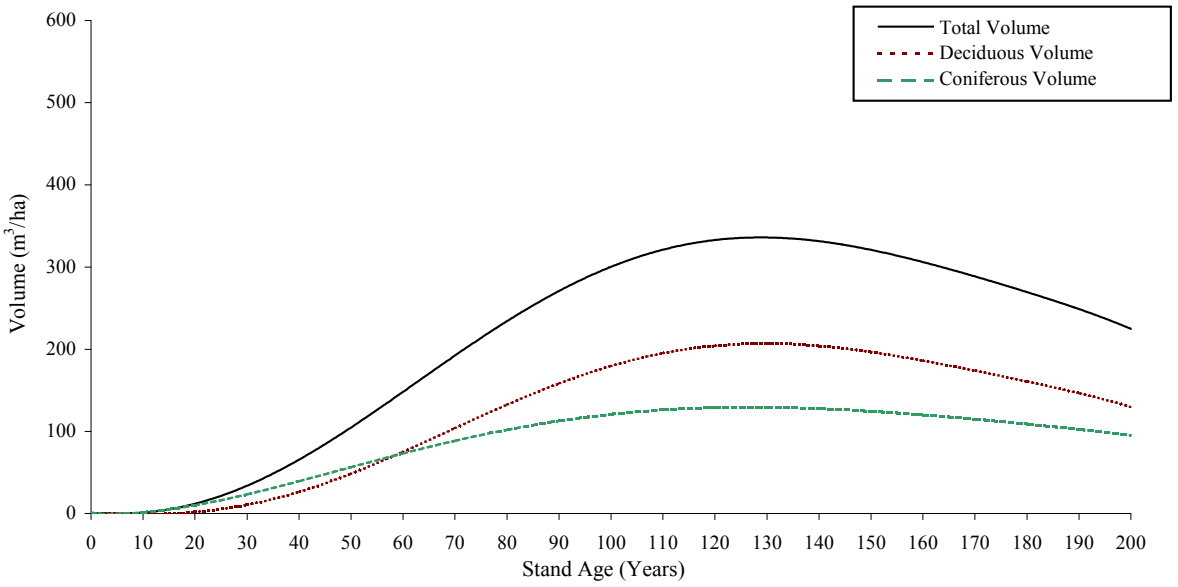
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.6	2.1	2.7	0.057	0.212	0.269
20	3.1	13.2	16.3	0.154	0.661	0.814
30	7.6	35.1	42.8	0.254	1.172	1.426
40	13.7	65.4	79.1	0.343	1.634	1.978
50	20.7	99.5	120.2	0.415	1.990	2.405
60	28.0	133.1	161.1	0.466	2.218	2.685
70	35.0	162.5	197.5	0.499	2.321	2.821
80	41.2	185.4	226.6	0.516	2.317	2.833
90	46.6	200.6	247.1	0.518	2.228	2.746
100	50.8	208.0	258.9	0.508	2.080	2.589
110	53.9	208.5	262.5	0.490	1.896	2.386
120	56.0	203.1	259.1	0.466	1.693	2.159
130	56.9	193.3	250.2	0.438	1.487	1.924
140	56.9	180.2	237.1	0.407	1.287	1.694
150	56.2	165.1	221.2	0.375	1.100	1.475
160	54.7	148.9	203.7	0.342	0.931	1.273
170	52.8	132.6	185.4	0.310	0.780	1.091
180	50.4	116.7	167.1	0.280	0.648	0.928
190	47.7	101.6	149.3	0.251	0.535	0.786
200	44.8	87.6	132.4	0.224	0.438	0.662

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

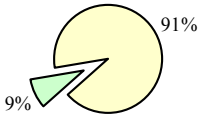
FMU W13 / Base Composite Yield Curve for Natural Stands, DC Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	19,047

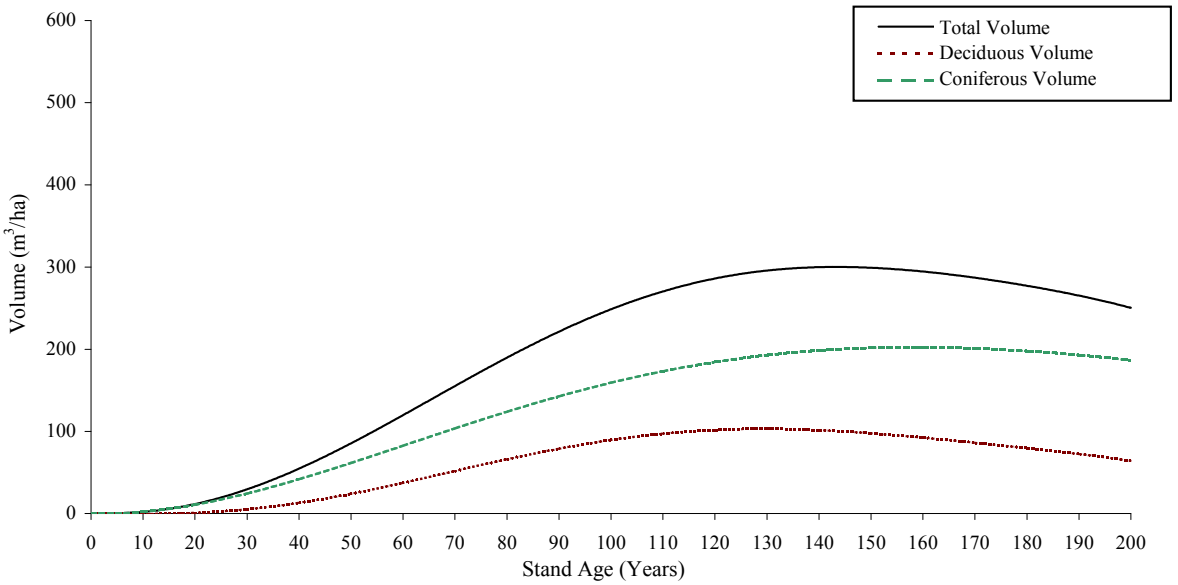
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	2.1	0.2	2.3	0.210	0.018	0.228
20	10.0	2.5	12.5	0.499	0.127	0.626
30	22.9	10.3	33.2	0.763	0.344	1.107
40	38.9	25.4	64.4	0.974	0.636	1.610
50	56.2	47.6	103.9	1.125	0.953	2.078
60	73.2	74.9	148.1	1.220	1.248	2.468
70	88.7	104.4	193.1	1.267	1.491	2.759
80	102.0	133.2	235.2	1.275	1.665	2.940
90	112.7	158.9	271.6	1.252	1.765	3.017
100	120.6	179.6	300.3	1.206	1.796	3.003
110	125.9	194.5	320.4	1.144	1.769	2.913
120	128.6	203.3	331.9	1.072	1.694	2.766
130	129.1	206.2	335.2	0.993	1.586	2.579
140	127.6	203.8	331.4	0.911	1.456	2.367
150	124.5	197.1	321.6	0.830	1.314	2.144
160	120.2	187.0	307.1	0.751	1.169	1.920
170	114.8	174.4	289.2	0.675	1.026	1.701
180	108.7	160.3	269.0	0.604	0.890	1.494
190	102.1	145.3	247.5	0.538	0.765	1.302
200	95.3	130.2	225.5	0.476	0.651	1.127

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

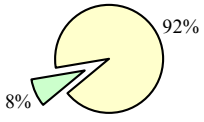
FMU W13 / Base Composite Yield Curve for Natural Stands, CD Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	17,809

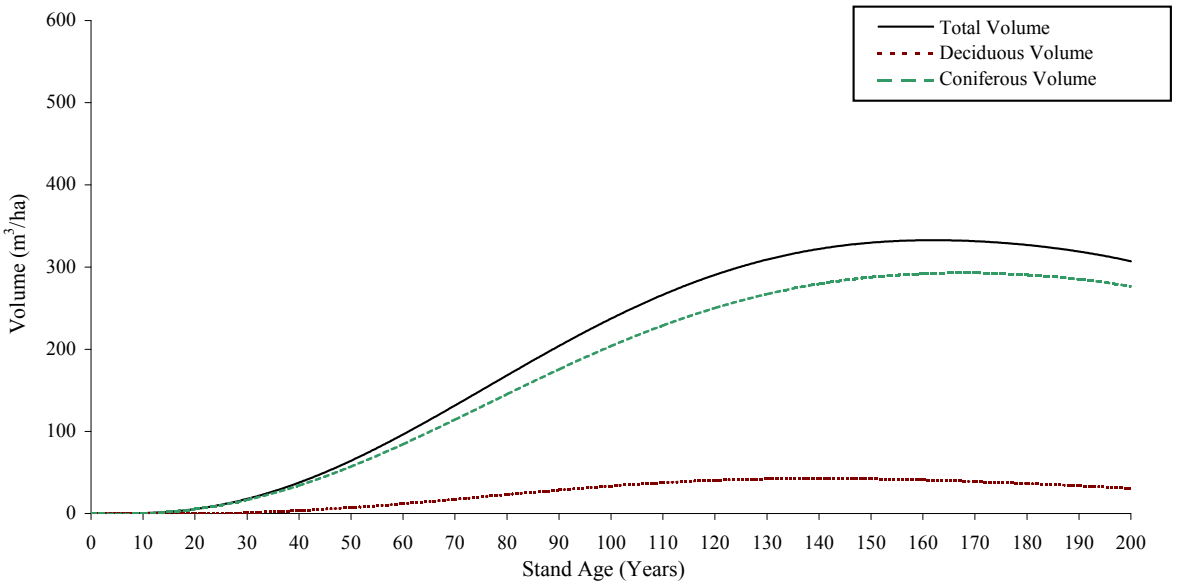
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	2.4	0.1	2.5	0.239	0.008	0.248
20	10.6	1.2	11.9	0.532	0.061	0.593
30	24.1	5.0	29.2	0.804	0.168	0.972
40	41.5	12.5	54.0	1.038	0.313	1.351
50	61.4	23.6	85.0	1.228	0.471	1.700
60	82.5	37.2	119.7	1.375	0.620	1.995
70	103.7	51.9	155.6	1.481	0.742	2.223
80	123.9	66.3	190.3	1.549	0.829	2.379
90	142.6	79.2	221.8	1.584	0.880	2.464
100	159.1	89.5	248.6	1.591	0.895	2.486
110	173.0	96.9	270.0	1.573	0.881	2.454
120	184.3	101.2	285.5	1.536	0.843	2.379
130	192.8	102.6	295.3	1.483	0.789	2.272
140	198.5	101.3	299.8	1.418	0.724	2.141
150	201.6	97.9	299.5	1.344	0.652	1.997
160	202.4	92.7	295.1	1.265	0.580	1.844
170	201.0	86.4	287.4	1.182	0.508	1.690
180	197.6	79.3	276.9	1.098	0.441	1.539
190	192.7	71.8	264.5	1.014	0.378	1.392
200	186.4	64.3	250.7	0.932	0.321	1.253

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

FMU W13 / Base Composite Yield Curve for Natural Stands, C Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

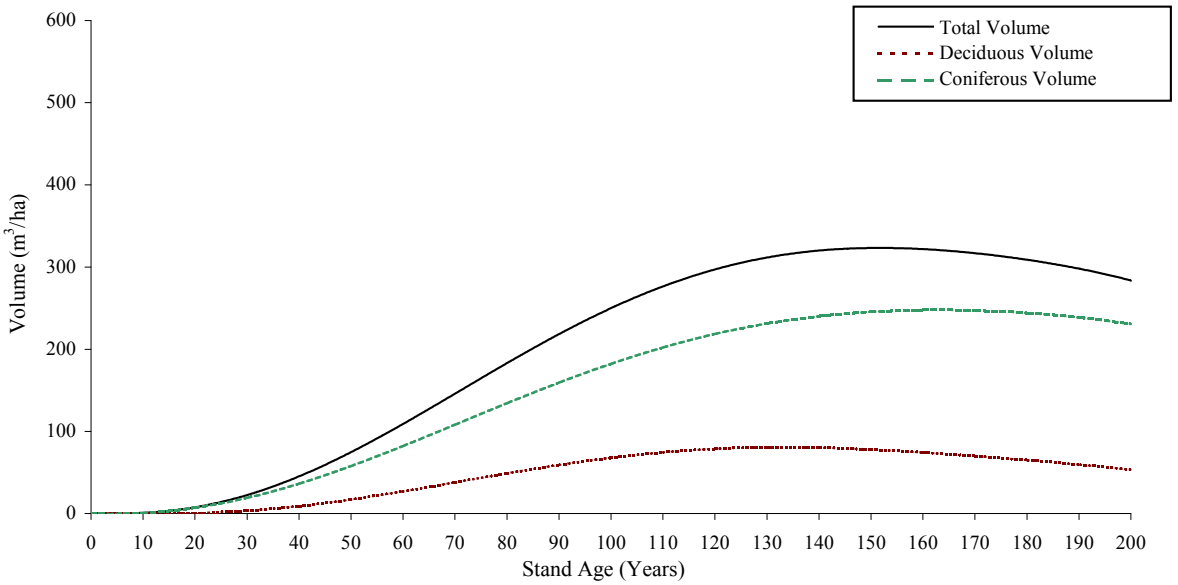
Stratum Summary:	
Stratum Area (ha) :	73,194

Stratum as a proportion of total managed landbase, FMU W13:

Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.8	0.0	0.8	0.076	0.002	0.077
20	5.4	0.3	5.7	0.272	0.014	0.286
30	16.2	1.3	17.5	0.541	0.043	0.584
40	33.6	3.5	37.1	0.841	0.088	0.928
50	56.8	7.1	63.9	1.137	0.141	1.278
60	84.4	11.8	96.2	1.407	0.196	1.603
70	114.5	17.3	131.8	1.636	0.247	1.883
80	145.5	23.1	168.5	1.818	0.288	2.107
90	175.6	28.6	204.2	1.951	0.318	2.269
100	203.7	33.5	237.2	2.037	0.335	2.372
110	228.6	37.4	266.0	2.078	0.340	2.419
120	249.8	40.3	290.1	2.081	0.336	2.417
130	266.8	42.0	308.7	2.052	0.323	2.375
140	279.4	42.5	322.0	1.996	0.304	2.300
150	287.9	42.1	330.0	1.919	0.281	2.200
160	292.2	40.8	333.1	1.827	0.255	2.082
170	292.9	38.9	331.8	1.723	0.229	1.952
180	290.2	36.4	326.6	1.612	0.202	1.815
190	284.7	33.6	318.3	1.498	0.177	1.675
200	276.7	30.7	307.3	1.383	0.153	1.537

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

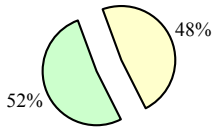
FMU W13 / Base Composite Yield Curve for Natural Stands, C/CD/DC Broad Cover Group



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	110,050

Stratum as a proportion of total managed landbase, FMU W13:

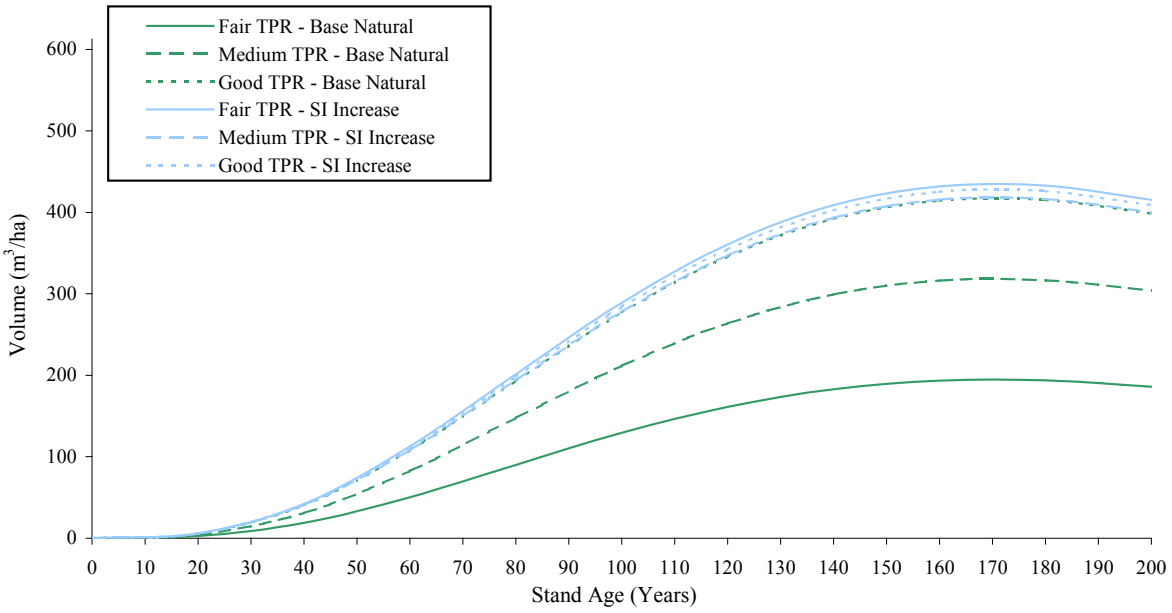


Stand Age	Predicted Gross Stand Volume[1] (m³/ha)			Mean Annual Increment[2] (m³/ha/year)		
	Conifer	Deciduous	Total	Conifer	Deciduous	Total
0	0.0	0.0	0.0	0.000	0.000	0.000
10	1.3	0.1	1.3	0.125	0.006	0.131
20	7.1	0.8	7.9	0.353	0.041	0.394
30	18.7	3.5	22.1	0.622	0.115	0.738
40	35.8	8.8	44.6	0.896	0.219	1.115
50	57.5	16.8	74.2	1.150	0.335	1.485
60	82.2	26.8	109.0	1.369	0.447	1.816
70	108.3	38.0	146.3	1.547	0.542	2.090
80	134.5	49.1	183.6	1.681	0.614	2.295
90	159.4	59.3	218.7	1.771	0.659	2.430
100	182.1	67.9	249.9	1.821	0.679	2.499
110	201.8	74.3	276.1	1.835	0.675	2.510
120	218.2	78.4	296.6	1.818	0.653	2.471
130	231.0	80.2	311.1	1.777	0.617	2.393
140	240.1	80.0	320.0	1.715	0.571	2.286
150	245.6	78.0	323.6	1.638	0.520	2.157
160	247.9	74.5	322.4	1.549	0.466	2.015
170	247.2	70.0	317.2	1.454	0.412	1.866
180	243.8	64.8	308.6	1.355	0.360	1.715
190	238.2	59.1	297.3	1.254	0.311	1.565
200	230.7	53.3	284.0	1.153	0.267	1.420

[1] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[2] Maximum MAI highlighted in blue.

Appendix XV. FMU W13 Pine Site Index Increase Yield Curves

FMU W13 / PL STRATUM / Site Index Increase Yield Curve / Coniferous Volume

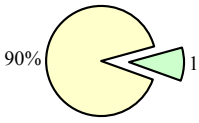


Site Index Values:		
Natural Stand Pine SI	F	10.9
	M	14.3
	G	17.1
Pine SI with SI Increase	F	17.6
	M	17.1
	G	17.4

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha) :	20,802

Stratum as a proportion of total managed landbase, FMU W13:



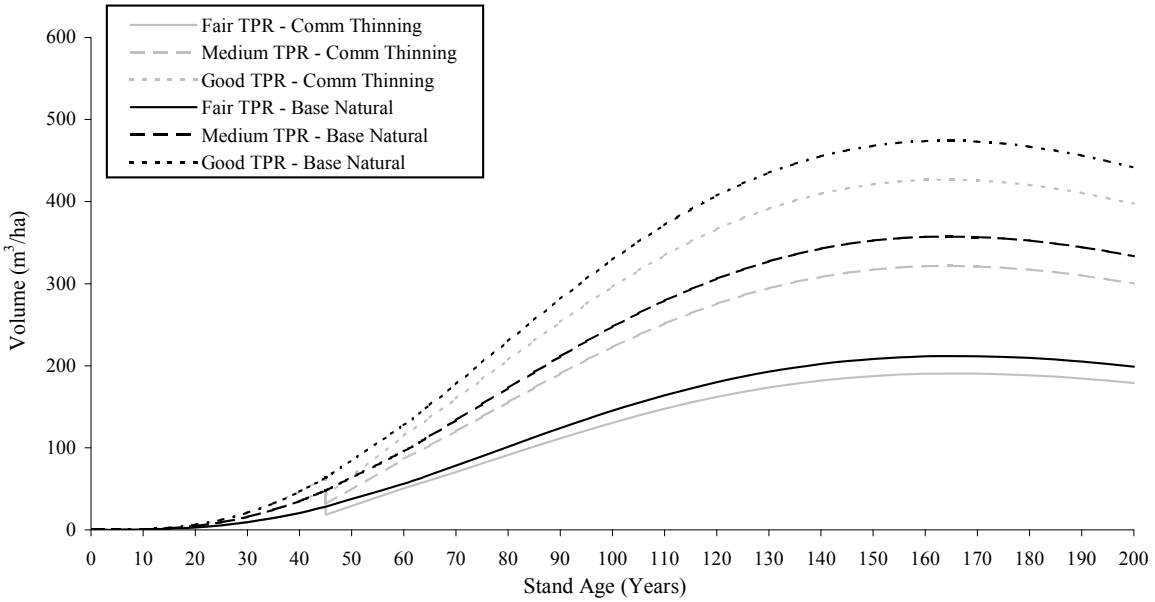
Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Conifer			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.7	0.7	0.7	0.068	0.065	0.067
20	5.9	5.7	5.8	0.296	0.285	0.291
30	19.3	18.6	19.0	0.644	0.620	0.633
40	42.2	40.6	41.5	1.054	1.015	1.037
50	73.9	71.1	72.7	1.477	1.422	1.454
60	112.6	108.4	110.8	1.877	1.807	1.847
70	155.9	150.1	153.5	2.228	2.145	2.192
80	201.3	193.8	198.1	2.516	2.422	2.476
90	246.3	237.1	242.3	2.736	2.634	2.693
100	288.8	278.0	284.2	2.888	2.780	2.842
110	327.2	315.0	322.0	2.975	2.864	2.927
120	360.4	347.0	354.7	3.004	2.891	2.956
130	387.7	373.2	381.5	2.982	2.871	2.935
140	408.7	393.4	402.2	2.919	2.810	2.873
150	423.3	407.5	416.6	2.822	2.717	2.777
160	431.9	415.8	425.0	2.699	2.599	2.656
170	434.8	418.6	427.9	2.558	2.462	2.517
180	432.6	416.5	425.7	2.403	2.314	2.365
190	425.9	410.0	419.1	2.242	2.158	2.206
200	415.3	399.8	408.7	2.077	1.999	2.044

[1] Only site index increase volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

Appendix XVI. FMU W13 Thinning Yield Curves

PL Stratum Commercial Thinning Curves

FMU W13 / PL STRATUM / Commercial Thinning Yield Curve / Total Volume

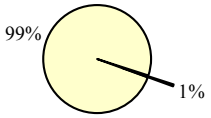


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	1,132

[1] Includes salvage thinning areas.

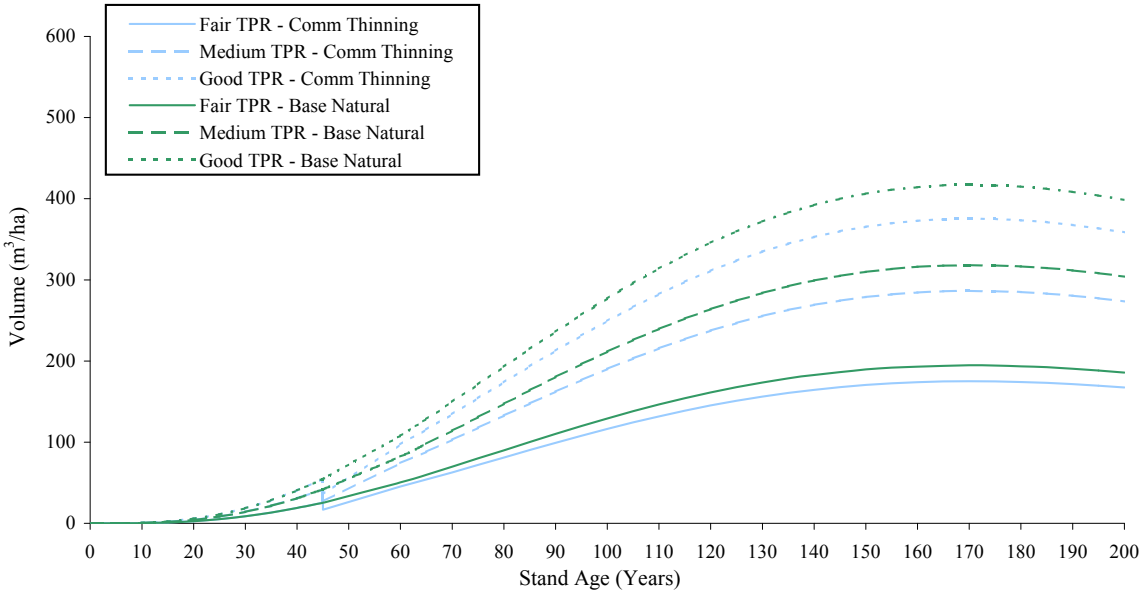
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.3	0.5	0.7	0.031	0.052	0.068
20	2.8	4.7	6.2	0.140	0.234	0.310
30	9.3	15.7	20.8	0.311	0.524	0.694
40	20.7	35.0	46.5	0.518	0.876	1.163
45	28.2	47.8	63.5	0.626	1.061	1.410
45	18.3	31.0	41.3	0.407	0.690	0.917
60	50.7	86.3	114.9	0.845	1.439	1.915
70	70.5	120.2	160.1	1.008	1.717	2.287
80	91.2	155.6	207.2	1.140	1.944	2.590
90	111.6	190.3	253.4	1.240	2.114	2.815
100	130.6	222.6	296.4	1.306	2.226	2.964
110	147.6	251.3	334.4	1.341	2.284	3.040
120	161.9	275.4	366.4	1.349	2.295	3.053
130	173.4	294.5	391.5	1.334	2.265	3.012
140	181.9	308.4	409.8	1.299	2.203	2.927
150	187.4	317.2	421.3	1.250	2.115	2.808
160	190.2	321.3	426.4	1.189	2.008	2.665
170	190.5	321.1	425.9	1.120	1.889	2.505
180	188.5	317.2	420.3	1.047	1.762	2.335
190	184.6	310.0	410.6	0.971	1.632	2.161
200	179.1	300.2	397.3	0.895	1.501	1.987

[1] Only commerical thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / PL STRATUM / Commercial Thinning Yield Curve / Coniferous Volume

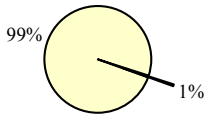


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	1,132

[1] Includes salvage thinning areas.

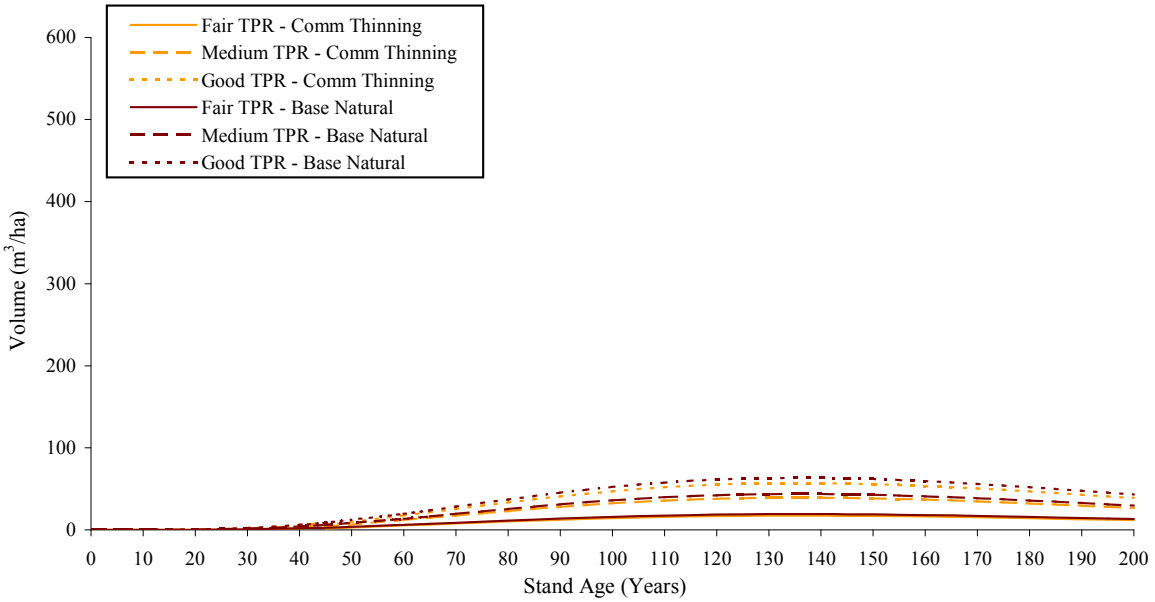
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Conifer			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.3	0.5	0.7	0.030	0.050	0.065
20	2.6	4.3	5.7	0.132	0.217	0.284
30	8.6	14.1	18.5	0.288	0.471	0.617
40	18.9	30.8	40.4	0.472	0.771	1.011
45	25.5	41.7	54.7	0.567	0.927	1.215
45	16.6	27.1	35.5	0.368	0.602	0.790
60	45.4	74.2	97.2	0.756	1.236	1.620
70	62.8	102.7	134.6	0.897	1.467	1.923
80	81.1	132.6	173.8	1.014	1.657	2.172
90	99.2	162.2	212.6	1.102	1.802	2.362
100	116.3	190.2	249.3	1.163	1.902	2.493
110	131.8	215.5	282.5	1.198	1.959	2.568
120	145.2	237.4	311.2	1.210	1.978	2.593
130	156.2	255.3	334.7	1.201	1.964	2.575
140	164.6	269.2	352.8	1.176	1.923	2.520
150	170.5	278.8	365.5	1.137	1.859	2.437
160	174.0	284.5	372.9	1.087	1.778	2.331
170	175.1	286.4	375.4	1.030	1.685	2.208
180	174.2	284.9	373.5	0.968	1.583	2.075
190	171.5	280.5	367.7	0.903	1.476	1.935
200	167.3	273.5	358.6	0.836	1.368	1.793

[1] Only commerical thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.

FMU W13 / PL STRATUM / Commercial Thinning Yield Curve / Deciduous Volume

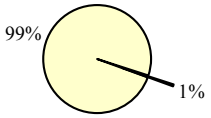


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	1,132

[1] Includes salvage thinning areas.

Stratum as a proportion of total managed landbase, FMU W13:

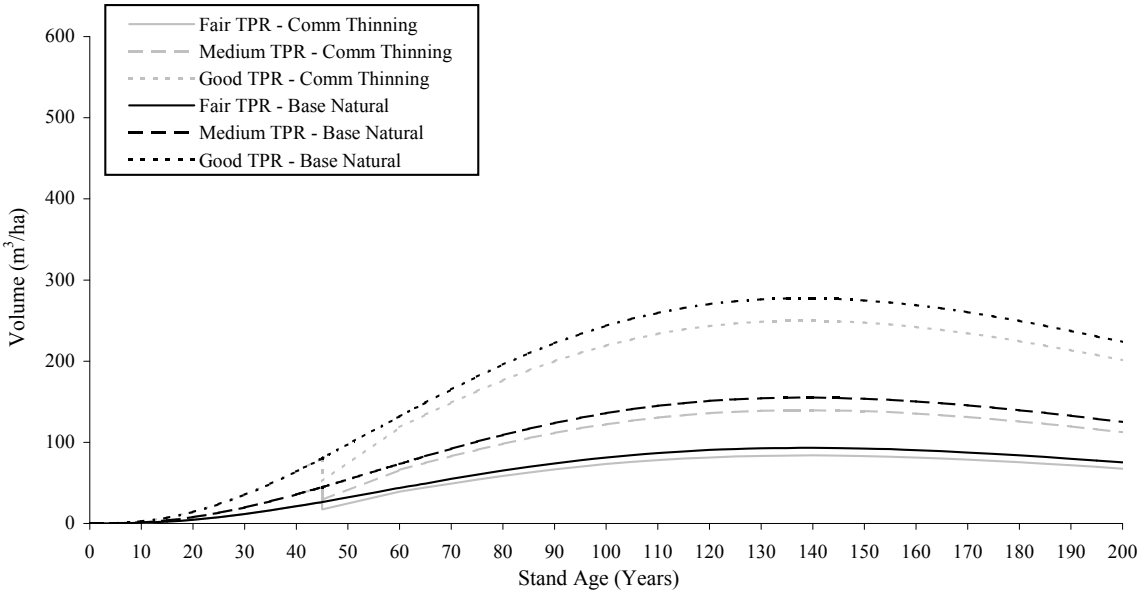


Stand Age	Predicted Gross Stand Volume[1,2] (m3/ha) - Deciduous			Mean Annual Increment[3] (m3/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.0	0.0	0.0	0.001	0.002	0.003
20	0.2	0.4	0.5	0.008	0.018	0.026
30	0.7	1.6	2.3	0.023	0.053	0.077
40	1.8	4.2	6.1	0.046	0.105	0.152
45	2.7	6.1	8.8	0.059	0.135	0.195
45	1.7	3.9	5.7	0.039	0.087	0.127
60	5.4	12.2	17.7	0.089	0.203	0.294
70	7.7	17.5	25.4	0.110	0.250	0.363
80	10.1	23.0	33.4	0.127	0.287	0.417
90	12.4	28.1	40.8	0.137	0.312	0.453
100	14.3	32.4	47.1	0.143	0.324	0.471
110	15.8	35.7	51.9	0.143	0.325	0.472
120	16.7	38.0	55.2	0.140	0.317	0.460
130	17.2	39.1	56.8	0.133	0.301	0.437
140	17.3	39.2	56.9	0.123	0.280	0.407
150	16.9	38.4	55.7	0.113	0.256	0.372
160	16.2	36.8	53.5	0.102	0.230	0.334
170	15.3	34.7	50.4	0.090	0.204	0.297
180	14.2	32.2	46.8	0.079	0.179	0.260
190	13.0	29.5	42.9	0.068	0.155	0.226
200	11.8	26.7	38.7	0.059	0.133	0.194

[1] Only commerical thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

SB Stratum Commercial Thinning Curves

FMU W13 / SB STRATUM / Commercial Thinning Yield Curve / Total Volume

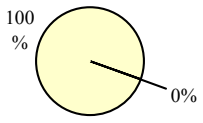


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	69

[1] Includes salvage thinning areas.

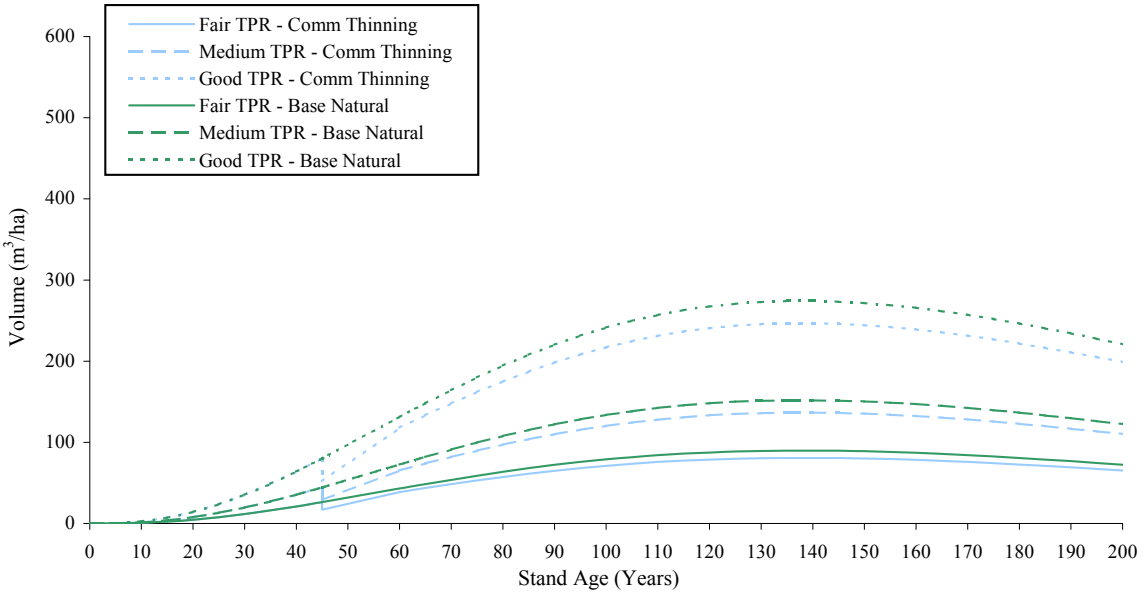
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.8	1.4	2.5	0.083	0.141	0.254
20	4.6	7.8	14.1	0.231	0.391	0.705
30	11.6	19.6	35.4	0.387	0.654	1.179
40	21.1	35.6	64.1	0.527	0.889	1.602
45	26.5	44.6	80.3	0.588	0.991	1.785
45	17.2	29.0	52.2	0.382	0.644	1.160
60	39.2	65.9	118.6	0.654	1.099	1.977
70	49.3	82.8	148.8	0.705	1.183	2.125
80	58.6	98.2	176.2	0.732	1.227	2.203
90	66.6	111.4	199.9	0.740	1.238	2.221
100	73.1	122.2	219.1	0.731	1.222	2.191
110	78.1	130.4	233.5	0.710	1.185	2.123
120	81.4	135.9	243.2	0.679	1.132	2.027
130	83.3	138.9	248.5	0.641	1.068	1.912
140	83.8	139.6	249.7	0.599	0.997	1.784
150	83.1	138.4	247.4	0.554	0.922	1.649
160	81.3	135.4	242.1	0.508	0.846	1.513
170	78.7	131.1	234.3	0.463	0.771	1.378
180	75.5	125.6	224.6	0.419	0.698	1.248
190	71.7	119.4	213.5	0.377	0.628	1.123
200	67.6	112.6	201.3	0.338	0.563	1.006

[1] Only commerical thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / SB STRATUM / Commercial Thinning Yield Curve / Coniferous Volume

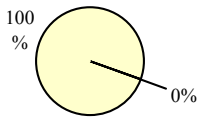


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	69

[1] Includes salvage thinning areas.

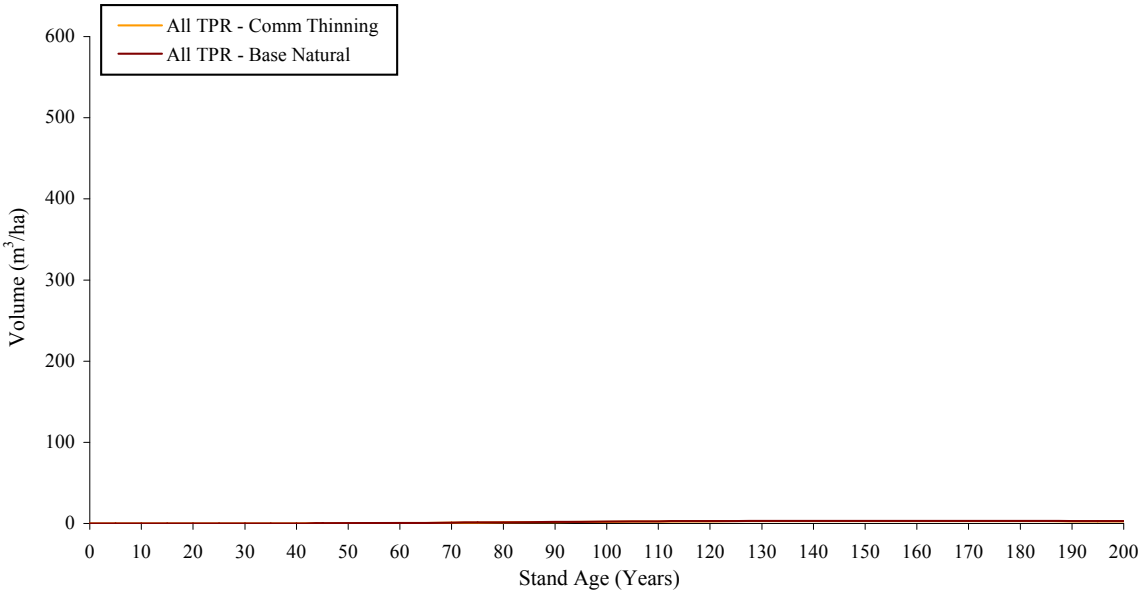
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m3/ha) - Conifer			Mean Annual Increment[3] (m3/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.8	1.4	2.5	0.083	0.141	0.254
20	4.6	7.8	14.1	0.231	0.390	0.705
30	11.6	19.6	35.3	0.386	0.652	1.177
40	20.9	35.4	63.9	0.524	0.885	1.599
45	26.2	44.3	80.1	0.583	0.985	1.779
45	17.0	28.8	52.0	0.379	0.640	1.157
60	38.7	65.4	118.1	0.644	1.090	1.968
70	48.4	81.9	147.9	0.692	1.170	2.112
80	57.3	96.9	175.0	0.716	1.211	2.187
90	64.9	109.8	198.3	0.722	1.220	2.203
100	71.1	120.2	217.1	0.711	1.202	2.171
110	75.7	128.0	231.2	0.688	1.164	2.102
120	78.8	133.3	240.6	0.657	1.110	2.005
130	80.5	136.1	245.7	0.619	1.047	1.890
140	80.8	136.7	246.8	0.577	0.976	1.763
150	80.0	135.3	244.4	0.534	0.902	1.629
160	78.3	132.4	239.1	0.489	0.827	1.494
170	75.8	128.1	231.4	0.446	0.754	1.361
180	72.6	122.8	221.8	0.404	0.682	1.232
190	69.0	116.7	210.8	0.363	0.614	1.109
200	65.1	110.1	198.8	0.326	0.550	0.994

[1] Only commerical thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / SB STRATUM / Commercial Thinning Yield Curve / Deciduous Volume

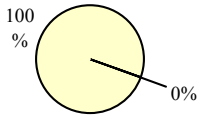


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	69

[1] Includes salvage thinning areas.

Stratum as a proportion of total managed landbase, FMU W13:

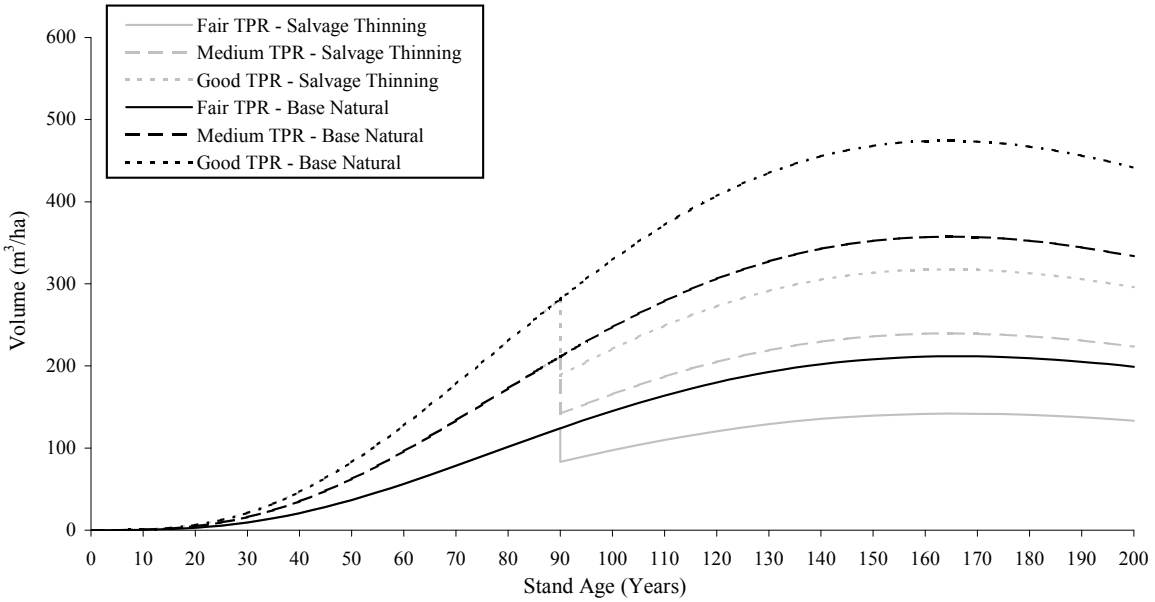


Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Deciduous			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.0	0.0	0.0	0.000	0.000	0.000
20	0.0	0.0	0.0	0.000	0.000	0.000
30	0.0	0.0	0.0	0.002	0.002	0.002
40	0.2	0.2	0.2	0.004	0.004	0.004
45	0.2	0.2	0.2	0.005	0.005	0.005
45	0.2	0.2	0.2	0.003	0.003	0.003
60	0.6	0.6	0.6	0.009	0.009	0.009
70	0.9	0.9	0.9	0.013	0.013	0.013
80	1.3	1.3	1.3	0.016	0.016	0.016
90	1.6	1.6	1.6	0.018	0.018	0.018
100	2.0	2.0	2.0	0.020	0.020	0.020
110	2.4	2.4	2.4	0.021	0.021	0.021
120	2.6	2.6	2.6	0.022	0.022	0.022
130	2.8	2.8	2.8	0.022	0.022	0.022
140	3.0	3.0	3.0	0.021	0.021	0.021
150	3.0	3.0	3.0	0.020	0.020	0.020
160	3.0	3.0	3.0	0.019	0.019	0.019
170	2.9	2.9	2.9	0.017	0.017	0.017
180	2.8	2.8	2.8	0.016	0.016	0.016
190	2.7	2.7	2.7	0.014	0.014	0.014
200	2.5	2.5	2.5	0.012	0.012	0.012

[1] Only commerical thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

PL Stratum Salvage Thinning Curves

FMU W13 / PL STRATUM / Salvage Thinning Yield Curve / Total Volume



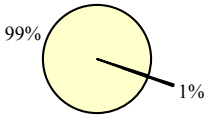
Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.3	0.5	0.7	0.031	0.052	0.068
20	2.8	4.7	6.2	0.140	0.234	0.310
30	9.3	15.7	20.8	0.311	0.524	0.694
40	20.7	35.0	46.5	0.518	0.876	1.163
50	36.7	62.3	82.9	0.734	1.246	1.657
60	56.4	95.9	127.6	0.939	1.599	2.127
70	78.4	133.6	177.9	1.120	1.908	2.541
80	101.3	172.8	230.2	1.267	2.160	2.877
90	124.0	211.4	281.5	1.377	2.349	3.128
90	83.1	141.6	188.6	0.923	1.574	2.096
100	97.2	165.7	220.6	0.972	1.657	2.206
110	109.8	187.0	249.0	0.999	1.700	2.263
120	120.5	205.0	272.7	1.005	1.708	2.273
130	129.1	219.2	291.5	0.993	1.686	2.242
140	135.4	229.6	305.1	0.967	1.640	2.179
150	139.5	236.1	313.6	0.930	1.574	2.091
160	141.6	239.2	317.4	0.885	1.495	1.984
170	141.8	239.1	317.0	0.834	1.406	1.865
180	140.3	236.1	312.9	0.779	1.312	1.738
190	137.4	230.8	305.6	0.723	1.215	1.609
200	133.3	223.5	295.8	0.666	1.117	1.479

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	1,132

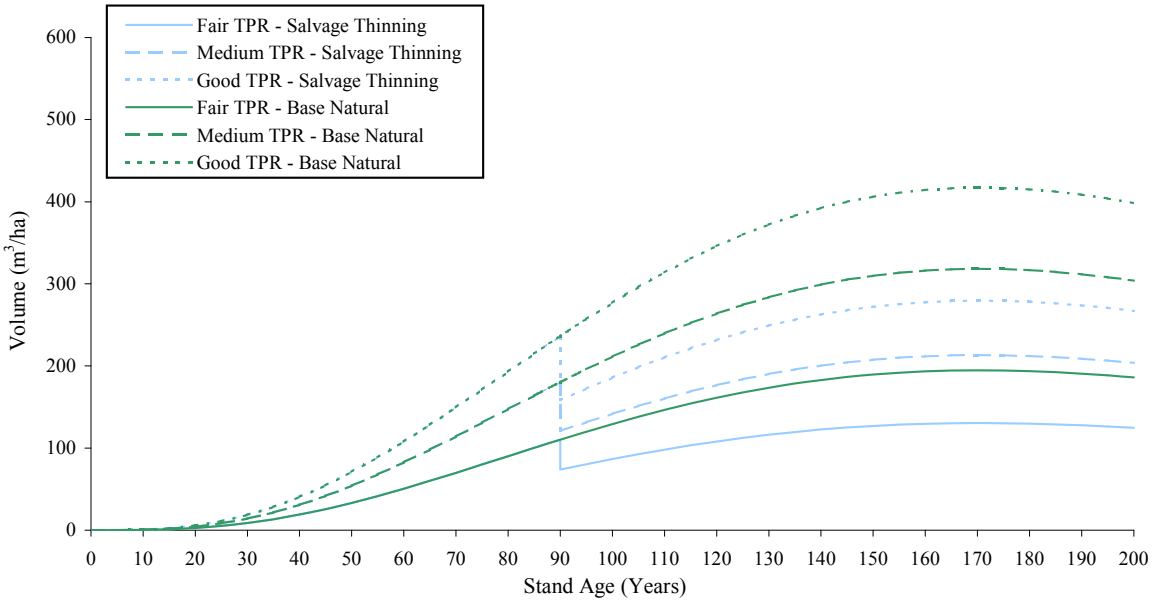
[1] Includes commercial thinning areas.

Stratum as a proportion of total managed landbase, FMU W13:



[1] Only salvage thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / PL STRATUM / Salvage Thinning Yield Curve / Coniferous Volume

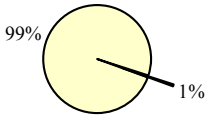


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	1,132

[1] Includes commercial thinning areas.

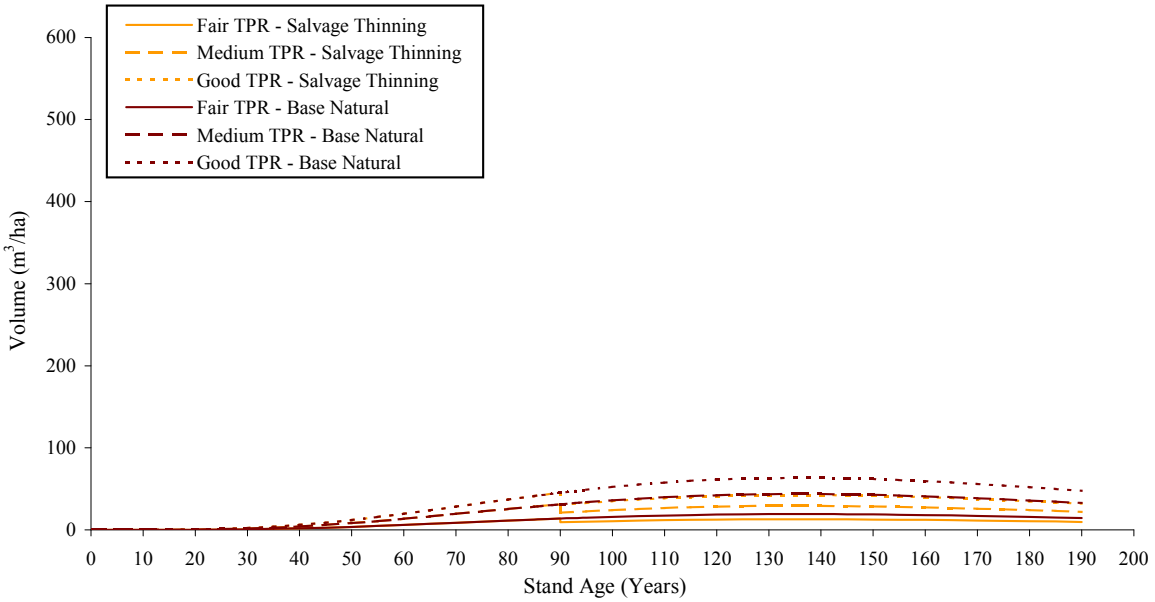
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Conifer			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.3	0.5	0.7	0.030	0.050	0.065
20	2.6	4.3	5.7	0.132	0.217	0.284
30	8.6	14.1	18.5	0.288	0.471	0.617
40	18.9	30.8	40.4	0.472	0.771	1.011
50	33.1	54.1	70.9	0.661	1.081	1.417
60	50.4	82.4	108.0	0.840	1.373	1.800
70	69.8	114.1	149.6	0.997	1.630	2.137
80	90.1	147.3	193.1	1.126	1.841	2.414
90	110.2	180.2	236.2	1.225	2.002	2.625
90	73.8	120.7	158.3	0.820	1.342	1.759
100	86.6	141.6	185.6	0.866	1.416	1.856
110	98.1	160.4	210.3	0.892	1.458	1.912
120	108.1	176.7	231.7	0.901	1.473	1.931
130	116.3	190.1	249.2	0.894	1.462	1.917
140	122.5	200.4	262.7	0.875	1.431	1.876
150	126.9	207.6	272.1	0.846	1.384	1.814
160	129.5	211.8	277.6	0.809	1.324	1.735
170	130.4	213.2	279.5	0.767	1.254	1.644
180	129.7	212.1	278.1	0.721	1.178	1.545
190	127.7	208.8	273.7	0.672	1.099	1.441
200	124.5	203.6	267.0	0.623	1.018	1.335

[1] Only salvage thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / PL STRATUM / Salvage Thinning Yield Curve / Deciduous Volume

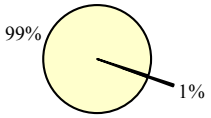


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	1,132

[1] Includes commercial thinning areas.

Stratum as a proportion of total managed landbase, FMU W13:

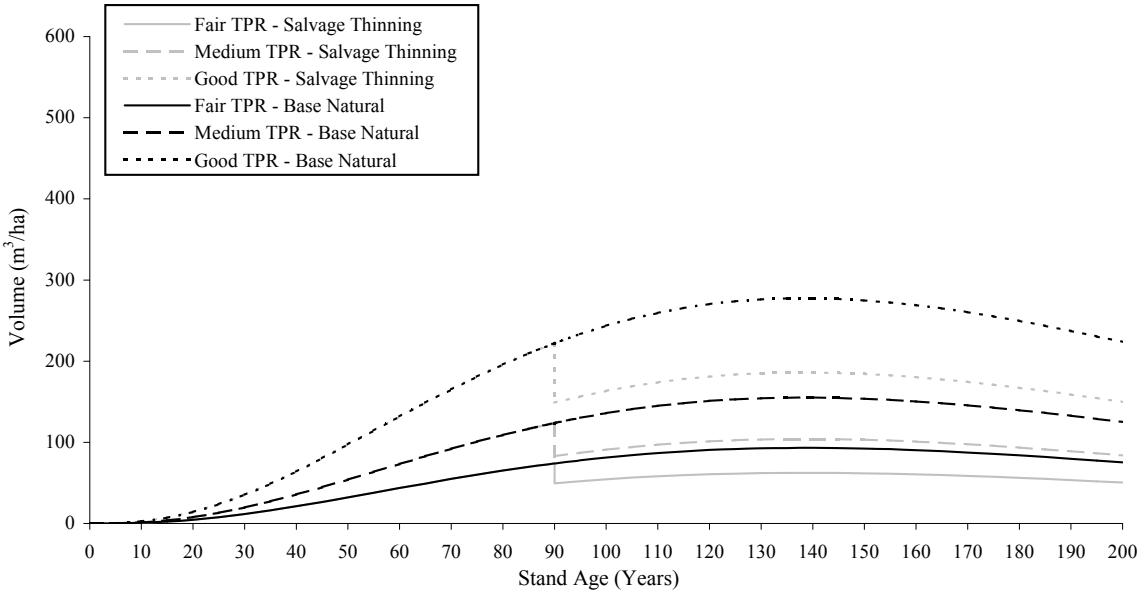


Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Deciduous			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.0	0.0	0.0	0.001	0.002	0.003
20	0.2	0.4	0.5	0.008	0.018	0.026
30	0.7	1.6	2.3	0.023	0.053	0.077
40	1.8	4.2	6.1	0.046	0.105	0.152
50	3.6	8.3	12.0	0.073	0.165	0.240
60	6.0	13.5	19.6	0.099	0.225	0.327
70	8.6	19.5	28.3	0.123	0.278	0.404
80	11.3	25.5	37.1	0.141	0.319	0.463
90	13.7	31.2	45.3	0.153	0.346	0.503
90	9.2	20.9	30.3	0.102	0.232	0.337
100	10.6	24.1	35.0	0.106	0.241	0.350
110	11.7	26.6	38.6	0.107	0.242	0.351
120	12.5	28.3	41.1	0.104	0.236	0.342
130	12.8	29.1	42.3	0.099	0.224	0.325
140	12.9	29.2	42.4	0.092	0.208	0.303
150	12.6	28.6	41.5	0.084	0.191	0.277
160	12.1	27.4	39.8	0.076	0.171	0.249
170	11.4	25.9	37.6	0.067	0.152	0.221
180	10.6	24.0	34.9	0.059	0.133	0.194
190	9.7	22.0	31.9	0.051	0.116	0.168
200	8.8	19.9	28.8	0.044	0.099	0.144

[1] Only salvage thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

SB Stratum Salvage Thinning Curves

FMU W13 / SB STRATUM / Salvage Thinning Yield Curve / Total Volume

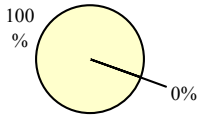


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	69

[1] Includes commercial thinning areas.

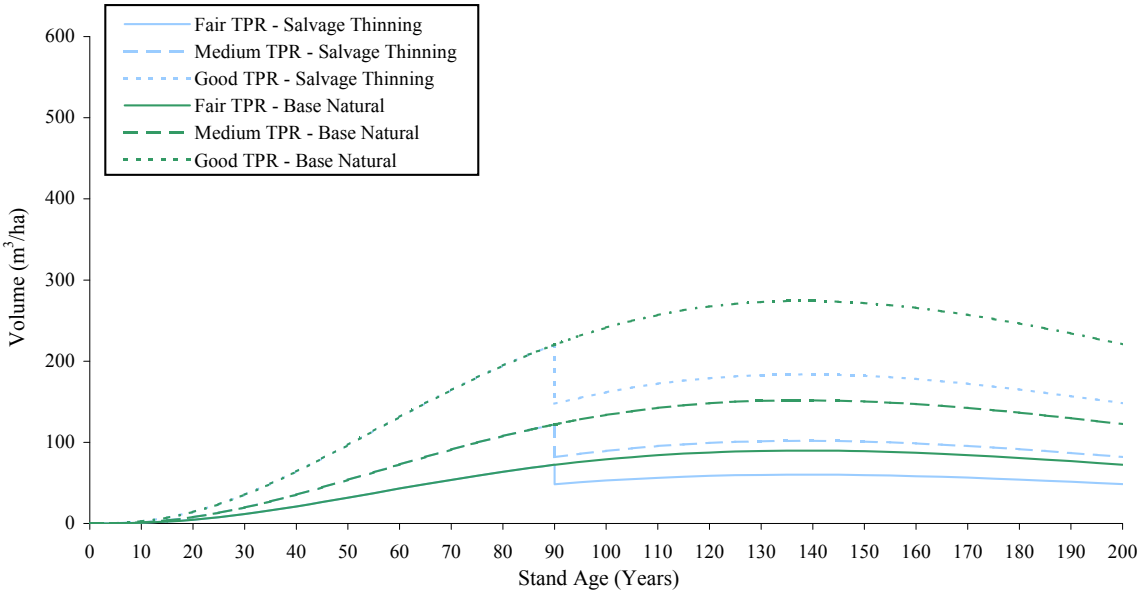
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Total			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.8	1.4	2.5	0.083	0.141	0.254
20	4.6	7.8	14.1	0.231	0.391	0.705
30	11.6	19.6	35.4	0.387	0.654	1.179
40	21.1	35.6	64.1	0.527	0.889	1.602
50	32.1	54.0	97.2	0.642	1.080	1.945
60	43.6	73.3	131.8	0.727	1.221	2.197
70	54.8	92.0	165.3	0.783	1.314	2.361
80	65.1	109.1	195.8	0.814	1.363	2.448
90	74.0	123.8	222.1	0.822	1.376	2.468
90	49.6	83.0	148.8	0.551	0.922	1.654
100	54.4	91.0	163.1	0.544	0.910	1.631
110	58.1	97.1	173.9	0.528	0.882	1.580
120	60.6	101.2	181.1	0.505	0.843	1.509
130	62.0	103.4	185.0	0.477	0.795	1.423
140	62.4	103.9	185.9	0.446	0.742	1.328
150	61.8	103.0	184.2	0.412	0.687	1.228
160	60.5	100.8	180.2	0.378	0.630	1.126
170	58.6	97.6	174.4	0.345	0.574	1.026
180	56.2	93.5	167.2	0.312	0.520	0.929
190	53.4	88.9	158.9	0.281	0.468	0.836
200	50.3	83.8	149.8	0.252	0.419	0.749

[1] Only salvage thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / SB STRATUM / Salvage Thinning Yield Curve / Coniferous Volume

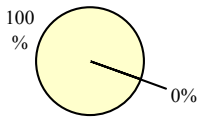


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	69

[1] Includes commercial thinning areas.

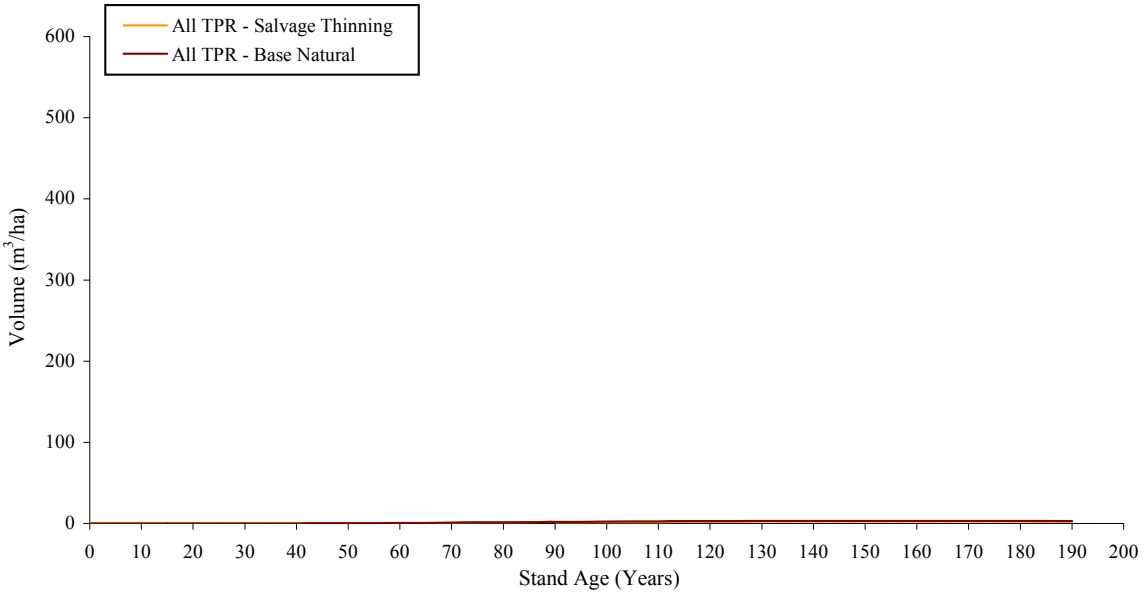
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Conifer			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.8	1.4	2.5	0.083	0.141	0.254
20	4.6	7.8	14.1	0.231	0.390	0.705
30	11.6	19.6	35.3	0.386	0.652	1.177
40	20.9	35.4	63.9	0.524	0.885	1.599
50	31.7	53.7	96.9	0.635	1.073	1.938
60	43.0	72.6	131.2	0.716	1.211	2.186
70	53.8	91.0	164.3	0.769	1.300	2.347
80	63.7	107.7	194.4	0.796	1.346	2.430
90	72.2	122.0	220.3	0.802	1.356	2.448
90	48.3	81.7	147.6	0.537	0.908	1.640
100	52.9	89.5	161.6	0.529	0.895	1.616
110	56.4	95.3	172.1	0.512	0.866	1.565
120	58.7	99.2	179.1	0.489	0.827	1.493
130	59.9	101.3	182.9	0.461	0.779	1.407
140	60.2	101.7	183.7	0.430	0.727	1.312
150	59.6	100.8	181.9	0.397	0.672	1.213
160	58.3	98.6	178.0	0.364	0.616	1.112
170	56.4	95.4	172.2	0.332	0.561	1.013
180	54.1	91.4	165.1	0.300	0.508	0.917
190	51.4	86.9	156.9	0.271	0.457	0.826
200	48.5	82.0	148.0	0.242	0.410	0.740

[1] Only salvage thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

FMU W13 / SB STRATUM / Salvage Thinning Yield Curve / Deciduous Volume

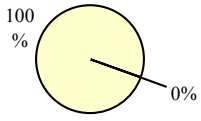


Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Stratum Area (ha)[4]:	69

[1] Includes commercial thinning areas.

Stratum as a proportion of total managed landbase, FMU W13:

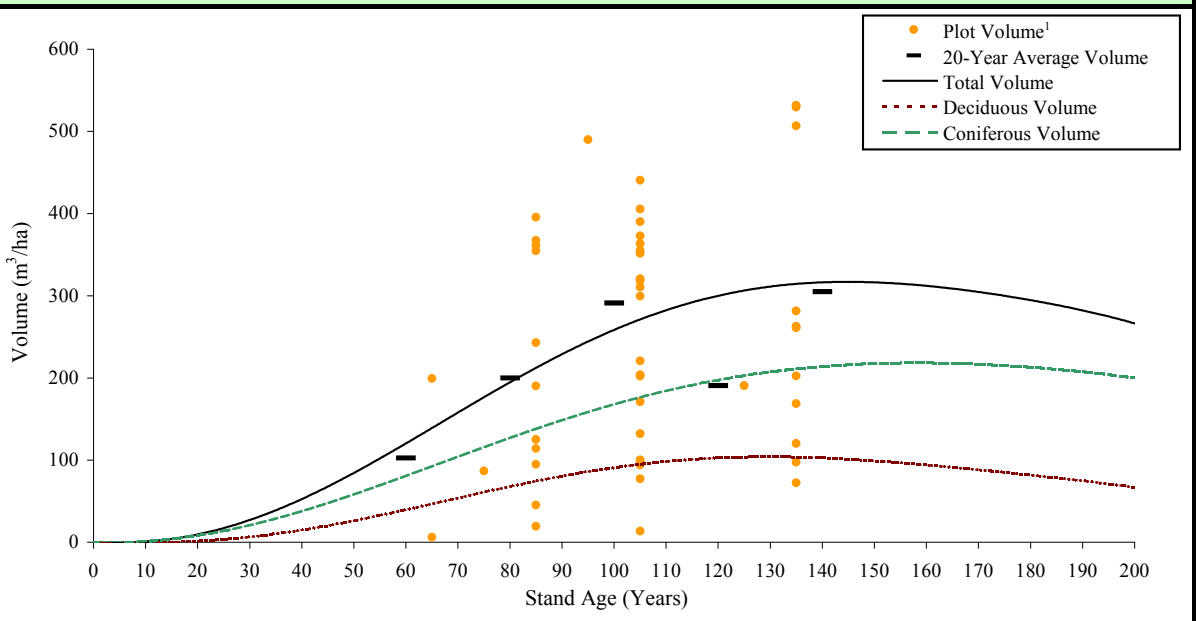


Stand Age	Predicted Gross Stand Volume[1,2] (m³/ha) - Deciduous			Mean Annual Increment[3] (m³/ha/year)		
	F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0	0.0	0.0	0.0	0.000	0.000	0.000
10	0.0	0.0	0.0	0.000	0.000	0.000
20	0.0	0.0	0.0	0.000	0.000	0.000
30	0.0	0.0	0.0	0.002	0.002	0.002
40	0.2	0.2	0.2	0.004	0.004	0.004
50	0.3	0.3	0.3	0.007	0.007	0.007
60	0.6	0.6	0.6	0.010	0.010	0.010
70	1.0	1.0	1.0	0.014	0.014	0.014
80	1.4	1.4	1.4	0.018	0.018	0.018
90	1.8	1.8	1.8	0.020	0.020	0.020
90	1.2	1.2	1.2	0.014	0.014	0.014
100	1.5	1.5	1.5	0.015	0.015	0.015
110	1.8	1.8	1.8	0.016	0.016	0.016
120	2.0	2.0	2.0	0.016	0.016	0.016
130	2.1	2.1	2.1	0.016	0.016	0.016
140	2.2	2.2	2.2	0.016	0.016	0.016
150	2.3	2.3	2.3	0.015	0.015	0.015
160	2.2	2.2	2.2	0.014	0.014	0.014
170	2.2	2.2	2.2	0.013	0.013	0.013
180	2.1	2.1	2.1	0.012	0.012	0.012
190	2.0	2.0	2.0	0.010	0.010	0.010
200	1.8	1.8	1.8	0.009	0.009	0.009

[1] Only salvage thinning volumes are presented here. See base natural stand yield curves for base volumes.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue; thinning event highlighted in yellow.
[4] Total thinned area; thinned stands have not yet been split into commecial and salvage thinning types.

Appendix XVII. FMU W13 Athabasca Flats Yield Curves

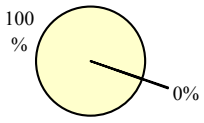
FMU W13 / Athabasca Flats Pre-Treatment Yield Curve



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	50
Stratum Area (ha) :	772

Stratum as a proportion of total managed landbase, FMU W13:

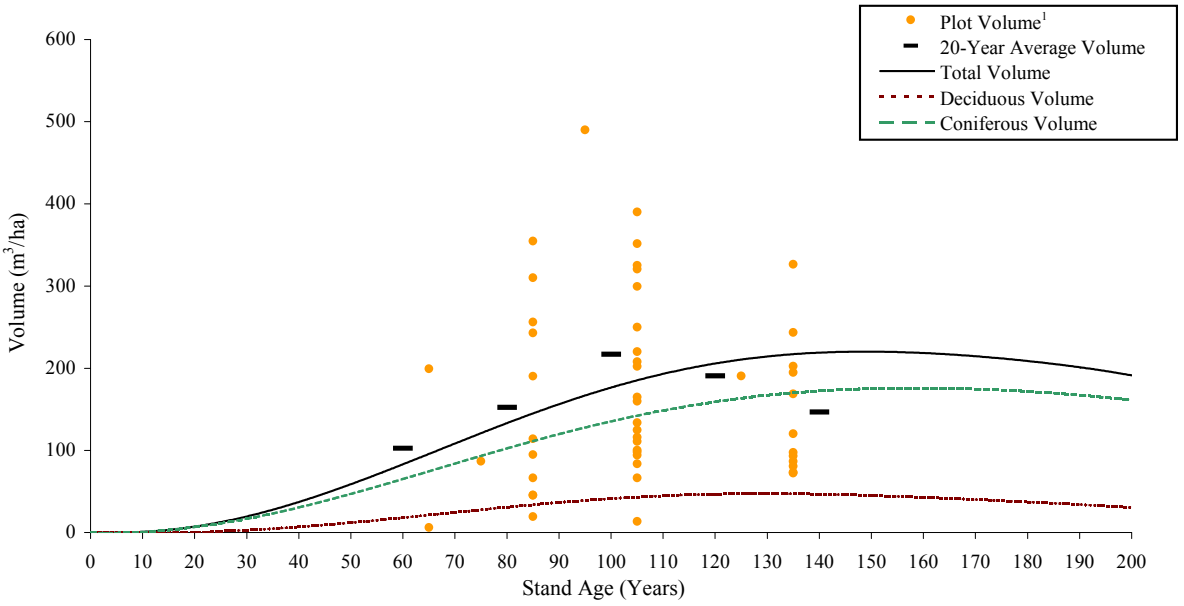


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha)			Mean Annual Increment[3] (m3/ha/year)		
		Conifer	Deciduous	Total	Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.6	0.2	1.8	0.164	0.015	0.179
20		8.3	1.7	10.0	0.414	0.085	0.498
30		20.4	6.2	26.6	0.681	0.206	0.887
40		37.4	14.3	51.7	0.936	0.358	1.294
50		58.0	25.8	83.8	1.160	0.516	1.676
60	2	80.7	39.5	120.2	1.346	0.658	2.004
70	1	104.2	54.1	158.3	1.489	0.773	2.261
80	11	127.2	68.2	195.3	1.590	0.852	2.442
90	1	148.6	80.6	229.2	1.651	0.896	2.547
100	22	167.7	90.7	258.4	1.677	0.907	2.584
110		184.0	97.9	282.0	1.673	0.890	2.563
120	1	197.2	102.2	299.4	1.643	0.851	2.495
130	12	207.1	103.6	310.7	1.593	0.797	2.390
140		213.9	102.5	316.4	1.528	0.732	2.260
150		217.5	99.3	316.8	1.450	0.662	2.112
160		218.3	94.4	312.8	1.365	0.590	1.955
170		216.7	88.3	305.0	1.275	0.519	1.794
180		212.8	81.4	294.2	1.182	0.452	1.634
190		207.1	74.1	281.1	1.090	0.390	1.480
200		199.8	66.6	266.4	0.999	0.333	1.332

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

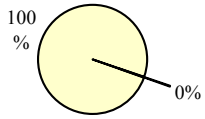
FMU W13 / Athabasca Flats Post-Treatment Yield Curve



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	50
Stratum Area (ha) :	772

Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha)			Mean Annual Increment[3] (m3/ha/year)		
		Conifer	Deciduous	Total	Conifer	Deciduous	Total
0		0.0	0.0	0.0	0.000	0.000	0.000
10		1.3	0.1	1.4	0.132	0.007	0.139
20		6.7	0.8	7.4	0.333	0.038	0.372
30		16.5	2.8	19.3	0.549	0.094	0.642
40		30.2	6.5	36.7	0.754	0.163	0.917
50		46.7	11.7	58.5	0.935	0.234	1.169
60	2	65.1	18.0	83.0	1.084	0.299	1.384
70	1	84.0	24.6	108.6	1.200	0.351	1.551
80	11	102.5	31.0	133.5	1.281	0.387	1.668
90	1	119.8	36.7	156.4	1.331	0.407	1.738
100	22	135.2	41.2	176.4	1.352	0.412	1.764
110		148.3	44.5	192.8	1.348	0.405	1.753
120	1	158.9	46.4	205.4	1.324	0.387	1.711
130	12	166.9	47.1	214.0	1.284	0.362	1.646
140		172.3	46.6	218.9	1.231	0.333	1.564
150		175.3	45.1	220.4	1.169	0.301	1.469
160		176.0	42.9	218.9	1.100	0.268	1.368
170		174.6	40.1	214.7	1.027	0.236	1.263
180		171.5	37.0	208.5	0.953	0.206	1.158
190		166.9	33.7	200.5	0.878	0.177	1.055
200		161.0	30.3	191.3	0.805	0.151	0.956

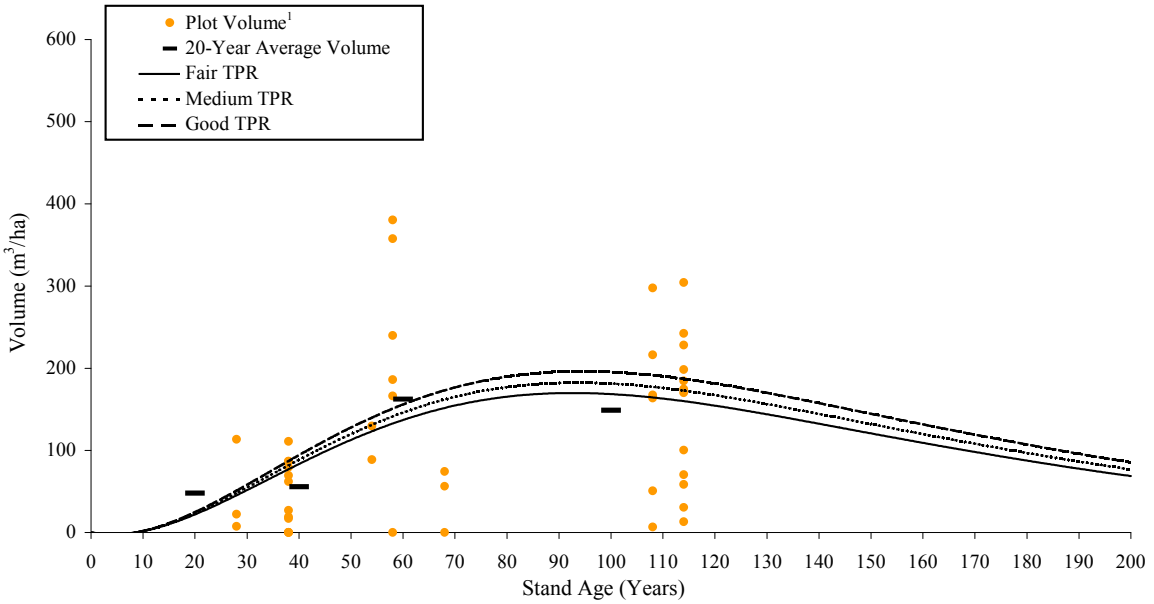
[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.

[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.

Appendix XVIII. FMU W13 Aspen Subunit Yield Curves

AW Whitecourt/Blue Ridge Subunit Natural Stand Curves

FMU W13 / AW STRATUM / W_BR Natural Stand Yield Curve / Total Volume

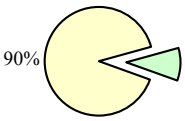


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Total F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		4.4	4.7	4.9	0.441	0.466	0.494
20	3	22.3	23.6	25.1	1.117	1.182	1.254
30	12	50.6	53.7	57.0	1.688	1.789	1.900
40		82.6	87.7	93.3	2.065	2.192	2.332
50	8	112.7	119.8	127.7	2.254	2.396	2.553
60	3	137.3	146.3	156.2	2.289	2.439	2.603
70		155.0	165.5	177.1	2.214	2.364	2.530
80		165.5	177.2	190.0	2.069	2.214	2.375
90		169.5	181.9	195.6	1.884	2.022	2.173
100	6	168.2	181.0	195.1	1.682	1.810	1.951
110	12	162.7	175.6	189.8	1.479	1.597	1.726
120		154.3	167.0	181.1	1.286	1.392	1.509
130		143.9	156.4	170.1	1.107	1.203	1.308
140		132.6	144.5	157.7	0.947	1.032	1.126
150		120.8	132.2	144.7	0.805	0.881	0.965
160		109.1	119.9	131.7	0.682	0.749	0.823
170		97.9	108.0	119.1	0.576	0.635	0.700
180		87.4	96.7	107.0	0.486	0.537	0.595
190		77.6	86.3	95.8	0.409	0.454	0.504
200		68.7	76.7	85.4	0.344	0.383	0.427

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

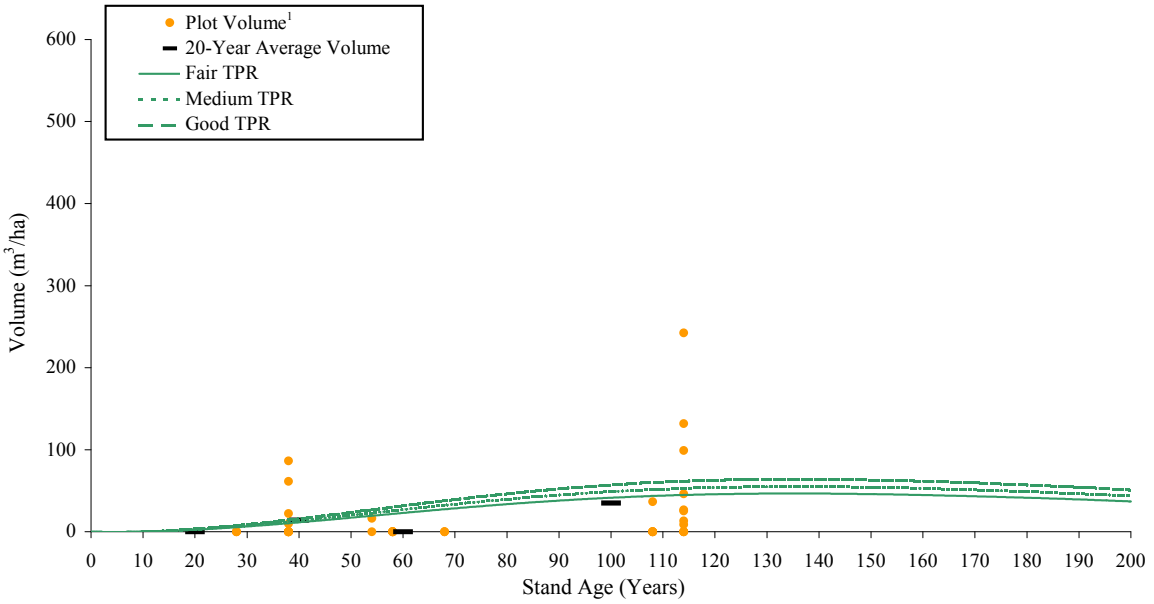
Stratum Summary:	
Total Number of Plots:	44
Stratum Area (ha) :	20,714

Stratum as a proportion of total managed landbase, FMU W13:



[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / W_BR Natural Stand Yield Curve / Coniferous Volume



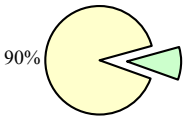
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a_0+a_1*SI*(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-2.337E-04
Eqn: 2P+k	a_1	1.086E-04
	b	2.7202683
	k	50
Site Index Inputs	F	12.4
	M	14.2
	G	16.2

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	44
Stratum Area (ha) :	20,714

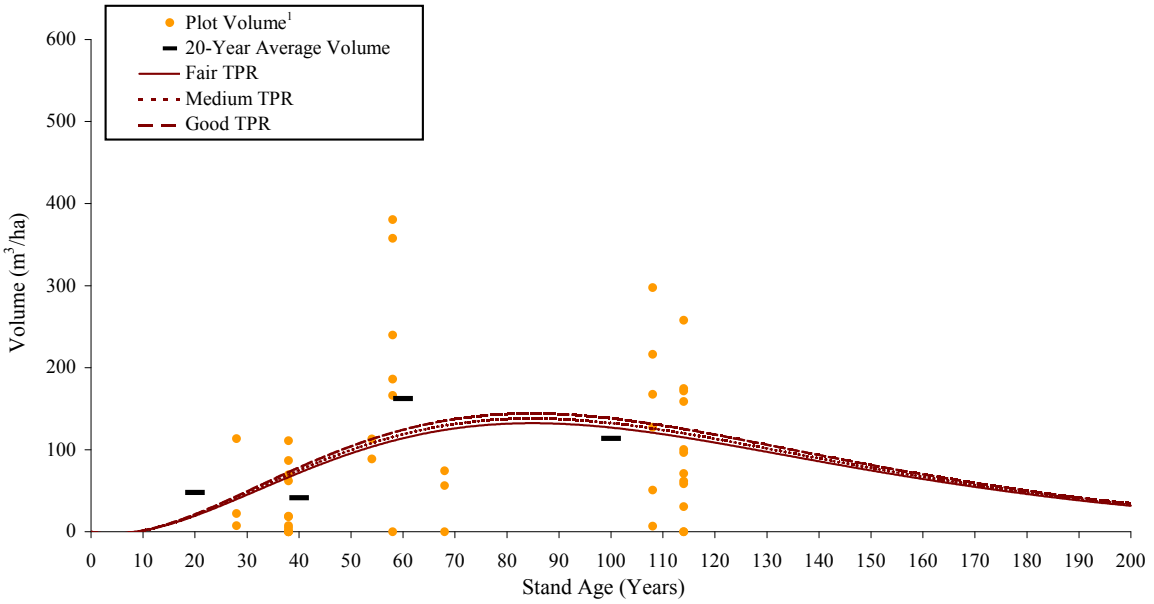
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.5	0.6	0.7	0.048	0.056	0.066
20	3	2.6	3.0	3.5	0.129	0.152	0.177
30	12	6.4	7.5	8.7	0.212	0.250	0.291
40		11.4	13.4	15.7	0.285	0.335	0.391
50	8	17.1	20.2	23.5	0.342	0.403	0.470
60	3	23.0	27.1	31.6	0.383	0.452	0.527
70		28.6	33.7	39.4	0.409	0.482	0.562
80		33.7	39.7	46.3	0.421	0.497	0.579
90		38.0	44.8	52.3	0.423	0.498	0.581
100	6	41.5	48.9	57.0	0.415	0.489	0.570
110	12	44.0	51.8	60.5	0.400	0.471	0.550
120		45.6	53.8	62.7	0.380	0.448	0.523
130		46.5	54.7	63.9	0.357	0.421	0.491
140		46.5	54.8	64.0	0.332	0.392	0.457
150		46.0	54.2	63.2	0.306	0.361	0.421
160		44.9	52.9	61.7	0.280	0.330	0.385
170		43.3	51.0	59.5	0.255	0.300	0.350
180		41.4	48.8	56.9	0.230	0.271	0.316
190		39.3	46.3	54.0	0.207	0.244	0.284
200		37.0	43.6	50.8	0.185	0.218	0.254

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / W_BR Natural Stand Yield Curve / Deciduous Volume



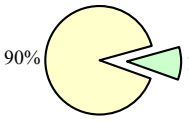
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a_0+a_1*SI*(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	5.988E-03
Eqn: 2P+k	a_1	1.636E-04
	b	2.8114068
	k	30
Site Index Inputs	F	15.1
	M	17.4
	G	19.8

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	44
Stratum Area (ha) :	20,714

Stratum as a proportion of total managed landbase, FMU W13:

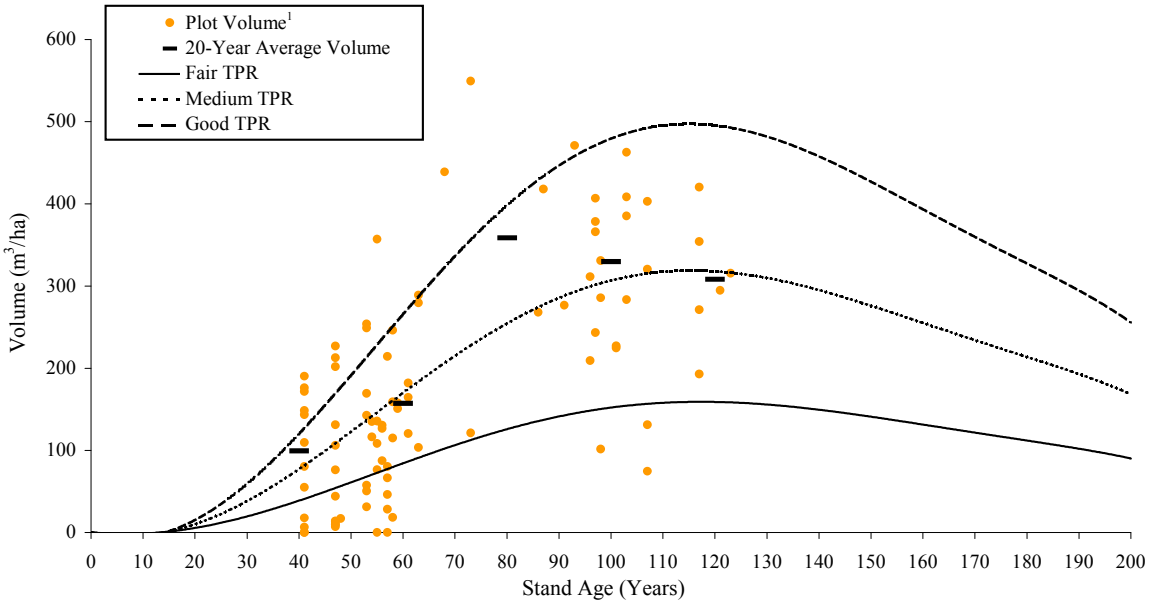


Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		3.9	4.1	4.3	0.393	0.410	0.428
20	3	19.8	20.6	21.5	0.988	1.030	1.077
30	12	44.3	46.2	48.2	1.476	1.539	1.608
40		71.2	74.3	77.6	1.781	1.857	1.940
50	8	95.6	99.7	104.1	1.912	1.993	2.083
60	3	114.3	119.2	124.6	1.906	1.987	2.076
70		126.4	131.8	137.7	1.805	1.882	1.967
80		131.8	137.4	143.6	1.648	1.718	1.795
90		131.5	137.1	143.3	1.461	1.524	1.592
100	6	126.7	132.1	138.1	1.267	1.321	1.381
110	12	118.7	123.8	129.3	1.079	1.125	1.176
120		108.6	113.3	118.4	0.905	0.944	0.986
130		97.5	101.6	106.2	0.750	0.782	0.817
140		86.0	89.7	93.7	0.614	0.641	0.670
150		74.8	78.0	81.5	0.499	0.520	0.544
160		64.3	67.0	70.0	0.402	0.419	0.438
170		54.6	57.0	59.5	0.321	0.335	0.350
180		46.0	47.9	50.1	0.255	0.266	0.278
190		38.3	40.0	41.8	0.202	0.210	0.220
200		31.7	33.1	34.6	0.159	0.165	0.173

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

AW McLeod/Virginia Hills Subunit Natural Stand Curves

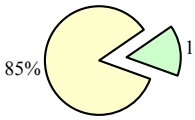
FMU W13 / AW STRATUM / MC_VH Natural Stand Yield Curve / Total Volume



Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	94
Stratum Area (ha) :	31,683

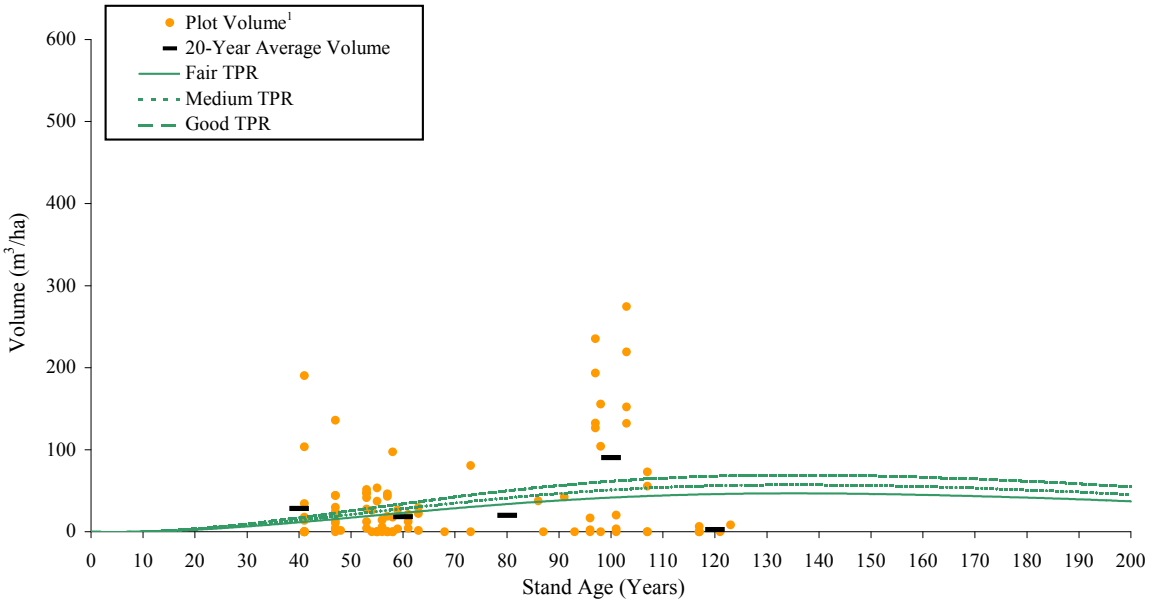
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m3/ha) - Total			Mean Annual Increment[3] (m3/ha/year)		
		F TPR	M TPR	G TPR	F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.9	1.5	2.2	0.087	0.148	0.218
20		6.3	11.9	18.0	0.317	0.593	0.902
30		18.7	36.4	56.1	0.624	1.213	1.871
40	25	37.5	74.3	115.5	0.937	1.858	2.887
50	29	60.3	121.0	188.8	1.207	2.420	3.775
60	7	84.4	170.4	266.3	1.407	2.840	4.439
70	2	107.2	216.9	339.4	1.531	3.099	4.849
80	2	126.7	256.5	401.4	1.583	3.206	5.017
90	12	141.7	286.6	448.3	1.575	3.184	4.981
100	11	151.8	306.2	478.7	1.518	3.062	4.787
110	4	157.1	315.7	492.9	1.429	2.870	4.481
120	2	158.1	316.1	492.6	1.317	2.634	4.105
130		155.3	308.7	480.2	1.195	2.375	3.694
140		149.6	295.4	458.3	1.068	2.110	3.274
150		141.6	277.7	429.6	0.944	1.851	2.864
160		132.2	257.1	396.6	0.826	1.607	2.479
170		121.9	234.9	361.2	0.717	1.382	2.125
180		111.3	212.3	325.2	0.618	1.179	1.807
190		100.6	190.0	289.8	0.530	1.000	1.526
200		90.3	168.5	256.0	0.451	0.843	1.280

[1] Plot volumes greater than 600 m3/ha, if any, are not shown on the graph.
[2] Gross total stand volume is the sum of gross coniferous stand volume plus gross deciduous stand volume.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / MC_VH Natural Stand Yield Curve / Coniferous Volume



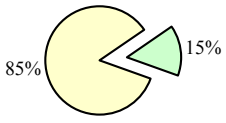
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a_0+a_1*SI*(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-2.337E-04
Eqn: 2P+k	a_1	1.086E-04
	b	2.7202683
	k	50
Site Index Inputs	F	12.4
	M	14.7
	G	17.3

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	94
Stratum Area (ha) :	31,683

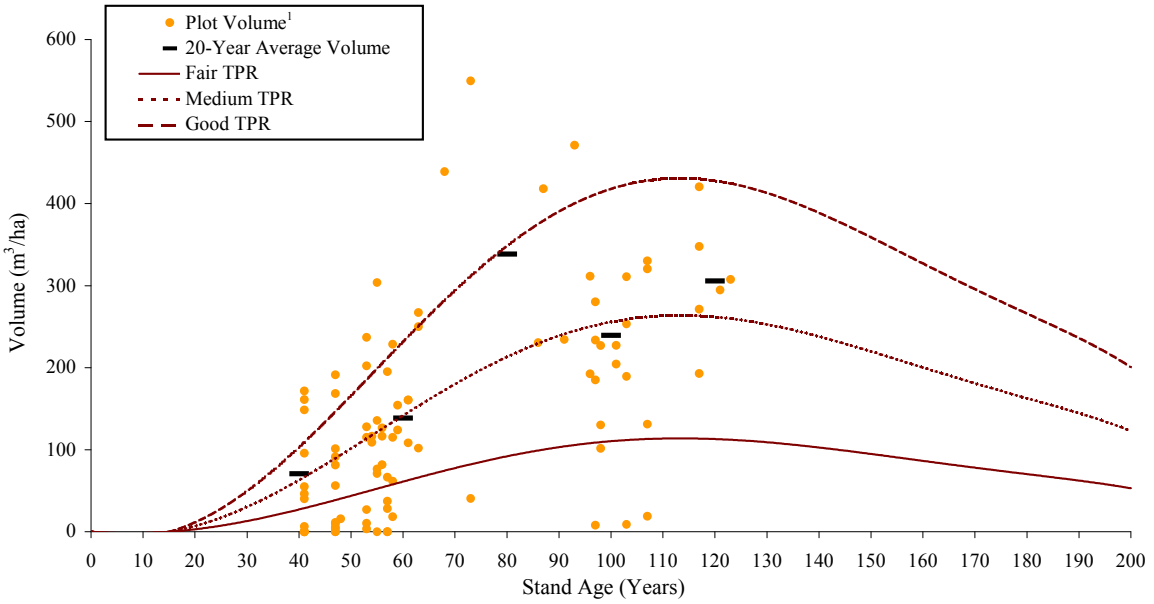
Stratum as a proportion of total managed landbase, FMU W13:



Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m³/ha) - Conifer F TPR	M TPR	G TPR	Mean Annual Increment[3] (m³/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.5	0.6	0.7	0.048	0.059	0.071
20		2.6	3.2	3.8	0.129	0.158	0.191
30		6.4	7.8	9.4	0.213	0.260	0.314
40	25	11.4	14.0	16.9	0.286	0.349	0.422
50	29	17.2	21.0	25.4	0.343	0.420	0.508
60	7	23.1	28.2	34.1	0.385	0.470	0.569
70	2	28.7	35.1	42.5	0.411	0.502	0.607
80	2	33.8	41.4	50.0	0.423	0.517	0.625
90	12	38.2	46.7	56.4	0.424	0.519	0.627
100	11	41.6	50.9	61.5	0.416	0.509	0.615
110	4	44.2	54.0	65.3	0.402	0.491	0.593
120	2	45.8	56.0	67.7	0.382	0.467	0.564
130		46.6	57.0	68.9	0.359	0.439	0.530
140		46.7	57.1	69.0	0.334	0.408	0.493
150		46.1	56.4	68.2	0.308	0.376	0.455
160		45.0	55.0	66.5	0.281	0.344	0.416
170		43.5	53.2	64.3	0.256	0.313	0.378
180		41.6	50.8	61.5	0.231	0.282	0.341
190		39.4	48.2	58.3	0.208	0.254	0.307
200		37.1	45.4	54.9	0.186	0.227	0.274

[1] Plot volumes greater than 600 m³/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

FMU W13 / AW STRATUM / MC_VH Natural Stand Yield Curve / Deciduous Volume



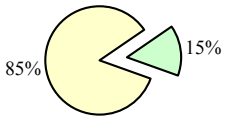
2-PARAMETER EQUATION WITH CONSTANT (2P+k): volume = $a_0+a_1*SI*(age)^b e^{(-age/k)}$

Inputs:		
Parameter Values	a_0	-5.765E-04
Eqn: 2P+k	a_1	4.558E-05
	b	3.7568663
	k	30
Site Index Inputs	F	14.7
	M	17.5
	G	20.5

Utilization Standards:	
Top Diameter (cm):	10.0
Stump Diameter (cm):	15.0
Stump Height-SW (cm):	30.0
Stump Height-Other (cm):	20.0
Minimum Log Length (m):	4.88

Stratum Summary:	
Total Number of Plots:	94
Stratum Area (ha) :	31,683

Stratum as a proportion of total managed landbase, FMU W13:



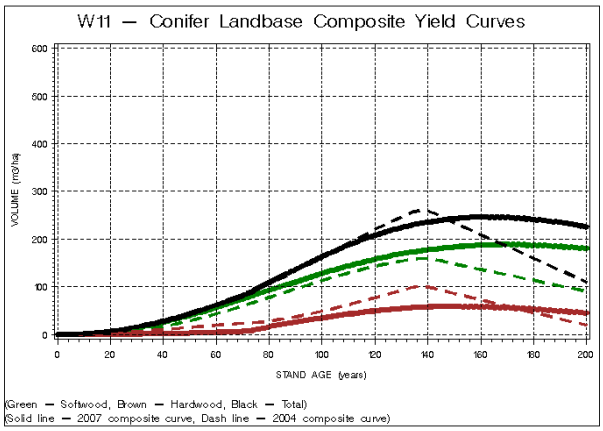
Stand Age	Number of Plots	Predicted Gross Stand Volume[2] (m^3/ha) - Deciduous F TPR	M TPR	G TPR	Mean Annual Increment[3] (m^3/ha/year) F TPR	M TPR	G TPR
0		0.0	0.0	0.0	0.000	0.000	0.000
10		0.4	0.9	1.5	0.039	0.090	0.147
20		3.8	8.7	14.2	0.188	0.435	0.710
30		12.3	28.6	46.7	0.411	0.953	1.557
40	25	26.1	60.4	98.6	0.651	1.509	2.465
50	29	43.2	100.0	163.4	0.863	2.000	3.268
60	7	61.4	142.2	232.2	1.023	2.369	3.870
70	2	78.4	181.8	296.9	1.121	2.597	4.242
80	2	92.8	215.1	351.4	1.160	2.688	4.392
90	12	103.5	239.9	391.9	1.150	2.665	4.354
100	11	110.2	255.4	417.2	1.102	2.554	4.172
110	4	113.0	261.8	427.6	1.027	2.380	3.887
120	2	112.2	260.1	424.9	0.935	2.167	3.541
130		108.6	251.7	411.2	0.836	1.936	3.163
140		102.8	238.3	389.3	0.735	1.702	2.780
150		95.5	221.2	361.4	0.637	1.475	2.410
160		87.2	202.0	330.0	0.545	1.263	2.063
170		78.5	181.8	297.0	0.462	1.069	1.747
180		69.7	161.5	263.8	0.387	0.897	1.465
190		61.2	141.7	231.6	0.322	0.746	1.219
200		53.2	123.1	201.2	0.266	0.616	1.006

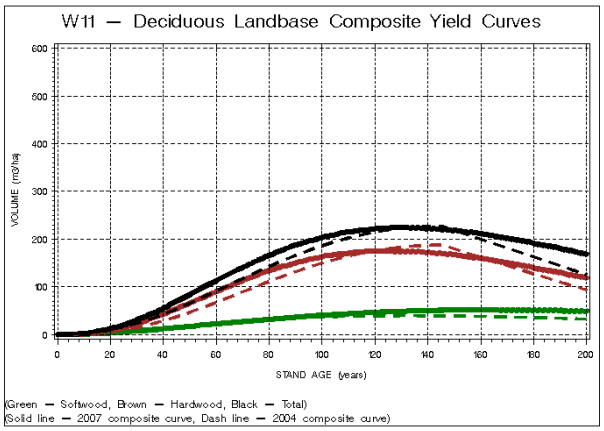
[1] Plot volumes greater than 600 m^3/ha, if any, are not shown on the graph.
[2] Gross stand volume is calculated at the utilization standards specified on this page with no deductions for cull.
[3] Maximum MAI highlighted in blue.

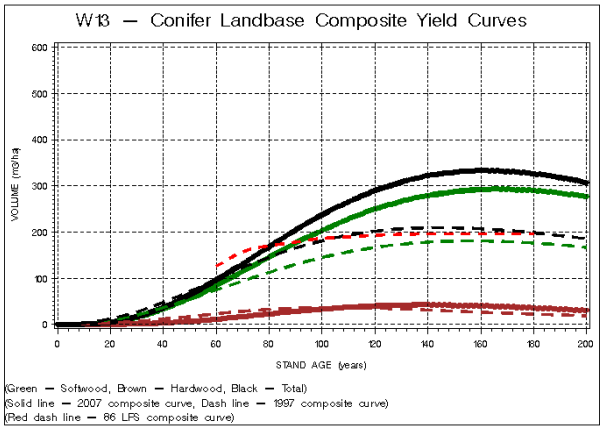
Appendix XIX. Yield Curve Comparisons

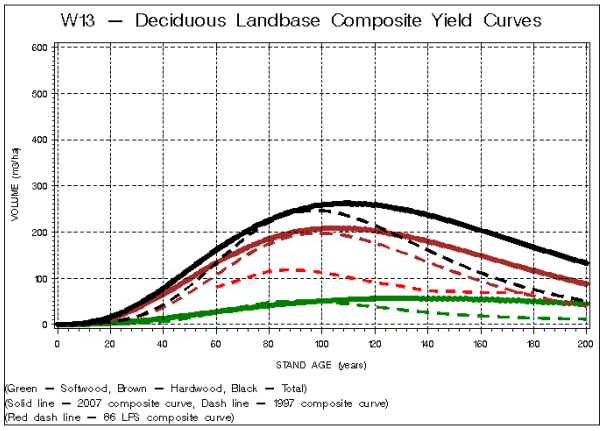
Yield curve comparisons show a variety of curves graphically overlaid for comparison purposes. Composite curves from the current plan are shown against composite curves prepared for previous plans. In addition, the yield curves from Appendices IX to XVIII are graphed together by FMU and DFMP yield stratum for comparison purposes. Note that curves only show total gross merchantable stand volume. For FMU W11, only the APAS_ABCD and the PASA_ABCD yield strata have more than one type of yield curve, therefore these are the only DFMP yield strata presented. Composite natural stand yield curves (deciduous landbase, coniferous landbase and combined landbase) for each FMU are also presented side-by-side for comparative purposes. For FMU W13, pine curves developed for the PL DFMP yield stratum are shown relative to GYPSY simulations.

Current DFMP vs. Past FMPs







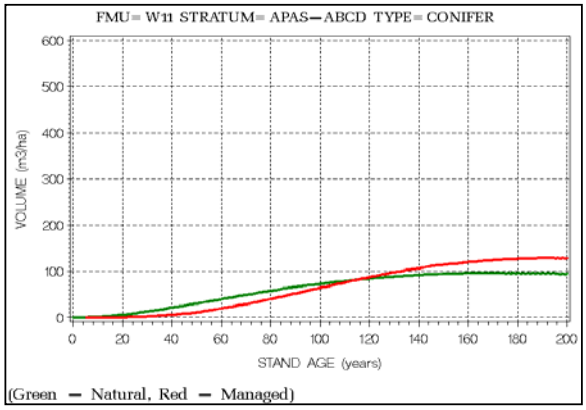


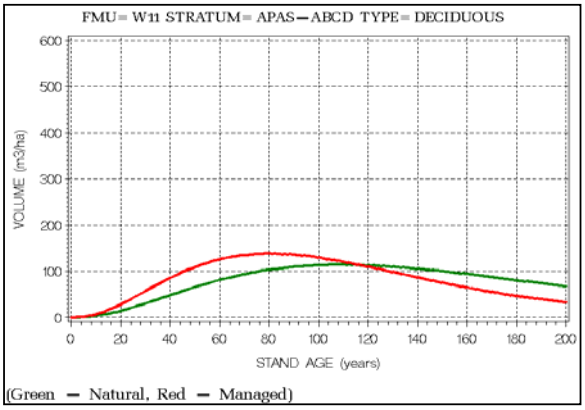
In past plans, composite curves were presented for the coniferous (C, CD, DC) and deciduous (D) landbases only, and not separated by broad cover group. As such, comparisons are done at that level.

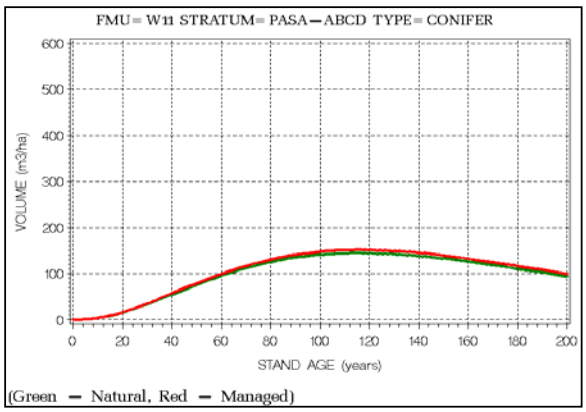
For FMU W11, the 2007 composite curves are based on the natural stand yield curves and landbase areas presented in this document. The 2004 composite curves are based on natural stand yield curves and landbase areas presented in the FMU W11 Preliminary Forest Management Plan (Millar Western 2004e).

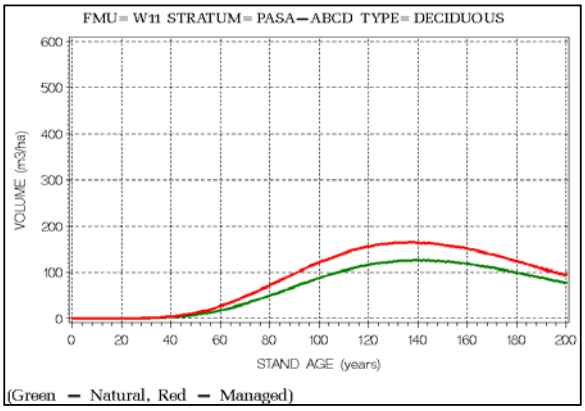
For FMU W13, the 2007 composite curves are based on the natural stand yield curves and landbase areas presented in this document. The 1997 composite curves are based on natural stand yield curves and landbase areas used in developing the 1997 DFMP for FMU W11 (Millar Western 2000). In the 1997 DFMP, composite yields for coniferous volume on the coniferous landbase and deciduous volume on the deciduous landbase were also included. These are included as the 1986 LFS composite curves.

FMU W11 Yield Curves by DFMP Yield Stratum



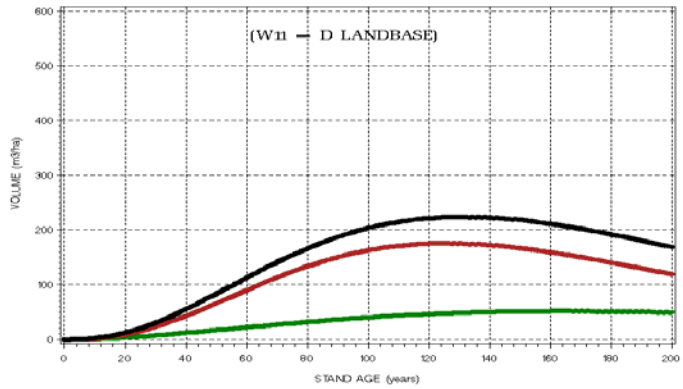




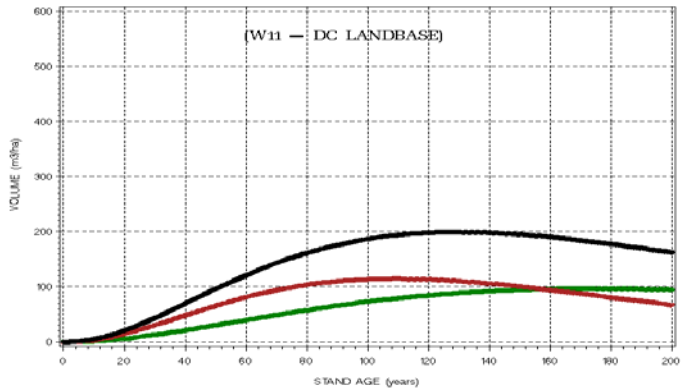


The remaining DMFP yield strata for FMU W11 only have base natural stand yield curves, and as such, are not presented here.

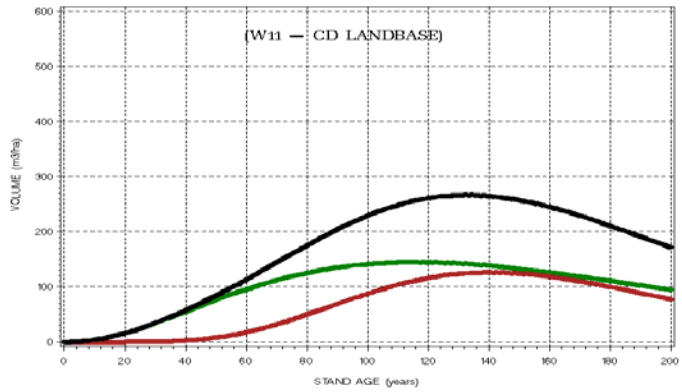
FMU W11 Composite Yield Curves:
Broad Cover Group (D, DC, CD, C) and Coniferous Landbase (DC/CD/C Combined)



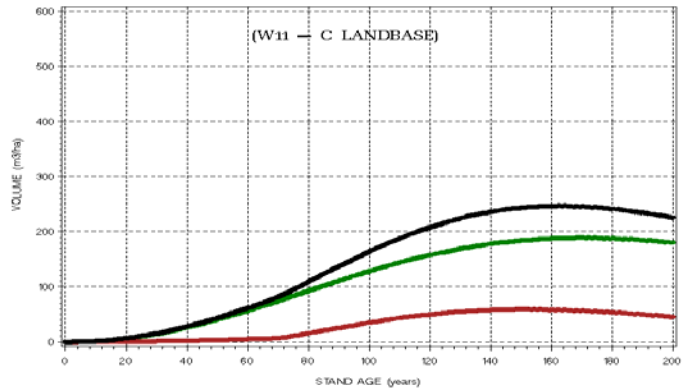
(Green — Softwood, Brown — Hardwood, Black — Total)



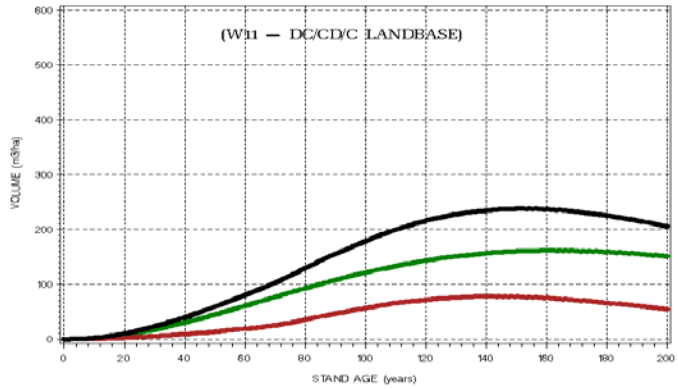
(Green — Softwood, Brown — Hardwood, Black — Total)



(Green — Softwood, Brown — Hardwood, Black — Total)

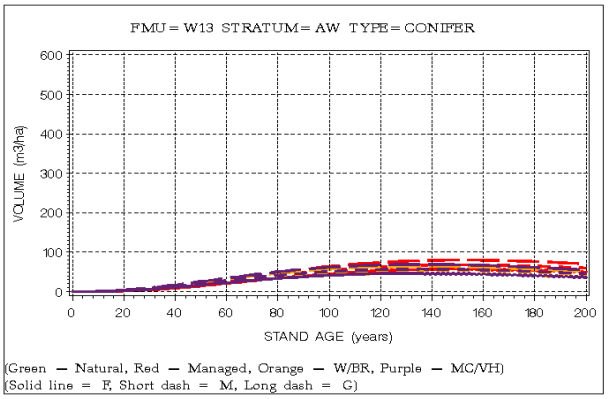


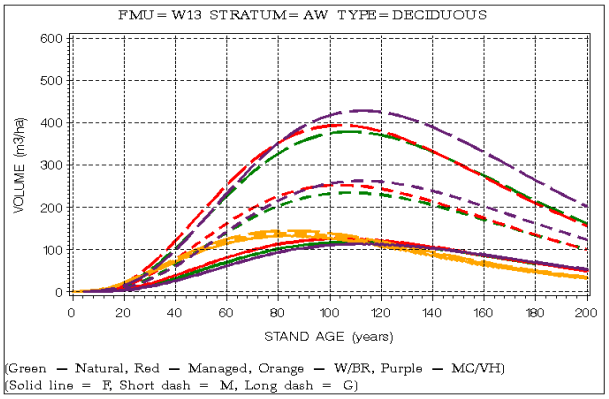
(Green — Softwood, Brown — Hardwood, Black — Total)

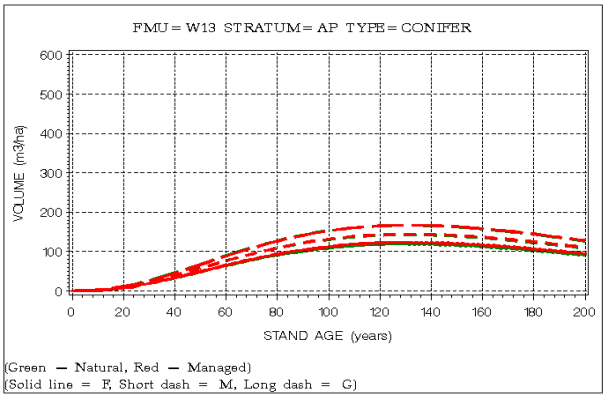


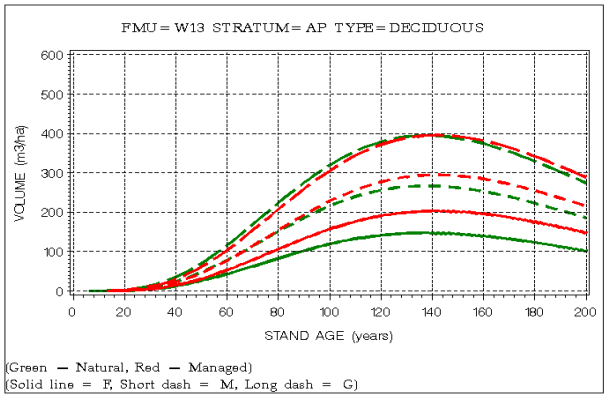
(Green — Softwood, Brown — Hardwood, Black — Total)

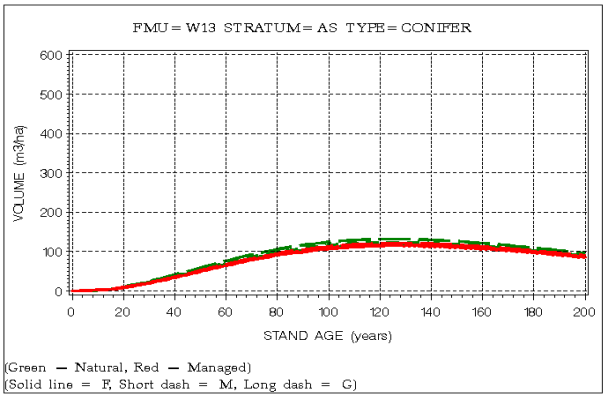
FMU W13 Yield Curves by DFMP Yield Stratum

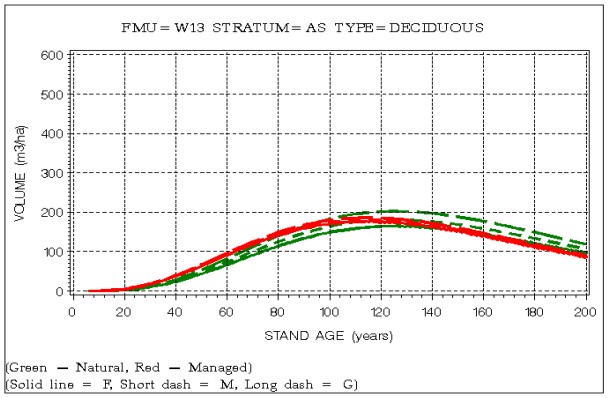

FMU = W13 STRATUM = AW TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed, Orange — W/BR, Purple — MC/VH)
(Solid line = F, Short dash = M, Long dash = G)

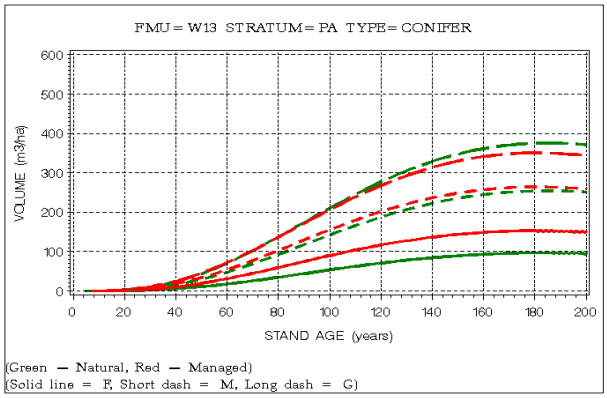

FMU = W13 STRATUM = AW TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed, Orange — W/BR, Purple — MC/VH)
(Solid line = F, Short dash = M, Long dash = G)

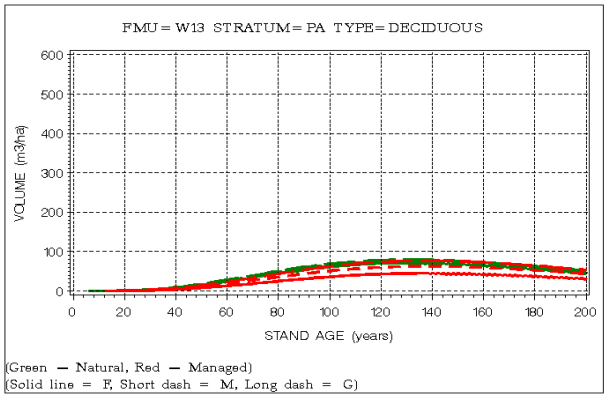

FMU = W13 STRATUM = AP TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

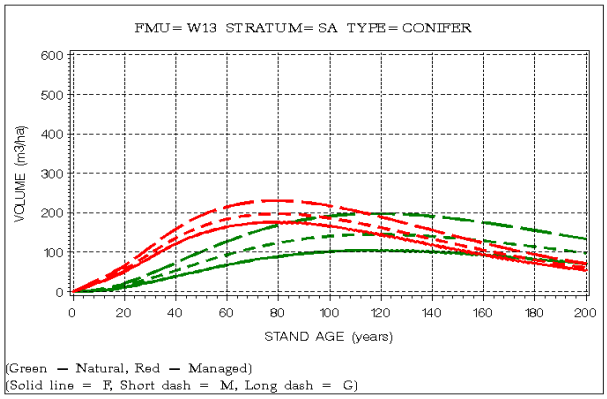

FMU = W13 STRATUM = AP TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

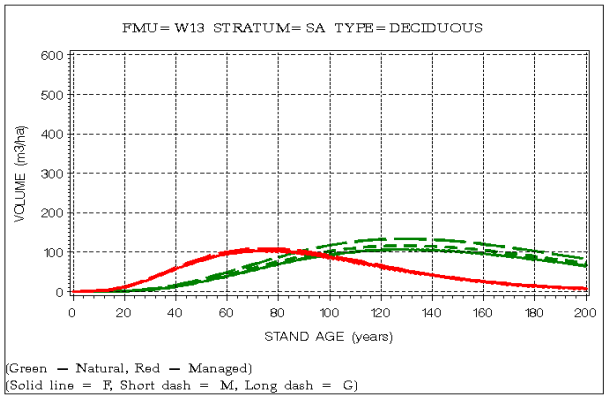

FMU = W13 STRATUM = AS TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

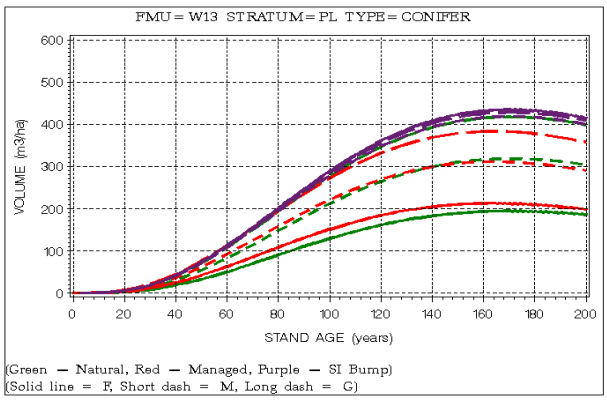

FMU = W13 STRATUM = AS TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

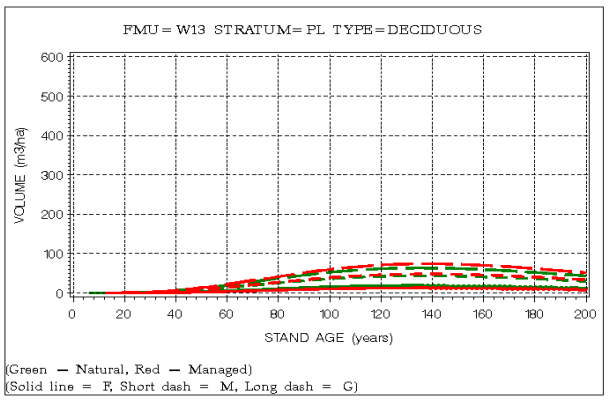

FMU = W13 STRATUM = PA TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

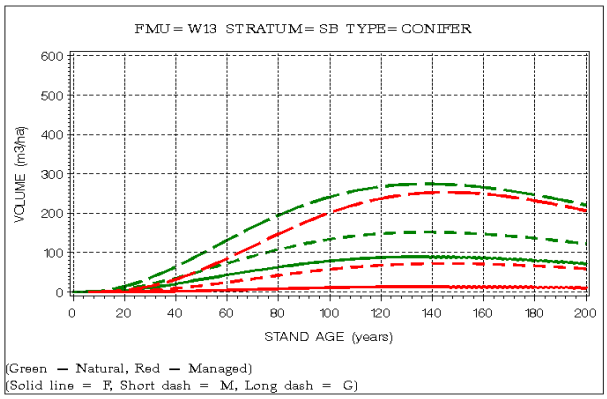

FMU = W13 STRATUM = PA TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

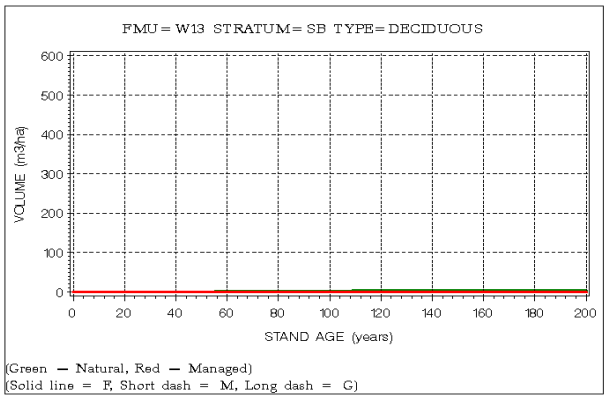

FMU = W13 STRATUM = SA TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

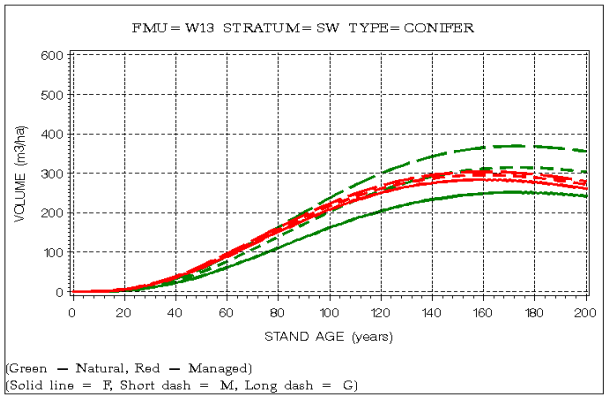

FMU = W13 STRATUM = SA TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

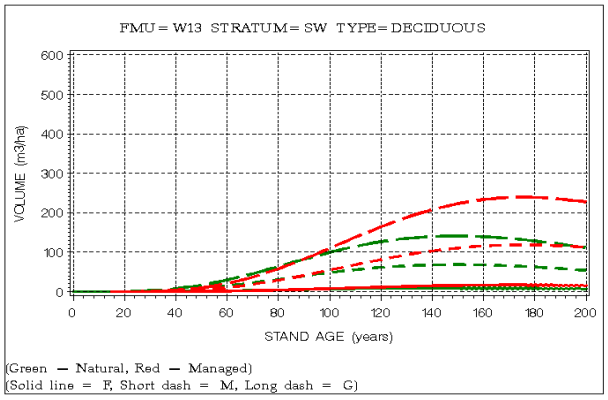

FMU = W13 STRATUM = PL TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed, Purple — SI Bump)
(Solid line = F, Short dash = M, Long dash = G)


FMU = W13 STRATUM = PL TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

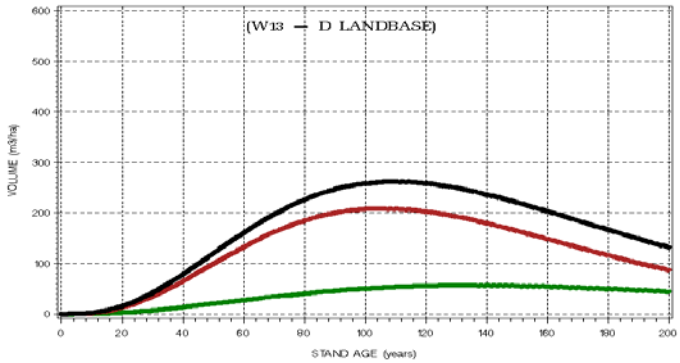

FMU = W13 STRATUM = SB TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)


FMU = W13 STRATUM = SB TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

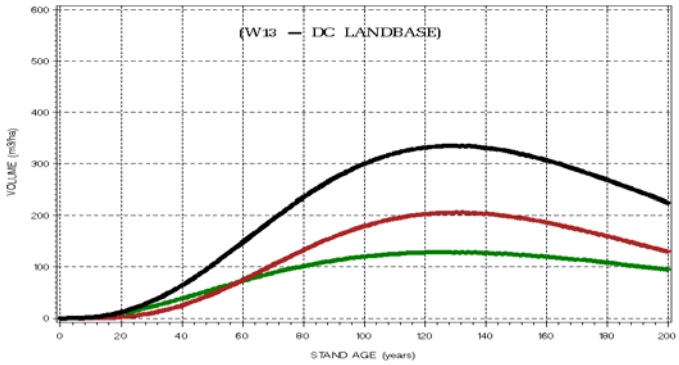

FMU = W13 STRATUM = SW TYPE = CONIFER
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)


FMU = W13 STRATUM = SW TYPE = DECIDUOUS
VOLUME (m3/ha)
STAND AGE (years)
(Green — Natural, Red — Managed)
(Solid line = F, Short dash = M, Long dash = G)

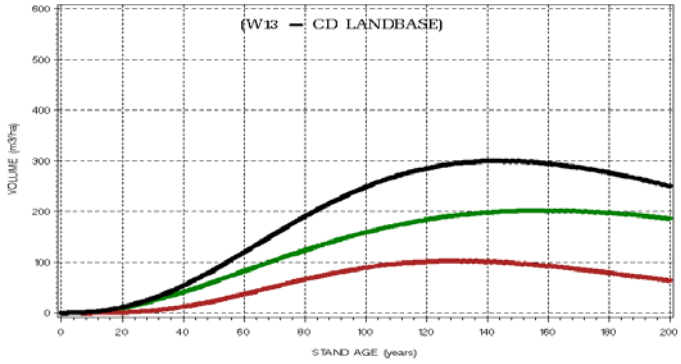
FMU W13 Composite Yield Curves:
Broad Cover Group (D, DC, CD, C) and Coniferous Landbase (DC/CD/C Combined)



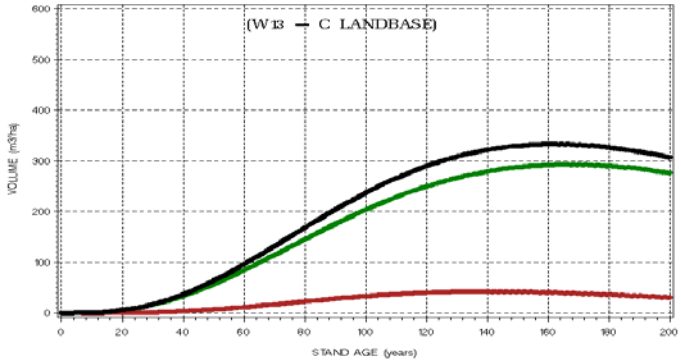
(Green — Softwood, Brown — Hardwood, Black — Total)



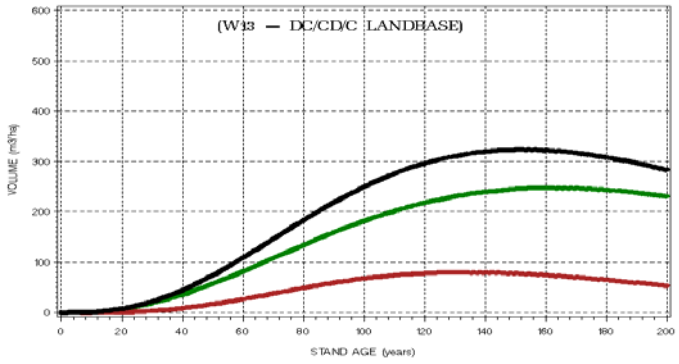
(Green — Softwood, Brown — Hardwood, Black — Total)



(Green — Softwood, Brown — Hardwood, Black — Total)

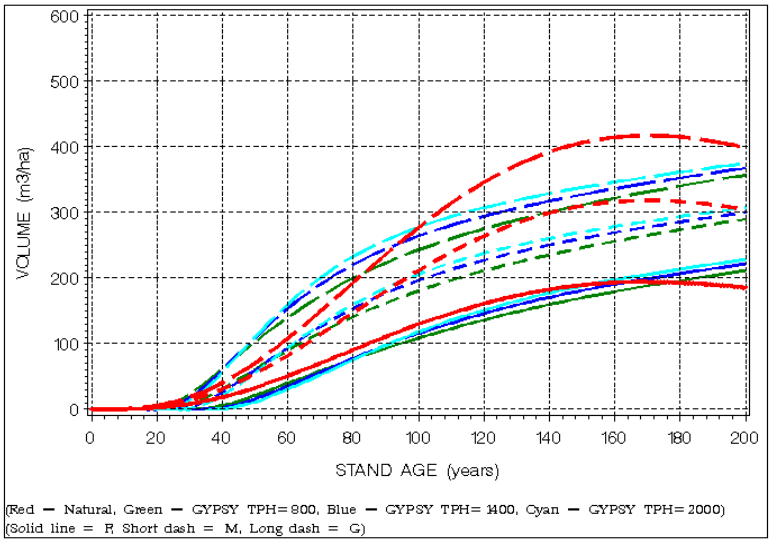


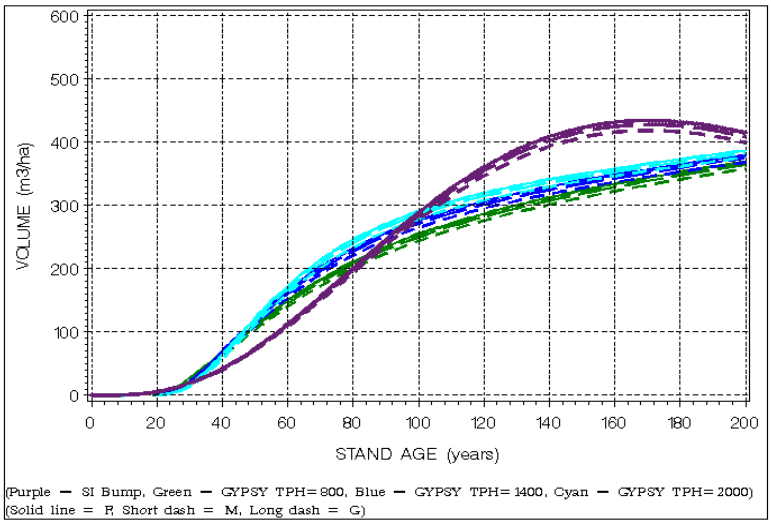
(Green — Softwood, Brown — Hardwood, Black — Total)



(Green — Softwood, Brown — Hardwood, Black — Total)

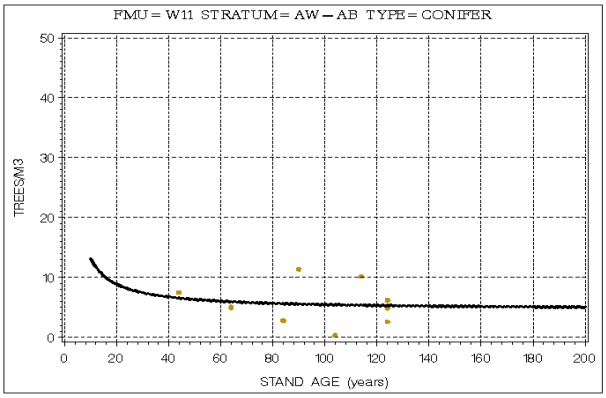
FMU W13 Pine Yield Curves vs. GYPSY Simulations

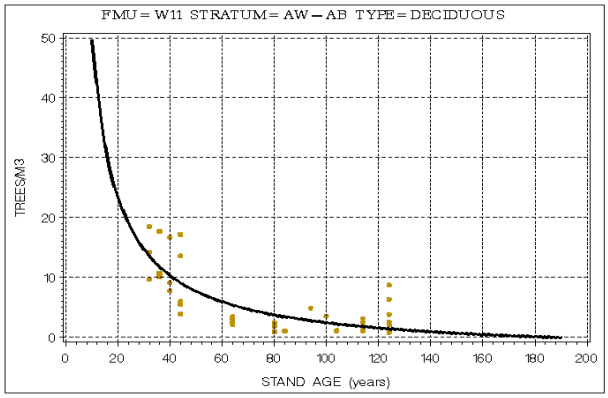

VOLUME (m3/ha)
STAND AGE (years)
(Red — Natural, Green — GYPSY TPH=800, Blue — GYPSY TPH=1400, Cyan — GYPSY TPH=2000)
(Solid line = F, Short dash = M, Long dash = G)

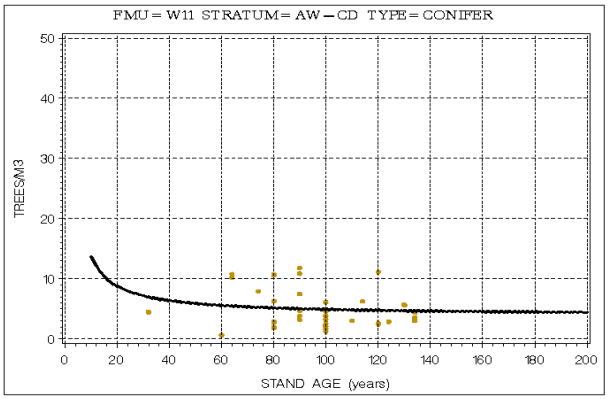

VOLUME (m3/ha)
STAND AGE (years)
(Purple — SI Bump, Green — GYPSY TPH=800, Blue — GYPSY TPH=1400, Cyan — GYPSY TPH=2000)
(Solid line = F, Short dash = M, Long dash = G)

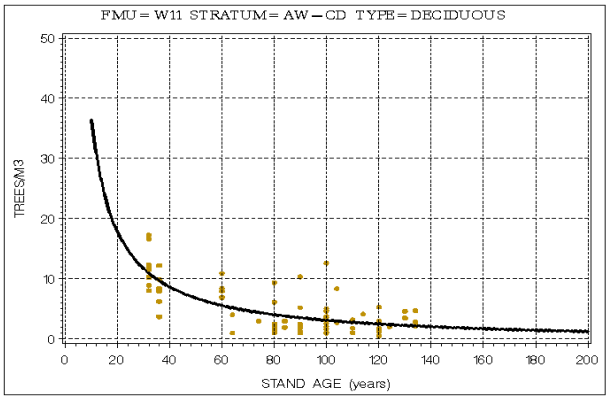
Appendix XX. Piece Size Curves

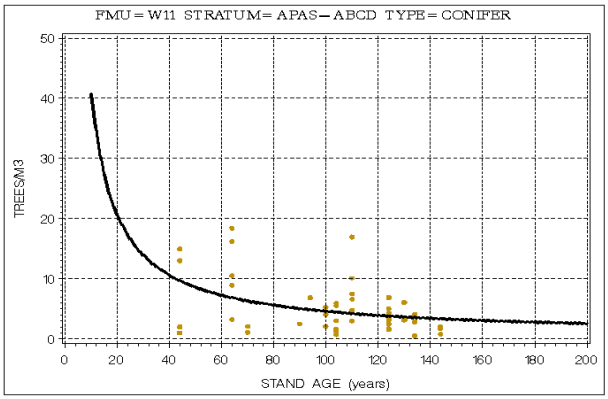
FMU W11 Piece Size Curves

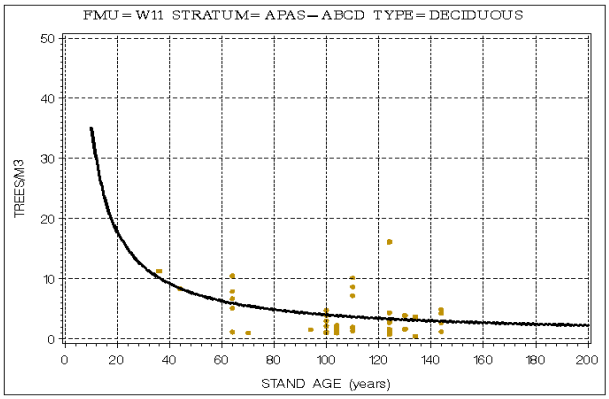

FMU = W11 STRATUM = AW – AB TYPE = CONIFER
TREES/M3
STAND AGE (years)

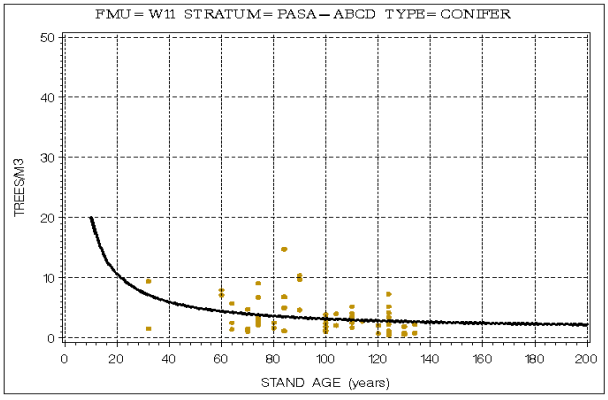

FMU = W11 STRATUM = AW – AB TYPE = DECIDUOUS
TREES/M3
STAND AGE (years)


FMU = W11 STRATUM = AW – CD TYPE = CONIFER
TREES/M3
STAND AGE (years)


FMU = W11 STRATUM = AW – CD TYPE = DECIDUOUS
TREES/M3
STAND AGE (years)


FMU = W11 STRATUM = APAS – ABCD TYPE = CONIFER
TREES/M3
STAND AGE (years)


FMU = W11 STRATUM = APAS – ABCD TYPE = DECIDUOUS
TREES/M3
STAND AGE (years)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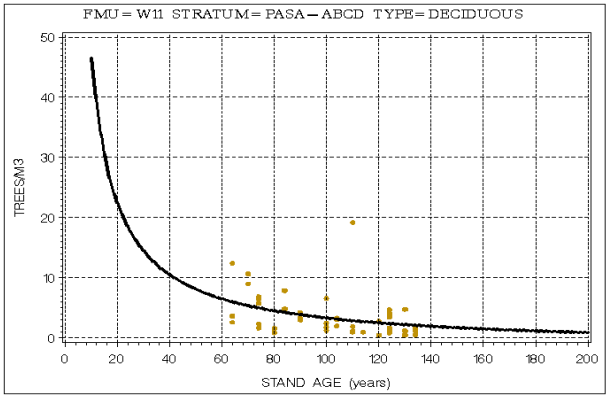
TREES/M3
STAND AGE (years)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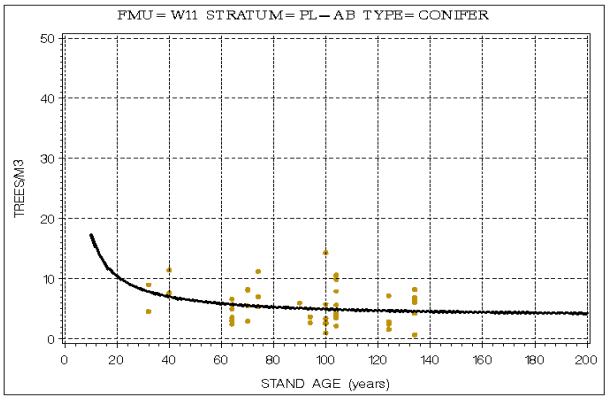
TREES/M3
STAND AGE (years)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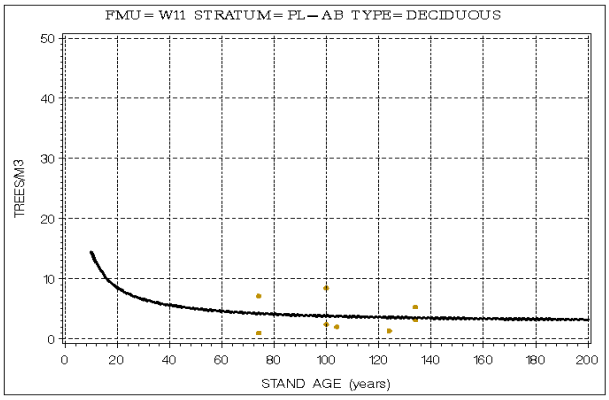
TREES/M3
STAND AGE (years)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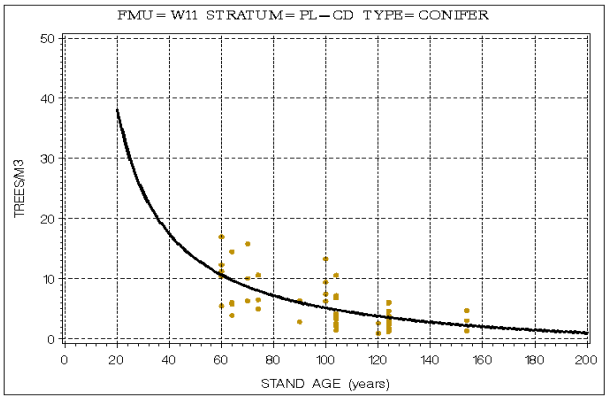
TREES/M3
STAND AGE (years)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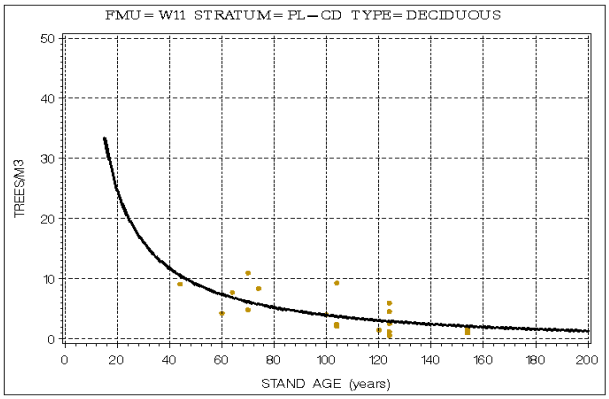
STAND AGE (years)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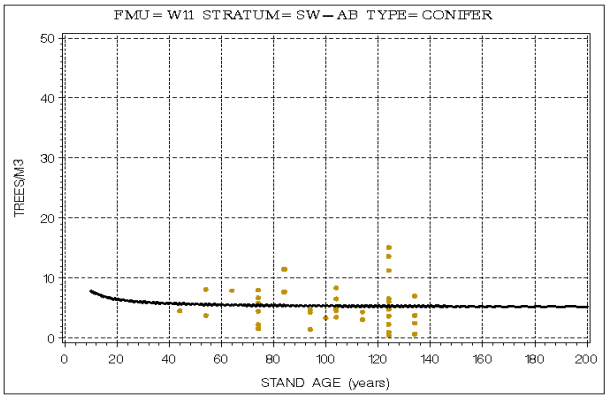
TREES/M3
STAND AGE (years)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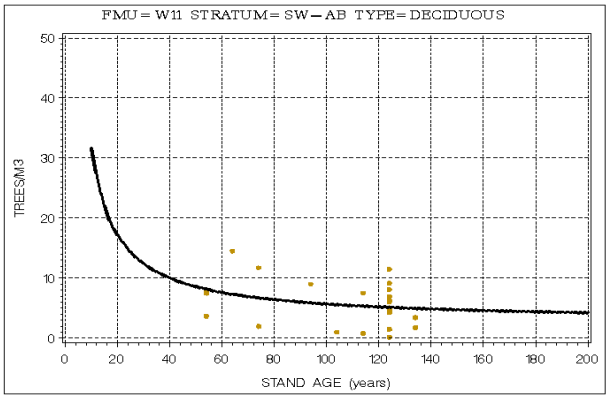
TREES/M3
STAND AGE (years)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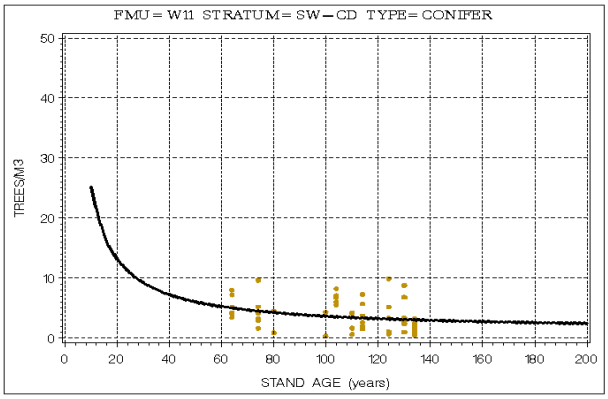
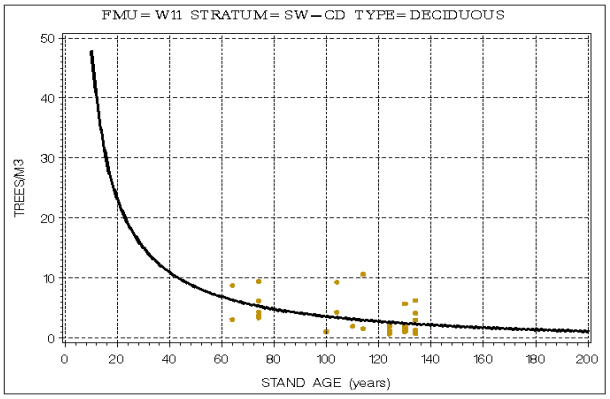
TREES/M3
STAND AGE (years)


FMU = W11 STRATUM = SW – CD TYPE = CONIFER
TREES/M3
STAND AGE (years)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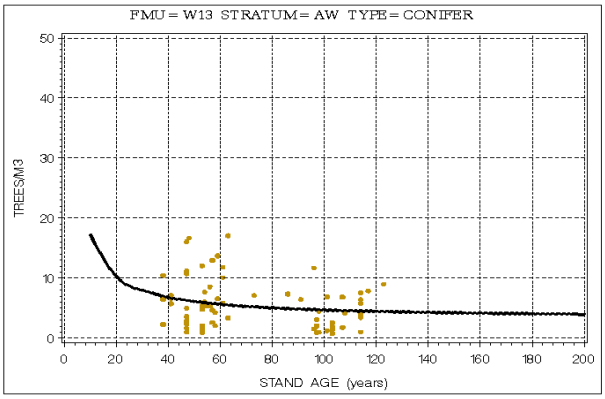
TREES/M3
STAND AGE (years)

FMU W13 Piece Size Curves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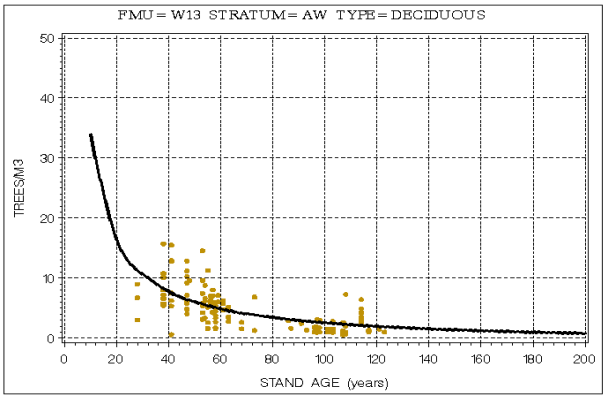
TREES/M3
STAND AGE (years)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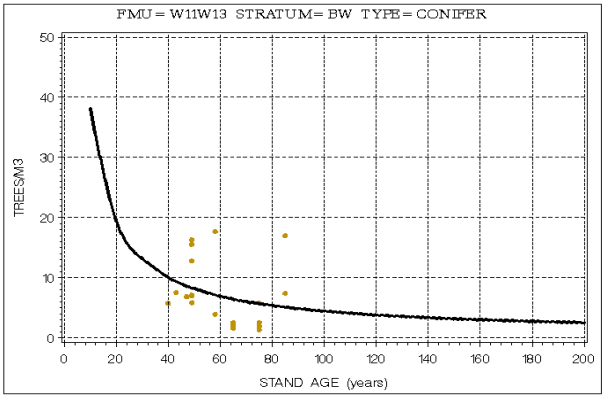
TREES/M3
STAND AGE (years)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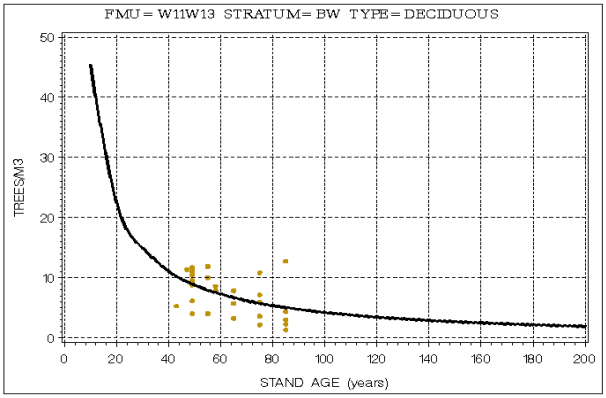
TREES/M3
STAND AGE (years)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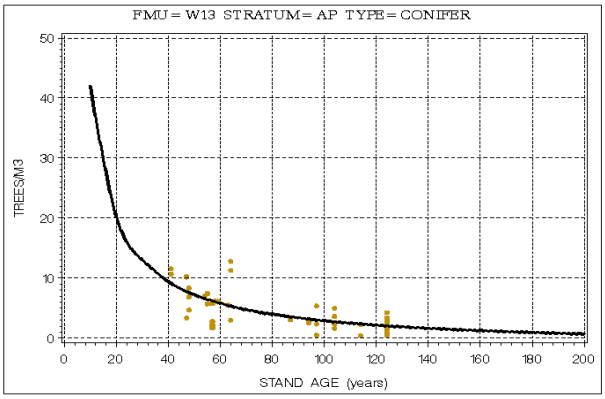
TREES/M3
STAND AGE (years)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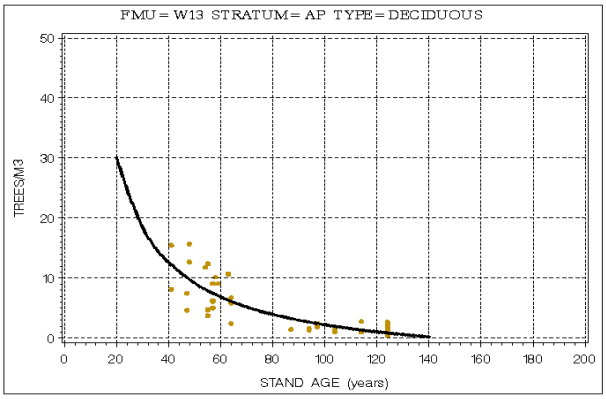
TREES/M3
STAND AGE (years)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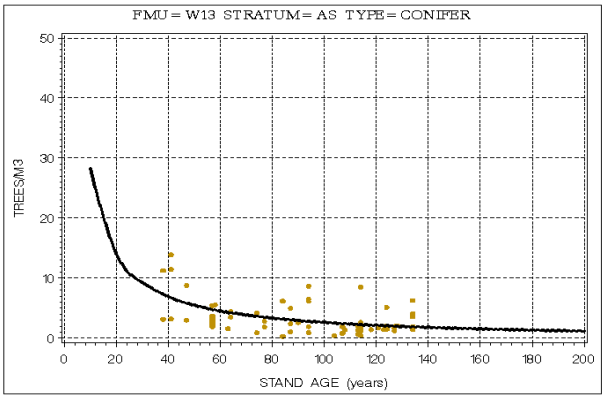
TREES/M3
STAND AGE (years)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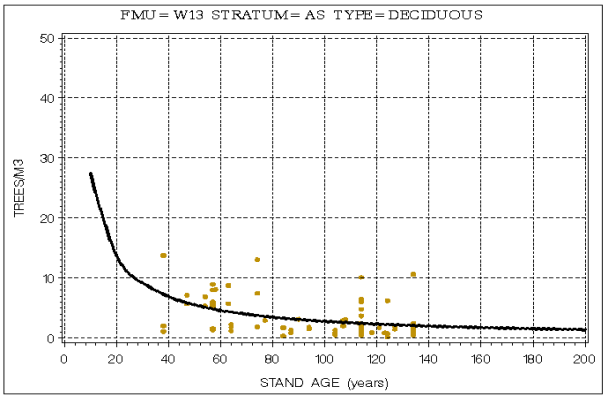
TREES/M3
STAND AGE (years)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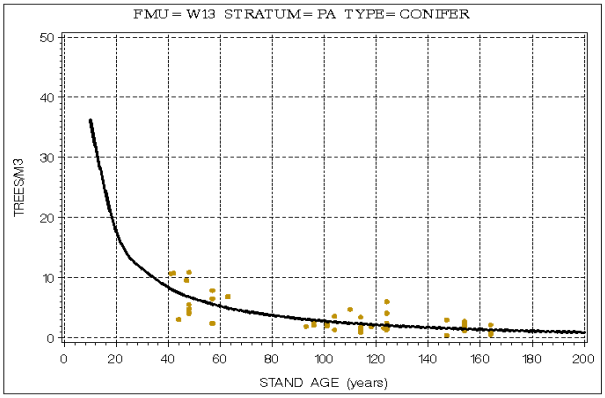
TREES/M3
STAND AGE (years)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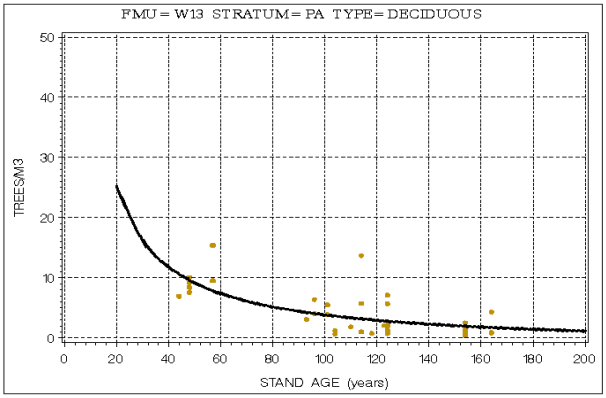
TREES/M3
STAND AGE (years)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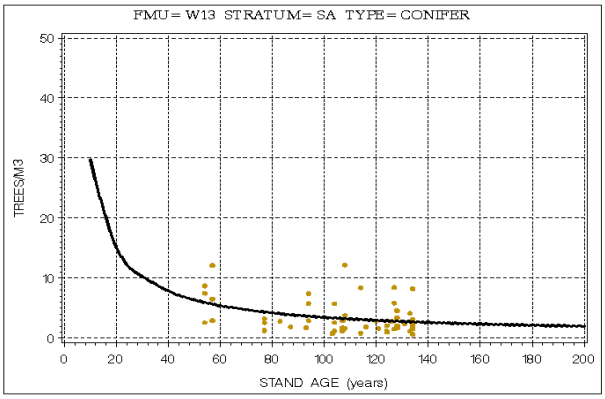
TREES/M3
STAND AGE (years)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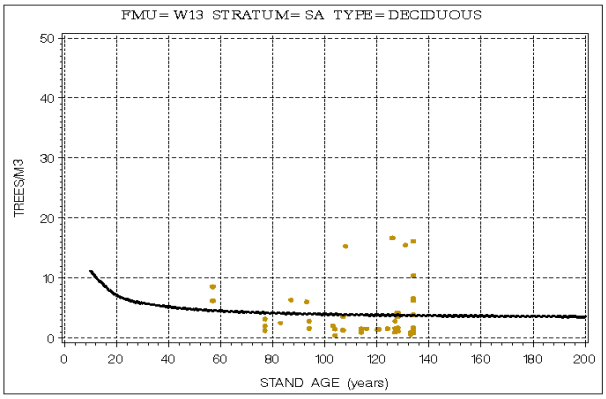
TREES/M3
STAND AGE (years)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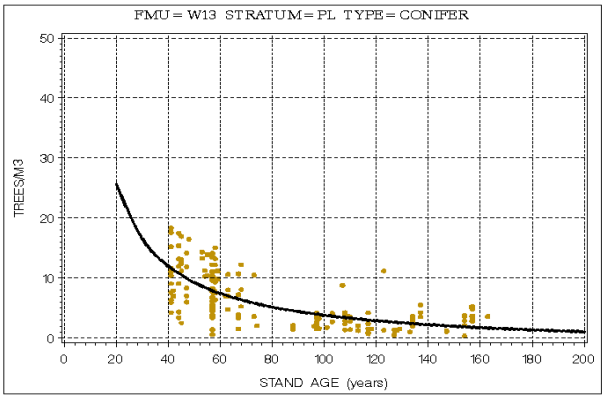
TREES/M3
STAND AGE (years)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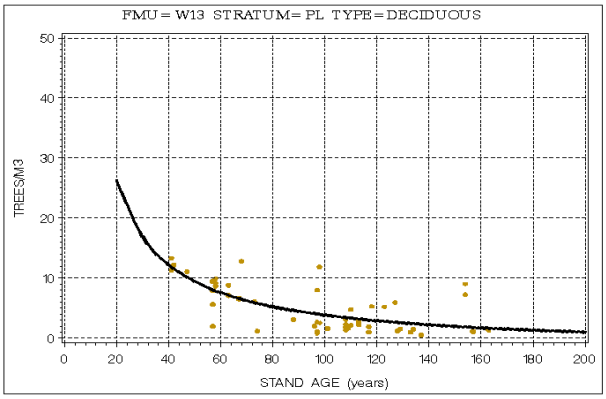
TREES/M3
STAND AGE (years)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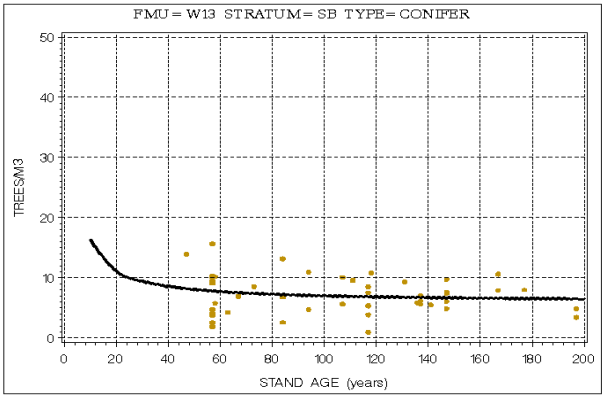
TREES/M3
STAND AGE (years)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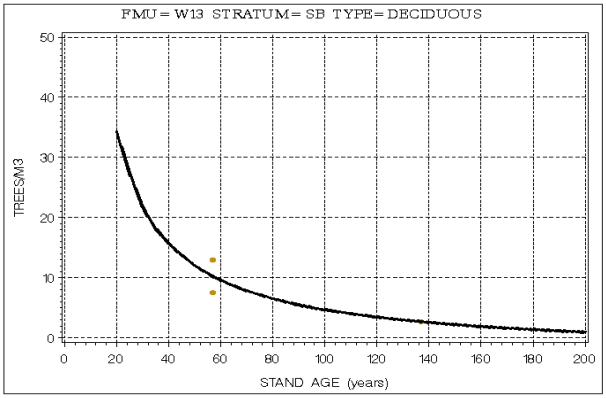
TREES/M3
STAND AGE (years)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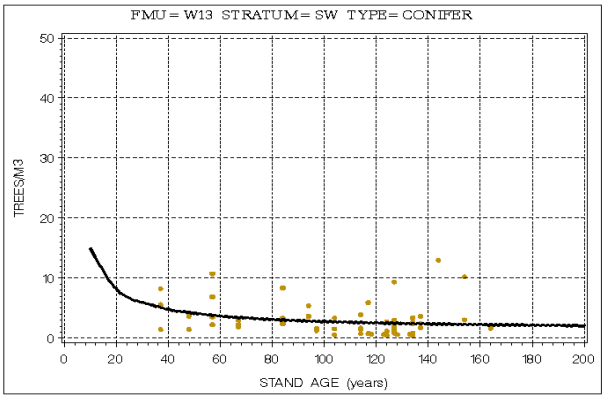
TREES/M3
STAND AGE (years)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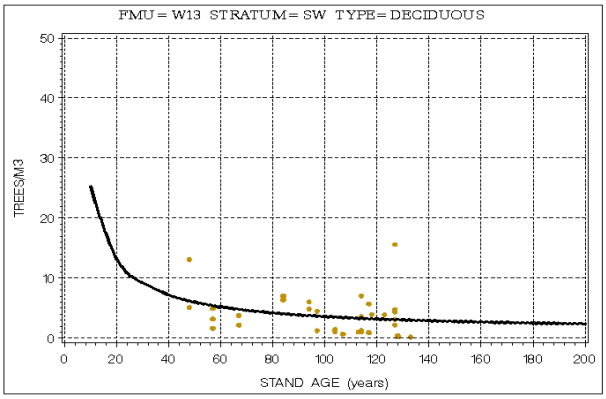
TREES/M3
STAND AGE (years)


FMU = W13 STRATUM = SW TYPE = DECIDUOUS
TREES/M3
STAND AGE (years)

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