MANNING DIVERSIFIED FOREST PRODUCTS LTD.

Growth and Yield Plan

2007 – 2017 Forest Management Plan for FMA 0200041

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1. Overview

1.1 Background

Manning Diversified Forest Products (MDFP) Ltd.'s Forest Management Agreement (FMA) 0200041 applies to Forest Management Unit (FMU) P16 (comprised of two FMUs, referred to as FMU P6 and FMU P9). As part of the 2007-2017 Forest Management Plan (FMP) submission, MDFP has prepared a growth and yield plan for FMA 0200041.

Based on past experiences, Alberta Sustainable Resources Development (ASRD) has developed a framework for growth and yield plans (ASRD 2005). According to this document, the overarching goal of growth and yield planning should be to ensure that data are collected that are suitable for:

- Meeting desired future model development initiatives;
- Monitoring special assumptions made in current yield estimation; and
- Satisfying any specific approval decision criteria associated with the current FMP.

Primary components of a growth and yield plan, as identified by Alberta SRD, should include:

1. Standing timber growth and yield modelling. Comprised of both a PSP and TSP component to address the needs for growth and yield modelling (from empirical yield curves to complex growth and yield models), as well as landscape-level monitoring of growth and yield characteristics. To include an approved sampling protocol and plot design to monitor both growth and yield in standing timber.

2. Post-harvest growth and yield monitoring. Comprised of PSPs as well as regeneration surveys to capture current information on existing stands as well as to develop models to project these stands into the future. To include an approved sampling protocol and plot design to monitor early growth in regenerating stands, and to include regeneration survey data as a data source to anchor post-harvest conditions.

3. Implementation timeline. To specify an implementation schedule for all components, including timelines for submission of field manuals, a plot remeasurement schedule, and a reporting schedule.

This document details the methods by which these requirements will be addressed in FMA 0200041.

1.2 The Value of Growth and Yield Data

Growth and yield data have a variety of uses, some which are very specific to operational planning and Government mandates, while others have a more far-reaching purpose. Among their many varied uses, growth and yield data are of use for:

- Empirical yield curve development.
- Growth and yield modelling.
- Development of Alternative Regeneration Standards.
- Assessing response to treatment.
- Examination of growth trends, successional pathways and other dynamic processes.
- Testing for differences between populations or subpopulations.
- Validating assumptions.

While this growth and yield plan is focused on gathering data suitable for addressing the existing needs for growth and yield data, the data that are collected must be sufficiently flexible, in order that they may meet future needs which may not yet have been identified.

1.3 Stratification

1.3.1 Stratification for the 2007-2017 FMP

Yield stratification used in the 2007-2017 FMP is outlined in Table 1-1. These strata will be used for all reporting in this document, in order to be consistent with the current plan. For full details on yield stratification, please see section 4 of the **Landbase Netdown**.

Table 1-1. Yield strata for the 2007-2017 FMP.

			Defining Layer Attributes			Understory Layer Attributes		
Yield Stratum	FMU(s)	Defining Layer[1]	Broad Cover Group	Crown Closure Class	Leading Coniferous Species	Broad Cover Group	Crown Closure Class	Leading Coniferous Species
D-B-COMB	P6, P9	1 or 2	D	B	-	-	-	-
D-CD-COMB	P6, P9	1 or 2	D	CD	-	-	-	-
DU-A-COMB	P6, P9	3	D	BCD	-	C, CD, DC	A	SW
	P6, P9	3	D	BCD	-	C, CD, DC	BCD	FB, PL, SB
DU-BCD-COMB	P6, P9	3	D	BCD	-	C, CD, DC	BCD	SW
DC-BCD-COMB	P6, P9	1 or 2	DC	BCD	-	-	-	-
MXU-B-COMB	P6, P9	3	DC, CD	B	-	C, CD, DC	-	FB, PL, SB, SW
MXU-CD-COMB	P6, P9	3	DC, CD	CD	-	C, CD, DC	-	FB, PL, SB, SW
CD-BCD-COMB	P6, P9	1 or 2	CD	BCD		-	-	-
PL-BCD-P6	P6	1 or 2	C	BCD	PL	-	-	-
PL-BCD-P9	P9	1 or 2	C	BCD	PL	-	-	-
SB-BCD-COMB	P6, P9	1 or 2	C	BCD	SB	-	-	-
SW-B-P6	P6	1 or 2	C	B	FB, SW	-	-	-
SW-B-P9	P9	1 or 2	C	B	FB, SW	-	-	-
SW-CD-P6	P6	1 or 2	C	CD	FB, SW	-	-	-
SW-CD-P9	P9	1 or 2	C	CD	FB, SW	-	-	-

[1] Layer 1 = overstory, layer 2 = understory, layer 3 = overstory with understory modifier.

Yield stratification for the 2007-2017 FMP was developed to address a number of issues, including productivity differences, regeneration strategies, silviculture strategy (e.g., understory protection), and other operational concerns. For example:

- D and DU strata are differentiated by the presence of a valid coniferous understory in DU stands. Separating yield strata based on the presence of an understory was necessary to reflect the competing needs resulting from both coniferous and deciduous harvesting operations within the FMA area and is consistent with the direction provided in MDFP's Forest Management Agreement.
- The naming convention for the DU-A and DU-BCD yield strata is distinctive: crown closure class reflects understory crown closure class rather than the defining layer crown closure class. Separation of the these strata was required to reflect potential management strategies (see Table 1-3).
- MXU yield strata are distinguished from the DC and CD yield strata by the presence of a valid understory layer in MXU stands.
- In the MXU (mixedwood with coniferous understory) yield strata, strata were separated into B and CD crown closure classes, but combined by broad cover group (CD and DC). Due to the small areas that these strata comprise, the yield strata could not be divided by both crown closure class and broad cover group, and MDFP's management strategy for these stand types were driven more by crown closure class than by broad cover group.
- Separate FMU-specific yield strata were developed for the PL and SW yield strata. In the case of SW, yield strata were also split into B and CD crown closure classes. Separation of yield strata by FMU and crown closure class was intended to reflect productivity differences in these stand types and intended management strategies.

Total area by yield stratum is presented in Table 1-2.

Table 1-2. Area (ha) by yield stratum.

Yield Stratum	Stand Type				Total
	Natural	Managed Pre-91[1]	Managed Post-91[2]	Understory Protection[3]	
D-B-COMB	15,513	189	223	-	15,924
D-CD-COMB	54,170	498	1,160	-	55,829
DU-A-COMB	58,041	1,027	819	250	60,137
DU-BCD-COMB	34,989	3,502	511	-	39,003
DC-BCD-COMB	5,383	167	655	-	6,205
MXU-B-COMB	9,308	5	4	-	9,317
MXU-CD-COMB	12,211	-	35	-	12,247
CD-BCD-COMB	5,744	3,935	1,092	-	10,771
PL-BCD-P6	7,090	89	505	-	7,684
PL-BCD-P9	18,726	-	-	-	18,726
SB-BCD-COMB	4,196	44	20	-	4,260
SW-B-P6	22,213	223	1,780	-	24,216
SW-B-P9	5,189	-	-	-	5,189
SW-CD-P6	20,542	354	1,122	-	22,019
SW-CD-P9	3,765	-	-	-	3,765
Total	277,081	10,033	7,927	250	295,291

[1] Stands harvested prior to May 1, 1991.

[2] Stands harvested on or after May 1, 1991.

[3] Stands harvested using understory protection methods.

1.3.2 Regenerating Strata

Not all yield strata identified in the 2007-2017 FMP will be applicable to regenerating stands. Based on current management practices, transitions from one stand type to another are expected to occur. Table 1-3 provides the transition matrix from the 2007-2017 FMP. Note that this transition matrix does not apply to existing cutblocks, many of which have been assigned to yield strata based on AVI attributes and/or were established under past management practices.

Table 1-3. Transition matrix from the 2007-2017 FMP.

	Original Stratum			Post-Treatment Stratum					
		Overstory	Understory	D	DC	CD	C-PL	C-SB	C-SW
Treatment	Species	Density	Density	CD	BCD	BCD	BCD	BCD	CD
Clearcut									
	D	B	-						
	D	CD	-						
	DU	BCD	BCD						
	DC	BCD	-						
	CD	BCD	-						
	DCU	B	-						
	DCU	CD	-						
	CDU	B	-						
	CDU	CD	-						
	C-PL	BCD	-						
	C-SB	BCD	-						
	C-SW	B	-						
	C-SW	CD	-						
Clearcut DUA with Deciduous Priority									
	DU	BCD	A						
Clearcut DUA with Conifer Priority									
	DU	BCD	A						

Deciduous Landbase
Coniferous Landbase

Based on the transition matrix, there are 8 regenerating yield strata (Table 1-4). These strata map to the ASRD "base 10" stratification scheme, with the exception of the mixedwoods. Under the ASRD stratification scheme, mixedwoods are split by leading coniferous species. For FMA 0200041, this is not the case. Assuming all landbase areas transition according to the rules presented in Table 1-3, the final landbase will be as presented in Table 1-4.

Table 1-4. Regenerating yield strata.

Regenerating Stratum	FMU(s)	Landbase	Active LB Area (ha)[1]	SRD Minimum Stratum
D-CD-COMB	P6, P9	Deciduous	71,753	HW
DC-BCD-COMB	P6, P9	Conifeorus	79,909	HW_PL, HW_SWSB
CD-BCD-COMB	P6, P9	Coniferous	57,769	PL_HW, SW_HW, SB_HW
PL-BCD-P6	P6	Coniferous	7,684	PL
PL-BCD-P9	P9	Coniferous	18,726	PL
SB-BCD-COMB[2]	P6, P9	Coniferous	4,260	SB
SW-CD-P6	P6	Coniferous	46,234	SW
SW-CD-P9	P9	Coniferous	8,954	SW
Total			295,291	

[1] Assuming all landbase has been transitioned according to rules presented here.

[2] Much of this area will transition to SW strata where it occurs on the fringes of larger blocks.

Table 1-4 indicates that considerable landbase will be added to CD and DC stands over time. As such, an examination of whether separate regenerating yield strata by leading coniferous species are needed was undertaken. The total area of existing natural stands was tabulated by mixedwood regenerating yield stratum, current yield stratum and leading coniferous species (Table 1-5). It is evident that the pine and black spruce components of these strata are quite small relative to white spruce leading stands (insufficient area in either the pine or black spruce mixedwoods to merit separate strata). As such, no separate regenerating yield strata by leading conifer species will be used.

Table 1-5. Area (ha) of existing natural stands by leading conifer.

Regenerating Stratum	Yield Stratum	Leading Conifer[1]			Total
		PL	SB	SW	
DC	DU-A-COMB	473	1,766	55,802	58,041
	MXU-B-COMB (DCU)	736	7	4,360	5,103
	MXU-CD-COMB (DCU)	1,832	36	6,802	8,670
	DC-BCD-COMB	2,623	39	2,721	5,383
	Total	5,665	1,848	69,685	77,197
CD	DU-BCD-COMB	-	-	34,989	34,989
	MXU-B-COMB (CDU)	732	6	3,467	4,205
	MXU-CD-COMB (CDU)	1,784	-	1,757	3,541
	CD-BCD-COMB	2,811	57	2,875	5,744
	Total	5,327	63	43,089	48,479

[1] Assigned based on understory leading conifer for DU strata (DU-A-COMB and DU-BCD-COMB).

2. Standing Timber

2.1 Grid-based Permanent Sample Plots

2.1.1 Overview

The basic premise of grid-based sampling is to create a sampling system that is independent of inventory systems. Classification of stands will change from inventory to inventory, even under the same system of classification; in the future (as in the past), inventory systems may also change the way in which stands are classified. By establishing a grid independent of inventory boundaries, an unbiased snapshot of the existing forest may be obtained at any given point in time.

However, from the forest company's perspective, productive forests are generally the primary area of interest. Establishing permanent sample plots in non-productive stand types, particularly when access is an issue, is generally of little benefit to the company in terms of monitoring and the development of yield curves, which is the main use of growth and yield data at this time. As such, this growth and yield plan proposes a grid-based approach that focuses on sampling only productive forested grid points.

2.1.2 Sampling Design

A grid-based sampling program was undertaken in 2000, designed by Olympic Resources Management (ORM). Plots were sampled as TSPs, but with the potential for continued measurement of grid points as PSPs later on[1]. Since the intention is to establish some of these grid points as permanent sample plots, these data will be referred to as PSP data in this document.

[1] Will require full plot monumentation (e.g., addition of boundary markings), which did not occur at first measurement.

PSP plots were comprised of a fixed-area, 15.96 m radius tree plot, within which a 7.98 m radius sapling plot and a 3.99 m radius regeneration plot were nested. In "dense" plots[2], plot sizes were decreased to 11.28/5.64/2.82 m radii, and in "super dense" plots[3], plot sizes were decreased to 7.98/3.99/1.99 m radii. The plot center was permanently marked and spatially documented (GPS'd) for relocation purposes.

All trees and saplings were tagged and measured within their respective plots, while regeneration was tallied (no tagging) within the regeneration plot. Species, DBH and condition codes were recorded for all live and dead trees in the tree (≥ 9.1 cm DBH) and sapling (> 1.3 m tall and < 9.1 cm DBH) plots. Crown class was also recorded for live trees, while decay class was recorded for dead trees.

A subsample of 20% of live trees[4] were measured for total height, height to base of live crown, and crown width. Within the regeneration plot (≤ 1.3 m tall), regeneration was tallied by species and height class. A subsample of trees (two trees per species and canopy layer) was selected for age sampling.

Non-tree data collection included an ecological assessment (soils, moisture and nutrients, ecosite, vegetation, slope, aspect, etc.) and collection of coarse woody debris information.

Full sampling protocols are included in the appendices of the **Yield Curves** chapter.

2.1.3 Existing Plots

Sampling was initiated by MDFP in 2000. A systematic grid of sample plots was installed across FMUs P9 and P6 on a 2.8 km by 2.8 km spacing. From within this grid, only productive stands were sampled, using AVI-based criteria for defining productive versus non-productive stands.

Field data were collected over three field seasons, between 2000 and 2002. A total of 522 grid points were sampled under this methodology, one of which was established in an incorrect location and is excluded for that reason.

The number of sampled grid points by yield stratum and age class is provided in Table 2-1[5].

[2] The combined live tree count on Main and Sapling sub-plots exceeds 80 when using the Standard Area and Radius (0.08 ha, 15.96 m radius).

[3] The combined live tree count on Main and Sapling sub-plots exceeds 80 when using the Dense Area and Radius (0.04 ha, 11.28 m radius).

[4] A 20% sample was taken where there were sufficient trees meeting the measurement criteria.

[5] Note that the total number of plots does not match the number of plots cited in the **Yield Curves** chapter. Yield curve development was undertaken using a version of the shapefile that did not include all plot locations, and therefore not all plot data could be successfully linked to the landbase. By the time of development of this growth and yield plan, a shapefile was created that links all 521 plots to the plot database.

Table 2-1. Existing number of sampled grid points by yield stratum and age class.

Yield Stratum	Natural[1] Age Class 0-39	40-79	80-119	120-159	160-200	Total	Managed[2] Age Class 0-39	Total	Nonop[3] Total	Grand Total
D-B-COMB	-	16	2	-	-	18	2	2	-	20
D-CD-COMB	-	56	6	-	-	62	7	7	-	69
DU-A-COMB	-	40	32	3	-	75	2	2	-	77
DU-BCD-COMB	1	30	27	1	-	59	3	3	-	62
DC-BCD-COMB	-	1	1	-	-	2	3	3	-	5
MXU-B-COMB	-	2	7	6	-	15	-	-	-	15
MXU-CD-COMB	-	4	9	2	-	15	-	-	-	15
CD-BCD-COMB	1	-	3	2	1	7	10	10	-	17
PL-BCD-P6	1	1	7	-	-	9	1	1	-	10
PL-BCD-P9	-	29	2	-	-	31	-	-	-	31
SB-BCD-COMB	-	1	2	-	-	3	-	-	-	3
SW-B-P6	-	1	9	10	4	24	4	4	-	28
SW-B-P9	-	2	2	-	-	4	-	-	-	4
SW-CD-P6	-	11	16	2	2	31	2	2	-	33
SW-CD-P9	-	1	1	-	-	2	-	-	-	2
Unassigned	-	-	-	-	-	-	3	3	127	130
Total	3	195	126	26	7	357	37	37	127	521

[1] Natural stands with no landbase deletions: (F_DEL1= 'NONE') and (THEME6 = 'NONE', 'PLANNED').

[2] Managed stands with no landbase deletions: (F_DEL1= 'NONE', 'NNF') and (THEME6 = 'CC', 'CCPRE').

[3] Landbase deletions.

2.1.4 Planned Plots

All sampled grid points will be continued as permanent sample plots with one exception: the number of grid points will be capped at a maximum of 10 PSPs per stratum for natural stands. The number of capped PSPs will be distributed across age classes as shown in Table 2-2. This will result in a total sample of 117 grid-based PSPs in natural (fire origin) stands and an additional 37 grid-based PSPs in managed stands.

Table 2-2. Proposed number of PSP grid points by yield stratum and age class.

Yield Stratum	Natural[1] Age Class 0-39	40-79	80-119	120-159	160-200	Total	Managed[2] Age Class 0-39	Total	Grand Total
D-B-COMB	-	8	2	-	-	10	2	2	12
D-CD-COMB	-	5	5	-	-	10	7	7	17
DU-A-COMB	-	4	3	3	-	10	2	2	12
DU-BCD-COMB	1	4	4	1	-	10	3	3	13
DC-BCD-COMB	-	1	1	-	-	2	3	3	5
MXU-B-COMB	-	2	4	4	-	10	-	-	10
MXU-CD-COMB	-	4	4	2	-	10	-	-	10
CD-BCD-COMB	1	-	3	2	1	7	10	10	17
PL-BCD-P6	1	1	7	-	-	9	1	1	10
PL-BCD-P9	-	8	2	-	-	10	-	-	10
SB-BCD-COMB	-	1	2	-	-	3	-	-	3
SW-B-P6	-	1	3	3	3	10	4	4	14
SW-B-P9	-	2	2	-	-	4	-	-	4
SW-CD-P6	-	3	3	2	2	10	2	2	12
SW-CD-P9	-	1	1	-	-	2	-	-	2
Unassigned	-	-	-	-	-	-	3	3	3
Total	3	45	46	17	6	117	37	37	154

[1] Natural stands with no landbase deletions: (F_DEL1= 'NONE') and (THEME6 = 'NONE', 'PLANNED').

[2] Managed stands with no landbase deletions: (F_DEL1= 'NONE', 'NNF') and (THEME6 = 'CC', 'CCPRE').

Selecting PSPs for continued measurement will be achieved by randomly selecting grid points from within the existing grid based on stratum and age class, but preferentially selecting from non-straddle plots with no disturbance present at first measurement. An additional consideration will be FMU. More PSPs will be sampled in P6 than P9 due to the fact that FMU P9 is comprised primarily of deciduous and pine types which are homogeneous in nature, and FMU P6 has more variability in stand composition.

All plots will be measured according to the MDFP PSP field manual. The field manual is included with the **Yield Curves**; however, it is currently undergoing revisions. See Section 4.2 for a list of proposed changes. PSPs will be measured every 5 years until the stand is 40 years of age; stands 40 years of age and older will be remeasured every 10 years.

2.2 Temporary Sample Plots

2.2.1 Overview

TSP sampling was used to intensify the number of plots available for empirical yield curve development in target yield strata for the 2007-2017 FMP.

2.2.2 Sampling Design

Sampling was undertaken in the 2005 field season. The sampling frame was all merchantable stands ≥ 41 years of age within FMUs P6 and P9. Stands were classified by stratum and age class, with a goal of sampling 15 plots per stratum/age class combination.

Three plots were randomly located within selected stands. Plot locations were moved to randomly selected alternates if the plot area was intersected by a mappable disturbance. Mappable disturbances included seismic lines ≥ 5 m in width, well sites, or harvested areas. If the plot was intersected by an unmappable disturbance (< 5 m in width, primarily seismic lines), then the plot was offset rather than moved. Prior to moving or offsetting plots, measurements of the area of the plot disturbed by seismic lines or other disturbance were made.

To maintain some similarity in plot sizes, the smallest plot size from grid-based PSP sampling was used for TSP sampling (7.98 m radius) for trees ≥ 9.1 cm DBH. In order to obtain information relevant to understanding understory stand dynamics, a sapling (> 1.3 m tall with a DBH < 9.1 cm) plot was also established, using the minimum plot size from grid-based PSP sampling (3.99 m radius). No regeneration plots were established.

While trees and saplings were not tagged and dead trees were not measured, TSP measurements on live trees were compatible with the original PSP sampling manual. Species, DBH, crown class, and condition code were recorded for each live tree or sapling. In order to create a link between ground sampled data and inventory labels, each sampled stem was assigned to a canopy layer, as defined by the AVI 2.1 inventory label. Tree heights were not measured, since good DBH-height equations already existed and could be used to predict height for volume calculations. Because of the interest in understory trees, combined with the potential variability in height growth expected in non-dominant canopy positions, total height of saplings was subsampled within the 3.99 m radius plot. Age stems were subsampled (two per leading species per layer based on AVI label information) from each identified canopy layer within the 7.98 m radius plot.

TSP sampling protocols and the associated volume sampling program documentation are included in the appendices of the **Yield Curves**.

2.2.3 Existing Plots

A total of 564 TSP plots were sampled in 2005. Based on the landbase developed for the 2007-2017 FMP, the number of plots by yield stratum and age class is provided in Table 2-3.

Table 2-3. Number of temporary sample plots by FMU and yield stratum.

Yield Stratum	Natural[1] Age Class 0-39	40-79	80-119	120-159	160-200	Total	Managed or Nonop[2]	Grand Total
D-B-COMB	-	10	9	10	-	29	-	29
D-CD-COMB	-	-	11	9	-	20	-	20
DU-A-COMB	-	3	-	9	9	21	-	21
DU-BCD-COMB	-	9	3	12	3	27	-	27
DC-BCD-COMB	-	10	9	-	-	19	-	19
MXU-B-COMB	-	18	12	9	6	45	-	45
MXU-CD-COMB	-	18	12	3	6	39	-	39
CD-BCD-COMB	-	17	3	3	9	32	-	32
PL-BCD-P6	-	21	12	3	15	51	-	51
PL-BCD-P9	-	5	15	-	-	20	-	20
SB-BCD-COMB	-	26	9	12	3	50	-	50
SW-B-P6	-	18	6	9	-	33	-	33
SW-B-P9	-	21	21	9	3	54	-	54
SW-CD-P6	-	15	3	9	3	30	-	30
SW-CD-P9	-	24	11	24	-	59	-	59
Unassigned	-	-	-	-	-	-	35	35
Total	-	215	136	121	57	529	35	564

[1] Natural stands with no landbase deletions: (F_DEL1= 'NONE') and (THEME6 = 'NONE', 'PLANNED').

[2] Managed stands or landbase deletions: (F_DEL1 <> 'NONE') or (THEME6 <> 'NONE', 'PLANNED').

2.2.4 Planned Plots

Prior to the next plan, a volume sampling program will be developed to address data needs. As part of this plan, the existing number of PSP measurements that may be used for yield curve development will be tabulated. Additional TSPs required for yield curve development will then be determined. It is MDFP's intention to use TSP data collected in 2004 to supplement both the existing PSP data and the new TSP data. Details of the volume sampling plan will be developed and submitted to ASRD for review prior to implementation of volume sampling for the 2017 FMP.

3. Post-Harvest Stands

3.1 Early Post-Harvest Permanent Sample Plots

3.1.1 Overview

The timber supply analysis for the 2007-2017 FMP was designed to prevent the harvest of areas within a 100 m radius of existing grid-based PSP plot locations over at least the next 10 years, in order to protect PSPs from harvest (where possible) until at least two measurements have been obtained, As such, the number of grid-based PSPs in regenerating stands should not increase during this period. In order to increase sample sizes in regenerating stands in the near term, additional (non-grid-based) PSPs are required.

Additional PSPs will therefore be established in regenerating stands on a stratified random basis. Two subpopulations of interest have been identified and are described here separately.

Stream 1 Reforestation

As stands begin to be harvested according to the Spatial Harvest Sequence, the stands harvested will be treated using such methods as scarification, planting, drag scarification, vegetation management, etc. These are the standard silvicultural practices applied to help ensure successful conifer regeneration and to meet the assumptions of yield. Steam 1 Reforestation therefore is a subpopulation representing stands treated using normal regeneration practices, which are expected to achieve, on average, the yields predicted by the base managed stand yield curves developed for the 2007-2017 FMP.

Although the Stream 1 Reforestation stand types will be the prevalent type of managed stand on the landbase, the grid-based PSPs will likely not capture sufficient numbers of plots in the near term, especially since PSPs are currently protected from harvest. As such, additional PSPs will be established on a stratified random basis in order to increase the sample size.

Note that the SB-BCD-COMB stratum represents a harvest level of approximately 22 ha/y over the first 20 year period. Much of this area is on the fringe of larger white spruce blocks; in these cases, SB will be planted to SW. Any remaining SB areas will comprise insufficient area to sample via Stream 1 Reforestation PSPs.

Stream 2 Reforestation

MDFP is currently a partner in the Forest Genetics Association of Alberta. Other partner members are Tolko Industries Ltd. (High Level Lumber Division) and Alberta SRD (through the Alberta Tree Improvement and Seed Center). Through these partnerships, MDFP has access to improved seed for the G2 (white spruce) and J (lodgepole pine) breeding regions. As per their FMP, MDFP will be deploying this seed within their FMA and breeding region areas. Deployment will begin by 2010.

Planted stock will be deployed into one of six regenerating yield strata:

Lodgepole pine stock:

- PL-CD-P6
- PL-BCD-P9

White spruce stock:

- CD-BCD-COMB
- DC-BCD-COMB
- SW-CD-P6
- SW-CD-P9

In the yield curves developed for the 2007-2017 FMP, tree improved stock was assumed to have height gains of 1% for lodgepole pine and 2.5% for white spruce. These gains were translated to an increase in volume yields of 2% at 90 years for lodgepole pine and 5% at 110 for white spruce. Gains were applied to produce the increases in yield at the target age, while retaining the same overall maximum yields; in essence, the curves reflect the achievement of volume at an earlier age, without assuming a change in the overall maximum capacity of the site for timber yield.

Since there is an assumed difference in early yields above Stream 1 Reforestation stands, these stand types must be tracked separately in order to allow comparisons in terms of growth and yield, and for future growth and yield modelling.

3.1.2 Sampling Design

Blocks will be stratified by regenerating stratum and Reforestation Stream (Table 3-1). Within each Stream, approximately equal numbers of blocks will be selected for sampling within each eligible yield stratum. Blocks will be selected randomly from the pool of eligible blocks, with probability of selection proportional to area. Within each selected block, one potential plot location will be randomly selected using random spatial selection processes. Each block will be buffered such that the entire plot will fall within the block boundary.

Table 3-1. Stratification for Reforestation Stream PSP selection.

Regenerating Stratum	FMU(s)	Stream 1 Reforestation	Stream 2 Reforestation
D-CD-COMB	P6, P9	☑	
DC-BCD-COMB[1]	P6, P9	☑	☑
CD-BCD-COMB[1]	P6, P9	☑	☑
PL-BCD-P6[1]	P6	☑	☑
PL-BCD-P9[1]	P9	☑	☑
SB-BCD-COMB[1, 2]	P6, P9		
SW-CD-P6	P6	☑	☑
SW-CD-P9	P9	☑	☑

[1] All regenerating stands are C/D density.

[2] Insufficient area in TSA for inclusion.

PSPs will be established in accordance with the revised PSP field manual, with three additional modifications for regenerating stands:

1) Plot size in managed stands will be standardized at an 11.28 m radius for large trees and a 5.64 m radius for saplings. Four 1.78 m radius (10 m^2) regeneration plots will be established at cardinal directions from plot center, but still within the sapling plot radius.

2) Where deciduous densities are > 20,000 sph, deciduous saplings will be tagged and measured within the regeneration plots only.

3) At initial measurement, all planted conifers in the regeneration plots will be assessed as "P" for regular planting stock and "T" for tree improvement planting stock. These trees will be tracked as such to maturity.

3.1.3 Existing Plots

Based on the existing landbase, there are currently 37 grid-based PSPs in managed stands (Table 2-2). All of these PSPs are in Stream 1 Reforestation stands. There are currently no PSPs in stands with improved stock (Stream 2 Reforestation).

3.1.4 Planned Plots

Stream 1 Reforestation

A minimum of 1 PSP per 1,000 ha harvested will be established over the next 10 years. The harvest level for the FMA area will be approximately 2,600 ha per year[6] (Table 3-2), of which approximately 350 ha will be regenerated under Stream 2 Reforestation (Table 3-3), leaving a Stream 1 Reforestation program of 2,250 ha/year. Therefore under the Stream 1 Reforestation program, a minimum of 23 PSP plots will be established over the next 10 years. The program will focus on establishing an equal number of plots within each regenerating yield stratum.

[6] Approximately 1,200 ha and 1,360 ha will be harvested by DMI and MDFP, respectively.

Table 3-2. Predicted average harvest levels over the first 20-year period.

	MDFP			DMI			
Harvest Years	CLEARCUT Conifer ha/year	CCDUCON DUA ha/year	Total ha/year	CLEARCUT Deciduous ha/year	CCDUDEC DUA ha/year	Total ha/year	Grand Total ha/year
1-5	1,336	36	1,371	558	634	1,192	2,563
6-10	1,174	0	1,174	553	649	1,202	2,377
11-15	1,468	65	1,533	580	678	1,258	2,791
16-20	1,353	0	1,353	571	662	1,234	2,587
Average	1,333	25	1,358	566	656	1,221	2,580

Stream 2 Reforestation

Over the next 10 years, 1 PSP per 500 ha harvested and subsequently planted with improved stock will be established, with a minimum of 10 PSPs over 10 years. Current estimates (based on seed availability) indicate that roughly 350 ha of improved stock will be planted per year.

Table 3-3. Predicted tree improvement deployment levels over the first 20-year period.

Planting Years	PlantJ Pine ha/year	PlantG Spruce ha/year	Total ha/year
1-5	73	38	111
6-10	400	65	465
11-15	9	99	107
16-20	331	384	715
Average	203	146	350

The program will ensure that each stratum receives an equal number of PSP plots (assuming that sufficient area is planted with improved stock). Note that seed availability and deployment schedules may affect the availability of stands for sampling.

Grid-Based PSPs

Grid-based PSPs will be reestablished following harvest (generally occurring only after at least two measurements have been obtained), further increasing the sample size in regenerating stands over time. New Stream 1 and Stream 2 PSPs will therefore be added in proportion to the amount of landbase harvested and, in the case of Stream 2 regeneration, the amount of area planted to improved seed.

Although the harvest sequence was designed to avoid scheduling PSPs for harvest within the next 10 years, some PSPs may still be in planned blocks. Other PSPs may be in blocks selected for harvest within normal variance due to operational considerations. Any PSPs in stands scheduled for harvest in the next 10 years will have a measurement taken immediately before harvest if a second measurement has not yet been obtained. The PSP will then be reestablished as a managed stand PSP. This PSP will count towards that year's Stream 1 or Stream 2 reforestation targets.

3.2 Regeneration Surveys

3.2.1 Overview

ASRD regeneration surveys are mandated by the Alberta government. The objective of ASRD regeneration surveys is to ensure prompt reforestation and a sufficient level of stocking, survival and growth is attained (ASRD 2006). These levels were set in order to ensure a level of performance that emulates natural yields.

3.2.2 Sampling Design

Every harvested block is subjected to an Establishment survey and, with the exception of deciduous blocks, also subjected to a Performance Survey (only conditionally restocked deciduous blocks require Performance surveys). Within each block, a grid of 10 m^2 circular plots is established. Sampling intensity and grid spacing is determined based on block size, using rules outlined in the ASRD Regeneration Survey Manual (ASRD 2006).

At the Establishment survey, height and age are recorded for one crop tree per species (if present) in the plot. Capped deciduous density (maximum 10) is also recorded. The same data are collected during the Performance survey, with the additional assessment of competition and measurement of root collar diameter on provisionally free-to-grow pines and larches. The timing of surveys depends on intended broad cover group and survey type: Establishment surveys occur between 4-8 years for C, CD, and DC stands and 3-5 years for D stands; Performance surveys occur between 8-14 years for C, CD, and DC stands and 10-14 years for conditionally stocked D stands. Currently, minimum targets (*e.g.*, height) are identified in the ASRD Regeneration Survey Manual.

3.2.3 Existing Plots

Regeneration survey data have been collected on every cutblock, as required under the requirements of the Alberta Regeneration Survey Manual (ASRD 2006). To date, establishment surveys are the only data that have been collected.

3.2.4 Planned Plots

Data gathered during regeneration surveys are recognized as an important source of juvenile data for growth and yield purposes. Since regeneration surveys are required on all harvested blocks, this is an abundant source of data.

MDFP will continue to collect regeneration survey data at Establishment and Performance ages, according to the standards set out in the Alberta Regeneration Survey Manual (ASRD 2006).

Consideration of additional measurements (*e.g.*, top height/Site Index, growth intercept) and revised standards for surveys will occur during the development of Alternative Regeneration Standards.

4. Implementation Timelines

4.1 PSP Establishment and Remeasurement

A proportion of PSP plots will be sampled each year on a rotating basis in order to provide an even workflow. One fifth of PSP plots will be measured every 5 years if on a 5-year remeasurement schedule (less than 40 years of age) and one tenth of plots will be measured every 10 years if on a 10-year remeasurement schedule. An establishment and remeasurement schedule is provided in Table 4-1.

The majority of grid-based PSPs are 40 years of age or older, and as such will be placed on a 10-year remeasurement schedule. All are in natural (fire origin) stands. Initial measurements were made between 2000 and 2002. In order to spread remeasurements across a 10-year schedule, the first remeasurement will occur between 2007 and 2016. Subsequent remeasurements will occur 10 years from measurement 2 (see table).

A total of 40 of the grid-based PSPs are under 40 years of age, 3 in natural stands and 37 in managed stands. These plots will be placed on a 5-year remeasurement schedule. First remeasurements will occur between 2007 and 2011. Subsequent remeasurements will occur every 5 years. Note that remeasurements shown in Table 4-1 assume all of these PSPs will not exceed 40 years of age in the next 20 years of scheduling.

Post-harvest PSP establishment will occur over the next 10 years (2007 to 2016), with plots scheduled for remeasurement on a 5-year remeasurement schedule.

Table 4-1. PSP establishment and measurement schedule for both grid-based and post-harvest PSPs.

	Grid-Based PSPs						Post-Harvest PSPs								Total PSP
	10-Year PSP		5-Year PSP				Stream 1				Stream 2				
Year	Mmt 2[1]	Mmt 3	Mmt 2[1]	Mmt 3	Mmt 4	Mmt 5	Estab	Mmt 2	Mmt 3	Mmt 4	Estab	Mmt 2	Mmt 3	Mmt 4	Mmts
2007	12		8				3				1				24
2008	12		8				3				1				24
2009	12		8				3				1				24
2010	12		8				2				1				23
2011	11		8				2				1				22
2012	11			8			2	3			1	1			26
2013	11			8			2	3			1	1			26
2014	11			8			2	3			1	1			26
2015	11			8			2	2			1	1			25
2016	11			8			2	2			1	1			25
2017		12			8			2	3			1	1		27
2018		12			8			2	3			1	1		27
2019		12			8			2	3			1	1		27
2020		12			8			2	2			1	1		26
2021		11			8			2	2			1	1		25
2022		11				8			2	3			1	1	26
2023		11				8			2	3			1	1	26
2024		11				8			2	3			1	1	26
2025		11				8			2	2			1	1	25
2026		11				8			2	2			1	1	25
Total	114	114	40	40	40	40	23	23	23	13	10	10	10	5	505

[1] First remeasurement (measurement 2) will require full PSP monumenting (e.g., painting of boundaries).

4.2 Field Manual Development

MDFP already has TSP and PSP field manuals, which are included with the **Yield Curves**. However, the PSP field manual is currently being revised to reflect the data collection protocols described in this document. The main changes to the existing manual will be:

Plot Layout

- Addition of plot sizes for managed stands
    - Main Tree = 11.28 m radius, Sapling = 5.64 m radius, Regen = 4 x 1.78 m radius
- Addition of density rules for managed stands
    - Where deciduous density > 20,000 sph, tag and measure deciduous in the regeneration plots only.

Straddle Plots/Offsetting Rules

- No new seismic or other anthropogenic disturbance is allowable within plot boundaries following plot establishment[7]
- When re-establishing PSP plots after harvesting, PSPs will not be allowed to occur in more than one cover type[8] (e.g., part in a cutblock and part in a managed stand, or two very distinctive cover types)

[7] Existing PSPs may have seismic disturbance within plots, however, it is preferable that future plots do not incorporate anthropogenic disturbance since it is accounted for in the landbase (and AAC) using other means.

- PSP plots will be offset using the same rules in the TSP manual (anthropogenic disturbances, permanent water bodies)
    - PSP plots will also be offset to ensure that the plot is established within a single cover type
    - Natural openings are considered part of natural variability and plots will not be moved for this reason

Tree Measurements

- Crown width will no longer be subsampled

Site Index Measurements

- In fire origin stands, site index will be sampled at establishment or first remeasurement
- Site index will be sampled in regenerating stands once the majority of trees are greater than 5 years of age at breast height
- Site index sampling will occur in a 300 m^2 area outside of the main plot (in the plot buffer)

Ecological Assessment

- Ecological assessment will occur at establishment only
- Vegetation will not be assessed except at establishment, since the primary use of vegetation is for ecosite assessment (already assessed for grid-based PSPs)

Remeasurement Scheduling

- PSPs will be measured every 5 years until 40 years of age; stands 40 years of age and older will be remeasured every 10 years

A revised field manual will be submitted to Alberta SRD by August 31, 2007.

4.3 Reporting

Documentation of the number of plots established and/or remeasured will be provided in stewardship reporting.

4.4 Ongoing Growth and Yield Plan Development

As requirements for growth and yield modelling are refined or revised over time, certain aspects of this growth and yield program may change. If significant changes are made to this program, a revised growth and yield plan will be resubmitted to Alberta SRD.

[8] Some of the existing PSPs are "straddle plots" comprised of more than one cover type. To ensure that data are suitable for yield curve development and/or stand level growth modelling, a single cover type is preferable.

5. References

Alberta Sustainable Resources Development. 2005. Growth and Yield Program: ASRD Expectations (DRAFT). Edmonton, AB.

Alberta Sustainable Resources Development. 2006. Alberta Forest Management Planning Standard Version 4.1. Edmonton, AB.

Alberta Sustainable Resources Development. 2006. Alberta Regeneration Survey Manual. Edmonton, AB.

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