FMA #9700035

Detailed Forest Management Plan

2004 - 2014

Volume II

Chapter 6: Timber Supply Forecasting

Weyerhaeuser Company Ltd.

Edson, Alberta

Foreword

This is Volume II of the Detailed Forest Management Plan (DFMP) for the FMA. Each Volume of the DFMP can be read as a free-standing report. However, the entire set of three Volumes together is the full DFMP. Each Volume has a separate Table of Contents, but for consistency they all share a common Glossary and List of Acronyms.

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ACRONYM LIST

AAC:	Annual Allowable Cut
AAFMI:	Alberta Advanced Forest Management Institute
ACE:	Allowable Cut Effect
AOP:	Annual Operating Plan
ASL:	Above Sea Level
ASRD:	Alberta Sustainable Resource Development
AUM:	Animal Unit Measure
AVI:	Alberta Vegetation Inventory
CDWD:	Coarse Down Woody Debris
CNT:	Consultative Notation
CTP:	Commercial Timber Permit
CTQ:	Coniferous Timber Quota
DFA:	Defined Forest Area
DFMP:	Detailed Forest Management Plan
DTM:	Digital Terrain Model
EFM:	Enhanced Forest Management
EMS:	Environmental Management System
ESIP:	Eastern Slopes Interdepartmental Planning
FAC:	Forest Advisory Committee
FMA:	Forest Management Agreement
FMU:	Forest Management Unit
FRIAA:	Forest Resource Improvement Association of Alberta
FRIP:	Forest Resource Improvement Program
FYHS:	Five-Year Harvest Schedule
GDP:	General Development Plan
GIS:	Geographic Information System
GPS:	Global Positioning System
HDA:	Harvest Design Area
IRM:	Integrated Resource Management
IRP:	Integrated Resource Plan
LRSYA:	Long Run Sustained Yield Average

MAI:	Mean Annual Increment
NIVMA:	Northern Interior Vegetation Management Association
PHA:	Pre-Harvest Assessment
PLFD:	Public Lands and Forests Division
PSP:	Permanent Sample Plot
PNT:	Protective Notation
PTA:	Post-Treatment Assessment
RET:	Rare, Endangered or Threatened
RLTAP:	Rolling Long Term Access Plan
SFM:	Sustainable Forest Management
SHS:	Spatial Harvest Sequence
SRD:	Sustainable Resource Development
SYU:	Sustained Yield Unit
TDA:	Timber Damage Assessment
WESBOGY:	Western Boreal Growth & Yield Co-Op
WeyFAC:	Weyerhaeuser Forest Advisory Committee

GLOSSARY

A

Adaptive management approach: A learning approach that states intent, provides monitoring and verification of intent, and makes changes to planned or intended activities as required.

Age Class: The classification of stands in a forest, or trees in a stand, into a series of ages (e.g. 0 to 4.99 = age class 1). For the DFMP, the age class of the AVI stands on the FMA area is defined by the stand age. The stand age is determined by using the DFMP base year minus the AVI origin plus five years.

Age Class Distribution: Distribution of the amount of area by age class and species group.

Aeolian: Well-sorted, poorly compacted, medium to fine sand and coarse silt sediment that has been transported and deposited by wind.

Aesthetics: The philosophy concerning judgments made about beauty.

Afforestation: The conversion of non-forested land to forested land through the practice of introducing commercial trees species to the site, through appropriate silviculture techniques.

Alberta Vegetation Inventory (AVI): A system for describing the quantity and quality of vegetation present. It involves the stratification and mapping of the vegetation to create digital data according to the AVI Standards Manual and associated volume tables.

Allowable Cut Effect (ACE): The allocation of anticipated future forest timber yields to the present allowable cut. The effect is typically based on several assumptions about the yields that may develop as a result of activities and decisions taken in the present. Shortening the rotation period, raising the increment, or both, increases the allowable cut.

Annual Allowable Cut (AAC): The volume of timber that can be harvested under sustainable forest management in any one year.

Annual Operating Plan (AOP): Plans prepared and submitted annually by timber operators describing how, where and when to develop roads and harvest timber. They describe the integration of operations with other resource users, the mitigation of the impacts of logging, the reclamation of disturbed sites and the reforestation of harvested areas.

Artificial regeneration: The creation of a new stand by direct seeding or by planting seedlings or cuttings.

Autecology: Growth characteristics of specific tree species.

B

Berm: A raised mound of soil.

Biodiversity: The variety, distribution and abundance of different plants, animals and other living organisms, the ecological functions and processes they perform, and the genetic diversity they contain at local, regional and landscape levels of analysis.

Bisequa: A dark beige colour.

Broadcast slash buildup: Slash scattered across a cutblock due to logging practices.

Broad Cover Group: Defined by the occurrence of coniferous as determined by AVI:

> Coniferous - stands with at least 80% conifer,
> Coniferous/Deciduous - stands with at least 50% and less than 80% conifer, and leading species conifer.
> Deciduous/Coniferous - stands with at least 30%, and no more than 50% conifer, and leading species deciduous.
> Deciduous - stands with less than 30% conifer.

Buffer: A protected strip of vegetated land beside roads, watercourses, mineral licks or other important features.

Buck-For-Wildlife Area: Area identified for wildlife habitat improvement.

C

Carrying Capacity: The number of individuals in any one species that can live in a habitat without degrading it.

Chert: A rock resembling flint.

Chinook: A warm dry wind that blows east from the Rockies.

Clear cut System: A silviculture system that removes an entire stand of trees from an area of one hectare or more, and greater than two heights in width, in a single harvest operation. With the clearcut system, the opening size and dimensions created are generally large enough to limit significant microclimatic influence from the surrounding stand.

Coarse filter management: Forest management at a landscape level or over broad regions aimed at maintaining a range of stands of different size, age and composition to provide habitat for all species.

Coarse Down Woody Debris: Sound and rotting logs and stumps that provide habitat for plants and animals, and a source of nutrients for soil structure and development. Generally classified as material greater that 10 centimeters in diameter.

Colluvial: Rock or soil material deposited as a result of gravity.

Common corridors: Linear land areas established to concentrate utilities and roads and to provide access for resource use and development.

Commercial Timber Permit: A timber disposition issued under section 22 of the Forests Act authorizing the permittee to harvest public timber.

Community Timber Program: A term used to describe a category of timber use that provides for those operators who harvest volumes through permits.

Coniferous species: Are cone bearing plants; pertaining to the class Gymnospermae. In this DFMP, it refers to the following tree species used in the processing facilities: white spruce, black spruce, Engelmann spruce, lodgepole pine, balsam fir, alpine fir, and tamarack.

Coniferous stands: Forest stands that consist predominately (> 70%) of coniferous tree species.

Coniferous Timber Quota (CTQ): A share of the allowable cut of coniferous timber within a forest management unit.

Constituency: A group or body that patronizes, supports, or offers representation.

Constraint: The restrictions, limitations, or regulation of an activity, quality, or state of being to a predetermined or prescribed course of action or inaction. Constraints can arise from the influence of policies, political will, management direction, attitudes, perceptions, budgets, time, personnel, data availability limitations, or complex interaction of all these factors.

Cordillera: A system of usually parallel mountain ranges together with intervening plateaus.

Criterion: A distinguishable characteristic of sustainable forest management; a value that must be considered in setting objectives and in assisting performance.

Cross-ditching: The practice of constructing ditches across roads to allow for the movement of water from one side of the road to the other.

Crown charges: Amounts paid to the Province as a royalty or in consideration of services rendered.

Crown land: Land owned by the Province of Alberta.

Cubic metre: Unit of measure of the volume of total wood contained in a tree or log, measured as one metre by one metre by one metre of solid wood.

Cumulative impact: Additive nature of individual effects.

Cut control period: A period of five consecutive forest management operating years or as otherwise agreed to by the Minister and a Company.

Cut sequence: The order of harvest operations in time and space.

D

Deciduous species: Belongs to the class Angiospermae. In this DFMP, it refers to the following tree species used in the processing facilities: trembling aspen, balsam poplar, and white birch.

Deciduous stands: Forest stands that consist predominately (> 70%) of deciduous tree species.

Deciduous Timber Allocation (DTA): Percentage of the deciduous annual allowable cut for a management unit, based on either volume or area.

Decommissioning: To take out of active service.

Deleterious: Harmful.

Denning sites: Areas where animals hibernate or raise their young.

Detailed Forest Management Plan (DFMP): A strategic long-term plan. It is the foundation for all forest management activities upon the FMA.

Digital Terrain Model (DTM): The computerized portrayal of a landform in three dimensions. It involves translating contour lines into digital format for use in the computer. It is also called digital elevation model.

Disposition: A lease, license, permit or letter of authority issued under provincial legislation for activities either surface or sub-surface.

Disturbance: A force that causes significant change in structure and or composition of a habitat.

Disturbance modeling: Computer program that models the degree of some type of disturbance.

Diversity: An assessment of the number of species present, their relative abundance in an area, and the distribution of individuals among the species.

E

Eastern Slopes Policy: A Policy for Resource Management of the Eastern Slopes. A policy covering about 90,000 km^2 of the eastern slopes of the Rocky Mountains in Alberta. It was first released in 1977 and revised in 1984. The policy presents the Government of Alberta's resource management policy for public lands and resources within the region.

Ecology: The science that studies the interrelationships, distribution, abundance, and contexts of all organisms and their interconnections with their living and non-living environment.

Ecological integrity: Unimpaired, functional processes.

Ecoregion: A geographic area that has a distinctive, mature ecosystem on reference sites plus specified edaphic variations as a result of a given regional climate.

Ecosite: Ecological units that develop under similar environmental influences (climate, moisture, and nutrient regime). It is a functional unit defined by moisture and nutrient regime.

Ecosystem: A dynamic complex of plants, animals, and micro-organisms and their non-living environment interacting as a functioning unit.

Ecotone: A transition area between two communities which has characteristics of both as well as characteristics of its own.

Edaphic: Pertains to the soil, particularly with respect to its influence on plant growth and other organisms together with climate.

Edge: Where plant communities meet.

Endangered: In jeopardy of continuing existence.

Endangered, threatened and rare species: Classifications of the status of species populations as determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Endangered indicates any indigenous species of fauna or flora that is threatened with imminent extirpation or extinction throughout all or a significant portion of its Canadian range. Threatened indicates any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting it vulnerability do not become reversed. Rare indicates an indigenous species of fauna or flora that, because of its biological characteristics or because it occurs at the fringe of its range, or for some other reasons, exists in low numbers or in very restricted areas in Canada but is not a threatened species.

Endangered wood: Timber that has or will be impacted by some natural or man-made process.

Enhanced forest management (EFM): Undertaking silviculture efforts that exceed Provincial requirements or liabilities.

Establishment period: The time elapsing between initiation of regeneration and its acceptance according to defined reforestation standards in the Timber Management Regulation.

Establishment stage: The early stage of reforestation where a crop of trees is initiated.

Even-aged Stand: A forest stand comprising trees with less than a 20-year difference in age.

Even flow: In harvest scheduling, the requirement that the harvest level in each period be equal to the harvest level in the preceding period.

Extensive silviculture: Silviculture practices which, at the minimum, meet current provincial reforestation standards and support the current annual allowable cut.

F

Fauna: Animal life.

Feature species: Those species that are rare, threatened, endangered or of social value.

Fine filter management: Specific habitat management for a single or a few species rather than broad management at a landscape level to maintain a range of habitat opportunities for all wildlife species (coarse filter).

Fire cycle: The number of years required to burn over an area equal to the entire area of interest.

Flora: Plant life.

Forecast: A prediction of future conditions and occurrences based on the perceived functioning of a forest system. A forecast differs from a "projection" which is a prediction of anticipated future conditions based on an extrapolation of past trends.

Forest: A collection of stands that occur in similar space and time.

Forest Access Zone: An area designated by the Provincial government that has specific access constraints in place.

Forest Advisory Committee (FAC): A collection of stakeholder representatives for Weyerhaeuser's FMA area that give advice and direction to the company and Alberta Sustainable Resource Development to ensure that integrated forest resource management is practiced, to sustain the health and integrity of the land and forests for future generations.

Forest connectivity: A measure of how well different areas (patches) of a landscape are connected by linkages such as habitat patches or corridors of like vegetation.

Forest health: As a specific condition, the term refers to a growing forest having many or all of its native species of plants and animals. As a management objective, it refers to maintaining or restoring the capacity of a forest to achieve health.

Forest Management Agreement (FMA): Agreement between the Province and a company to grow, harvest and reforest on a land base tenure.

Forest Management Area (FMA area): Refers to the tract of forest land over which a company has been given management rights for establishing, growing and harvesting trees on a perpetual sustained yield basis for a defined period of time.

Forest Management Plan: A generic term referring to both Forest Management Unit plans prepared by the government, and Detailed Forest Management Plans prepared by industry.

Forest Management Unit (FMU): A defined area of forest land located in the Green Area of the province designated by the Department to be managed for sustainable forest management.

Forested land: Land is considered to be forested if it supports tree growth, including seedlings and saplings.

Forests Act: Revised Statutes of Alberta 1980, Chapter F-16 as amended from time to time. It establishes the authority and means by which the Minister of Environment administers and manages timber on public land for sustained yield. It describes how timber allocations can be made on crown land and empowers the Minister to enforce the Act and associated regulations.

Fragmentation: The process of transforming large continuous forest patches into one or more smaller patches surrounded by disturbed areas. This includes loss of stand area, loss of stand interior area, changes in relative and absolute amounts of stand edge, and changes in insularity. This occurs naturally through such agents as fire, landslides, windthrow and insect attack. It also occurs due to anthropogenic activities such as timber harvesting, road building and wellsite development.

Free-to-grow: Stands that meeting stocking, height, and/or height growth rate as indicated by specifications or reforestation standards, and judged to be essentially free from competing vegetation.

Furbearer: Animals whose pelts and carcasses have a legal trade value.

G

General Development Plan (GDP): A five-year operating plan prepared, updated and submitted annually by the timber harvest operator.

Glaciofluvial deposits: Stratified outwash transported and deposited by glacial meltwaters that flowed upon, within, under, or beyond the glacier.

Goal: Broad statements of intent or direction relative to an aim, end or state of being to be achieved at some point in the future or maintained over a period of time.

Grazing disposition: An authorization issued under authority of the Public Lands Act for the purpose of domestic livestock grazing on Crown land.

Green Area: Area designated by the Province whose primary function is timber production.

Green-up: The process of re-establishment of vegetation following logging.

Green-up period: The time needed to re-establish vegetation after disturbance. Specific green-up periods may be established to satisfy visual objectives, hydrological requirements, or as a means of ensuring re-establishment of vegetation (for silviculture, wildlife habitat, or hydrological reasons) before adjacent stands can be harvested.

Ground rules: Provide direction to timber operators and employees of Alberta Sustainable Resource Development for planning, implementing and monitoring timber operations on the FMA. They highlight important management principles, define operating and planning objectives, and present standards and guidelines for timber harvest, road development, reclamation, reforestation and integration of timber harvesting with other forest users.

Growing stock: The sum (by number, basal area, or volume) of trees in the forest or a specified part of it.

Growth and yield: In timber management, the "yield" is the volume of wood available for harvest at the end of a rotation, usually measured as unit volume per unit area (e.g. Cubic meters per hectare). The "growth" is the rate and yield of biomass produced by plants regardless of function or use.

Guidelines: A set of recommended or suggested methods or actions that should be followed in most circumstances to assist administrative and planning decisions, and their implementation in the field. Note that guidelines cannot, by definition, be mandatory.

H

Habitat: The place where a plant or animal naturally or normally lives and grows.

Harvest area: A cutblock or cutover.

Harvest area orientation: Alignment of harvest area for some purpose, normally perpendicular to the prevailing wind.

Harvest design: A forest harvesting plan for a given area which may include in addition to the initially sequenced cutblocks, reserves for fish and wildlife or protection of unique sites, a reforestation program, watershed and riparian area protection, and roading and reclamation requirements.

Harvest design area (HDA): Geographically defined area for planning purposes

Hectare: Area of land measuring 10,000 square meters.

Hibernacula: A sheltered place where snakes spend the winter

Historical resources: Man-made objects of historical significance.

Hog fuel: A by-product of the processing facilities, which is used to generate heat and/or electricity. Hog fuel can be made up of bark, saw dust, and trim blocks.

I

Improved stock: The result of long-term tree breeding programs geared towards selecting for heritable characteristics that are desired.

Incidental: Having a minor role in relation to a more important thing or event.

Increment: Increase in volume of a particular tree or stand overtime.

Indicator: A measurable variable used to report progress toward the achievement of a goal.

Integrated Resource Management (IRM): A cooperative and comprehensive approach to the establishment of plans and to the delivery of benefits from the resource base in an efficient and effective manner.

Integrated Resource Plan (IRP): A regional plan developed by provincial government agencies in consultation with the public and local government bodies. It provides strategic policy direction for the use of public land and its resources within the prescribed planning area. It is used as a guide for resource planners, industry and publics with responsibilities or interests in the area.

Issue: A matter of wide public concern.

J, K & L

Lacustrine: Fine sand, silt, and clay sediments deposited on the lake bed or coarser sands that are deposited along a beach by wave action.

Landscape: A heterogeneous land area with interacting ecosystems.

Landscape diversity: The size, shape, and connectivity of different ecosystems across a large area.

Linear disturbance: The removal of vegetation in a narrow and generally long pattern, such as a road, pipeline, or seismic line.

Long run sustained yield average (LRSYA): The hypothetical timber harvest that can be maintained indefinitely from a management area once all stands have been converted to a managed state under a specific set of management activities.

M

Mean annual increment (MAI): The total increment to a given age in years, divided by that age.

Merchantable: A standard applicable to stands of timber or to individual trees indicating net usable volume.

Miscellaneous Timber Unit (MTU): Portion of a Forest Management Unit set aside for programs to make timber available to small operators.

Miscellaneous Timber Use Area (MTU area): An area managed by Land and Forest Service to provide timber to operators who harvest small volumes of timber each year.

Mission: The reason an organization exists, the societal need it fulfils, and its functional focus.

Mixedwood stands: Stands containing both deciduous and coniferous species. Species content of either/or would be greater than or equal to 20% or less than or equal to 80% of the total cover in the canopy.

Monitor: The process of checking a situation or operation to validate.

N

Natural regeneration: The renewal of a forest stand by natural rather than human means, such as seeding-in from adjacent stands, with the seed being deposited by wind, birds, or animals. Regeneration may also originate from sprouting, suckering, or layering.

Natural process: Naturally occurring function, such as decomposition, fire, etc. Non-forested land: Land is considered to be non-forested if it does not support tree growth, including seedlings and saplings.

Non-productive land: Forest land currently incapable of producing a merchantable stand within a reasonable length of time.

Nutrient Cycling: The circulation or exchange of elements and compounds, such as nitrogen and carbon dioxide, between nonliving and living portions of the environment.

O

Objective: A clear, specific statement of result or conditions to be achieved through implementation of the management plan.

Old growth forest: Forest older than rotation age that contains live and dead trees of various sized, species, composition, and age class structure.

Operability: Classification of a forest site based on the potential to harvest the timber on this site. The physiographic characteristics and moisture conditions of the site are critical to this classification, as is the harvesting equipment available and the technology associated with the harvesting operation.

Operating guidelines: Rules that define forest management practices.

Order in Council: An order made by the Lieutenant Governor or Governor General by and with the advice of the Executive or Privy Council, sometimes under statutory authority or sometimes by virtue of royal prerogative Oriented Strand Board (OSB): wood composite product Own use permits: Small volume permit issued to individuals for their own use, e.g., post and rails.

P

Patch: A relatively heterogeneous non-linear area that differs from its surroundings.

Patch retention: Islands of timber retained within a generally clearcut area.

Periodic Allowable Cut: The total of the annual allowable cuts approved for a five-year cut control period.

Permanent roads: Roads that will be in use for more than two years.

Permanent sample plot (PSP): Plots established for long-term timber growth and yield studies.

Philosophy: General understanding of values.

Physiography: Pertains to the physical landform characteristics, also known as geomorphology

Policy: A course of action adopted or proposed; prudent conduct.

Potentially productive: A site that is capable of growing trees but is currently void of commercial tree species.

Predictive modeling: Computer models that forecast outcomes of actions.

Pre-harvest assessment: Survey of area prior to harvest to determine pre– and post-logging requirements, such as season of harvest, reforestation tactics, etc.

Prescribed burning: Burning planned to provide some type of desired results.

Principle: A formal statement that provides a basis for sustainable forest management policy and that serves as a fundamental guide to action.

Productive land base: Area deemed to support forest growth.

Public Lands and Forests Division (PLFD): A part of the Department of Alberta Sustainable Resource Development.

Q

Quadrant Volumes: Five year's accumulation of AAC

Quota: A form of timber disposition defined by the Forests Act that allows for the allocation of a portion of the sustainable harvest level determined for a given forest management unit.

Quota Certificate: A certificate that entitles the owner to a percentage share of the AAC of a forest Management Unit. This percentage is translated into a fixed roundwood volume.

R

Range of natural variability: The range of results that have occurred naturally.

Range of variability: Characterizes fluctuations in ecosystem conditions or process over time. It can describe variations in diverse characteristics such as tree density, vertebrate population size, water temperature, frequency of disturbance, rate of change, etc.

Rare: Few.

Reference ecosite: Site having average characteristics.

Reforestation: Process of reestablishing a crop of trees.

Reforestation deletion: Stands which are deleted from the timber harvesting land base due to their relatively low productivity combined with the difficulty of reforesting the sites.

Reforestation lag period: The time between completion of timber harvest operations and the establishment of a regenerated stand, based on current procedures for evaluating successful stand establishment.

Refugium: Large areas free from trapping and land-use activity.

Regeneration: The renewal of a forest or stand of trees by natural or artificial means.

Retention period: The length of time between harvesting passes.

Right-of-way: A strip of land over which a power line, railway line, road, or other linear disturbance extends.

Riparian areas: Those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and /or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics.

Roll-back: Strippings and debris returned to disturbed areas for reclamation purposes.

Rotation: The period of years required to establish and grow timber crops to a specified condition of maturity.

Rotation Age: The planned number of years between regeneration of a forest stand and its final harvest.

S

Salvage Cut: A cutting method to remove dead or damaged trees with merchantable wood.

Scarification: Silvicultural practice involving the mechanical disruption of the ground surface to expose mineral soil.

Sedimentation: Deposit of waterborne material.

Selection harvest: An uneven-aged silvicultural system in which selected trees are harvested individually or in small groups at periodic intervals.

Selective cutting: A harvest practice in which only trees of a certain species with a specified diameter and/or value are harvested.

Sensitivity analysis: An analytical procedure in which the value of one or more parameters is varied and the changes that this produces are analyzed in a series of iterative evaluations. If a small change in a parameter results in a proportionately larger change in the results, the results are said to be sensitive to the parameter.

Seral stages: The stages of ecological succession of a plant community from young to old. This is the characteristic sequence of biotic communities that successively occupy and replace each other.

Silviculture: The theory and practice of controlling the establishment, composition, structure and growth of forests.

Silviculture regimes: Tactics to establish a crop of trees.

Single-tree retention: Process of leaving single trees standing in generally clearcut area.

Site index: A measure of forest site productivity expressed as the average height of the tallest trees in the stand at a defined index age, typically less than the planned rotation ages. For this DFMP, a site index age of 50 years was used.

Site preparation: Mechanical preparation of forest soils for reforestation purposes.

Site productivity: The mean annual increment in merchantable volume which can be expected for a forest area, assuming it is fully stocked by one or more species best adapted to the site, at or near rotation age.

Slash hazard reduction: Process to remove or reduce the buildup of logging slash.

Snag: A standing dead tree from which the leaves and most of the branches have fallen.

Spatial database: Data referenced to a set of geographical coordinates and encoded in digital format so that they can be sorted, selectively retrieved, statistically and spatially analyzed. The different data planes can be overlaid in virtually any order.

Special Places: A Government of Alberta initiative committed to the establishment of a network of Special Places that represent the environmental diversity of the province's six natural regions (20 subregions). The program encompasses a balanced approach to preservation, outdoor recreation, heritage appreciation, tourism and economic development.

Stand: A continuous group of trees or other growth occupying a specific area and sufficiently uniform in composition, age, arrangement, and conditions as to be distinguishable from the forest or other growth on adjoining areas.

Stand structure: The various horizontal and vertical physical elements o the forest. The physical appearance of canopy and subcanopy trees and snags, shrub and herbaceous strata, and down woody material.

Stand Tending: Activities such as thinning, spacing, removal of diseased trees, and weed or brush control, carried out in already established stands.

Stewardship: Obligation to manage.

Stewardship Report: A report that accounts for all activities, undertaken as a steward of a given article, resource, area or process, related to strategies to achieve stated stewardship goals. Measures of performance are included and linked to plans that express the desired goals.

Stocking: A measure of the proportion of an area occupied by trees/seedlings, expressed in terms of percentage of occupied fixed area sample plots.

Strata: A multitude of layers or groups.

Strategy: Statement of broad activity designed to achieve the goals or objectives.

Stratum: A single layer or group.

Sub-regional Integrated Resource Plans: A system of Cabinet approved plans incorporating a cooperative and comprehensive approach to decision making relative to the allocation and use of Crown land and resources.

Succession: The replacement of one plant community by another in a progressive development towards climax vegetation.

Successional patterns: Evolutionary process of vegetation stages.

Sustainable development: Development of a resource while maintaining other values.

Sustainable forest management (SFM): The maintenance of the ecological integrity of the forest ecosystem while providing for social and economic values such as ecosystem services, economic, social and cultural opportunities for the benefit of present and future generations.

Sustainable timber management: Managing the forest to provide a perpetual supply of timber now and into the future.

Sustained-yield timber management: The yield a forest can produce continuously at a given intensity of management.

Sustained Yield Unit (SYU/ FMA): Unit of land used to determine an annual allowable cut.

T

Tactic: A method to achieve something.

Temporary road: Temporary roads are those that are part of a cutblock, or connect cutblocks and are built, used and reclaimed before expiry of the AOP, or reclaimed within two years of construction.

Temporary sample plot (TSP): an area of established size used in the measurement of trees and other physical characteristics.

Threatened: Class of plant or animal life under pressure to maintain existence.

Timber harvesting land base: The timber harvesting land base is the portion of the total land area of the FMA that can be considered to contribute to and be available for long-term timber supply. It is the land base remaining after deductions for areas that cannot, should not, or will not be managed for timber production.

Timber management: The activity involving the allocation of forested lands for harvesting of the timber on that land. Timber management may involve planning, road building, logging extraction of merchantable timber for processing off-site, and varying intensities of silvicultural activity to encourage another stand of trees to grow back. Timber management is an important subset of forest management, but it is not an equivalent activity.

Timber Management Regulation: The legislative stature that describes the mechanism and regulations by which the forested lands of Alberta are managed.

Timber Operations: Includes all activities related to timber harvesting including site assessment, planning, road construction, harvesting, reclamation and reforestation.

Tufa: A porous rock composed of calcium carbonate and found around mineral springs.

U

Understorey: Those trees or vegetation in a forest stand below the main canopy level.

Understorey protection: Avoidance of damaging immature tree species during harvesting operations.

Uneven aged stands: Stands in which the trees differ markedly in age, usually with a span greater than 20 years.

Ungulate: Hoofed animal.

Unique areas: Sites that contain natural features or special values for wildlife and plant species. Also includes historical and archeological significant areas.

Unique ecological sites: Areas supporting rare species or processes.

Utilization standards: Standards establishing stand and tree merchantability

V

Value: A principle, standard, or quality considered worthwhile or desirable.

Viewshed: The visible area, as it appears from one or more viewpoints.

Vision: Foresight.

Volume table: A table, graph or equation showing the estimated average tree or stand volume corresponding to selected values of more easily measured tree or stand variables.

W, X, Y & Z

Water source areas: That portion of a watershed where soils are water saturated and/or surface flow occurs and contributes directly to stream flow.

Water yield: The quantity of water derived from a unit area of watershed.

Watershed: An area of land that collects and discharges water into a single creek or river through a series of smaller tributaries.

White Area: Forested area in the Province managed primarily for grazing, while also managing for some sustainable timber production. It also includes a mixture of private and Crown land.

Wood chip direction: Provincial direction of byproduct of timber manufacturing to specific pulping facilities.

Woody debris: Live or dead, standing or downed, woody material left on a site after logging.

Yield Curve: Graphical representation of a yield table.

Yield Table: A summary table showing, for stands (usually even aged) of one or more species on different sites, characteristics at different ages of the stand.

6 Timber Supply Forecasting

6.1 Introduction

The purpose of Chapter 6 is to present the methods and results used to select the preferred management scenario. The preferred scenario indicates current and future expected levels of outputs associated with meeting all management goals presented in the previous sections. Outputs include measures and indicators of a wide variety of forest resource values.

The timber supply analysis (TSA) component of the detailed forest management plan provides a focal point for a wide variety of objectives designed to address the sustainable use of timber resources within the DFMP. The TSA includes the legal boundaries of FMA #9700035 and the embedded grazing dispositions (Figure 6.1), with the exception of Grazing Reserves, in Forest Management Units (FMUs) E1, E2, W5 and W6. For simplicity, the combined areas will be referred to as the FMA area.

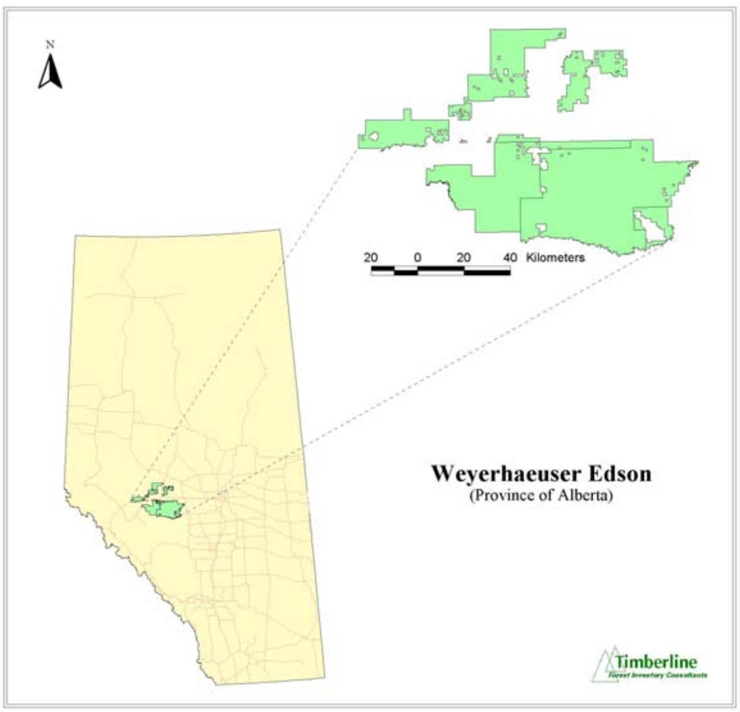


Figure 6.1 Location and Extent of FMA Area

Both the Forest Act and the Forest Management Agreement (FMA) between the Government of Alberta and Weyerhaeuser define the rights and responsibilities of Weyerhaeuser as the sole area-based forest land manager. The FMA defines an area-based tenure that requires Weyerhaeuser to fulfill timber supply objectives to sustain its own fibre requirements as well as to fulfill a number of other volume-based commitments to the Crown. The TSA will also quantify the other overlapping timber allocations upon the FMA area.

6.2 Overview of the Timber Supply Forecasting Process

Estimating long-term sustainable harvest levels is the culmination of data collection, data processing, stakeholder meetings, public consultation meetings, company philosophy, values, objectives, etc. It all comes together in the timber supply modeling process to determine the allowable harvest level, the various impacts on competing values, and the future forest condition (Figure 6.2).

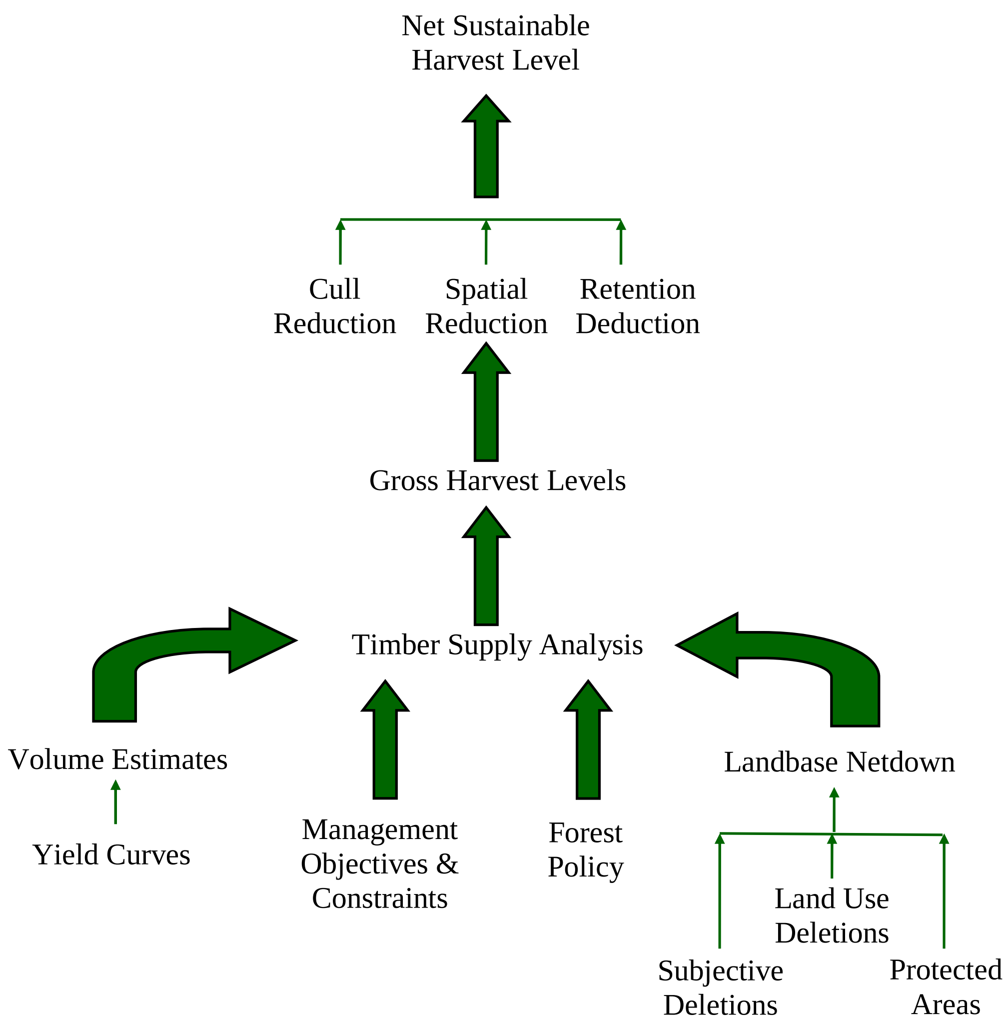


Figure 6.2 Overview of Timber Supply Forecasting Process

6.3 Current Status of FMA Area

6.3.1 Forest Inventory

The land base inventory includes information on both non-forested and forested areas. Parks, recreation areas, reserves for wildlife habitat, transportation and utility corridors, and other industrial sites are assigned as non-harvestable land base. These areas however, contribute to a variety of other management objectives. The FMA area is composed of four Forest Management Units (FMUs): E1, E2, W5 and W6. They are treated as separate sustained yield units in the timber supply analysis.

The total area of FMA encompasses 509,373 hectares (ha). Of this area, 468,209 ha (92%) are capable of supporting forest vegetation. Almost 188,094 ha (37%) are excluded from the timber harvesting land base (with the exception of marginal stands as described in Section 6.5.1). Similar to non-forest areas that do not contribute to the timber harvesting land base, the forested area excluded from timber harvesting is maintained in the database due to its significance in contributing to a variety of other forest management objectives.

Finally, about 55% (280,115 ha) of the FMA area is net harvestable land base. This is the land base from which sustainable harvest levels and Annual Allowable Cuts are determined. A detailed description of the net harvestable forested land base is in Appendix 6.1.

In addition to the current age class distribution and the levels of Broad Cover Groups, various attributes of the current status of the land base where observed. Although there is much anthropogenic history on the land base the current status serves as the starting point to which the today's forest management assumptions are applied. The model shows how the current status of the forest changes over time with those assumptions applied.

6.3.2 Growing Stock

Growing stock is the amount of standing merchantable volume within the net harvestable land base. This is further refined to the operable growing stock which is that portion of the growing stock that is currently harvestable as defined by the operability limits (refer to section 6.12.1.8). The amount of growing stock and operable growing stock at the beginning of the planning horizon are summarized in Table 6.1.

Table 6.1 Summary of Growing Stock at the Beginning of the Planning Horizon

		Initial Growing Stock (m^3)					
LMU		Coniferous	% of Total C	Deciduous	% of Total D	Total	% of Total T
E1	Total	6,055,616	100.0%	2,563,681	100.0%	8,619,298	100.0%
	Operable	5,442,040	89.9%	2,337,184	91.2%	7,779,223	90.3%
E2	Total	4,817,487	100.0%	6,166,938	100.0%	10,984,425	100.0%
	Operable	4,258,771	88.4%	5,786,560	93.8%	10,045,331	91.5%
W5	Total	1,750,060	100.0%	2,739,484	100.0%	4,489,544	100.0%
	Operable	1,413,312	80.8%	2,351,867	85.9%	3,765,179	83.9%
W6	Total	10,108,472	100.0%	8,498,538	100.0%	18,607,011	100.0%
	Operable	8,837,697	87.4%	7,220,794	85.0%	16,058,491	86.3%
FMA	Total	22,731,636	100.0%	19,968,642	100.0%	42,700,277	100.0%
	Operable	19,951,820	87.8%	17,696,404	88.6%	37,648,224	88.2%

6.3.3 Defining the Net Harvestable Land Base

Many polygons could potentially be assigned to several deletion types. Therefore, a deletion hierarchy was ranked from “harder” to “softer” deletions. The “harder” deletions identified areas which can confidently be removed from the net land base because of productivity or land use criteria. “Softer” deletions such as subjective deletions are also excluded from the net harvestable land base. This method facilitated understanding of how much forested land is ultimately deleted under various criteria. Refer to Appendix 6.1 for further details regarding the types of features excluded and the process used to define the net harvestable land base.

A hierarchy of non-operable land base deletion rules was identified and applied to a composite land base resulting in the forested productive land base. The deletion hierarchy and net areas identified by deletion category are depicted in Table 6.2. An expanded version of this table is located in Appendix 6.1 (Table 3-1). This table summarizes the classification of the FMA area and timber harvesting land base by forest management units. The current timber harvesting land base is approximately 55% (280,115 ha) of the total area, and about 59% of the total forested area. The majority of forest land excluded from the timber harvesting land base (about 37% of all forested land) is either economically inoperable, or environmentally sensitive, or both.

Table 6.2 Classification of the FMA Land Base by FMU

Category		FMU E1	FMU E2	FMU W5	FMU W6	FMA Total (ha)	FMA % Total
		Forest Management Units Area (ha)					
Total Non-Forested Area		*5,495*	*9,091*	*5,660*	*20,918*	*41,164*	*8.08%*
Total Dispositions and Protection/Park Area		*4,834*	*9,890*	*3,708*	*13,461*	*31,893*	*6.26%*
Total Water Course Buffers and Operational Removal Area		*3,006*	*2,344*	*937*	*3,518*	*9,805*	*1.92%*
Total Poor Tree Growth Potential or Difficult Reforestation		*39,835*	*24,780*	*16,280*	*65,501*	*146,396*	*28.74%*
Total Deletion Area		**53,170**	**46,105**	**26,585**	**103,398**	**229,258**	***45.01%***
Timber Harvesting Land base							
Deciduous	Deciduous	6,394	30,832	16,578	37,026	**90,830**	**17.83%**
Deciduous	Deciduous / Coniferous	5,239	8,577	598	1,915	**16,329**	**3.21%**
Deciduous	Coniferous / Deciduous	5,131	6,554	111	0	**11,796**	**2.32%**
Deciduous	Coniferous	299	340	63	0	**702**	**0.14%**
Deciduous Land base Totals		**17,063**	**46,303**	**17,350**	**38,941**	**119,657**	**23.49%**
Coniferous	Coniferous	31,911	17,544	7,120	55,891	**112,466**	**22.08%**
Coniferous	Coniferous / Deciduous	5,195	3,346	4,795	19,582	**32,918**	**6.46%**
Coniferous	Deciduous / Coniferous	0	0	3,413	11,661	**15,074**	**2.96%**
Coniferous	Deciduous	0	0	0	0	**0**	**0.00%**
Coniferous Land base Totals		***37,106***	***20,890***	***15,328***	***87,134***	***160,458***	***31.50%***
Total Harvestable Area		**54,169**	**67,193**	**32,678**	**126,075**	**280,115**	**54.99%**
Grand Total		**107,339**	**113,298**	**59,263**	**229,473**	**509,373**	**100.00%**

The following pie chart (Figure 6.3) depicts the same values as Table 6.2. The total sums between the chart and table differs slightly due to rounding errors.

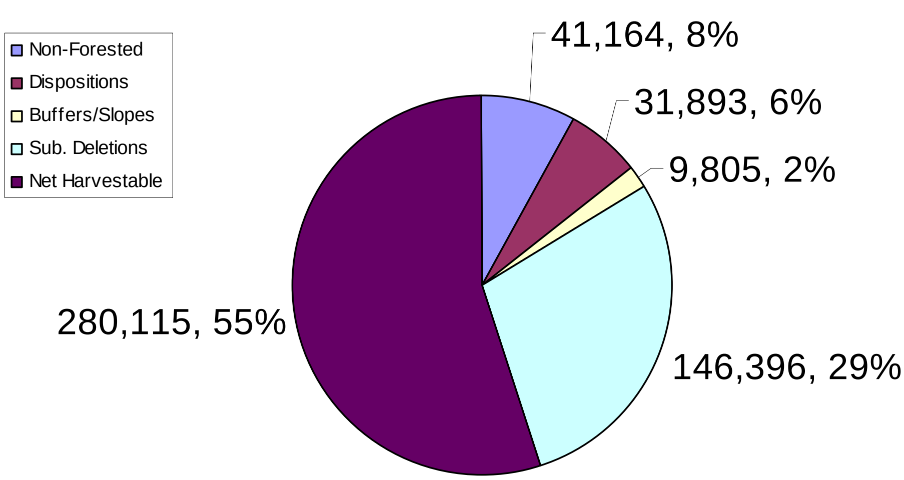


Figure 6.3 FMA Area Overview

Table 6.3 Summary of Land Base Netdown by FMU

	FMU E1		FMU E2		FMU W5		FMU W6		FMA	
Category	Total (ha)	% Total	Total (ha)	% Total	Total (ha)	% Total	Total (ha)	% Total	Total (ha)	% Total
Non-Forested	5,495	5.1%	9,091	8.0%	5,660	9.6%	20,918	9.1%	41,164	8.1%
Dispositions	4,834	4.5%	9,890	8.7%	3,708	6.3%	13,461	5.9%	31,893	6.3%
Buffers/Slopes	3,006	2.8%	2,344	2.1%	937	1.6%	3,518	1.5%	9,805	1.9%
Sub. Deletions	39,835	37.1%	24,780	21.9%	16,280	27.5%	65,501	28.5%	146,396	28.7%
Net Harvestable	54,169	50.5%	67,193	59.3%	32,678	55.1%	126,075	54.9%	280,115	55.0%
Total	107,339	100.0%	113,298	100.0%	59,263	100.0%	229,473	100.0%	509,373	100.0%

6.3.4 Comparison to the 1986 FMU Management Plans

The differences in forest land base between 1986 and the current TSA (2006) can be summarized as follows:

- There have been significant changes in the FMU boundaries between management plans;
- The timber harvesting land base area in the FMA has been reduced by withdrawals for industrial activities;
- Forest inventory measures for site productivity, ecosystem classification, and the species composition of current stands are key determinants for inclusion of forest in the timber harvesting land base. The current management plan is based on a new forest inventory known as the Alberta Vegetation Inventory Version 2.1 (AVI);
- The current management plan includes better information on the physical and economic operability to describe the net harvestable land base, such as the ecological land classification; and
- Due to past modeling constraints, multiple rules sets (usually driven by different green up delays) when modeling the harvest sequence had to be implemented sequentially, providing some bias to the first land base modeled. Advancements in these models now permit concurrent modeling of groups with different rule sets.

6.3.5 Age Class Distribution Area

Figure 6.4 and Figure 6.5 shows the current age composition of the forested land base in the FMA area. The age class distribution of forested area excluded from the timber harvesting land base can affect timber supply. In order to provide a suitable area for habitat and other non-timber values, some portions of the forest area are reserved from harvesting. These attributes are facilitated by maintaining certain age ranges and patch sizes distributions across the landscape.

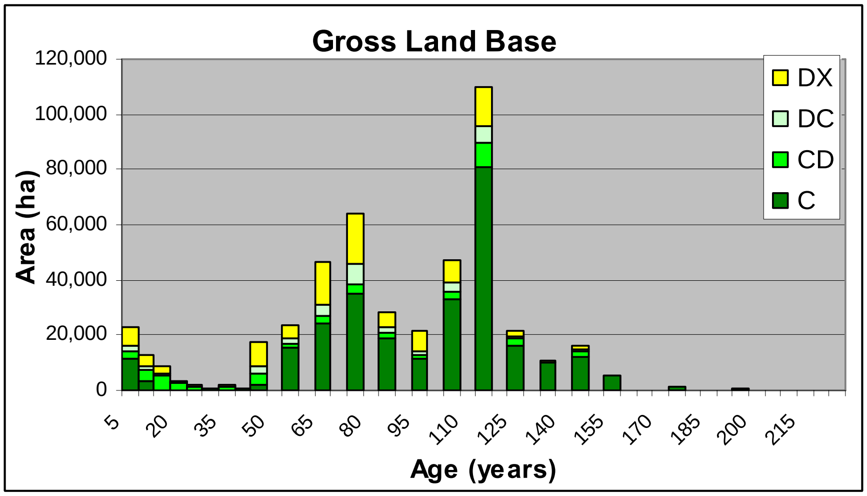


Figure 6.4 Initial Age Class Distribution of Gross Forested Land Base

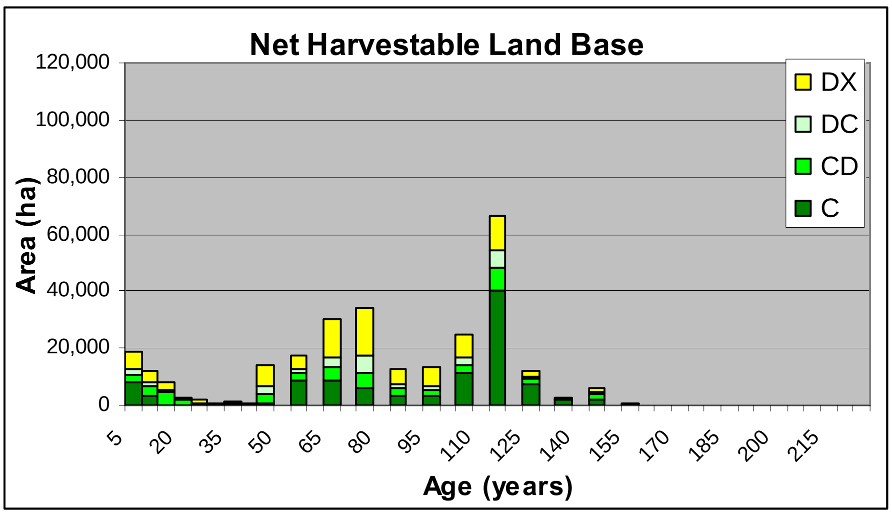


Figure 6.5 Initial Age Class Distribution of Net Harvestable Land Base

6.4 Yield Curves

6.4.1 Yield Curve Development

Yield curves were developed by estimating volume as a function of age, site, crown closure, Natural Subregion, and coniferous composition. Coniferous volumes are based on a 15/11 utilization while deciduous was based on 15/10. Both assume a 15 cm stump height.

Most growth and yield models available for use in Alberta are equations developed from volume sampling data collected in the forests they will be used to analyze. Ideally, a growth and yield model, or the parameters that define a growth and yield equation, would be estimated with data that accurately capture a wide variety of ages, tree densities, states of management, and other such parameters. The reality is that much of the forest in Alberta has a very narrow and uneven age distribution, and many of the parameters used to define the forest are quite general. For example, stand density is represented by a cardinal index of four values – A, B, C, or D – where A is the sparsest and D is densest. So it is with site productivity where stands are classified by three categories – fair, medium, or good.

Timber volumes are estimated from equations with right-hand-side variables being various stand attributes. These attributes include species composition, density class, and site productivity class. Each unique combination of these attributes is called a yield stratum. For each yield stratum, a set of yield equations is produced in order to estimate total coniferous volume, total deciduous volume, and individual species volumes for larch, black poplar, aspen, and white birch. Table 6.4 summarizes the 30 yield strata within which the full set of yield curves was developed.

Area-weighted projections for 111 coniferous and 50 deciduous yield curves were weighted by estimated net harvestable area to produce four yield curves to represent yields from each broad cover group (C, CD, DC, and D). Yields are based on 15/11/15[1] coniferous utilization and 15/10/15 deciduous utilization standard. Four area-weighted yield curves are presented next as Figure 6.6 and Figure 6.7.

[1] 15/11/15 is the short form used to describe the utilization standard. It depicts the minimum diameter at breast height measured outside the bark (cm) / minimum diameter of the top of the bole measured inside the bark (cm) / stump height (cm).

Table 6.4 The 30 Yield Strata used in Forecasting Timber Supply

No.	Dominant Covertype	Natural Subregion	Site	Crown Closure
1	Coniferous	Lower Foothills	Good	“A”
2	Coniferous	Lower Foothills	Good	“B”
3	Coniferous	Lower Foothills	Good	“C”
4	Coniferous	Lower Foothills	Good	“D”
5	Coniferous	Lower Foothills	Medium	“A”
6	Coniferous	Lower Foothills	Medium	“B”
7	Coniferous	Lower Foothills	Medium	“C”
8	Coniferous	Lower Foothills	Medium	“D”
9	Coniferous	Lower Foothills	Poor	All
10	Coniferous	Upper Foothills	Good	“A”
11	Coniferous	Upper Foothills	Good	“B”
12	Coniferous	Upper Foothills	Good	“C”
13	Coniferous	Upper Foothills	Good	“D”
14	Coniferous	Upper Foothills	Medium	“A”
15	Coniferous	Upper Foothills	Medium	“B”
16	Coniferous	Upper Foothills	Medium	“C”
17	Coniferous	Upper Foothills	Medium	“D”
18	Coniferous	Upper Foothills	Poor	All
19*	Coniferous	Lower/Upper Foothills	Good	All
20*	Coniferous	Lower/Upper Foothills	Medium	All
21*	Coniferous	Lower/Upper Foothills	Poor	All
22	Deciduous	Lower Foothills	Good	“A”
23	Deciduous	Lower Foothills	Good	“B”
24	Deciduous	Lower Foothills	Good	“C”
25	Deciduous	Lower Foothills	Good	“D”
26	Deciduous	Upper Foothills	Good	“A”
27	Deciduous	Upper Foothills	Good	“B”
28	Deciduous	Upper Foothills	Good	“C”
29	Deciduous	Upper Foothills	Good	“D”
30**	Deciduous	Lower/Upper Foothills	Poor	All

Yield Curves – Terms Yield Curve and Yield Strata are not synonymous. Each yield strata has 6 associated yield curves (except *=1 yield curve, **=2 yield curves), all of which project the same total volumes. The 6 curves differ only in the relative coniferous/deciduous volume contribution, which is based on coniferous species composition. In total 161 yield curves were applied to the land base (108 for coniferous dominated stands, 50 for deciduous dominated stands, and 3 for coniferous dominated switch stands).

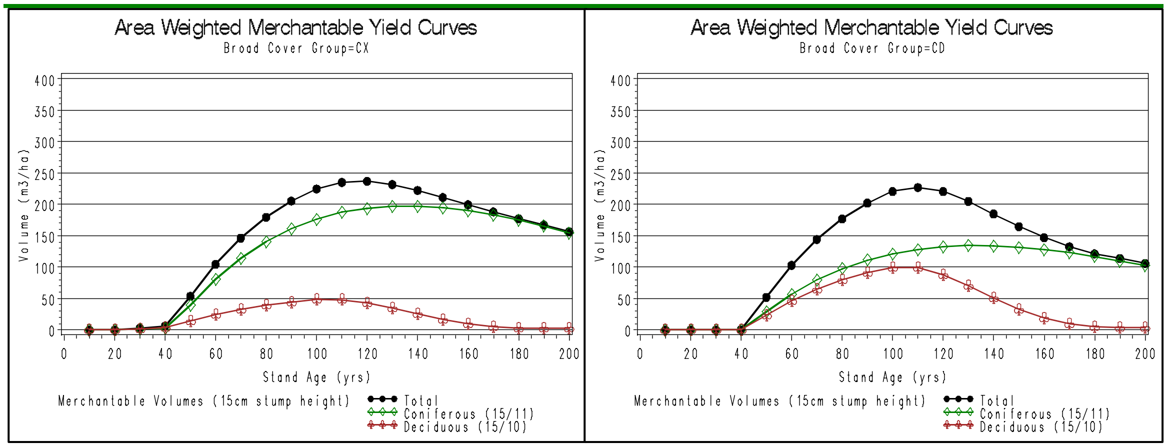


Figure 6.6 Area Weighted Yield Curves for the 'CX' and 'CD' Broad Cover Groups

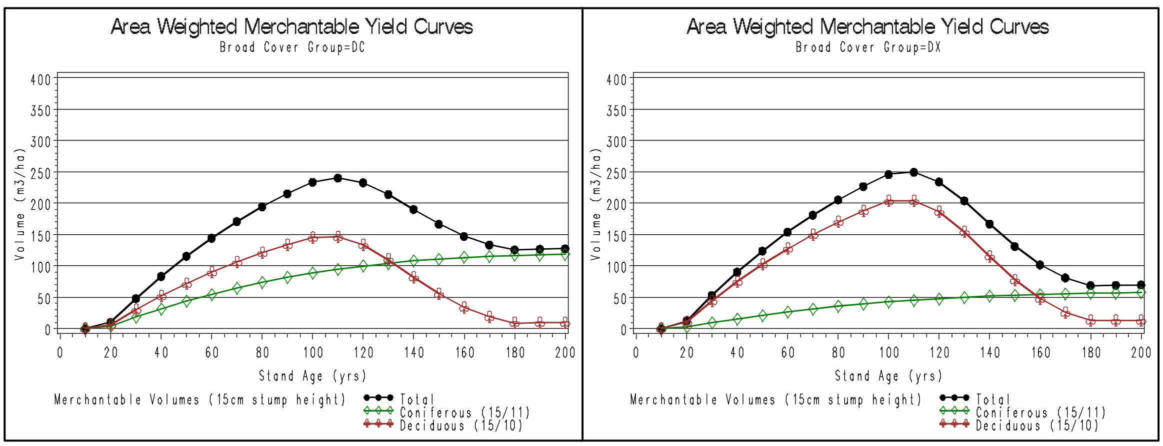


Figure 6.7 Area Weighted Yield Curves for the 'DC' and 'DX' Broad Cover Groups

6.4.2 Strata Variables and Equation Parameters

Yield equations for the FMA area were developed by stratifying locally collected TSP data (sample years 1996 to 1999) by broad inventory cover group (coniferous dominated versus deciduous dominated) and applying nonlinear volume estimation procedures to the data.

Plot and spatial data overlay: Each TSP was spatially linked to an Alberta Vegetation Inventory (AVI) polygon, a SiteLogix™ ecosite classification polygon, and the provincial Natural Subregion spatial coverage.

Site Index: When possible, each sampled stand was assigned a site index value. To be eligible as for a site index measurement a tree could not be severely damaged and had to be either dominant or co-dominant with both a valid field measured height and age.

Height prediction equations: Localized species-specific coefficients were produced for height prediction from DBH using the Chapman-Richards functional form. These calculations were conducted for individual site productivity classes based on the plot level ecosite class and Natural Subregion. A minimum of 20 observations was required for a valid model. If valid coefficients could not be found, the provincial coefficients were used.

Plot age calculations: Plot age was assigned using the following equation:

TSP sample year – AVI inventory origin year = Plot Age

Tree volume compilation: Coniferous volumes were compiled based on a whole tree system at a 15/11-utilization standard. Deciduous volumes were compiled based on a short wood harvesting system and a 15/10 utilization standard. Both systems assume a 15 cm stump height. These are consistent with current mill standards.

Subjective deletions and cull: The land base netdown process was also applied to the plot data such that the final yield curves actually model the net harvestable land base. All plots located in stands with a composition of 80%+ black spruce or 10%+ larch composition were assumed to be un-merchantable and removed from any yield projections. Cull was not deducted during the yield analysis. It was addressed as a proportional reduction applied to the recommended annual allowable cut level based on historical scaling data.

Merchantable total volume: In general, total stand yields were estimated as a function of coniferous/deciduous composition dominance, AVI crown closure, site index, site quality, and stand age.

Merchantable major species volume: In general, major species volume (i.e. coniferous volume from coniferous dominated stands) was estimated as a function of Natural Subregion, total volume, and AVI coniferous composition.

Merchantable incidental volume: Incidental volume (i.e. deciduous volume from coniferous dominated stands) was estimated by simply subtracting merchantable major species volume from merchantable total volume.

Deciduous mortality reductions: Although TSP data to some extent already considers mortality (as dead trees do not contribute merchantable volume) an additional mortality constant was applied to deciduous volumes.

6.4.3 Alternate Utilization Standards

It was determined that some of the conifer operators with quotas in the FMA preferred to harvest at an alternate utilization standard. Rather than operating at a 15/11, some quota holders operate at a 15/10 utilization standard. This means they harvest stems down to a 10 cm minimum top diameter rather than 11 cm. An adjustment factor was calculated to convert the yield estimates from 15/11 to 15/10. Details regarding the adjustment factor for the alternate 15/10 coniferous utilization factor are located in Appendix 6.11.

6.5 Linking the Yield Curves to the Land Base

Each stand eligible for forest management activities is assigned a yield curve based on broad cover group, Natural Subregion and site quality, crown closure, percentage coniferous composition, and the overstorey or understorey AVI call used for the primary story of management. During the process of defining the net harvestable land base, each forested stand is assigned to a yield stratum using the exact same definitions used to stratify the plot data (Table 6.5). The land base netdown process was also applied to the plot data such that the final yield curves actually model the net harvestable land base. This ensures that the estimated volumes are appropriately assigned to delineated stands of the same composition. In the timber supply model, each yield curve is given a unique label. This unique label is also assigned to each stand in the land base definition process, and is carried forward into the model.

Table 6.5 Yield Stratum Stratification

Total Yield Stratum Number*	Yield Group Description	NSR	Site	Mean SI	CC	Net Area (ha)	Number of Plots
C1	Coniferous Switch Stands Not included	LF	G	16.2	A	13,289	109
C2					B	10,410	113
C3					C	37,846	277
C4					D	5,615	38
C5			M	14.7	A	4,502	44
C6					B	8,500	92
C7					C	31,937	242
C8					D	8,642	85
C9			P	12.1	A to D	11,556	97
C10		UF	G	16.2	A	914	24
C11					B	2,000	50
C12					C	8,805	199
C13					D	2,409	47
C14			M	14.5	A	606	18
C15					B	118	3
C16					C	608	10
C17					D	86	2
C18			P	11.1	A to D	13,289	3
Coniferous Non-Switch Stand Totals						**147,997**	**1,453**
C19	Coniferous Switch Stands	LF/UF	G	NA	A to D	9,607	130
C20			M	NA	A to D	196	0
C21			P	NA	A to D	81	0
Coniferous Totals						**9,884**	**130**

Table 6.5 continued… Yield Stratum Stratification

Total Yield Stratum Number*	Yield Group Description	NSR	Site	Mean SI	CC	Net Area (ha)	Number of Plots
D1	Deciduous Good Site Switch and Non-switch stands	LF	G	17.7	A	7,631	109
D2					B	19,276	259
D3					C	75,217	828
D4					D	14,089	167
D5		UF	G	17.1	A	422	12
D6					B	1,010	28
D7					C	3,361	101
D8					D	374	3
Deciduous Good Site Non-Switch and Switch Stand Totals						**123,381**	**1,507**
D9	**Deciduous Poor Site Switch and Non-switch stands**	LF/UF	P	NA	A to D	852	10
Deciduous Totals						**852**	**10**

6.5.1 Marginal Stands

The Edson FMA has a number of timber operators with diverse operation standards. These operators agree upon the definition of what constitutes a truly merchantable stand. However, there is a relatively small range of forest types (hereafter referred to as *marginal*) where there was some disagreement as to merchantability and inclusion into the productive land base. Some Edson FMA timber harvesters expressed a concern that the subjective deletion rules were too coarse and removed some merchantable stands. To identify the most likely operationally viable area, the previously subjectively deleted stands with the most favorable AVI stand attributes were identified and assigned to marginally operable status. The following points summarize the steps to identify and incorporate marginal stands:

- **Identify marginal stands** – In the process of defining the net land base, two subjective deletion rules were used: 1) Stands with 10% or more Larch composition or 2) Stands with 80% or more Black spruce composition. All stands that met either of the above criteria were removed from the net land base. The following rules identify potential marginal stands eligible for harvesting activities
    - The stand must have been classified as a subjective deletion in the November 24, 2004 land base allocation process and have no more than 20% larch composition and or 80 % black spruce composition;
    - The stand must be at least 14m tall;
    - The stand must have greater than an “A” crown closure.

- **Estimate volume from marginal stands** – Initially yield curve plots located within marginal areas were removed and did not contribute to the final yield curve projections for the net land base. To estimate volumes for these types plot volumes sampled on marginal area were compiled separately. A conservative rotation age of 140 years was assumed for marginal stands. Mean Annual Increment (MAI) was then calculated by dividing mean volume (m^3/ha) by 140 years.

- **Estimate marginal stand potential harvest volumes** – Potential harvest levels from marginal stands were calculated by multiplying MAI by marginal stand area for each FMU (Table 6.6).

- **Locate marginal stands on Spatial Harvest Sequence map** – After the Spatial Harvest Sequence had been derived (marginal stands not included) marginal stands neighboring sequenced stands were identified and flagged for possible inclusion.

- **Allocation** – The identified marginal stands were allocated to participating operators in proportion to their quota allocation.

Table 6.6 Estimated Annual Gross* Marginal Stand Volume by FMU

FMU	Marginal Stand Area (ha)	Coniferous MAI (m^3/ha/yr)	Coniferous Volume (m^3/yr)
E1	2,331	0.87	2,028
E2	2,564	0.87	2,231
W5	730	0.87	635
W6	3,178	0.87	2,765
FMA	8,803		7,659

*does not take into account cull, retention, or spatial reduction percentage

6.6 Forecasting Model

6.6.1 Remsoft Spatial Planning System

Established in 1992 and located in Fredericton, NB, Remsoft is dedicated to the creation and support of software for integrated, spatial forest management planning. Its flagship products - Woodstock™, Spatial Woodstock™, Stanley™ and the Allocation Optimizer™ are collectively referred to as the Remsoft Spatial Planning System (RSPS, see Figure 6.8). This system is used by companies in the forest industry and leading public agencies and interest groups throughout North America, Australia, New Zealand and Southeast Asia for a host of different strategic and tactical planning issues (Remsoft 2005). This software lets you make resource allocation decisions that meet commercial objectives while ensuring the trade-offs from timber and other non-timber resources are assessed and considered. In the DFMP analysis for each Forest Management Unit, the

RSPS (without the Allocation Optimizer) was used to forecast sustainable harvest volumes.

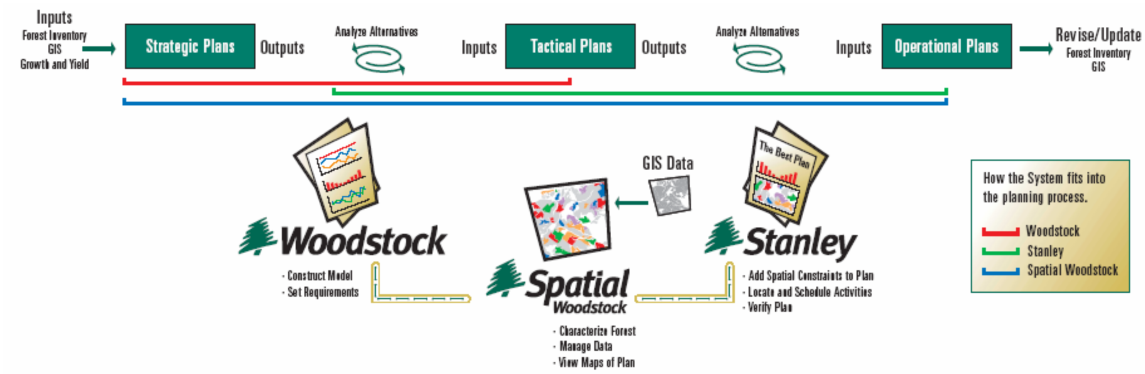


Figure 6.8 Overview of Remsoft Spatial Planning System (Remsoft 2005)

The first module of the RSPS is called Woodstock. Woodstock is an aspatial model that is used for strategic-level planning and is designed to address forest management planning questions. It is a user-defined model that is commonly used to estimate expected harvest volumes over time and to assess trade-offs from other values and objectives. Woodstock also allows the user to define a wide variety of expected output levels such as growing stock volumes, harvested areas, and age class distributions.

The second module is Spatial Woodstock. Spatial Woodstock provides the spatial connection between Woodstock and Stanley. Spatial Woodstock was used to create the area files (land base to be modeled) and to generate time specific spatial characteristics of the land base.

The third module utilized in the RSPS is Stanley. Stanley is a tactical-level planning tool that is used to define both where and when the timber volumes projected with Woodstock will be harvested. Unlike Woodstock, Stanley is a simulation-based spatial activity allocation model. Stanley takes the planned blocks created from our harvest planning team, as well as the Woodstock schedule, and spatially allocates the schedule subject to minimum, maximum, and target opening sizes, adjacency, green-up and other spatial constraints.

6.6.2 MOSEK

MOSEK was established in 1997 by Erling D. Andersen and Knud D. Andersen and it specializes in creating advanced software for solution of mathematical optimization problems. In particular, the company, based in Copenhagen, Denmark, focuses on solution linear, quadratic, and nonlinear convex optimization problems. MOSEK is a provider of optimization software which helps the customers to make better decisions. The customer base consists of financial institutions and companies, universities, and software vendors, among others (MOSEK, 2005). MOSEK is a commercial partner of Remsoft.

The MOSEK optimization software is designed to solve large-scale mathematical optimization problems.

Problems MOSEK can solve:

- Linear problems (integer constrained variables allowed).
- Conic quadratic problems.
- Quadratic and quadratically constrained problems (integer constrained variables allowed).
- General convex nonlinear problems.

Technical highlights of MOSEK are:

- For continuous problems MOSEK implements the simplex and interior-point based algorithms.
- For mixed integer problems MOSEK implements a branch & bound & cut algorithm.
- The MOSEK interior-point optimizer is capable of exploiting multiple processors.

Table 6.7 Versions of the Various Models used in Forecasting

Model	Version
Woodstock	2006.08 / 2006.10
Spatial Woodstock	2006.08
Stanley	2006.08
MOSEK	4.0.0.31

6.7 General Description of the Modeling Process

Due to the different operators and management scenarios, each of the four FMUs were run as separate SYUs and independent of one another. This resulted in four separate models. The following section reviews the TSA set-up for the AACs calculations for each of the four management units.

Once interim approval has been received from Alberta Sustainable Resource Development for both the net harvestable land base and the growth and yield forecasts, the land base is prepared for the RSPS. The necessary fields for modeling are added which include pre-blocks and themes. These attributes are populated where necessary so that planner-defined harvest blocks and previously harvested areas are appropriately sequenced with the correct period and action (so the correct rule sets may be applied).

Spatial Woodstock was then used to create area file and LP schedule (of all the planned blocks) files. The modeling approach used in this analysis followed the pathway shown in Figure 6-9 and is outlined in this section.

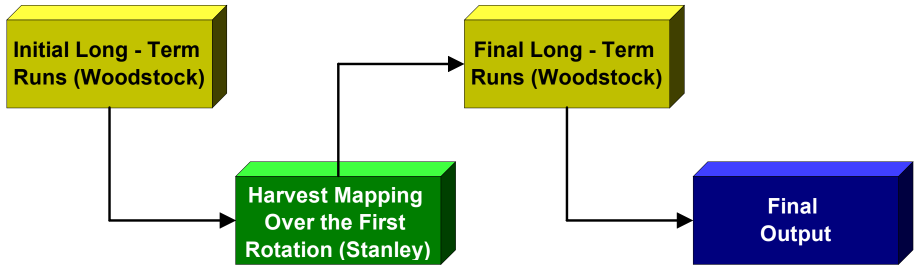


Figure 6-9 Overview of the Modeling Approach

6.7.1 Changes to the General Model Sequence

To reduce the gap between strategic and operational planning, a series of pre-blocks for each FMU that would be harvested during the first 20 years of the planning horizon have been prepared. The objective was to integrate as many of these planned blocks as possible into the spatial harvest sequence. This objective was achieved using the pre-blocks that contain information about planned harvest areas and timing of planned activities.

However, the pre-blocks created infeasibility problems for most of the Woodstock runs and, in order to preserve them, a non-conventional approach was required to reach a feasible solution. Therefore, two slightly different approaches were developed for the TSA analysis and SHS formulation for the Weyerhaeuser Edson FMA area: *traditional* and *modified*. Both approaches are summarized below.

The *traditional* approach (Figure 6-10) for TSA modeling can be summarized as follows:

Initial TSA Run with a Subset of Pre-Blocks
↓
Stanley
↓
SHS Woodstock Playback

The *traditional* approach was only used in FMU E1 where a subset of all harvests was available for the first 20 years (four planning periods). An initial Woodstock solution including pre-blocks was generated that provided objectives for Stanley. In the final E1 SHS, Stanley incorporated all pre-blocks and added new harvest blocks for periods 1…12 (1 to 60 years) to meet the objectives.

The *modified* approach for TSA modeling was applied to E2, W5, and W6 and is described in Section 6.7.3. It is summarized as follows:

Initial TSA Run without Pre-Blocks
↓
Modified TSA Run with All Harvest Blocks (for the first 20 years)
↓
Stanley
↓
SHS Woodstock Playback

The *modified* Woodstock run was derived from the initial Woodstock run (no pre-blocks) and incorporated all harvests for the first 20 years. For this model most of the initial Woodstock run parameters remained unchanged except harvest level fluctuations and profile constraints.

The *modified* Woodstock solution was used to generate objectives for the Stanley run. The final SHS was derived from the 20 year pre-blocks and additional Stanley-generated harvest blocks for years 21 to 60.

Figure 6-10 summarizes the information flow for both approaches.

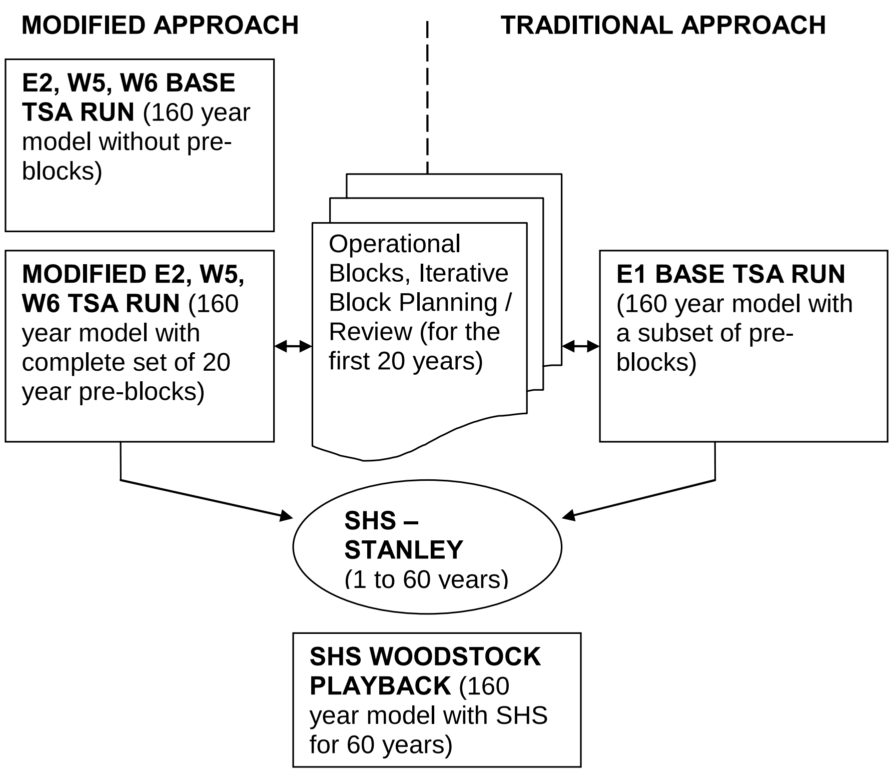


Figure 6-10 TSA Model Overview

6.7.2 Initial TSA Run

The Woodstock model was designed to achieve the maximum harvest volume within the objectives for operability and sustainability of both timber and non-timber resources. Yield relationships were applied to specific forest types (or yield strata) over a specified planning horizon. Harvest activities were applied to the forest based on specified objectives and parameters such as minimum harvest age, and minimum merchantable volume. Woodstock creates a matrix of the Linear Programming problem which is the collection of the objective and constraints, in consideration of the land base, yield curves, and other management protocols (refer to Section 6.12.1 for an overview of the modeling protocols). The linear optimization solver, MOSEK is used to solve the matrix, returning an optimized harvest schedule to Woodstock. Woodstock then uses this harvest schedule to calculate various outputs over the planning horizon. A list of outputs/indicators included in the analysis is presented in Table 6.8.

Table 6.8 Outputs / Indicators Modeled in Woodstock

Indicators / Outputs
Growing Stock
Operable Growing Stock
Age Class Structure
Volume Harvested
Average Harvest Age
Average Harvested Volume per Hectare
Late, Very Late, and Extremely Late Seral Stages
Area Harvested
Piece Size
Mortality

6.7.3 Modified TSA Run

For E2, W5, and W6, modified Woodstock runs were used. No modified Woodstock run for E1 was required. The purpose of the modified Woodstock run was to incorporate a pre-selected 20 year SHS into the base Woodstock run and obtain a feasible solution.

The solution from the modified Woodstock run was used as an objective for the harvest scheduling using Stanley (Section 6.7.4). The modified Woodstock run differed from the Base Woodstock run in the following ways:

- Excluded actions for periods 1…4 in lieu of pre-selected harvest blocks;
- Relaxed harvest fluctuation from strict even-flow to within the permissible range of fluctuation for the first 20 years (i.e., when pre-blocks will be used); and
- Relaxed operational constraints (e.g., coniferous and deciduous area requirements for various crown closures during periods 1 through 12).

All other parameters and input files remained unchanged.

6.7.4 Spatial Harvest Sequence Mapping

Harvest mapping ensured that forest/landscape pattern constraints were met over the first 60 years of the planning horizon and that green-up and adjacency requirements were met. Primary hardwood and softwood harvest objectives (softwood from conifer land base and hardwood from deciduous land base) were blocked simultaneously using Stanley. Spatial harvest scheduling was applied in a stepwise approach:

- All existing (prior to May 1, 2004) conifer and deciduous harvest blocks were identified. They were pre-blocked to ensure that green up delays in these blocks would be considered for subsequent blocks.
- Previously planned blocks were incorporated as pre-blocks into the harvest schedule. The majority of these were allocated into periods 1 and 2 however, a smaller number were scheduled into periods 3 and 4.
- The coniferous and deciduous land bases were blocked simultaneously, with the objective of maximizing the spatial allocation of the conifer and deciduous harvest level.

Stanley, the spatial harvest scheduling component of the suite, allocates the Woodstock schedule to specific polygons on the land base subject to spatial modeling parameters (refer to section 6.12.2 for a summary of the modeling protocols). Considering all of the pre-blocks created by the planning team, Stanley creates additional blocks in order to achieve the aspatial volumes generated in Woodstock. Following a period of time when there appears to be no “better” solutions created, the model is stopped and the spatial harvest sequence is written to the shapefile (a storage format for storing geometric location and associated attribute information). Maps of the areas scheduled for the 20 year Spatial Harvest Sequence were generated with Stanley. The map of expectations was repeatedly assessed and refined by the operations planning staff of Weyerhaeuser and the other timber operators to create a harvest design to be used operationally for the first 10 years and somewhat less for the following ten years (years 11 to 20). A map of the SHS is located in Appendix 6.6 of Volume II.

6.7.5 Final Long Term Runs (SHS Woodstock™ Playback)

The preferred spatial harvest schedule produced by Stanley was then incorporated into the long-term Woodstock run, providing a direct linkage between the operationally feasible spatial harvest schedule and long-term sustainability. The harvest schedule in periods 13 to 32 was re-optimized to account for adjustments made by Stanley in the first 12 periods of harvest and to incorporate these into the long-term harvest schedule. All modeling outputs displayed herein are based on this harvest schedule unless otherwise specified.

Woodstock is then used again to re-calculate the outputs based on the spatial harvest schedule developed using Stanley. This schedule considers both the operationally planned blocks (pre-blocks) as well as the Stanley generated openings. This tactical level sequence then becomes the "hard-wired" sequence for the tactical portion of the final Woodstock run. Woodstock is re-deployed to calculate the final (post spatial) values of the indicators defined in the model. To ensure additional blocks are not sequenced in the first tactical portion of the planning horizon the object is set to minimize volume. For the remainder of the planning horizon the objective is returned to the original setting.

Once the final outputs are calculated the aspatial reduction factors (cull and in-block retention) are applied to the estimated harvest volumes. These final numbers are the proposed sustainable harvest volumes for the FMUs.

6.8 Assumptions and Uncertainties

It is impossible to model all natural processes; however, to create realistic models, it is necessary to make certain key assumptions about natural forest processes. Many of these assumptions deal with the complexities of forest succession, stand modifying disturbances and forest growth rates. These are difficult to accurately predict (especially the timing, extent and severity of stand modifying events).

6.8.1 Succession Dynamics

As the planning horizon for the Woodstock™ model exceeds the lifespan of most tree species in FMA area, Woodstock™ requires rules by which complex changes over time in stand species composition and density can be modeled. This requires two main assumptions about how Woodstock™ will "grow" these stands from their present state to the end of their lifespan. The first assumption for stand dynamics is straightforward: stands are assumed to retain the same species composition until death/senescence. The second assumption is that as a stand dies or is harvested, it regenerates back to that same species composition and structure as it develops over time.

As regenerating stands develop within the model's planning horizon, these stands grow at the pace defined by the model's yield curves. These curves have been developed under natural forest conditions, without silvicultural intervention. Thus, this model grows the individual stands as they have previously grown, as indicated by the natural yield curve. It is important to model transition and have stands regenerate back to their previous condition, even for harvested areas, to reduce or eliminate the notion of stand conversion to other forest types. Stand conversion or alterations to regenerating yield curves is unreliable without supporting empirical evidence and for this area, empirical information of this nature is inadequate.

6.8.2 Natural Disturbance

One major assumption within the TSA was that the current volume losses due to the incidence of fire, insect and disease outbreaks are representative of future volume losses. Due to the large fluctuations in damage these disturbances cause and the unpredictability of the timing, location and the extent to which they will affect the land base, it is difficult to apply an accurate average deduction over the planning horizon. In addition, in many of these areas, the volume could be salvaged. In the event of a large scale impact (>= 2.5% of the harvestable land base) a re-calculation of the AAC is anticipated to occur. Stands lost to recent fire that have not regenerated, have been excluded from the harvestable land base until a time when a new inventory, update or survey can verify that they are producing forest species. As such this serves as a proxy aspatial deduction for fire on the land base.

6.9 Long Run Sustainable Yield

Long Run Sustainable Yield Calculation (LRSY) is the theoretical estimate of the yield attainable once a regulated state has been achieved and all stands are harvested at the point of a stand's maximum net-volume production (Mean Annual Increment (MAI) - culminating rotation age). The LRSY provides the theoretical maximum AAC that the forest can sustain. If the land base and yield information are accurate and the harvest and succession assumptions are reasonable, the model will provide a realistic estimate of the maximum sustainable AAC. Employing similar assumptions, the use of a more sophisticated model will not yield a sustainable AAC that is greater than the LRSY estimate, in theory, but should be more realistic.

The LRSYs are calculated by multiplying the initial net area in each broad cover group by the maximum, area weighted MAI for that cover group. The sum of all yield calculations for each land base is the LRSY derived AAC for the analysis area and is summarized in Table 6.9. The table shows the volumes summarized from the four individual FMUs. Since W5 has a different lower operability limit for CX and CD BCGs, the MAIs and MAI age are shown as averages across the FMUs. Details are provided in Appendix 6.9.

Table 6.9 Long Run Sustainable Yield

Timber Harvesting Landbase		FMA		Average MAI (m^3/ha/yr)			Volume (m^3/yr)		
	Broad Cover Group	Area (ha)	@Age	Conifer	Decid	Total	Conifer	Decid	Total
Deciduous	Deciduous	90,830	80.00	0.45	2.13	2.56	40,874	193,014	233,887
	Deciduous / Coniferous	16,329	80.00	0.93	1.51	2.44	15,104	24,698	39,802
	Coniferous / Deciduous	11,796	92.50	1.23	1.01	2.24	14,546	11,925	26,471
	Coniferous	702	92.50	1.78	0.49	2.27	1,255	343	1,597
	Sub-total	119,657					71,778	229,979	301,757
Coniferous	Coniferous	112,466	92.50	1.78	0.49	2.27	201,055	54,920	255,975
	Coniferous / Deciduous	32,918	92.50	1.23	1.01	2.24	40,487	33,183	73,670
	Deciduous / Coniferous	15,074	80.00	0.93	1.51	2.44	13,943	22,799	36,743
	Deciduous	0	80.00	0.45	2.13	2.56	0	0	0
	Sub-total	160,458					255,485	110,902	366,387
	Grand Total	280,115					327,263	340,881	668,144

6.10 Input Parameters

The nature and level of forest management practices for both timber and non-timber resources can have a significant impact on timber supply. These must be included in the analysis in such a way as to reflect actual management practices on both the individual FMU and FMA area.

The provision of information used to define current management practices involves virtually all stakeholders with the Edson DFMP, however timber supply analysis information is of particular relevance to operational and field staff with Weyerhaeuser in Edson, as well as the volume-based tenure holders in the Edson FMUs. Many meetings and discussions were required to articulate these inputs:

Silviculture practices: Reforestation activities required to establish free-growing stands of acceptable tree species. This includes the definition of the time it takes to establish seedlings in cut-over areas (the regeneration lag) for conifer, mixedwood, and deciduous cover types, and the expected levels of re-treatment. Regeneration involves some combination of site preparation, planting, and/or natural regeneration, depending on the specific requirements of each treatment area within a harvested area.

Forest health: It is reasonably well established that aspen and poplar decline rapidly in volume after a certain age as fungi and other wood decay organisms establish a presence. This age appears to be in the range of 100 to 120 years for aspen and black poplar. Yield curves for these species have incorporated a rate of loss of merchantable volume beyond this age range. As yield curves for other species are based on the volume sampling data, it is assumed that endemic levels of mortality due to insects and disease is captured in the estimates of volume.

Utilization levels: The utilization levels for coniferous and deciduous species are reflected in the yield curve volumes. They reflect the minimum tree sizes removed during harvesting. Yields are based on 15/11/15 coniferous utilization and 15/10/15 deciduous utilization. An alternate coniferous utilization was developed for some quota operators who harvested at an 15/10/15 (10cm top) utilization. 15/11/15 is the short form used to describe the utilization standard. It depicts the minimum diameter at breast height measured outside the bark (cm)/ minimum diameter of the top of the bole measured inside the bark (cm)/ stump height (cm).

Patch size distribution and green-up: The amount of area that can be harvested in a contiguous opening, or patch, as well as the amount of time that must pass until harvest of adjacent patches is specified. This time is determined by the estimate of the average time it takes for a regenerating stand to reach a certain average height. The size and distribution of patches or harvest openings is determined by a combination of factors such as the history of natural disturbance and wildlife habitat objectives, and the amount and distribution of within-block retention. All openings harvested on the FMA are expected to have some level of within-block retention that will be reserved from harvest for at least one rotation (approximately 80 years).

Maintenance of late, very late and extremely late seral forest: Representation of all forest cover types across a range of age and seral stages is necessary to address wildlife habitat objectives. Constraints are placed on minimum amounts of older forest that must be maintained over the planning horizon. Older forest is also represented within harvest openings through what is known as "within-block retention". Patches of mature trees are left to retain some older forest structure within harvested areas. Depending on the size of these retention patches, they may or not be mapped as distinct from the surrounding harvested area. In general, the smaller the patch, the less likely it will be that it is mapped as a distinct polygon. This may make within-block retention of mature forest difficult to track over time from an area perspective. In terms of the timber supply analysis, it is accounted for with an average percent reduction in the projected harvest volume.

Minimum harvestable ages: The minimum harvest age is the time it takes for a stand to grow to a merchantable condition. The actual harvest age of any stand may be greater than but not less than the minimum.

6.11 Model Structure

The analysis was conducted using five-year modeling periods with planning horizons of twice the expected rotation age. The overview of the modeling structure is listed in Table 6.10.

Table 6.10 Overview of the Forest Model Structure

	Basic Forest Modeling Principles	Description	WOODSTOCK™/STANLEY ™ STRUCTURE (Input files: []=WK, {}=STAN)
	Landbase Description	Netdown/Stratification	[AREAS] [LANDSCAPE]
	Development Patterns	m^3/ha	[YIELDS]
Treatments	Types	Harvesting Activity	[ACTIONS]
Treatments	Eligibility	Operability Windows	[ACTIONS] [LIFESPANS]
Treatments	Responses	Succession	[TRANSITIONS]
	Resource Indicators	Growing Stock	[OUTPUTS] [REPORTS] [GRAPHICS]
	Model Control	Planning Horizon	[CONTROL], [GRAPHICS] [OPTIMIZATION]
	Integration of Existing Plans	Cut Blocks / 5yr Plan	{SHAPEFILE}, [LPSCHEDULE]
	Spatial Constraints	Block Size / Green-up	{PARAMETERS}, {AREAS}

6.12 Summary of Model Variables

6.12.1 Woodstock™

A wide variety of input parameters and management assumptions must be specified prior to projecting harvest schedules with Woodstock. These are specified in order to reflect both the biological processes of the forest, as well as the current realities of operational forest management practices.

6.12.1.1 Effective Date

May 1st, 2004 was selected as the effective date. May 1st is the beginning of the timber operating and production tracking year. The start date is defined as the point in time that best reflects the forest attributes at the beginning of the TSA model. Therefore, every reasonable attempt was made to have all input data sets consistent with May 1st, 2004.

6.12.1.2 Strategic Level Planning Horizon and Period Length

The planning horizon used in this analysis was 160 years or 32 periods. The period length was set as five years.

6.12.1.3 Objective and Strategic Level Sustainability Criteria

The primary objective of the forecasting model was to maximize the total primary volume harvested over planning horizon. The timber supply objective is to maximize the sum of coniferous and deciduous primary harvest volumes (conifer volume from the conifer land base and deciduous volume from the deciduous land base) over the next 160 years.

Constraints have been incorporated into the model to ensure that the level of forest management is sustainable over time. One measure constrained was flow tolerance. The goal for primary volumes for each FMU was even flow volume over the entire planning horizon of 160 years with an allowable fluctuation of +/- 5%. Similarly, the goal for incidental volumes (deciduous volume from the coniferous land base and coniferous volume from the deciduous land base) for each FMU was even flow volume over the entire planning horizon of 160 years with an allowable fluctuation of +/- 10%.

Other sustainability constraints incorporated into the model included:

- Total harvestable growing stock on both the coniferous land base and deciduous land base will not decrease over the last 40 years (8 periods) of the planning horizon;
- In FMU E1, at least 320,000 m^3 of coniferous volume from pure CX and CD stands will be obtained from the Erith and Rodney Creek HDAs;
- LMUs will be utilized for controlling conifer primary harvest volume flows to facilitate embedded quota holders and their historic operating areas. In W6, the primary conifer harvest volumes will be constrained as follows:
    - Carrot River >= 19%; *Carrot River LMU (includes HDAs: Tower, Nine Mile, North Rat Creek, and North Minnow (note: Minnow North is open in period three));*
        - Operators: Blue Ridge, Millar Western
    - Cynthia >= 36%; *Cynthia LMU (includes HDAs: Granada, Nojack South, Chip Lake, Bigoray, Sinkhole, Eta Lake, and Paddy Creek)*
        - Operators: CCTL, MTU, Weyerhaeuser
    - Wolf Lake >= 42%; *Wolf Lake LMU (includes HDAs: Big Rock, Coyote Creek, North Pembina, Zeta Lake, South Rat Creek, and South Minnow (note: South Minnow is open in period 3))*
        - Operators: ANC
- Various Harvest Design Areas aggregated for preferred timing during sequence.

6.12.1.4 Seral Stages

Another sustainability measure implemented by Weyerhaeuser is the maintenance of various seral stages over time. A more detailed description of seral stages is located in Section 3.1.9.4 and 8.2.3. A range of late, very late, and extremely late seral stages in the main yield strata – DX, DC, CD, Sw , Pl, Sb was maintained. Due to the number of seral constraints the model initially had a very difficult time processing. It was determined that aggregations of cover types could be made without removing any integrity of the constraints or the amount of older seral stages in the future.

Table 6.11 Seral Stage Constraints

FMU	Natural Sub-region	Old Growth Broad Cover Group Category	Minimum Area that Must Be Late Seral Stage or Older	Minimum Area that Must Be Very Late Seral Stage or Older	Minimum Area that Must Be Over-mature Seral Stage or Older
E1	LF	CD	559	112	0
		Other Pure CX	2,398	480	0
		DC	282	56	0
		DX	351	70	0
		Pure CX Pine Leading	1,105	221	0
		Pure CX Pine/White Spruce Mix	188	38	0
		Pure CX White Spruce Leading	301	60	0
	UF	CD	3	1	0
		Other Pure CX	10	5	3
		DC	3	1	0
		DX	4	2	0
		Pure CX Pine Leading	2	1	1
		Pure CX Pine/White Spruce Mix	3	1	1
		Pure CX White Spruce Leading	1	0	0
E2	LF	CD	460	92	0
		Other Pure CX	1,583	317	0
		DC	387	77	0
		DX	1,594	319	0
		Pure CX Pine Leading	291	58	0
		Pure CX Pine/White Spruce Mix	117	23	0
		Pure CX White Spruce Leading	231	46	0
	UF	CD	98	39	0
		Other Pure CX	165	83	41
		DC	103	41	0
		DX	124	50	0
		Pure CX Pine Leading	76	38	19
		Pure CX Pine/White Spruce Mix	62	31	16
		Pure CX White Spruce Leading	74	25	12

FMU	Natural Sub-region	Old Growth Broad Cover Group Category	Minimum Area that Must Be Late Seral Stage or Older	Minimum Area that Must Be Very Late Seral Stage or Older	Minimum Area that Must Be Over-mature Seral Stage or Older
W5	LF	CD	273	55	0
		Other Pure CX	959	192	0
		DC	220	44	0
		DX	922	184	0
		Pure CX Pine Leading	188	38	0
		Pure CX Pine/White Spruce Mix	35	7	0
		Pure CX White Spruce Leading	167	33	0
W6	LF	CD	1,020	204	0
		Other Pure CX	3,810	762	0
		DC	725	145	0
		DX	2,007	401	0
		Pure CX Pine Leading	1,234	247	0
		Pure CX Pine/White Spruce Mix	217	43	0
		Pure CX White Spruce Leading	1,259	252	0
	UF	CD	49	20	0
		Other Pure CX	908	454	227
		DC	17	7	0
		DX	31	13	0
		Pure CX Pine Leading	87	43	22
		Pure CX Pine/White Spruce Mix	12	6	3
		Pure CX White Spruce Leading	31	10	5

6.12.1.5 Profile Constraints

To promote sustainability, constraints were used in the model to ensure that there were no significant unforeseen modeling biases toward any strata types. Prior to the inclusion of these controls, operational problems were observed relating to disproportionately high amounts of low density (CC='A') stand areas being scheduled for harvest. When unconstrained, the model was attempting to take maximum benefit from moving understocked stands to fully-stocked status as soon as possible.

To avoid this problem, crown closure and site class were identified as the two selection factors which most strongly influence the volume obtained from a stand. In the TSA each FMU is identified as a sustained yield unit and the area by crown closure class and site class were estimated for each unit. The goal was to identify a range of areas for each class that allowed for flexibility in the model yet ensured that most harvest strata types are harvested in some proportion to its distribution within the operable land base. Therefore, the goal harvest range for each site and crown closure class was to harvest between +50% or –50% of the proportional harvest area based on the rotation age (Table 6.12, and Table 6.13). For easier implementation into the model, the ranges were reported for each five-year period.

Table 6.12 Proportional Five-Year Operational Harvest Area Target by Site Class

FMU	Land Base	Site	Lower 50% Harvest Range (ha)	Upper 50% Harvest Range (ha)
E1	CON	G	517	1,550
		M	552	1,657
		P	91	272
	DEC	G	501	1,504
		M	27	80
		P	5	16
E2	CON	G	450	1,351
		M	171	512
		P	32	96
	DEC	G	1,396	4,189
		M	43	128
		P	8	24
W5	CON	G	244	733
		M	96	288
		P	43	128
	DEC	G	540	1,621
		P	2	6
W6	CON	G	1,711	5,132
		M	812	2,437
		P	200	599
	DEC	G	1,213	3,638
		P	4	13

Table 6.13 Proportional Five-Year Operational Harvest Area Target by Crown Closure Class

FMU	Land base	AVI Crown Closure	Lower 50% Harvest Range (ha)	Upper 50% Harvest Range (ha)
E1	CON	A	172	515
		B	192	577
		C	523	1,570
		D	272	817
	DEC	A	44	131
		B	96	288
		C	318	954
		D	75	226
E2	CON	A	119	357
		B	148	444
		C	293	879
		D	93	279
	DEC	A	94	282
		B	280	839
		C	909	2,728
		D	164	493
W5	CON	A	139	418
		B	50	150
		C	169	508
		D	24	73
	DEC	A	45	136
		B	93	280
		C	285	854
		D	119	356
W6	CON	A	398	1,193
		B	541	1,624
		C	1,659	4,976
		D	125	376
	DEC	A	37	112
		B	163	490
		C	891	2,673
		D	125	376

6.12.1.6 Periodic and Quadrant Reconciliation Volumes

With May 1st, 2004 being used as the effective date for the TSA process, some reconciliation of pre- May 1st, 2004 production levels occurred. This allowed the model to approximate the impact of these additional (or reduced) volumes on the long-term sustainability to the timber supply. Table 6.14 provides the estimated net volumes for each timber operator within individual FMUs. Actual audited numbers for over/under production will occur post-DFMP, and will likely deviate somewhat from the estimates provided in the tables below.

Table 6.14 Net Quadrant Reconciliation Volume Applied to Period 1

Species	Operator*	Net Volume (m^3)			
		E1	*E2*	*W5*	*W6*
Coniferous	Weyerhaeuser	404	8,388		-28,698
	MTU		-702	7,138	25,872
	ETP	-7,932			
	EDFOR		-26,426		
	CCTL				14,175
	ANC				219,520
	Blue Ridge				23,111
	Millar Western				5,978
	Total	-7,528	-18,740	7,138	259,958
Deciduous	Weyerhaeuser	66,956	59,610	-7,259	234,569
	MTU				30,006
	ETP				
	EDFOR				
	CCTL				
	ANC				
	Blue Ridge				
	Millar Western				
	Total	66,956	59,610	-7,259	264,575

* ETP - Edson Timber Products, MTU - Miscellaneous Timber Unit, CCTL - Cold Creek Timber Ltd, ANC - Alberta Newsprint Company

The timber supply models, however, used gross reconciliation volumes which were obtained from net volumes and adjusted for cull and stand retention. Details on the relationship between net and gross reconciliation volumes are described in Appendix 6.5, Section 3.5.

For operational reasons, harvest of all the first period blocks in the SHS may not be completed by the end of the first period. If this is the case, any un-harvested first period blocks will be harvested with the remainder of the second period blocks.

6.12.1.7 Treatment Types

The stand-level treatments are described in Table 6.15. Treatment responses were based on clear-cut harvest treatment; a constant aspatial, reduction factor was removed from the calculated AAC in the end to account for residual, in cut-block stand structure retention. Within the model, this action was referred to as a “HARVEST” action. In the model, “DEATH/SENESCENCE” is a treatment that models the natural break-up of a stratum at the end of its life span. This function is required by Woodstock™ as not all the merchantable timber volume can be harvested before it reaches a defined senescence age. Senescence for the deciduous land base was defined as 180 years;

senescence for coniferous the coniferous land base is 300 years. Table 6.16 outlines the lifespan used in this plan.

Table 6.15 Stand Level Treatments

Treatments	Description	Purpose
Death / Senescence	Removal of all merchantable stems through natural break-up	(a) Mimicking natural stand break-up
Clearcut Harvest	Removal of all merchantable stems of all species, followed by reforestation	(a) Even-aged management (b) Timber extraction

Table 6.16 Lifespan for Broad Cover Groups

BCG	Lifespan (years)
Deciduous	180
DC Mixedwood	180
CD Mixedwood	300
Coniferous	300

6.12.1.8 Treatment Eligibility

Operability ages were used to define a “window” when a stratum meets the minimum age requirement for harvest. Lower operability limits were defined for each land base type based on various components such as tree growth, volume, product sizes, harvesting practices and systems. The operability ages for the land base groups to be harvested by Weyerhaeuser are specific to FMUs as follows:

Coniferous dominated stands (CX and CD)

- E1 and E2: 80 years for entire planning horizon
  Rationale: most stands approaching max MAI (most coniferous dominated yield curves reach max MAI around 90)
- W5: 100 years 1st Rotation, 80 years 2nd Rotation
  Rationale: in negotiation with the MTU group 100 years was selected to ensure the oldest of the coniferous dominated stands were harvested first.
- W6: 80 years 1st Rotation, 70 years 2nd Rotation
  Rationale: 70 was selected based upon the direction provided from Alberta SRD.

Deciduous (D and DC stands)

- Entire FMA: 1st Rot 80 years, 2nd Rot – 60 years
  Rationale: there were concerns that the older deciduous stands must be sequenced first therefore 80 years was selected for the first rotation (most deciduous dominated yield curves reach max MAI around 70). A second

rotation of 60 was selected because most stands are approaching max MAI.

The rationale for the decrease in minimum harvest age for second rotation is based on two points:

- The density of regenerating stands allows for an earlier culmination age of Max MAI; and
- Considering improvements in piece size utilization that has occurred over the last 50 to 80 years it is reasonable to expect the trend for improvement to continue on in the future. The actual volumes that will be achieved for these second rotation stands is a very conservative estimate because the volumes assigned will still be based on the same utilization standards for the first rotation.

There were no upper operability limits for timber harvest eligibility in the timber supply model.

6.12.1.9 Transition Development Patterns (Responses)

The development patterns implemented in this model reflect those of basic transitions. Stands that are harvested are assumed for the purposes of modeling to regenerate to the fully-stocked pre-treatment stratum and are assigned an age of zero. Thus, 'A', 'B', 'C', or 'D' density strata are assumed, within the model, to regenerate back to "C" density strata. Transitions in strata are supported with firm commitments to conduct the necessary silviculture treatments to provide sufficient assurance that the transitions proposed are practical and reasonable.

Stands that are not harvested are subject to a mortality function. Stands that are on the harvestable land base and are removed through death/senescence are assumed for the purposes of modeling to return to the pre-treatment stratum (including density) and are assigned an age of zero. Stands that are within the non-harvestable forested areas (e.g. buffers), break-up and return to the same yield curve at 170 years of age.

6.12.1.10 Regeneration Lag

Regeneration lag is the time (number of growing seasons, expressed in years) following harvest required for a new stand of trees to initiate growth as compared to the natural yield curve. The regeneration lag is equivalent to the time a harvested area remains fallow without regenerating trees. The regeneration lag assessment used the timing of historical reforestation activities and the regeneration survey status as the basis for establishing the regeneration lag assumed in the timber supply analysis (TSA). Additional detail regarding the determination of regeneration lags is located in Appendix 6.10. Table 6.17 documents the regeneration lags used in this plan.

As the harvest projection output is recorded in five-year time periods, this was implemented such that a calculated regeneration lag value of 2.3 years would have 42%

(2.1 yrs / 5 yr period) of the area (ha) delayed one five-year period and 58% of blocks regenerate with no delay. This is represented in the transition rules.

Table 6.17 Regeneration Lag for Broad Cover Groups

BCG	Lag (years)
Deciduous	0.4
DC Mixedwood	2.1
CD Mixedwood	3.1
Coniferous	1.7

6.12.2 Stanley

6.12.2.1 Blocking and Sequencing Parameters Analysis

The blocking analysis explored the sensitivity of baseline spatial constraints to wood supply. These baseline parameters are described throughout this section and are summarized in Table 6.18.

Table 6.18 Summary of Input Parameters and Assumptions Required for Stanley

Parameter / Criteria	Value
Spatial Planning Horizon	60 years (12 periods)
Green-up Delays	First 20 years (4 periods) CX 20 years (3 periods) CD, DC, DX 15 years (2 periods) Last 40 years (periods 5 to 12) CX 15 years (2 periods) CD, DC, DX 10 years (1 period)
Minimum Block Size	2 ha
Maximum Block Size	None
Target Block Size	100 ha
Adjacency Distance	55 m
Proximity Distance	21 m
Timing Deviations	4 periods (20 years)
Spatial Flow Tolerance	Primary Flows 5%, Incidental Flows 10% difference between max & min
Objectives and Weights	Primary Volumes: *fmu*CON5YR: Primary Coniferous Volume – Weight = 3 fmuDEC5YR: Primary Deciduous Volume – Weight = 3 (3.5 in FMU E1 and E2) Incidental Volumes: *fmu*CONIN5YR: Primary Coniferous Volume – Weight = 1 fmuDECIN5YR: Primary Deciduous Volume – Weight = 1
Allow multi-period openings	Yes

For FMU E1 no green up constraints were used, instead the stand structure retention was increased to 8%.

The analysis was based on a standard blocking approach developed to address multiple objectives across multiple geographic areas. The following sections describe the blocking approach and present the results of the analysis for each of the critical and blocking parameters.

6.12.2.2 General

The planning horizon was twelve five-year periods, or 60 years from the model start date. Separate runs were made for each FMU. The objective was to block the primary conifer and primary deciduous volumes. Advancements in the RSPS now permit different rule sets to be modeled simultaneously. The spatial sequencing allowed Weyerhaeuser to model both the coniferous and deciduous blocks at the same time while applying different green-up constraints.

6.12.2.3 Adjacency Distances (Distance between same stratum blocks)

Adjacency describes the ways that polygons are spatially related to other polygons in the forest. Within the Stanley™ environment, adjacent polygons can be, and are, combined to form harvest blocks. This adjacency value dictates the maximum distance between polygons that Stanley™ would be allowed to group into a harvest block. The adjacency distance assigned for the constraint was 55 meters. The distance selected will allow polygons to be grouped into blocks that are separated by relatively narrow non-eligible features such as seismic lines, trails or other narrow linear features, but will prevent the grouping of polygons separated by landscape features that would, in reality, prohibit the harvest of the group as a single unit. In past analyses, the percentage harvest achieved was relatively insensitive to modifications to adjacency distances, as many non-eligible features are too narrow to be captured as individual polygons within the inventory. As a result, these features do not often act as block boundaries, whereas a 55-meter separation would usually denote a watercourse or a large right-of-way that would preclude these polygons from being grouped.

The adjacency distance is the maximum distance between stands that allows Stanley to combine the stands as one harvest opening. The greater the adjacency distance, the further away stands can be combined to form harvest openings. Any stand that is as close as or closer than the adjacency distance away from another stand can be included in a harvest opening, or block, provided other relevant criteria are met.

6.12.2.4 Minimum and Maximum Block Sizes

Minimum block size is a constraint within the Stanley™ modeling environment that sets the minimum acceptable harvest block size created using the adjacency distance. Single-polygon or composite-polygon blocks that are smaller than the minimum are identified as impossible area and become isolated stands.

The minimum block size can have significant effects on the spatial harvest levels; the larger the minimum block size, the greater the negative impact on the spatial harvest level. A size of two hectares was selected as the minimum block size for this analysis. Block sizes of less than two hectares are not operationally feasible. Conversely, setting the minimum block standards at some higher area, e.g. ten hectares may remove a large portion of productive land base and consequently constrain the Stanley™ model.

No maximum block size was used.

6.12.2.5 Target Block Sizes

The target block size parameter establishes the desired block size. It is very useful if the average block size differs greatly from the desired block size. Various scenarios were analyzed and due to the fragmented nature of the land base it was very difficult to create average disturbance patches in the vicinity of the desired patch sizes. The target block size was eventually raised to 100 ha. This meant the model would attempt to aggregate polygons until the patch was close to 100 ha in size.

6.12.2.6 Proximal Distances (Green-up distance between blocks)

Spatial blocking within the Stanley™ environment requires a value to represent the proximal distance (zero to some arbitrary maximum) within which Stanley™ would be allowed to place harvest blocks that have not achieved green-up. In this case, proximity represents how close each created opening can be to another (either existing, planned or both).

Once Stanley™ assigns a block to a harvest period; proximal stands will not be scheduled until the regenerating trees within the harvested area have achieved green-up. In the absence of a proximal distance, Stanley™ could place blocks as close together as the adjacent distance without causing a violation. However, under most management strategies this may be inappropriate; thus, by setting the proximal distance greater than or equal to the desired width of exclusion zones, Stanley™ will separate the proposed blocks by at least this amount within the green-up interval (Remsoft, 1999).

Results achieved in past analyses indicate that proposed harvest levels have been relatively insensitive to a changing proximal distance up to 60 meters, after which achievement of proposed aspatial harvest levels have decreased noticeably. Thus, in this analysis a proximal distance of 21 meters was selected. Two stands separated by a buffered small permanent stream (60 m width) would not be in violation of green-up.

Proximal distance defines the minimum distance that a stand must be away from another stand in order that the two stands as part of separate blocks can be scheduled for harvest in the same period.

6.12.2.7 Timing Deviation

The maximum timing deviation sets the maximum number of periods that harvest scheduling can deviate from the aspatial timings. The Stanley modeling process attempts to assign treatments to polygons such that deviations from the optimal timings outlined in the strategic schedule are minimized. However, it may be necessary to advance or delay activities to facilitate block allocation. A higher setting allows for greater flexibility in the allocation process at the expense of a greater divergence from the goals and objectives reconciled in the strategic schedule (Remsoft, 1999).

As discussed above, a maximum deviation of zero was used in some areas in the first three periods of the spatial planning horizon to ensure that operational objectives set up in Woodstock were not compromised by Stanley. The remainder of the spatial analysis used a maximum deviation of four periods.

Past analyses have shown that percentage harvest, especially for conifer land base, is highly sensitive to a changing maximum timing deviation. This stands to reason as the timing deviation allows for increased flexibility for the model to allocate the aspatial harvest level over a number of periods.

Stanley assigns treatments to polygons such that deviations from the scheduled timing in Woodstock are minimized. It may be necessary to advance or delay the timing of a scheduled activity. The periodic deviation parameter specifies the maximum number of periods away from the optimal schedule the activity can be blocked. For all runs this was set to four periods, or 20 years. The rationale for this is that all the forest is initially quite old, and this allows for greater flexibility in scheduling harvest.

6.12.3 Aspatial Post-Modeling Harvest Level Reductions

6.12.3.1 Stand Structure Retention

The volumes in this analysis were compiled using a flat rate volume reduction to account for the retention of merchantable volume left standing. A flat-rate volume reduction of 3% in FMUs E2, W5 and W6 and 8% in E1 was deducted from the AAC volume to account for in-block retention. This reduction rate was done as a flat-rate aspatial deduction. Refer to Table 6.19 for the quantitative reduction factors.

6.12.3.2 Cull Deductions

Cull deductions are applied as a method of accounting for non-merchantable volume loss due to defect, substandard and/or marginal quality of the harvested trees. In this analysis the cull deductions were removed as an aspatial deduction to the calculated harvest level and were removed after the stand structure retention was deducted. Refer to Table 6.19 for the quantitative reduction factors.

Table 6.19 Aspatial Post-Modeling Harvest Level Reductions

FMU	Cull Reduction %		Stand Structure Retention %		Total Reduction %	
	Coniferous	Deciduous	Coniferous	Deciduous	Coniferous	Deciduous
E1	3	7	8	8	11	15
E2	3	7	3	3	6	10
W5	3	7	3	3	6	10
W6	3	7	3	3	6	10

6.13 Exploring Trade-offs and Sensitivities

As part of any timber supply analysis it is important to understand how sensitive certain parameters are and the impacts they bear. A number of sensitivity runs were carried out to understand the impacts of certain aspects (6.13.1) as well as the quantification of grazing areas on the FMA (6.13.2). Additional details regarding both of these additional analyses are located in Appendix 6.7.

6.13.1 Sensitivity Analysis

Additional timber supply analysis was conducted to assess the sensitivity of the AAC to the following scenarios:

1. Spatial harvest sequence removed;
2. First period carry over volume removed;
3. Old forest constraints removed;
4. Profile constraints removed;
5. Harvest Design Area (HDA) access constraints removed;
6. Surge cut removed (FMU W6 only); and
7. Harvest Timing for Blocks in Periods One to Four of the SHS.

For this sensitivity analysis, the aspatial Woodstock model developed to generate the spatial harvest sequence and the PFMS was used as the base model. For FMU E1, a base case was developed by removing the planned blocks from periods 1-4; this provided a consistent approach for all FMUs with no pre-blocking. Scenarios one to five and seven were assessed for all four FMUs. Scenario six was assessed for FMU W6 only.

An additional series of sensitivity runs was conducted to assess the impact of changing the timing of harvesting blocks in periods one to four of the SHS. For this portion of the sensitivity analysis, the preferred forest management scenario that includes the LP schedule generated by Stanley was used as the base case. The biggest AAC impact has been identified for primary deciduous volumes in FMU E1 (Volume II Appendix 6.7 Table 7).

Over all, the Edson FMA AAC is most sensitive to the introduction of spatial constraints, as seen in the scenario examining the impact of the spatial harvest sequence. The AAC is relatively insensitive to all the scenarios examined. Removing the HDA access constraints made the greatest impact on AAC; it resulted in a 1.3% increase for deciduous AAC. Summary of FMA level impacts on AAC (except harvest timing for blocks) is provided in Table 6.20.

Table 6.20 Summary of FMA Level Impacts on AAC of Sensitivity Analysis Runs

Scenario	Total FMA					
	primary conifer	% change	primary deciduous	% change	total primary	% change
Base	301,018	0.0%	267,371	0.0%	568,389	0.0%
Impact of spatial sequence	300,017	-0.3%	260,592	-2.5%	560,609	-1.4%
Remove carry over volume	301,140	0.0%	268,758	0.5%	569,897	0.3%
Remove profile constraints	301,913	0.3%	267,538	0.1%	569,451	0.2%
Remove old growth constraints	300,943	0.0%	268,814	0.5%	569,758	0.2%
Remove HDA access constraints	300,031	-0.3%	267,206	-0.1%	567,237	-0.2%
Remove surge cut[1]	301,984	0.3%	268,593	0.5%	570,578	0.4%

1 – Surge cut was applied only in FMU W6.

Following an approval of SHS, Weyerhaeuser expects to treat period one and two blocks as a pool of blocks to be harvested in the first 10 years, and period three and four blocks as a pool of blocks to be harvested in the second ten years. The LP schedule generated by Stanley was modified to assess the potential impact of this practice. Strata scheduled for period one harvest were assigned to period two, and ages were adjusted upward by one period. Period two strata were assigned to period one and age was adjusted down by one period. The same swap was done for periods three and four.

AACs presented in Table 6.21 are the average harvest levels for periods 13 to 32. Only these periods were assessed, as earlier periods are controlled by the LP schedule and the intent of the scenario is to assess the impact on long-term sustainability.

Table 6.21 AAC impact of changing timing of harvest for blocks in the first four periods of the spatial harvest sequence

Scenario	FMU Primary AAC (m^3)								Total FMA	
	E1		E2		W5		W6			
	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduou
PFMS	72,382	25,527	41,844	89,169	23,336	41,533	152,821	92,611	290,383	248,841
Switched periods	72,406	22,228	41,859	89,148	23,371	41,534	152,765	92,368	290,401	245,278
Difference	-24	3,300	-15	21	-35	-1	56	243	-18	3,562
% difference	0.0%	12.9%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.3%	0.0%	1.4%

While the biggest AAC impact has been identified in FMU E1, the overall FMA impact is only 1.4%.

6.13.2 Grazing

The final, aspatial Woodstock models that were used to develop the spatial harvest sequence and the PFMS, were used to determine the grazing disposition AAC levels. Two separate models were run; one with harvesting only occurring on the grazing disposition areas, the second with harvesting only on areas outside grazing dispositions. This was intended to determine the sustainable even flow harvest level inside the grazing area and to determine the impact on gross AAC of requiring even flow within the grazing dispositions. These two scenarios were run for each FMU.

For the first model, the actions were modified to restrict harvesting to grazing areas. Flow constraints were maintained as in the original aspatial model, but carry over and surge volumes (for FMU W6) were removed. The definition of growing stock was changed in the outputs file so that growing stock included only the grazing areas. Profile constraints were turned off. For FMU E1, old growth and growing stock constraints had to be turned off to achieve a feasible solution. FMUs W5 and W6, an optimal solution was found when only the profile constraints were removed. In FMU E2, the old growth constraints were also turned off before an optimal solution was found.

With the exception of W6, the Gross AAC for each FMU was calculated as the sustainable, even-flow harvest levels starting in period two. Period one was excluded because it includes carryover volume. W6 has a coniferous surge cut for the first four periods and a carry over volume for deciduous and conifer in the first period.

Due to the changes and updates to the Woodstock models that were used to develop the SHS and the PFMS, direct comparisons between calculated PFMS and grazing sensitivity analysis AACs cannot be made.

Table 6.22 provides overview harvest level (primary and incidental combined) summary within grazing areas.

Table 6.22 Gross Harvest Levels within Grazing Areas for the FMUs

	E1		E2		W5		W6	
	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous
Primary								
Grazing Area AAC	44	45	2,873	12,575	3,495	12,614	1,002	3,194
Non-grazing Area AAC	74,839	28,466	40,357	83,223	20,444	28,816	157,401	93,484
Gross AAC	74,883	28,511	43,230	95,798	23,939	41,430	158,404	96,679
Incidental								
Grazing Area AAC	16	6	4,627	664	2,470	2,366	708	608
Non-grazing Area AAC	18,354	14,896	35,066	8,854	5,994	9,244	21,891	60,085
Gross AAC	18,370	14,903	39,693	9,518	8,464	11,609	22,599	60,693
Total *								
Grazing Area AAC	60	51	7,500	13,239	5,965	14,979	1,710	3,802
Non-grazing Area AAC	93,194	43,363	75,423	92,076	26,438	38,060	179,293	153,570
Gross AAC	93,253	43,414	82,923	105,316	32,403	53,039	181,003	157,372
% AAC on Grazing Areas	0.1%	0.1%	9.0%	12.6%	18.4%	28.2%	0.9%	2.4%

* No direct comparison to PFMS can be made

At the FMA level, the grazing disposition AAC is 3.9% of the total for coniferous and 8.9% for deciduous (Table 6.23).

Table 6.23 Gross Harvest Levels within Grazing Areas for the FMA Area

	FMA		
	Conifer	Deciduous	Total
Primary			
Grazing Area AAC	7,414	28,428	35,842
Non-grazing Area AAC	293,042	233,989	527,031
Gross AAC	300,456	262,417	562,874
Incidental			
Grazing Area AAC	7,820	3,643	11,464
Non-grazing Area AAC	81,306	93,079	174,385
Gross AAC	89,126	96,723	185,849
Total *			
Grazing Area AAC	15,234	32,072	47,306
Non-grazing Area AAC	374,348	327,068	701,416
Gross AAC	389,582	359,140	748,722
% AAC on Grazing Areas	3.9%	8.9%	6.3%

* No direct comparison to PFMS can be made

6.14 Preferred Management Strategy

6.14.1 Management Objectives and Model Constraints

Following consultation with other timber operators and SRD and various sensitivity analyses, a preferred scenario that best represented the collective goals and objectives was modeled to estimate sustainable harvest levels for the FMA. This scenario was constructed to observe non-declining yields on the operable growing stock as a sustainability constraint. This will ensure the model does not liquidate volume at the close of the planning horizon but instead will ensure forest timber volume will be present beyond the conclusion of the planning horizon. Additional components of the management strategy modeled by this scenario include:

- Maximization of primary deciduous and coniferous volume;
- An operationally base Spatial Harvest Sequence, including maintaining quota volumes within targeted geographic areas;
- Maintenance of older seral stages;
- Adequate average blocks size;
- Minimum block size of 2 ha; and
- Harvesting across the profile.

The harvest sequence selected provides a flexible operationally based scenario that allows Weyerhaeuser and the embedded quota holders to harvest volume from FMA economically and sustainably. A portion of the blocks in the 20 year spatial harvest sequence were manually planned by the Weyerhaeuser planning team in Edson and some of the other timber operators (mainly BRL and ANC) within the FMA. This increases the expected congruency between the Spatial Harvest Sequence and the operational harvesting activities.

6.14.2 Harvest Levels and Resulting Forest Conditions

The volumes that the company has calculated as the proposed net sustainable harvest levels are provided in Table 6.24. Figure 6.11 through Figure 6.14 show the pattern of harvest flows in each of the FMUs over the planning horizon.

Table 6.24 Proposed Harvest Levels

FMU	Coniferous Landbase			
	2004 to 2013 (periods 1 and 2)		2014 to 2023 (periods 3 and 4)	
	Primary Coniferous	Incidental Deciduous	Primary Coniferous	Incidental Deciduous
E1	65,295	11,733	65,295	12,289
E2	39,845	6,871	39,845	9,122
W5	22,116	11,324	22,116	10,855
W6	159,992	61,146	159,992	54,434
FMA	287,248	91,074	287,248	86,701

FMU	Deciduous Landbase			
	2004 to 2013 (periods 1 and 2)		2014 to 2023 (periods 3 and 4)	
	Primary Deciduous	Incidental Coniferous	Primary Deciduous	Incidental Coniferous
E1	22,140	24,563	22,140	15,810
E2	82,230	38,018	82,230	36,759
W5	38,107	7,878	38,107	8,215
W6	83,889	26,656	83,889	20,803
FMA	226,366	97,116	226,366	81,587

* Cull: 3% for coniferous; 7% for deciduous
Stand retention: 3% for E2, W5, W6; 8% for E1

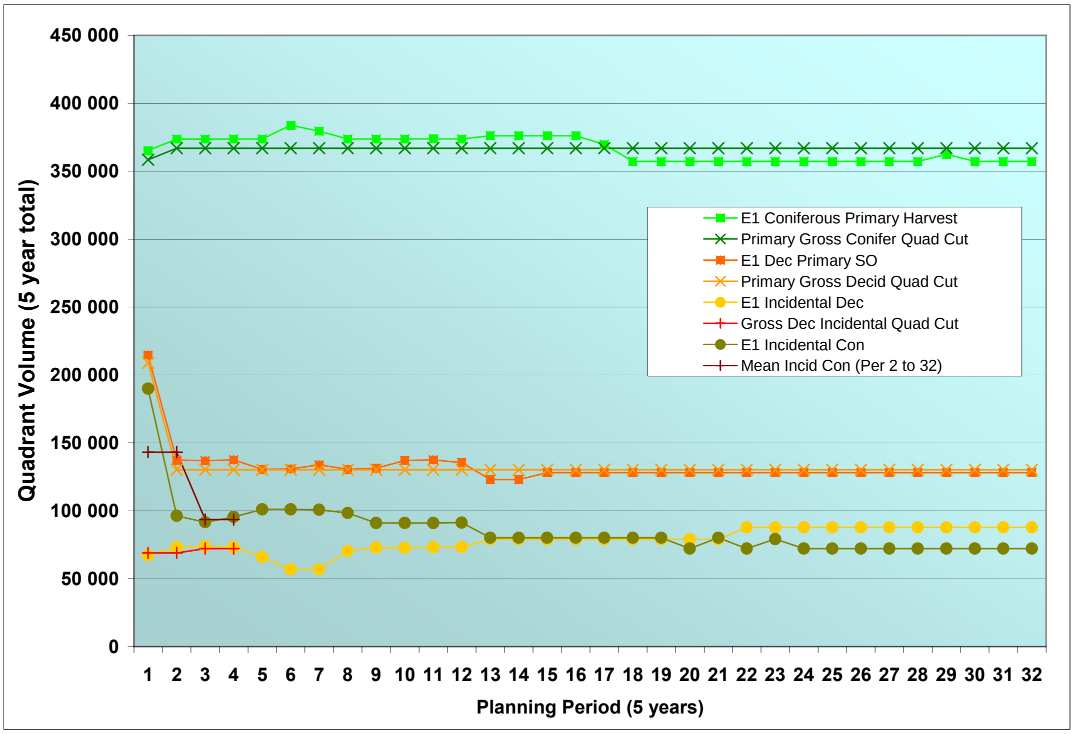


Figure 6.11 E1 Harvest Flows

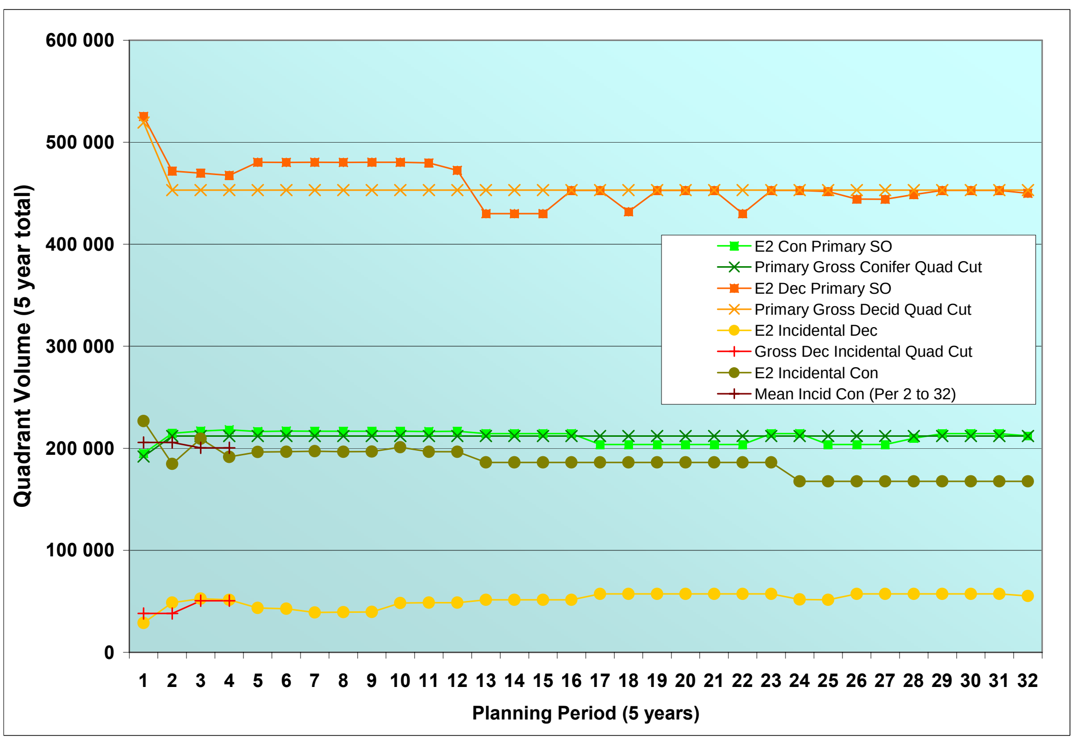


Figure 6.12 E2 Harvest Flows

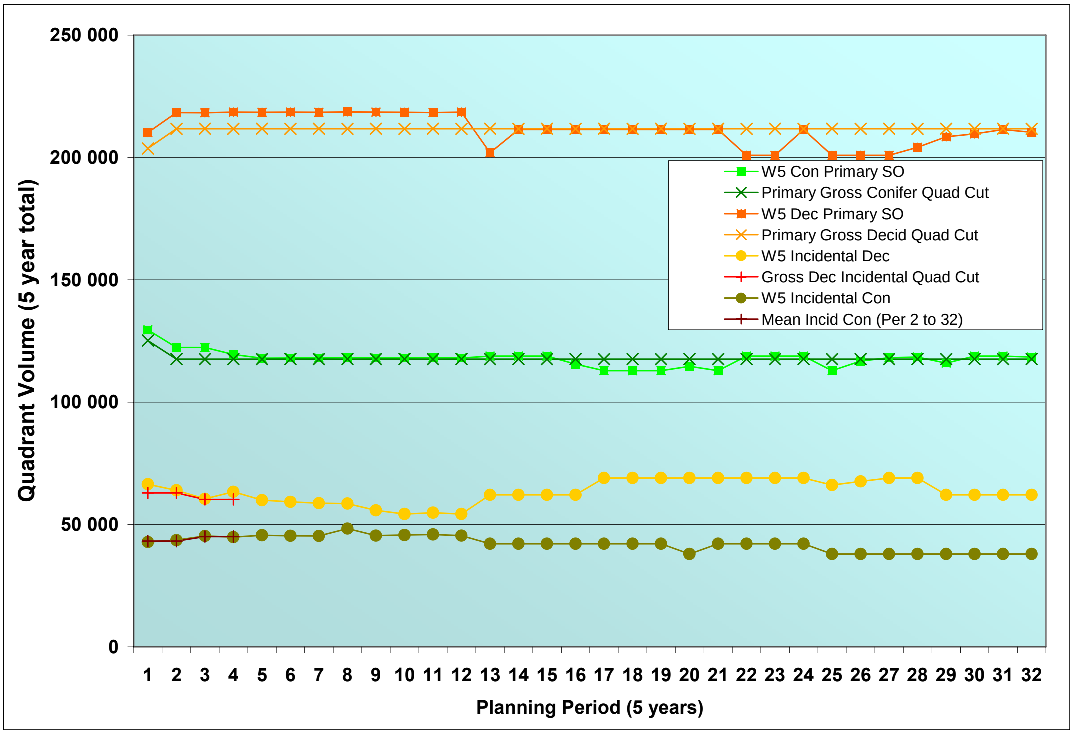


Figure 6.13 W5 Harvest Flows

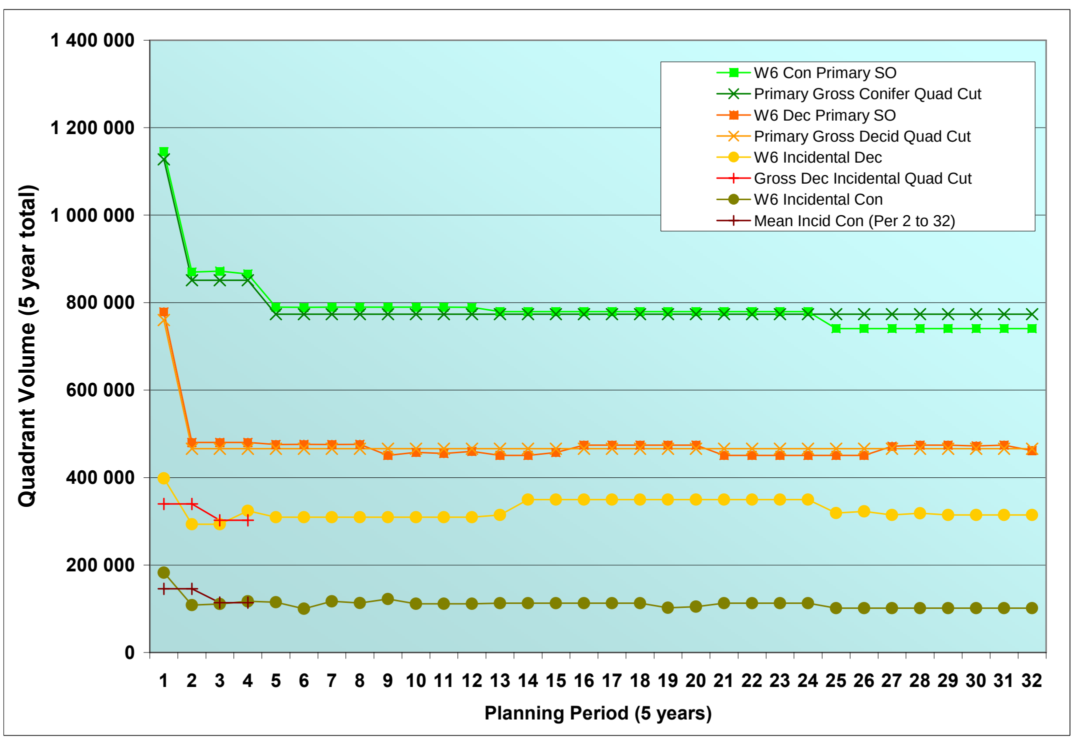


Figure 6.14 W6 Harvest Flows

6.14.2.1 Changes in Recommended Harvest Levels as Compared to Previous Management Plan Harvest Levels

Significant changes have occurred in both the area of timber harvesting land base and the associated primary harvest levels from past management plans. This is not surprising, since there have been many significant changes in both the state of the forest (such as the quantity of growing stock), and the information available used to conduct timber supply analyses. As noted previously, the timber harvesting land base has declined across the FMA area for a variety of reasons, however, primary harvest levels, as ratios to land base, have remained relatively the same, with some exceptions, most notably with deciduous types. Again, this is not surprising since there have been significant improvements in both inventory and growth and yield information for deciduous species, in keeping with their significance as a commercially valuable crop in Alberta since the early 1980s when previous management plans were being prepared.

Table 6.25 Comparison of Primary Harvest Levels and Net Land Base to the 1986 Management Plan

Management Plan	FMU	Net Conifer Land Base (ha)	Primary Conifer Vol (m3/yr)	Incid Conifer Vol (m3/yr)	Net Decid Land Base (ha)	Primary Decid Vol (m3/yr)	Incid Decid Vol (m3/yr)
1986	E1	54,748	118,300		26,325	24,111	
	E2	24,623	47,300		36,741	64,800	
	W5	35,006	66,100		44,935	86,200	
	W6	106,892	214,987		43,269	74,805	
	Sub-total	221,269	446,687	0	151,270	249,916	0
2006	E1	37,106	65,295	24,563	17,063	22,140	11,733
	E2	20,890	39,845	38,018	46,303	82,230	6,871
	W5	15,328	22,116	7,878	17,350	38,107	11,324
	W6	87,134	159,992	26,656	38,941	83,889	61,146
	Sub-total	160,458	287,248	97,116	119,657	226,366	91,074

* Information regarding incidental volumes in 1986 was not determined

6.14.3 Indicators from the Preferred Management Strategy

The preferred management strategy was designed to achieve the maximum harvest volume within the objectives for operability and sustainability of both timber and non-timber resources. As always, it is prudent to understand the tradeoffs and impacts that competing values, objectives, and goals have on one another. The remainder of this section will provide a thorough look at the various indicators established and tracked to assess the sustainability of the preferred scenario.

In letting the highly productive cohort reach it's maximum volume, the model temporarily strayed from the oldest first harvest paradigm, selecting younger stands in the periods leading up to year 110. This created a pocket / island of pure deciduous stands separated from the remainder of the age classes (Figure 6.34). The age class clump was harvested and that resulted in the spikes that appear in the graphs.

6.14.3.1 Average Volume per Hectare

Average harvest volumes are between 98 to 200 m^3/ha for the deciduous and 106 to 204 m^3/ha for the coniferous dominant cover types. The volumes were generally stable over time although there is a slight decline after period 12 (Figure 6.15 and Figure 6.16).

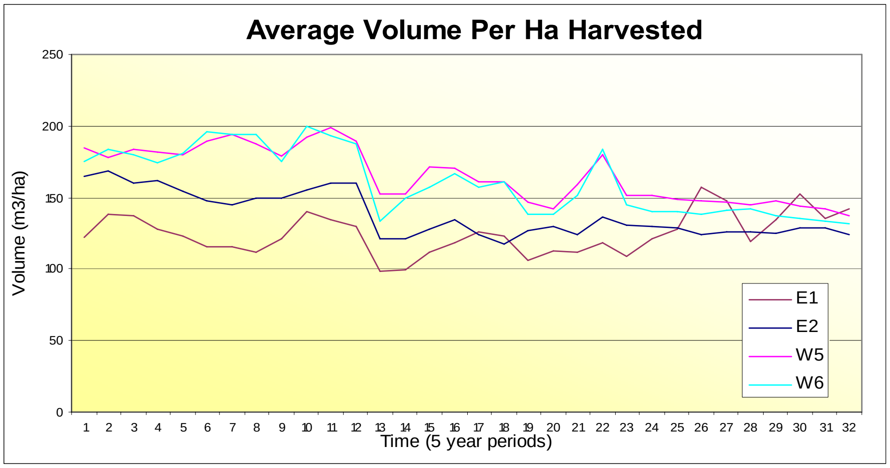


Figure 6.15 Average Volume per Hectare of Harvest from the Deciduous Land Base

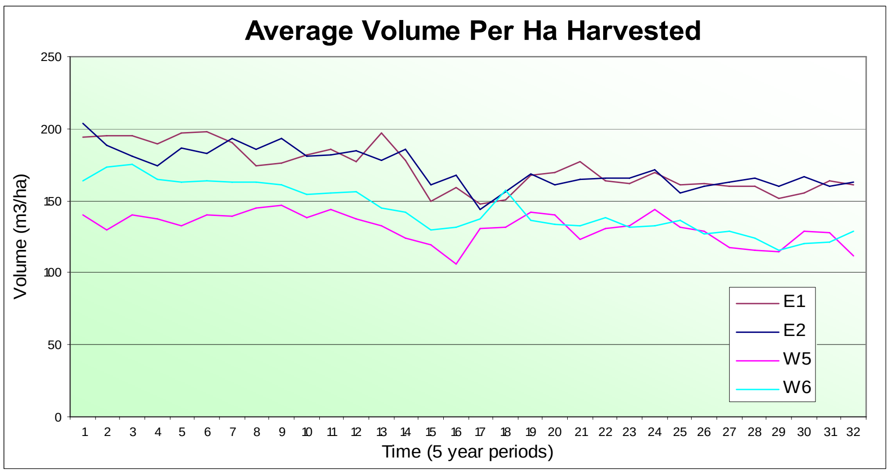


Figure 6.16 Average Volume per Hectare of Harvest from the Coniferous Land Base

6.14.3.2 Average Harvest Age

The average harvest age on the deciduous land base varies from 95 to 129 over the first 12 periods, with E1 and E2 generally being older. Average harvest age declines at that point and generally stabilizes between 60 (lowest point) and 115 (a spike in E1 in period 26) for the remainder of the planning horizon. Average harvest age initially increases in the conifer land base for the first 12 periods, varying between 110 (E2, period 4) and 133 (W6, period 11). At period 13, average harvest age begins to fluctuate before stabilizing at period 20 to an average of 84 (Figure 6.17 and Figure 6.18).

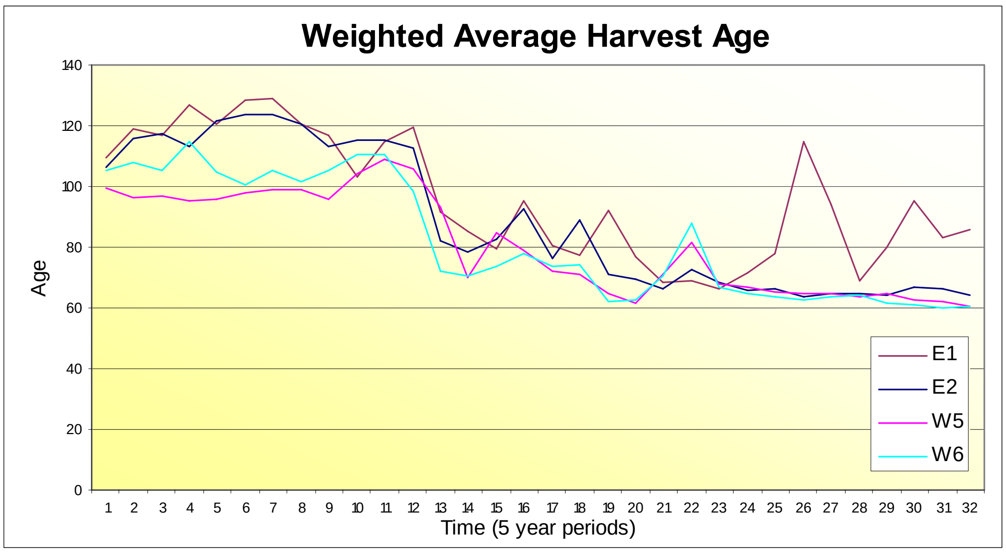


Figure 6.17 Average Age of Harvest over Time from the Deciduous Land Base

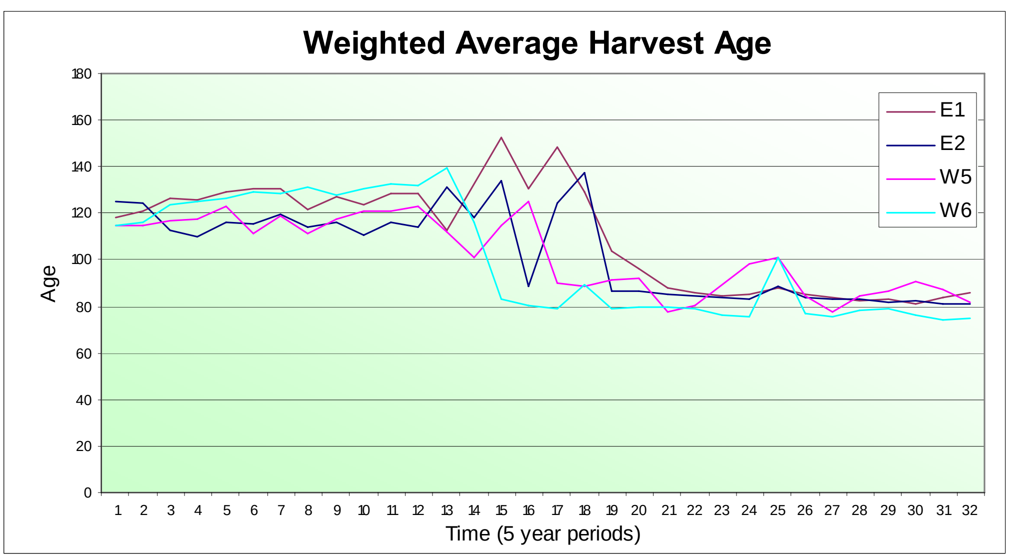


Figure 6.18 Average Age of Harvest over Time from the Coniferous Land Base

6.14.3.3 Piece Size Determination

Previous analyses assessed various options for modeling piece size. It was determined that piece size modeled through a surrogate variable quadratic mean diameter (DBHq) was stronger than the piece size estimate using trees/m^3 for all the major strata. Average piece size shows strong consistency between FMUs across the planning horizon (with exception of E1 in period 26). Deciduous DBHq ranges between 24 and 28 for the first 12 periods before declining to an average of 23 by the end of the planning horizon. The coniferous DBHq exhibits a similar trend, averaging 24 for the first 12 periods before declining to 20 (in FMU W6) by the end of the planning horizon. Figure 6.19 and Figure 6.20 show the piece size (DBHq) trends by FMU over the planning horizon.

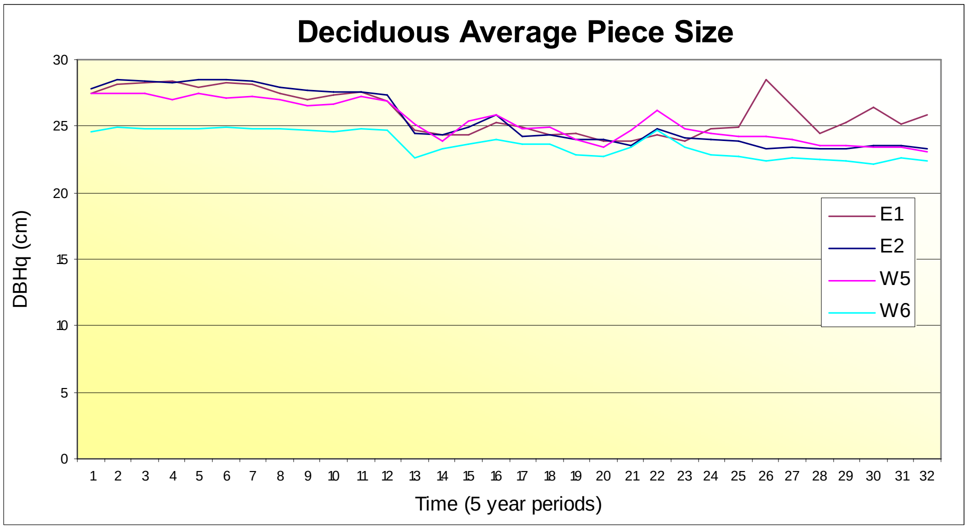


Figure 6.19 Deciduous Piece Size throughout the Planning Horizon

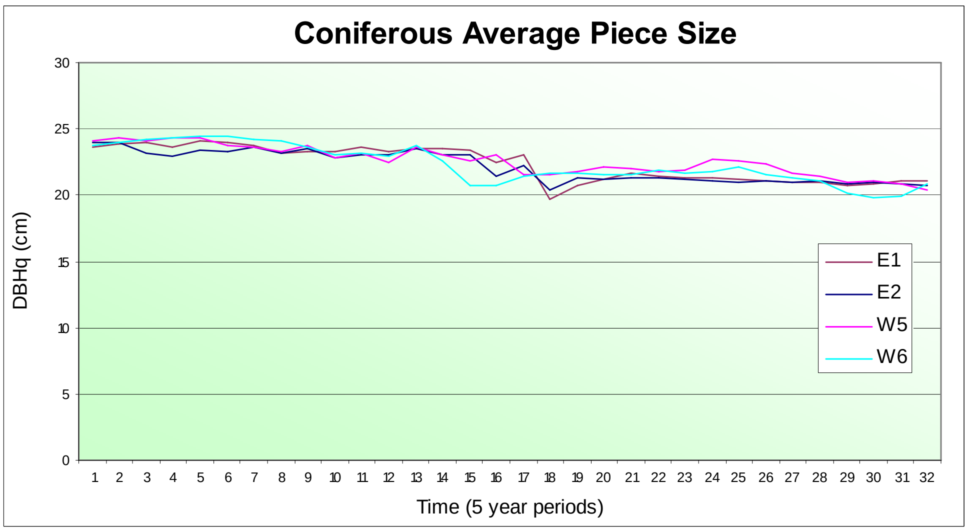


Figure 6.20 Coniferous Piece Size throughout the Planning Horizon

6.14.3.4 Growing Stock

Both softwood and hardwood total growing stock (GS) generally exhibit a declining trend over the majority of the planning horizon (Figure 6.21 and Figure 6.22). These patterns are typical of mature forest with plenty of standing merchantable volume at the beginning of the modeling start date. The rate of change in the deciduous operable growing stock (OGS) generally decreases from period 12 to the end of the planning horizon. The conifer operable growing stock follows a similar trend, with the rate of change decreasing after period 16. The exception is E1 total deciduous growing stock with most of the area concentrated in 110 to 120 year old stands (Figure 6.31). FMU E1 total growing stock decreases up to period 12; then it reaches an inflexion point and increases slightly thereafter. This inflexion point is related to the projected even flow harvest of the stands in the 115 year age class by period 12. Following period 12, the total growing stock volumes exceed the projected harvests creating an even age class distribution by the end of the planning horizon (Figure 6.35).

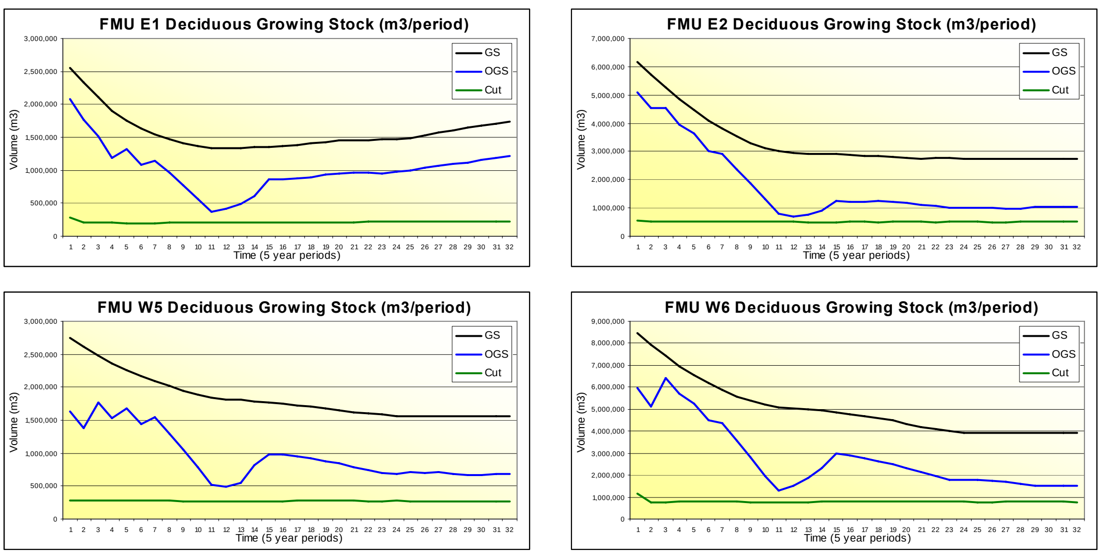


Figure 6.21 Deciduous Growing Stock Projections

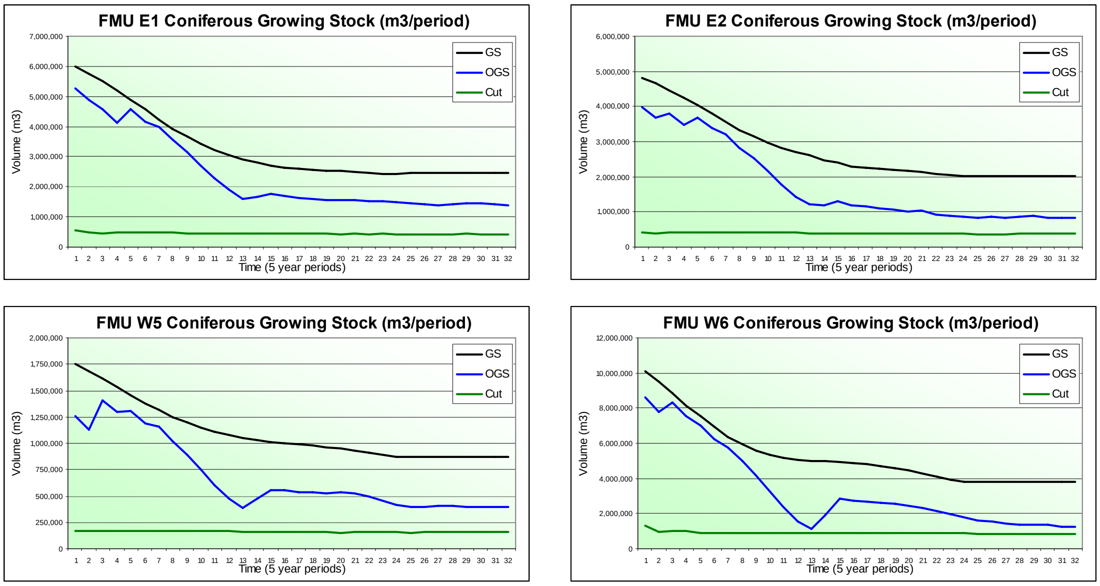


Figure 6.22 Coniferous Growing Stock Projections

6.14.3.5 Seral Stage Retention

Future forest conditions were modified under the management scenario modeled. Retention of late, very late, and extremely late seral stages for the various Natural Subregion over time is shown in Figure 6.23 through Figure 6.29, and Table 6.26 through Table 6.32. Overall, the seral constraints were easily met with the exception of the very late and extremely late conifer in the Upper Foothills region in the early portion of the planning horizon. A few of these constraints had to be postponed until period 7 (year 35) when those cover types matured enough to contribute to those specific constraints.

Table 6.26 FMU E1 Area of Older Seral Stages in the Lower Foothills Natural Subregion

E1 Lower Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	351	4 215	3 535	1 591	690	1 203
Very Late Decid	1.0	70	2 418	2 085	753	308	85
Late DC	5.0	282	3 159	2 596	1 242	2 031	282
Very Late DC	1.0	56	1 963	1 770	501	314	53
Late CD	5.0	559	4 267	3 190	2 634	929	2 441
Very Late CD	1.0	112	418	2 647	1 684	801	921
Late PL	5.0	1 105	15 902	13 753	9 882	2 320	1 689
Very Late PL	1.0	221	405	10 927	5 853	1 672	1 673
Late PS	5.0	188	3 730	3 215	1 366	529	457
Very Late PS	1.0	38	590	2 872	1 354	451	450
Late SW	10.0	301	2 875	2 471	1 531	882	614
Very Late SW	2.0	60	1 689	2 331	1 521	626	612
Late 'other' Con	5.0	2 398	30 153	33 895	44 229	42 671	41 340
Very Late 'other' Con	1.0	480	6 165	21 241	39 078	42 315	41 337

* PL = Pine,   PS = Pine/White Spruce,   SW = White Spruce

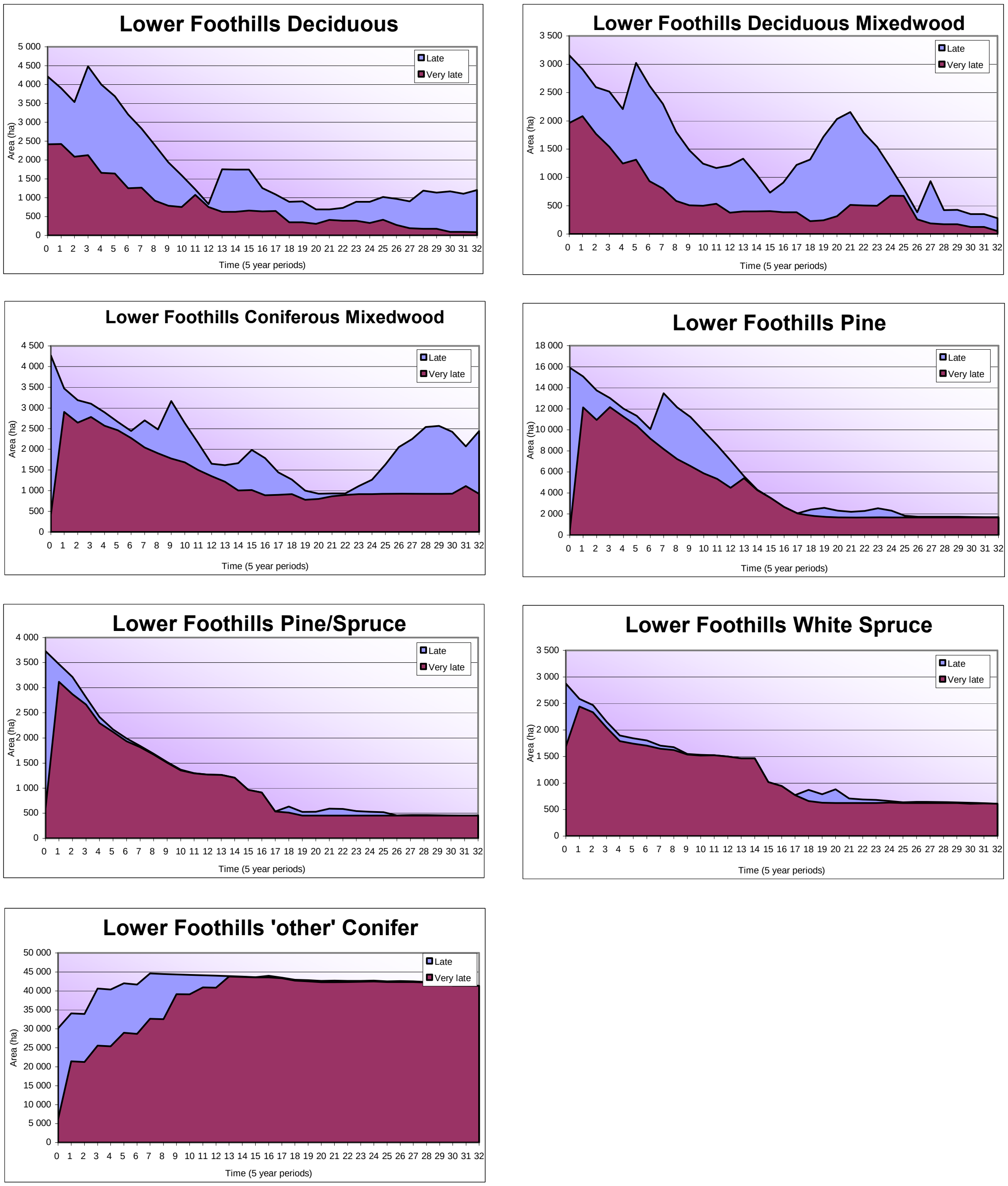


Figure 6.23   FMU E1 Area of Seral Stages within the Lower Foothills Natural Subregion

Table 6.27 FMU E1 Area of Older Seral Stages in the Upper Foothills Natural Subregion

E1 Upper Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	4	84	84	5	12	65
Very Late Decid	2.0	2	31	31	5	3	0
Late DC	5.0	3	55	35	9	24	3
Very Late DC	2.0	1	49	29	9	3	0
Late CD	5.0	3	63	47	47	4	4
Very Late CD	2.0	1	0	26	47	4	4
Late PL	2.0	2	121	85	52	44	4
Very Late PL	1.0	1	1	77	52	4	4
Extremely Late PL	0.5	1	0	0	0	4	4
Late PS	10.0	3	26	22	6	5	1
Very Late PS	5.0	1	0	22	6	1	1
Extremely Late PS	2.5	1	0	0	0	1	1
Late SW	10.0	1	10	10	6	3	1
Very Late SW	5.0	0	0	10	6	1	1
Extremely Late SW	2.5	0	0	0	0	1	1
Late 'other' Con	10.0	10	80	92	88	94	88
Very Late 'other' Con	5.0	5	7	68	86	88	88
Extremely Late 'other' Co	2.5	3	0	0	1	86	88

* PL = Pine, PS = Pine/White Spruce, SW = White Spruce

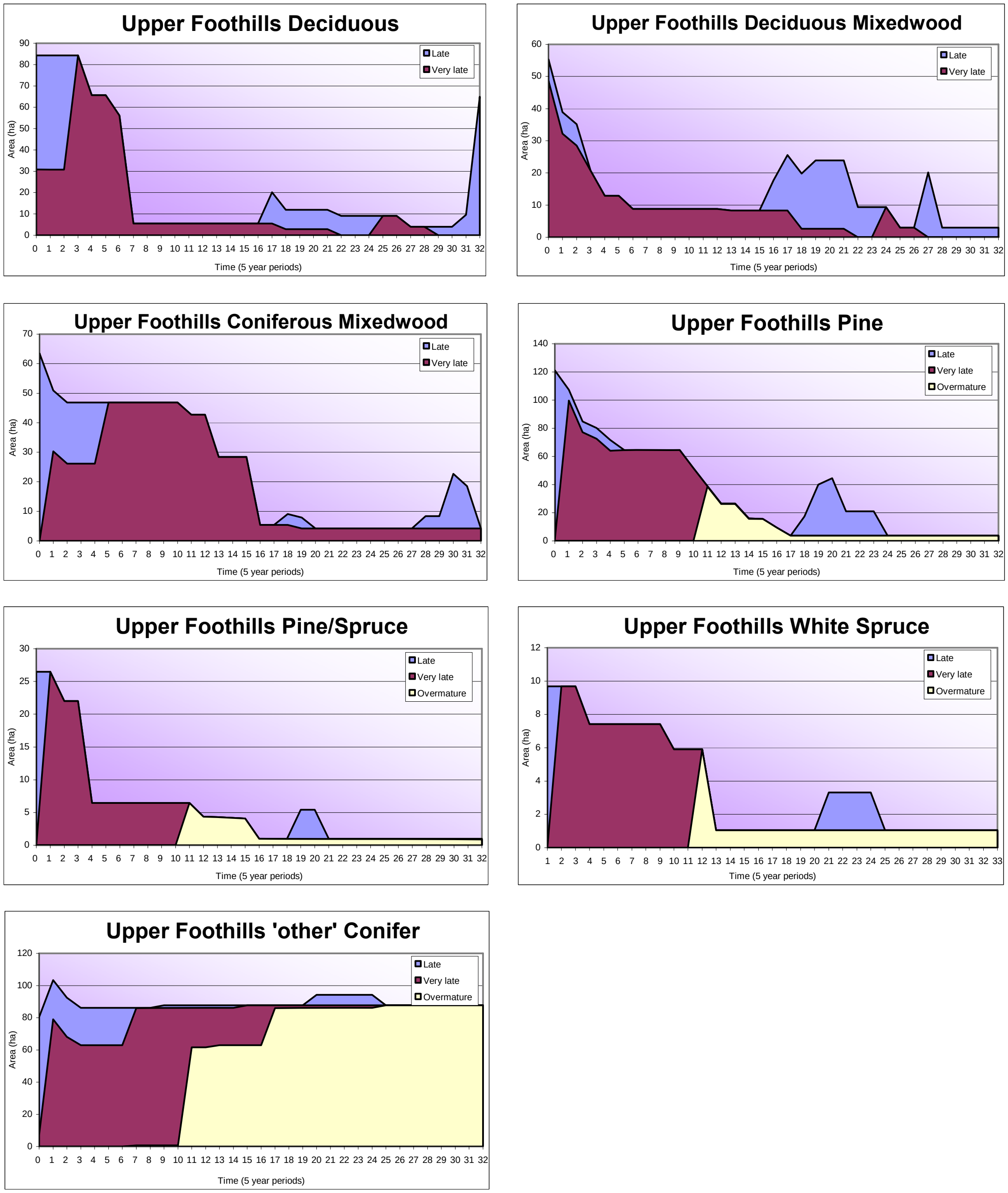


Figure 6.24 FMU E1 Area of Seral Stages within the Upper Foothills Natural Subregion

Table 6.28 FMU E2 Area of Older Seral Stages in the Lower Foothills Natural Subregion

E2 Lower Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	1 594	20 752	19 682	7 861	2 276	1 594
Very Late Decid	1.0	319	6 607	7 737	4 980	2 210	384
Late DC	5.0	387	6 163	6 278	2 418	1 720	387
Very Late DC	1.0	77	2 334	2 806	2 021	714	46
Late CD	5.0	460	2 961	2 560	2 975	1 843	1 231
Very Late CD	1.0	92	538	1 117	2 119	1 002	1 147
Late PL	5.0	291	2 488	2 172	2 087	847	847
Very Late PL	1.0	58	12	700	1 515	847	847
Late PS	5.0	117	1 644	1 425	679	378	374
Very Late PS	1.0	23	419	570	620	378	374
Late SW	10.0	231	1 716	1 420	860	422	362
Very Late SW	2.0	46	1 057	976	759	401	362
Late 'other' Con	5.0	1 583	16 484	18 462	29 373	28 714	24 457
Very Late 'other' Con	1.0	317	7 188	10 507	24 427	28 531	24 457

* PL = Pine, PS = Pine/White Spruce, SW = White Spruce

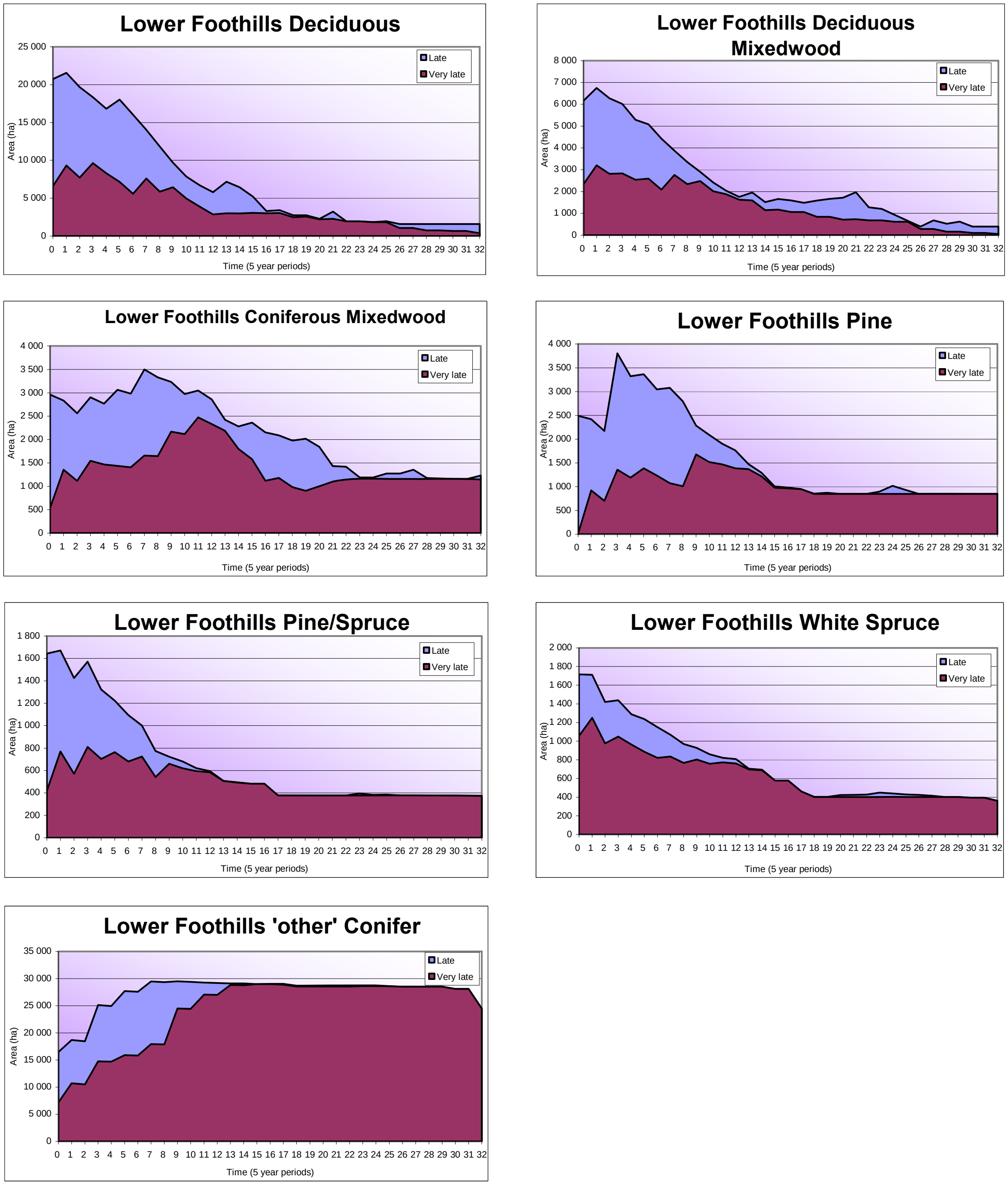


Figure 6.25 FMU E2 Area of Seral Stages within the Lower Foothills Natural Subregion

Table 6.29 FMU E2 Area of Older Seral Stages in the Upper Foothills Natural Subregion

E2 Upper Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	124	1 867	1 927	475	176	124
Very Late Decid	2.0	50	483	1 159	319	74	9
Late DC	5.0	103	1 574	1 599	785	547	103
Very Late DC	2.0	41	578	920	605	52	0
Late CD	5.0	98	1 243	981	1 349	134	98
Very Late CD	2.0	39	234	510	1 028	92	93
Late PL	2.0	76	1 247	1 024	1 998	160	146
Very Late PL	1.0	38	359	602	528	160	146
Extremely Late PL	0.5	19	0	0	171	60	146
Late PS	10.0	62	458	356	239	62	62
Very Late PS	5.0	31	216	269	222	27	18
Extremely Late PS	2.5	16	0	0	135	23	18
Late SW	10.0	74	382	331	176	74	74
Very Late SW	5.0	25	83	128	135	25	27
Extremely Late SW	2.5	12	0	0	29	21	22
Late 'other' Con	10.0	165	787	697	747	548	437
Very Late 'other' Con	5.0	83	226	315	494	525	437
Extremely Late 'other' Co	2.5	41	0	0	155	408	425

* PL = Pine, PS = Pine/White Spruce, SW = White Spruce

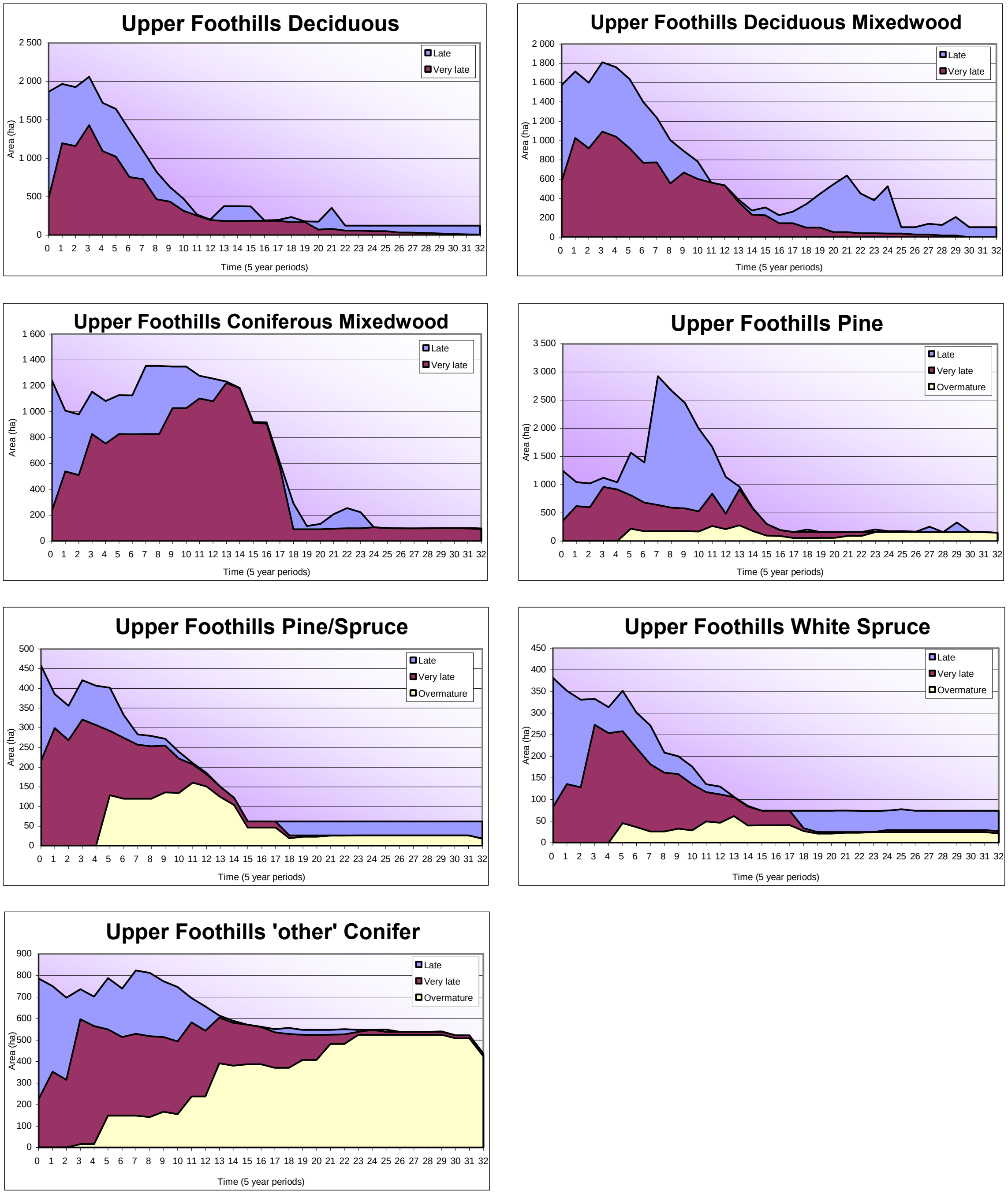


Figure 6.26 FMU E2 Area of Seral Stages within the Upper Foothills Natural Subregion

Table 6.30 FMU W5 Area of Older Seral Stages in the Lower Foothills Natural Subregion

W5 Lower Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	922	8 114	9 081	4 626	3 206	922
Very Late Decid	1.0	184	1 064	1 213	2 366	1 573	186
Late DC	5.0	220	2 560	2 454	1 086	1 260	786
Very Late DC	1.0	44	273	398	578	301	12
Late CD	5.0	273	1 493	1 441	1 385	1 059	577
Very Late CD	1.0	55	317	772	726	475	547
Late PL	5.0	188	1 549	1 164	1 888	439	301
Very Late PL	1.0	38	456	509	676	302	301
Late PS	5.0	35	542	477	222	136	77
Very Late PS	1.0	7	184	287	158	77	77
Late SW	10.0	167	1 020	1 091	640	429	280
Very Late SW	2.0	33	161	503	494	272	269
Late 'other' Con	5.0	959	8 495	10 115	17 865	17 644	16 537
Very Late 'other' Con	1.0	192	2 003	4 470	11 752	17 452	16 535

* PL = Pine, PS = Pine/White Spruce, SW = White Spruce

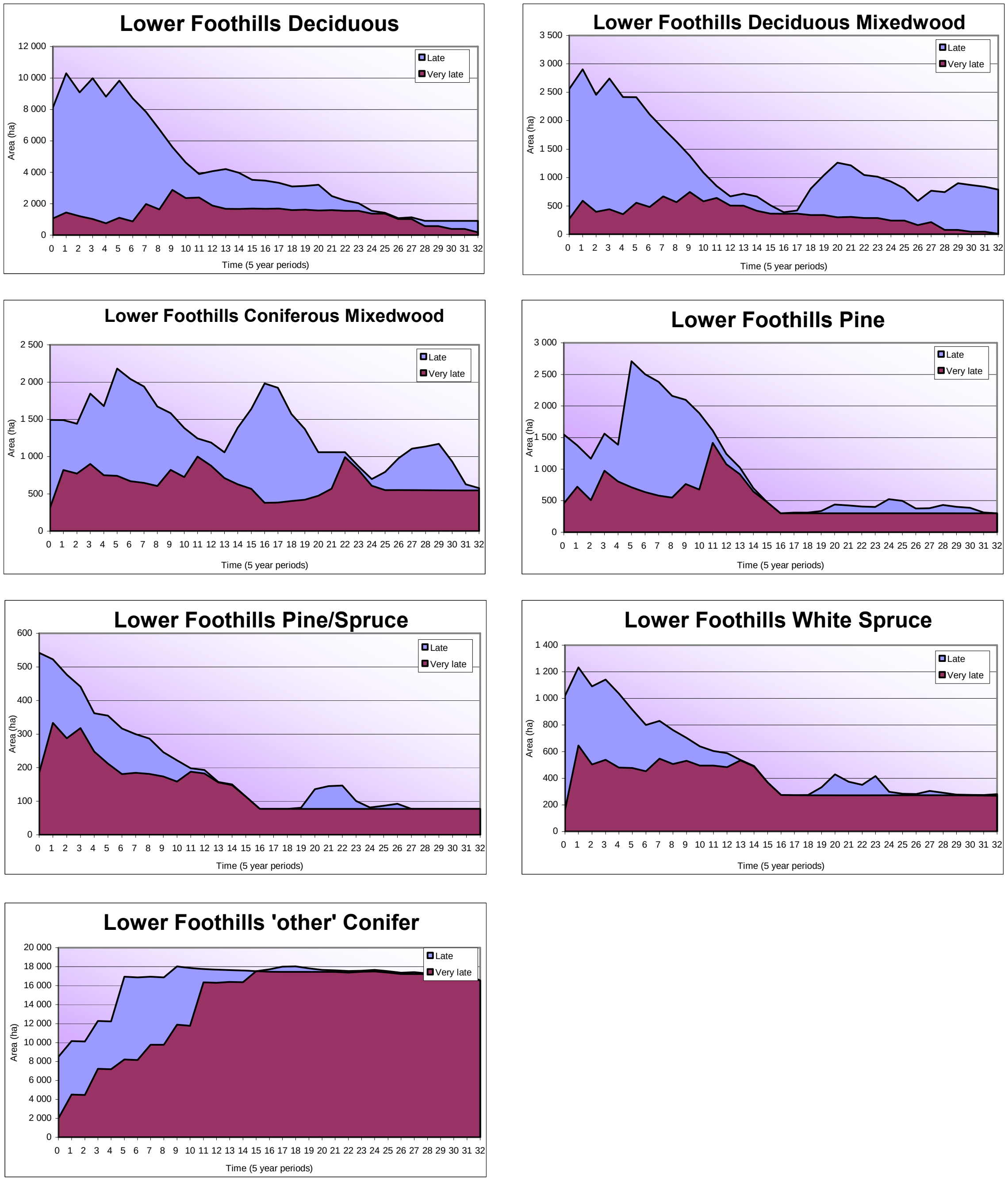


Figure 6.27 FMU W5 Area of Seral Stages within the Lower Foothills Natural Subregion

Table 6.31 FMU W6 Area of Older Seral Stages in the Lower Foothills Natural Subregion

W6 Lower Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	2 007	21 362	23 754	8 175	7 039	465
Very Late Decid	1.0	401	6 617	4 369	4 974	2 927	465
Late DC	5.0	725	8 458	9 037	5 051	4 023	285
Very Late DC	1.0	145	3 073	2 892	3 681	1 291	139
Late CD	5.0	1 020	7 174	6 686	4 008	1 838	1 662
Very Late CD	1.0	204	2 968	4 595	2 104	1 272	1 627
Late PL	5.0	1 234	17 786	14 289	8 719	2 514	2 454
Very Late PL	1.0	247	1 682	10 918	5 354	2 024	2 064
Late PS	5.0	217	2 667	2 457	1 582	516	530
Very Late PS	1.0	43	1 073	1 459	987	496	488
Late SW	10.0	1 259	4 805	5 409	3 666	1 602	1 317
Very Late SW	2.0	252	2 246	2 583	2 305	1 345	1 315
Late 'other' Con	5.0	3 810	46 445	52 397	63 924	65 937	55 309
Very Late 'other' Con	1.0	762	17 728	35 042	59 967	61 883	55 155

* PL = Pine, PS = Pine/White Spruce, SW = White Spruce

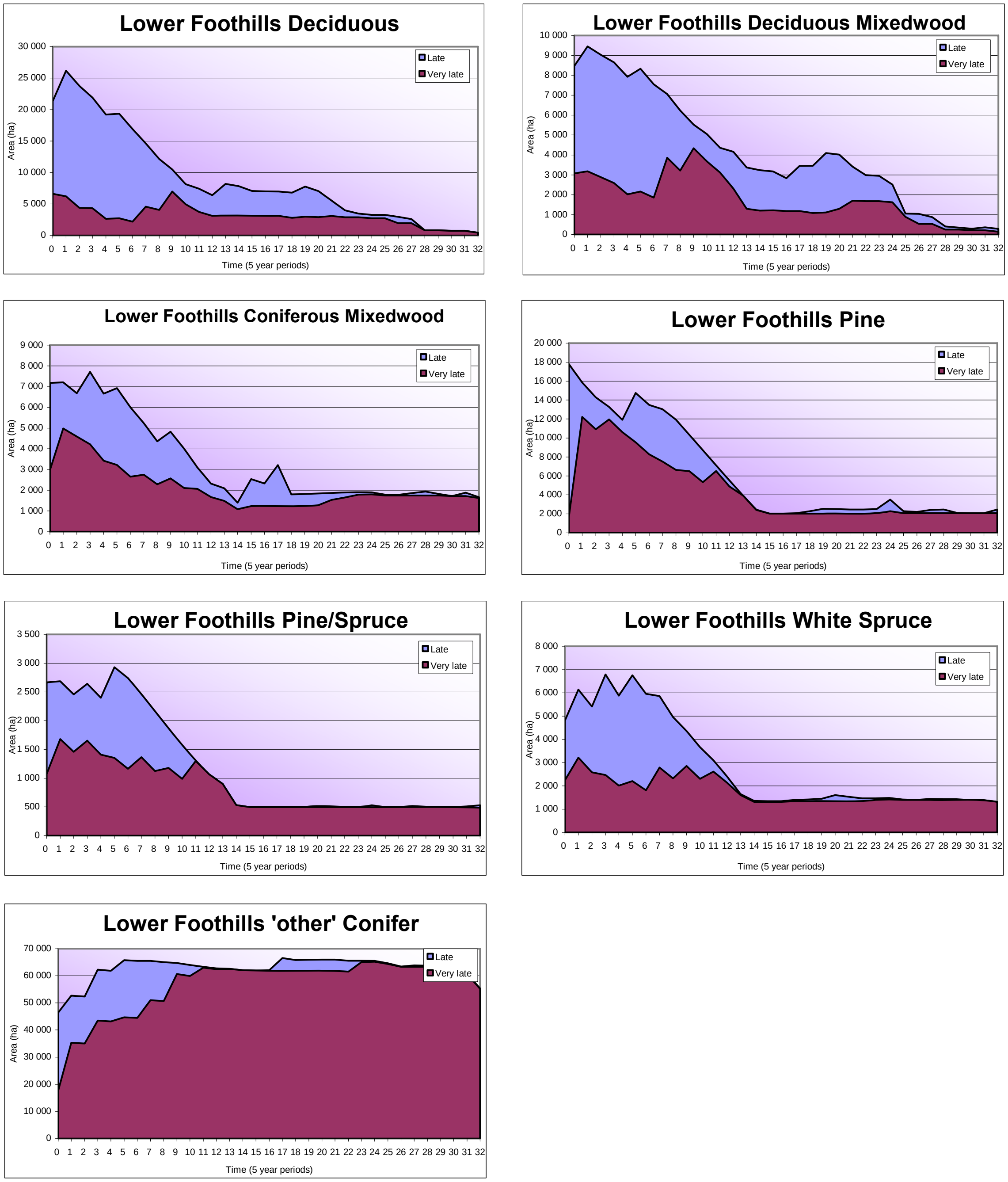
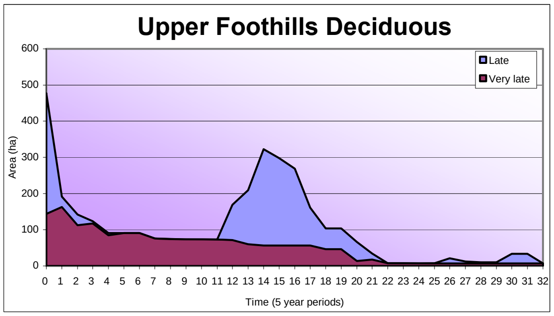


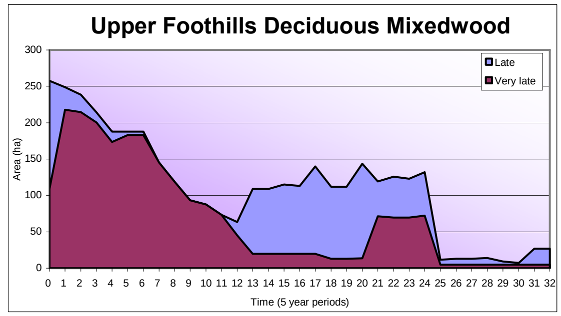
Figure 6.28 FMU W6 Area of Seral Stages within the Lower Foothills Natural Subregion

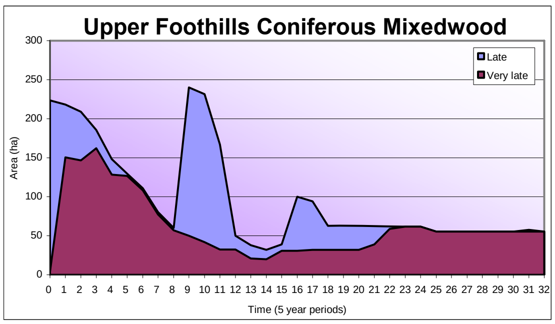
Table 6.32 FMU W6 Area of Older Seral Stages in the Upper Foothills Natural Subregion

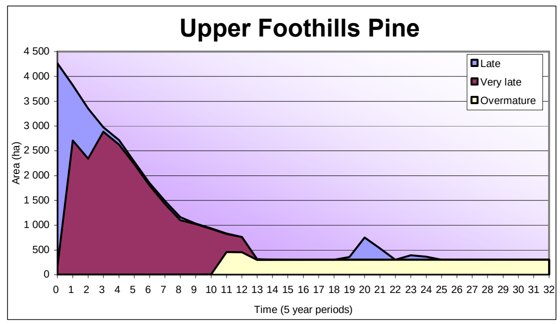
W6 Upper Foothills	Target Minimum Area		Time from Start Date (years)				
Seral Stage	(%)	(ha)	0	10	50	100	160
Late Decid	5.0	31	477	141	73	66	7
Very Late Decid	2.0	13	144	113	73	14	7
Late DC	5.0	17	258	239	88	143	27
Very Late DC	2.0	7	109	214	88	14	5
Late CD	5.0	49	224	209	232	63	56
Very Late CD	2.0	20	4	147	42	32	56
Late PL	2.0	87	4 266	3 356	938	750	303
Very Late PL	1.0	43	164	2 340	926	303	303
Extremely Late PL	0.5	22	0	0	11	302	303
Late PS	10.0	12	115	101	20	23	18
Very Late PS	5.0	6	37	77	20	18	18
Extremely Late PS	2.5	3	0	0	2	18	18
Late SW	10.0	31	165	151	68	72	60
Very Late SW	5.0	10	15	131	68	60	60
Extremely Late SW	2.5	5	0	0	2	60	60
Late 'other' Con	10.0	908	5 937	5 820	6 268	6 420	5 335
Very Late 'other' Con	5.0	454	2 486	4 393	6 187	6 215	5 334
Extremely Late 'other' Co	2.5	227	164	164	2 396	6 144	5 294

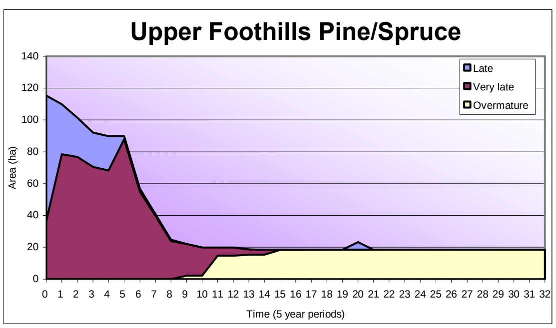
* PL = Pine, PS = Pine/White Spruce, SW = White Spruce

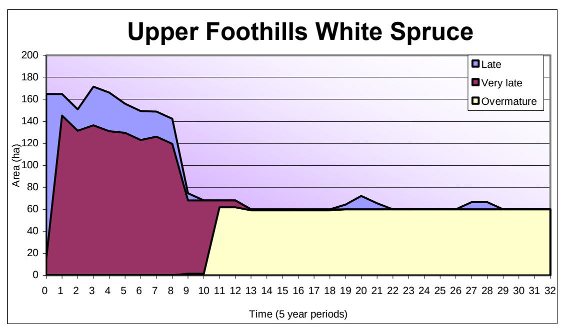












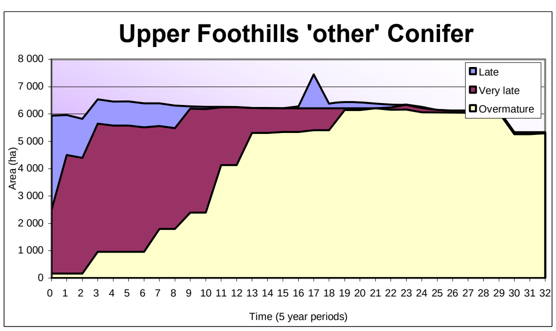


Figure 6.29 FMU W6 Area of Seral Stages within the Upper Foothills Natural Subregion

6.14.3.6 Patches

Patches, the areas of contiguous forest (defined using BCG and Seral Stage) during the spatial harvest sequence, were analyzed in periods 0 (initial), 2 (10 years), and 10 (50 years). As anticipated, patch sizes across the FMA varied. The average patch size, depending on FMU, planning period and seral stage, (Table 6.33) ranged from approximately 1.0 to 11.1 ha. The range of average patch sizes decreases over the spatial harvest planning horizon (i.e. the minimum increases and the maximum decreases). By period 10, patch size ranges from 1.2 to 11.1 ha. Similar tables showing individual BCG are shown in Appendix 6.9.

Table 6.33 Patch Size Distribution

Time From Now (yrs)	Seral Stage	Average Patch Area (ha) by FMUs				FMA
		E1	E2	W5	W6	
0	Early	3.1	2.2	1.3	4.3	2.9
	Immature	1.3	1.0	1.1	1.1	1.1
	Mature	8.6	5.3	4.7	6.5	6.1
	Late	7.9	5.6	4.6	6.0	6.1
	Very Late	5.3	6.0	3.1	5.0	5.1
	Over Mature	11.1	4.7	9.7	6.8	6.8
	Total	6.1	4.3	3.5	5.0	4.8
	Avg of Stages	6.2	4.1	4.1	4.9	4.7
10	Early	1.8	1.7	1.5	2.4	2.1
	Immature	1.6	1.3	1.2	1.8	1.5
	Mature	8.7	5.3	4.7	6.2	6.0
	Late	6.5	4.7	3.9	4.5	4.9
	Very Late	3.9	4.7	1.7	3.5	3.7
	Over Mature	11.1	3.1	9.7	6.0	6.0
	Total	4.9	3.7	3.0	3.9	3.9
	Avg of Stages	5.6	3.5	3.8	4.1	4.0
50	Early	2.0	1.6	1.5	1.2	1.5
	Immature	2.4	2.1	2.2	1.9	2.1
	Mature	2.1	1.9	1.8	2.4	2.2
	Late	5.2	2.8	2.4	3.3	3.2
	Very Late	3.3	1.7	1.4	1.7	1.9
	Over Mature	2.4	3.7	2.5	4.3	3.7
	Total	2.9	2.1	1.9	2.1	2.2
	Avg of Stages	2.9	2.3	2.0	2.5	2.4

Patches of Interior Older Forest (IOF) were also analyzed. Interior older forests were defined by SRD as contiguous forested area greater than 100 ha with no part of the area less than the following distance from a forest edge:

- 60 m from a linear disturbance greater than 8 m in width;
- 30 m from the line which cover group changes; and

- 30 meters from the line which forest seral stage changes.

Age classes included in the definition were defined as:

- Deciduous - 100 years or older;
- Mixedwood (DC & CD BCG combined) - 100 years or older;
- Pine leading - 100 years or older;
- White Spruce leading - 120 years or older; and
- Black Spruce leading - 140 years or older.

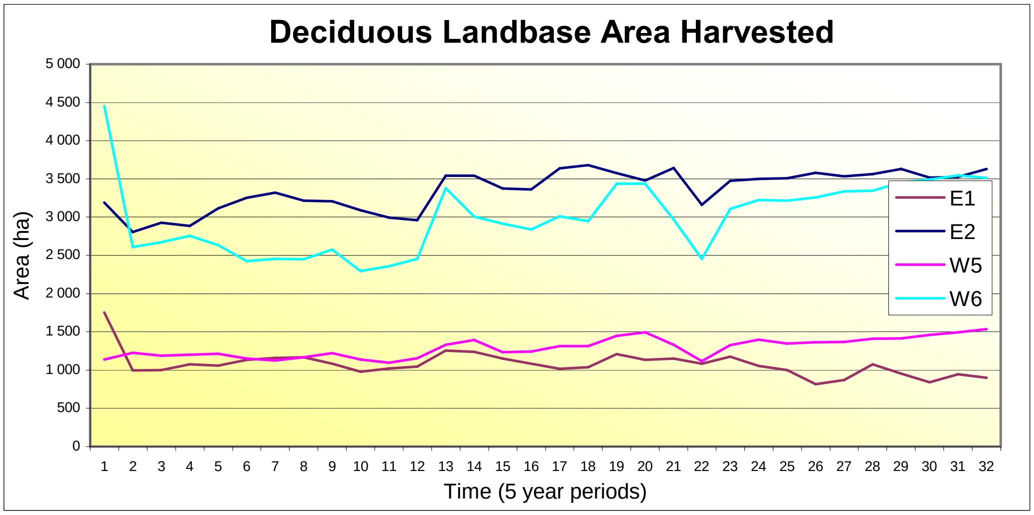
Table 6.34 looks at the amount of IOF at 0, 10, and 50 years both ignoring and incorporating seismic lines as hard edges. Both the total area of IOF and the average IOF patch size increase over time where seismic lines are ignored. Supporting tables are shown in Appendix 6.9. Maps of the IOF are located in Appendix 6.12.

Table 6.34 Area of Interior Older Forest

Time From Now (yrs)	Cover Type	Ignoring Seismics					Incorporating Seismics				
		E1	E2	W5	W6	FMA	E1	E2	W5	W6	FMA
0	Decid	-	179.8	-	114.4	173.2	-	146.1	-	-	146.1
	MX	-	122.7	-	-	122.7	-	-	-	-	-
	Pine	179.6	123.2	-	181.3	167.8	-	-	-	-	-
	SB	-	127.8	-	-	127.8	-	-	-	-	-
	SW	-	-	-	-	-	-	-	-	-	-
	Total	179.6	553.4	-	295.7	591.5	-	146.1	-	-	146.1
	Average	179.6	138.4	-	147.9	147.9	-	146.1	-	-	146.1
10	Decid	-	162.8	-	-	162.8	-	146.1	-	-	146.1
	MX	-	126.1	-	-	126.1	-	-	-	-	-
	Pine	179.6	-	-	128.6	147.7	-	-	-	-	-
	SB	-	127.8	-	281.1	250.4	-	-	-	-	-
	SW	-	-	-	-	-	-	-	-	-	-
	Total	179.6	416.7	-	409.7	687.1	-	146.1	-	-	146.1
	Average	179.6	138.9	-	204.8	171.8	-	146.1	-	-	146.1
50	Decid	-	-	-	-	124.4	-	-	-	-	-
	MX	-	162.4	-	-	177.6	-	-	-	-	-
	Pine	117.4	216.8	-	-	179.8	-	-	-	-	-
	SB	165.4	139.3	189.9	219.2	184.8	-	-	-	-	-
	SW	-	-	-	-	-	-	-	-	-	-
	Total	282.8	518.6	189.9	219.2	666.6	-	-	-	-	-
	Average	141.4	172.9	189.9	219.2	166.7	-	-	-	-	-

6.14.3.7 Area Harvested

The area harvested over time is fairly consistent, with FMU W6 exhibiting the greatest variability. The area of deciduous harvested ranges from 815 ha (FMU E1, period 26) up to 4,453 ha (FMU W6, period 1). The area of conifer harvested ranges from 797 ha (FMU W5, period 19) up to 6,991 ha (FMU W6, period 1) (Figure 6.30).



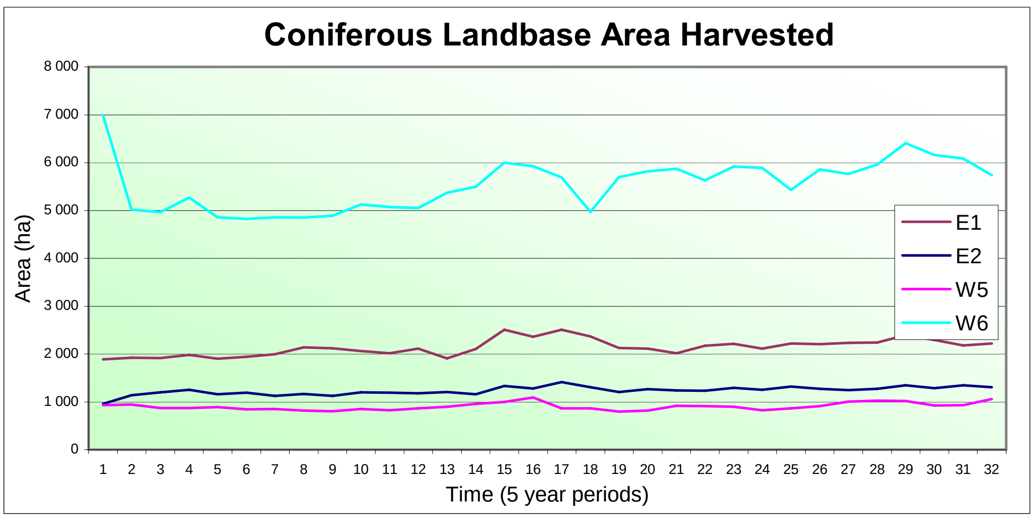


Figure 6.30 Projected Harvest Area (ha)

6.14.3.8 Age Class Distribution

The initial age class structure of the net harvestable land base is skewed towards the late seral stages. There is a large concentration of merchantable timber between 65 and 115 years of age and a relative shortage of younger (> 65 years) stands (Figure 6.31). This large spike (age 115) is the primary focus area of much of the harvest until enough area is converted to younger stands and the forest age class distribution becomes more balanced. Refer to Figure 6.32 thru Figure 6.35 for snapshots of the age class distribution over time.

The initial age class distribution for all forested stands is presented in Figure 6.36. The pattern looks almost exactly the same as the net land base but has much more area. The pattern of development over time (Figure 6.37 thru Figure 6.40) is similar as well as the large spike of mature timber diminishes over time as the merchantable component is harvested and is reforested into younger age classes. The apparent difference is that as the merchantable portion of the forest becomes regulated, the productive, but non-harvestable component continues to age over time.

These age class distributions only account for forest management activities and forest dynamics. They do not model the effects of other industries or natural disturbances.

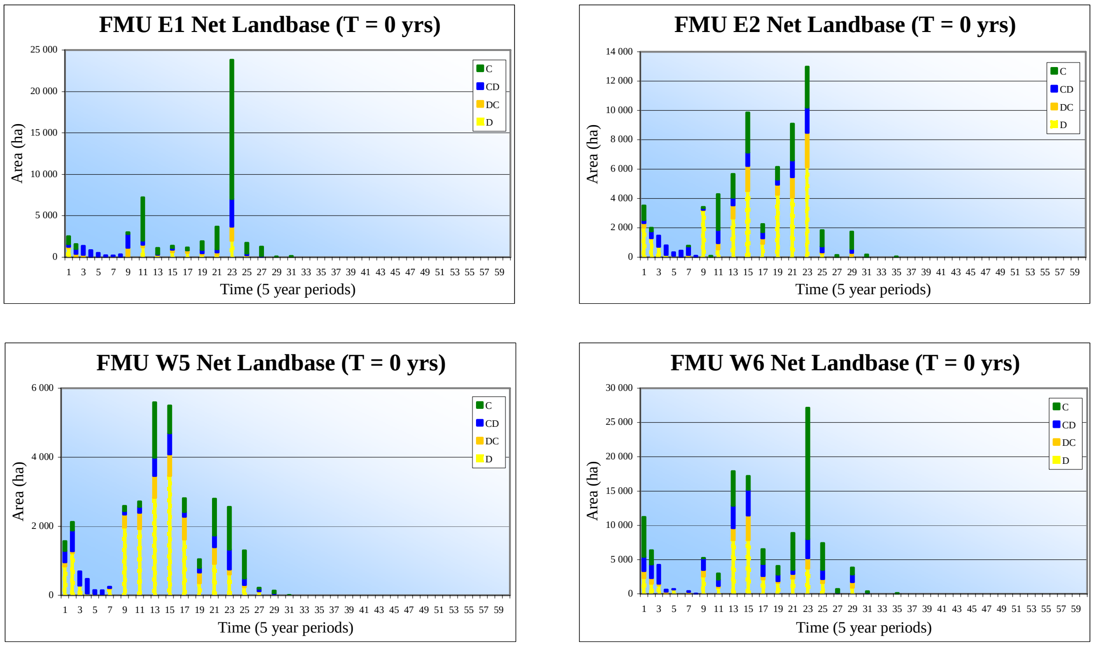


Figure 6.31 Age Class Distribution of the Net Harvestable Land Base at T = 0 years

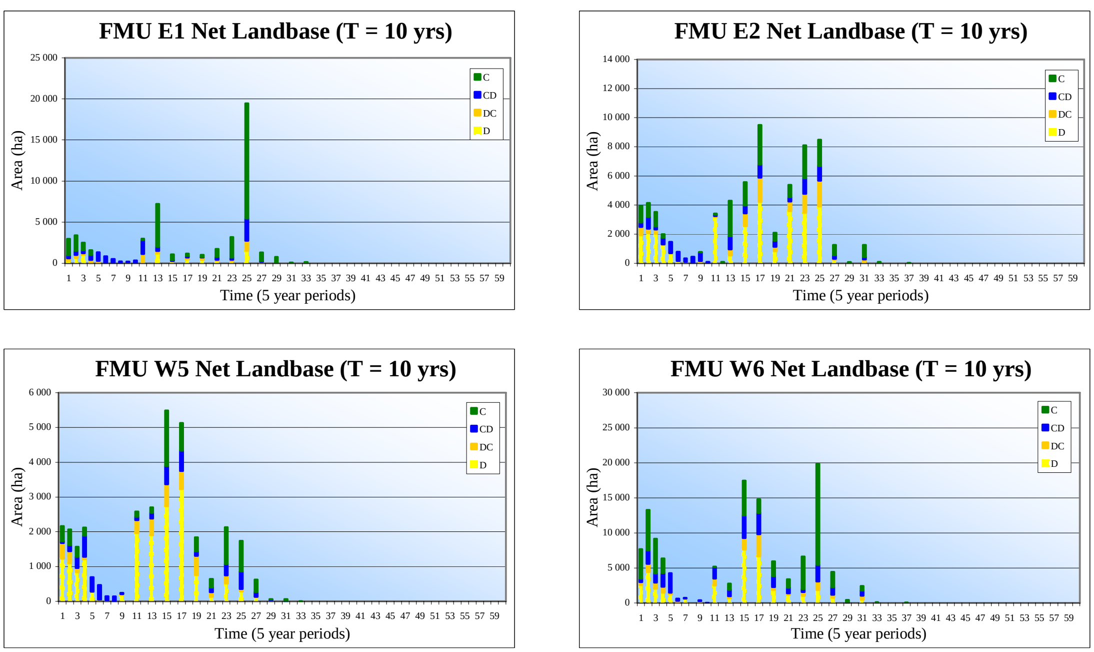


Figure 6.32 Age Class Distribution of the Net Harvestable Land Base at T = 10 years

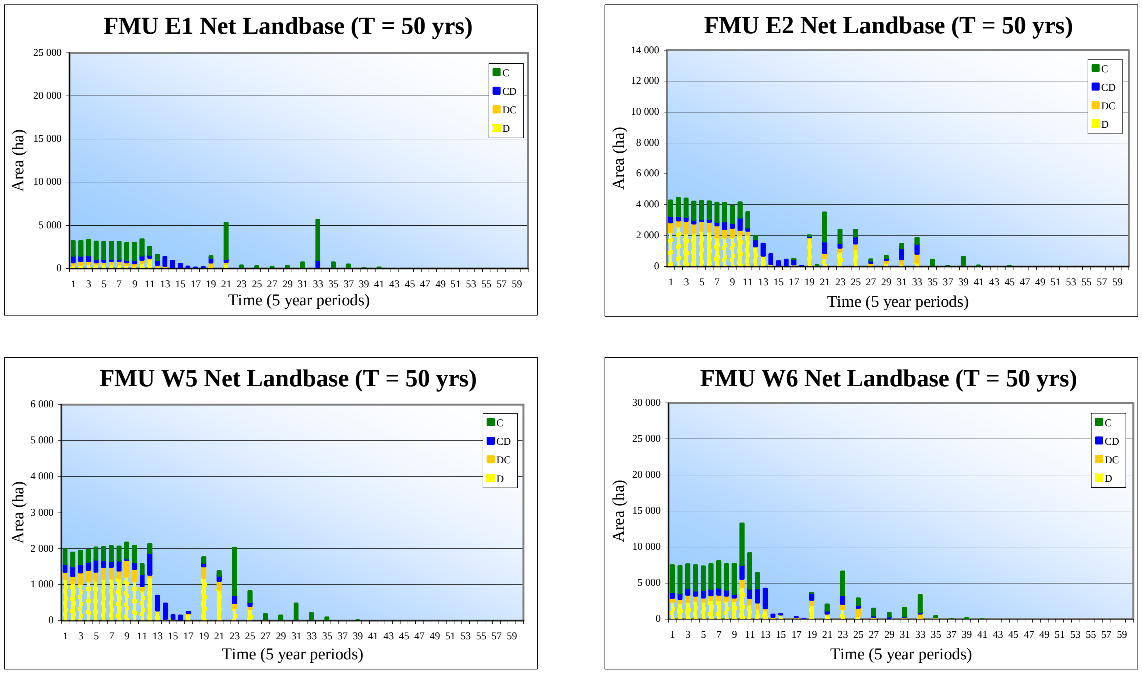


Figure 6.33 Age Class Distribution of the Net Harvestable Land Base at T = 50 years

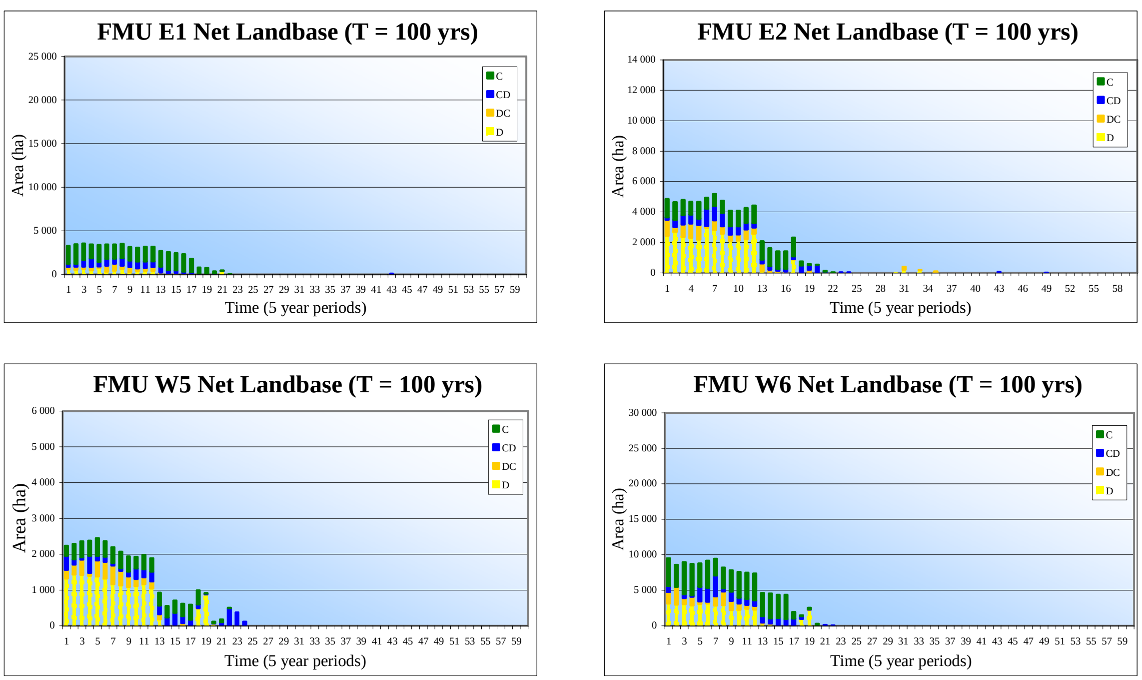


Figure 6.34 Age Class Distribution of the Net Harvestable Land Base at T = 100 years

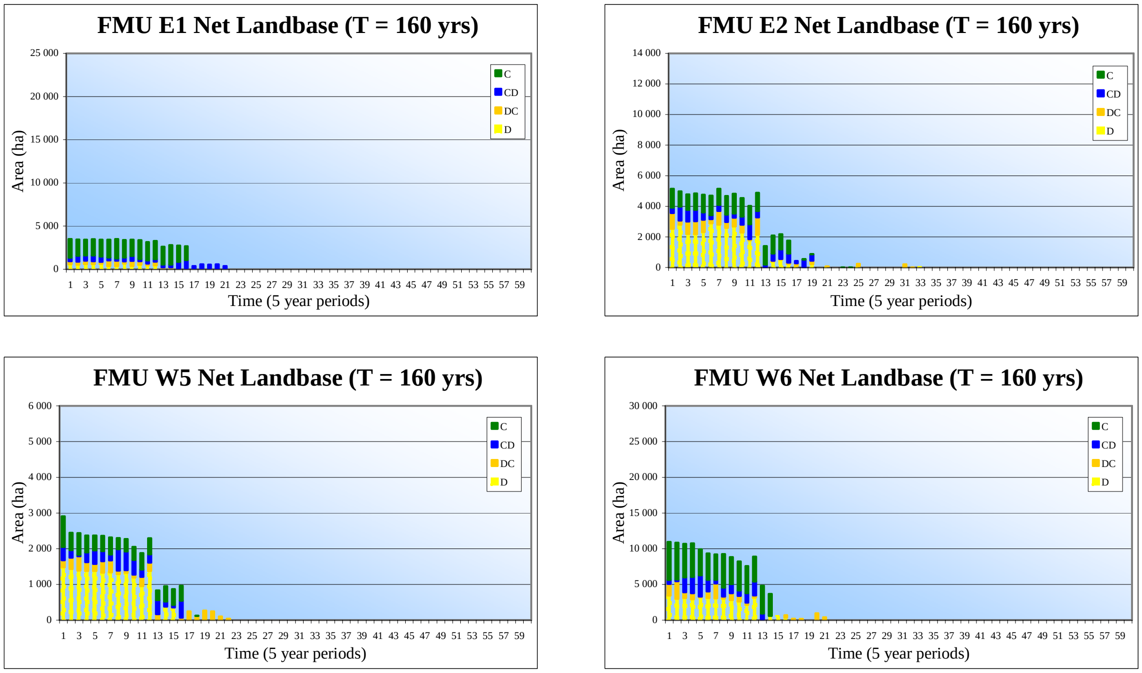


Figure 6.35 Age Class Distribution of the Net Harvestable Land Base at T = 160 years

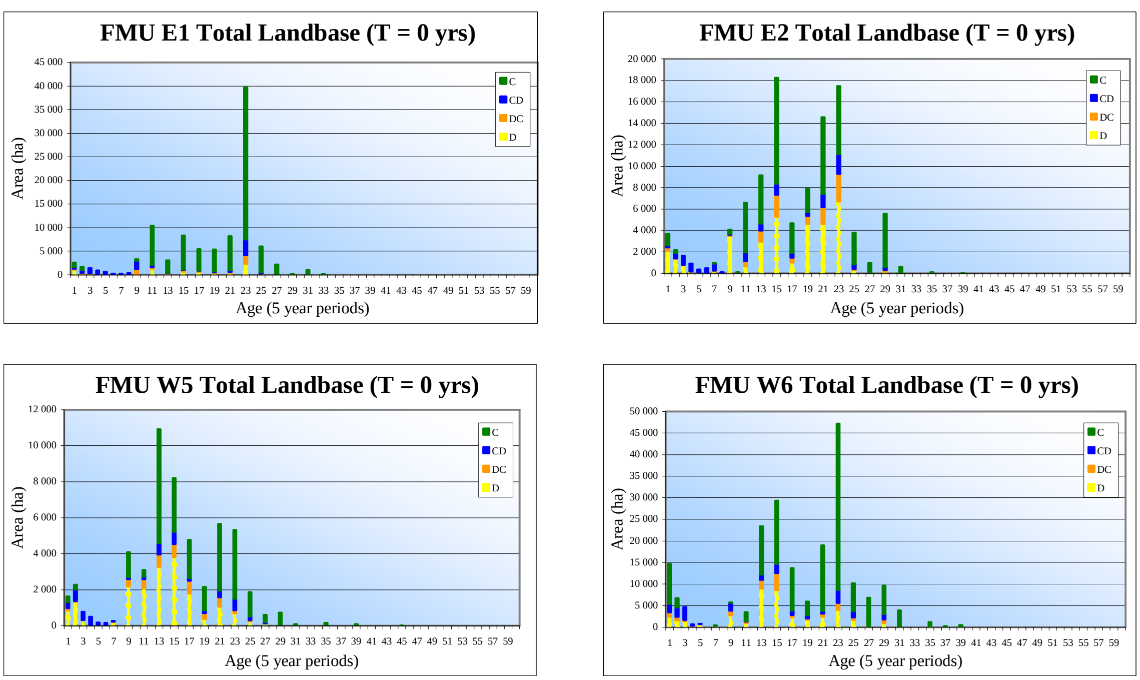


Figure 6.36 Age Class Distribution of the Gross Land Base at T = 0 years

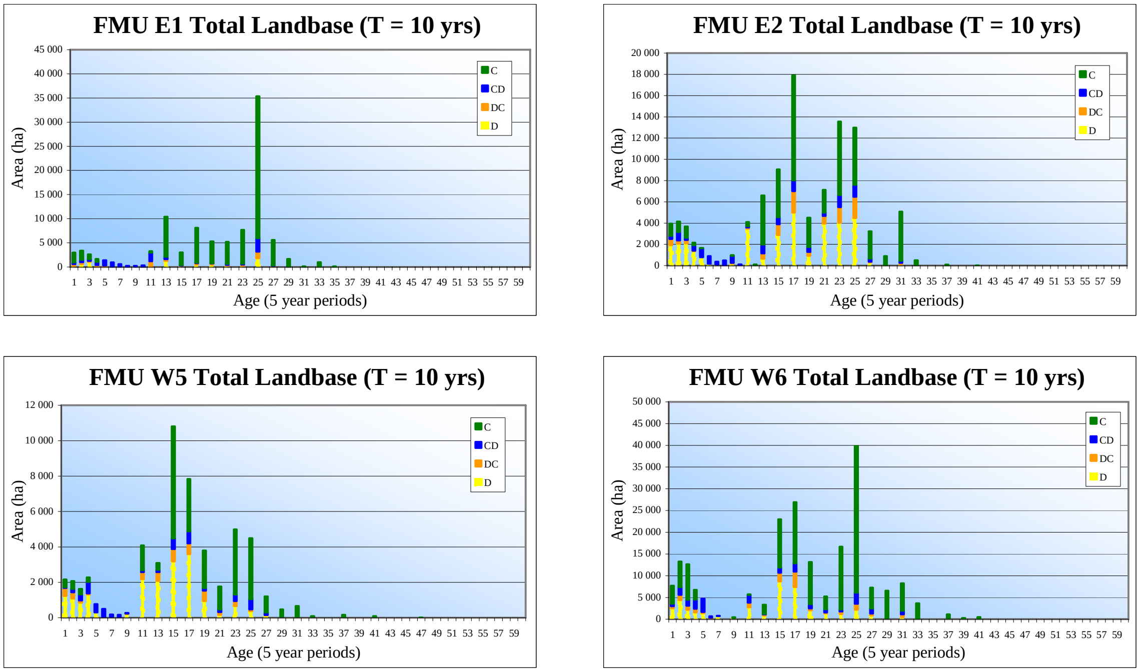


Figure 6.37 Age Class Distribution of the Gross Land Base at T = 10 years

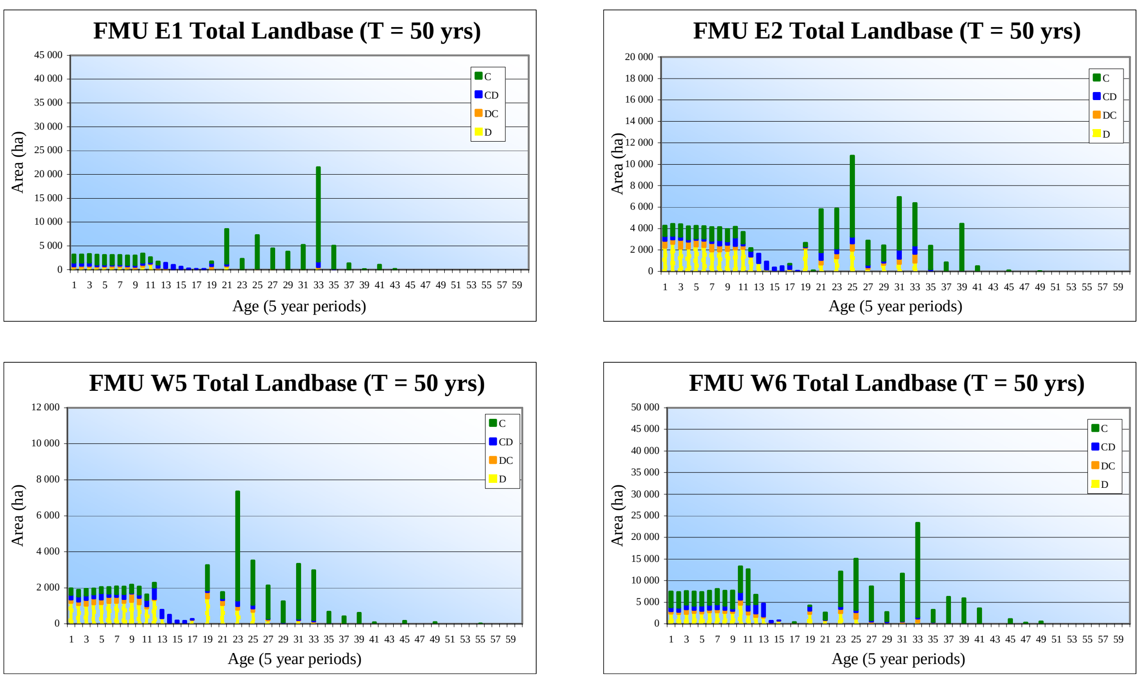


Figure 6.38 Age Class Distribution of the Gross Land Base at T = 50 years

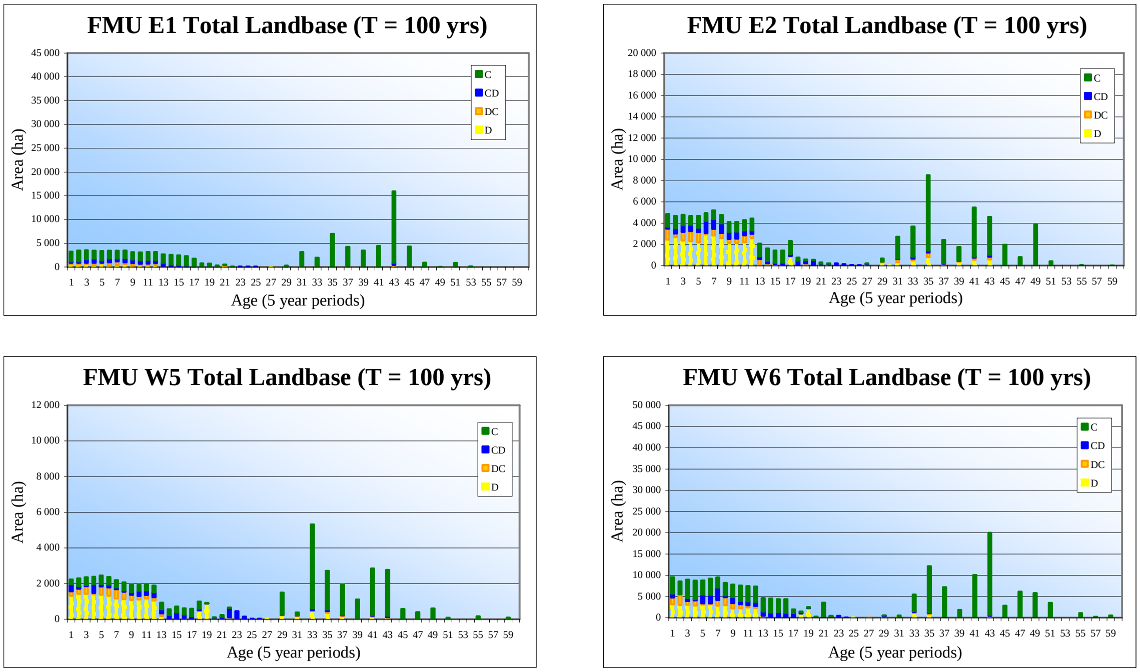


Figure 6.39 Age Class Distribution of the Gross Land Base at T = 100 years

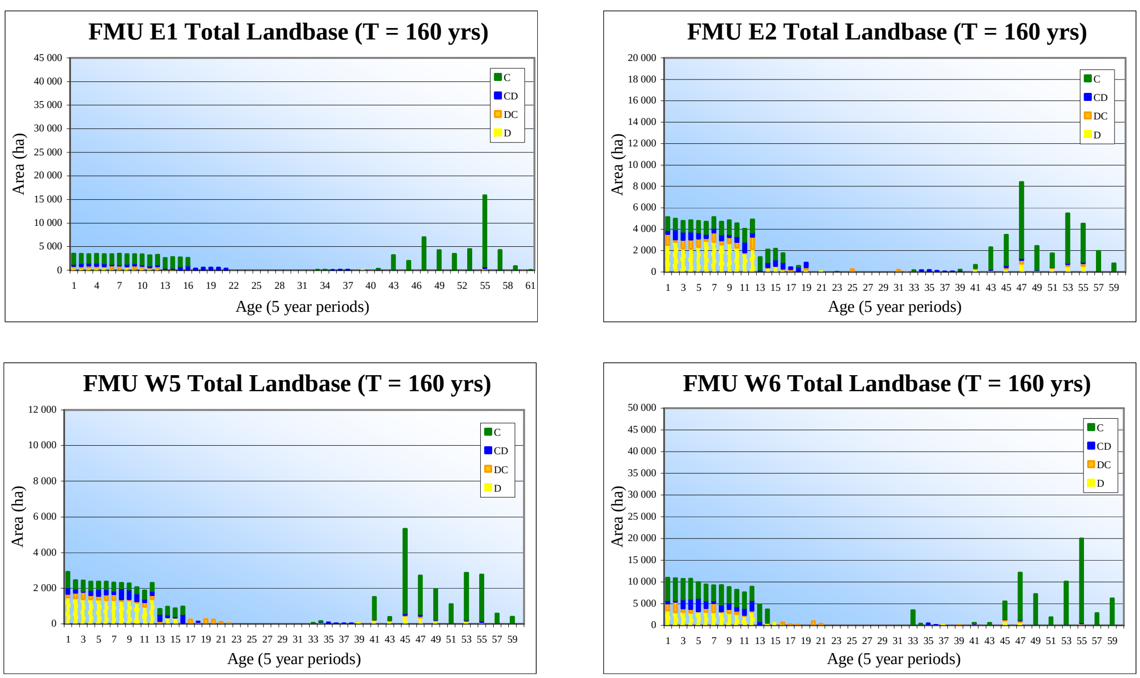


Figure 6.40 Age Class Distribution of the Gross Land Base at T = 160 years

Data shown graphically in Figure 6.15 through Figure 6.40 are shown in tabular form in Appendix 6.9. Appendix 6.9 also contains more detailed information about the harvest levels by strata and age class. Maps of the spatial harvest sequence can be found in Appendix 6.6. A statement and subsequent tables from Weyerhaeuser with respect to quota production chargeability can be found in Appendix 6.8. A patch size database for periods 0, 2, and 10 can be found on the accompanying DVD.

6.14.4 Quotas

The Crown has reserved the right to issue timber licenses to existing quota holders in the FMU. As a means of ensuring that this right is maintained, Weyerhaeuser has determined the obligations to existing quota holders. Table 6.35 through Table 6.38 set out the proposed allocation of harvest volume among licensees.

Table 6.35 Allocation of Volume within FMU E1

E1	Coniferous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Coniferous	Incidental Coniferous	Total Coniferous	Primary Coniferous	Incidental Coniferous	Total Coniferous
Weyerhaeuser	62,226	24,563	86,789	62,226	15,810	78,036
ETP	3,069	0	3,069	3,069	0	3,069
Total	**65,295**	**24,563**	**89,858**	**65,295**	**15,810**	**81,105**
	Deciduous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Deciduous	Incidental Deciduous	Total Deciduous	Primary Deciduous	Incidental Deciduous	Total Deciduous
Weyerhaeuser	22,140	11,733	33,873	22,140	12,289	34,429
ETP	0	0	0	0	0	0
Total	**22,140**	**11,733**	**33,873**	**22,140**	**12,289**	**34,429**

Table 6.36 Allocation of Volume within FMU E2

E2	Coniferous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Coniferous	Incidental Coniferous	Total Coniferous	Primary Coniferous	Incidental Coniferous	Total Coniferous
Weyerhaeuser	5,941	7,604	13,545	5,941	7,352	13,293
EDFOR	33,016	30,415	63,430	33,016	29,407	62,423
MTU	889	0	889	889	0	889
Total	**39,845**	**38,018**	**77,863**	**39,845**	**36,759**	**76,604**
	Deciduous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Deciduous	Incidental Deciduous	Total Deciduous	Primary Deciduous	Incidental Deciduous	Total Deciduous
Weyerhaeuser	80,730	6,871	87,601	80,730	9,122	89,853
EDFOR	0	0	0	0	0	0
MTU	1,500	0	1,500	1,500	0	1,500
Total	**82,230**	**6,871**	**89,101**	**82,230**	**9,122**	**91,353**

Table 6.37 Allocation of Volume within FMU W5

W5	Coniferous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Coniferous	Incidental Coniferous	Total Coniferous	Primary Coniferous	Incidental Coniferous	Total Coniferous
Weyerhaeuser	0	0	0	0	0	0
MTU	22,116	7,878	29,994	22,116	8,215	30,331
Total	**22,116**	**7,878**	**29,994**	**22,116**	**8,215**	**30,331**
	Deciduous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Deciduous	Incidental Deciduous	Total Deciduous	Primary Deciduous	Incidental Deciduous	Total Deciduous
Weyerhaeuser	34,107	0	34,107	34,107	0	34,107
MTU	4,000	11,324	15,324	4,000	10,855	14,855
Total	**38,107**	**11,324**	**49,431**	**38,107**	**10,855**	**48,962**

Table 6.38 Allocation of Volume within FMU W6

W6	Coniferous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Coniferous	Incidental Coniferous	Total Coniferous	Primary Coniferous	Incidental Coniferous	Total Coniferous
Weyerhaeuser	31,409	26,656	58,065	31,409	20,803	52,212
Cold Creek TL	10,000	0	10,000	10,000	0	10,000
MTU/CTP	18,252	0	18,252	18,252	0	18,252
ANC	69,021	0	69,021	69,021	0	69,021
Blue Ridge	30,190	0	30,190	30,190	0	30,190
Millar Western	1,120	0	1,120	1,120	0	1,120
Total	**159,992**	**26,656**	**186,648**	**159,992**	**20,803**	**180,795**
	Deciduous Volumes					
	2004 to 2013 (periods 1 and 2)			2014 to 2023 (periods 3 and 4)		
Company	Primary Deciduous	Incidental Deciduous	Total Deciduous	Primary Deciduous	Incidental Deciduous	Total Deciduous
Weyerhaeuser	83,889	43,555	127,443	83,889	36,843	120,731
Cold Creek TL	0	0	0	0		0
MTU/CTP	0	17,591	17,591	0	17,591	17,591
ANC	0	0	0	0	0	0
Blue Ridge	0	0	0	0	0	0
Millar Western	0	0	0	0	0	0
Total	**83,889**	**61,146**	**145,034**	**83,889**	**54,434**	**138,322**

Table 6.39 details procedure to estimate non-FMA quota allocations.

Table 6.39 Weyerhaeuser Non-FMA Quota Allocations

	E1		E2		W5		W6		FMA	
	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous	Conifer	Deciduous
Mean Gross AAC Grazing	60	51	7,500	13,239	5,965	14,979	1,710	3,802	15,234	32,072
Primary aac (1)	44	45	2,873	12,575	3,495	12,614	1,002	3,194	7,414	28,428
Incidental aac (2)	16	6	4,627	664	2,470	2,366	708	608	7,820	3,643
% allocation of aac to WY – Primary (3)	95.3%	100%	14.9%	100 – 15.3% of 1500	0	100-32.2% of 4000	20.1%	100-2.9% of 17591	N/A	N/A
% allocation of aac to WY – Incidental (4)	100%	100%	20%	100%	0	0	100%	100%	N/A	N/A
Gross Primary Volume allocations to WY (3X1)	42	45	428	12,346	0	11,326	201	2,684	672	26,401
Gross Incidental Volume allocations to WY (4X2)	16	6	925	664	0	0	708	608	1,649	1,278
Gross Grazing AAC to WY (Primary and Incidental)	58	51	1,354	13,010	0	11,326	909	3,292	2,321	27,679
Net Primary Volume allocations to WY	38	38	403	11,111	0	10,193	189	2,416	**630**	**23,758**
Net Incidental Volume allocations to WY	14	5	870	598	0	0	665	547	**1,549**	**1,150**
Net Total Grazing AAC to WY	51	43	1,273	11,709	0	10,193	855	2,963	**2,179**	**24,908**

Table 6.40 through Table 6.43 show area harvested by Forest Management Unit, Land Management Unit, and Harvest Design Area (HDA) for the duration of the SHS. The LMU will be the base unit to gauge the 20% allowable variance of sequenced harvest area.

Table 6.40 FMU E1 SHS Harvest of primary volumes by LMU and H.D.A.

E1	Harvest Design Areas Volumes (m3)							
Moose Creek LMU	Period 1		Period 2		Period 3		Period 4	
H.D.A.	Con	Dec	Con	Dec	Con	Dec	Con	Dec
Broken Cabin	0	0	0	0	115 486	47 151	41 429	4 722
Coyote Creek	0	0	1	0	75	0	110	0
Erith	41 228	33 547	145 704	54 142	0	0	0	0
Fickle Lake	11 586	45 784	9 692	6 480	11 081	16 906	11 600	29 129
Rodney Creek	41 489	58 413	185 835	66 427	149 157	55 685	204 957	88 458
Sang Lake	236 995	74 638	17 701	8 780	386	463	435	0
Svedberg	33 860	2 286	14 661	1 513	97 433	16 698	115 252	15 163

Table 6.41 FMU E2 SHS Harvest of primary volumes by LMU and H.D.A.

E2	Harvest Design Areas Volumes (m3)							
Edson LMU	Period 1		Period 2		Period 3		Period 4	
H.D.A.	Con	Dec	Con	Dec	Con	Dec	Con	Dec
Cricks Creek	9 609	245 700	26 542	111 597	12 574	101 072	9 336	24 732
Deer Hill	47 662	121 254	33 521	95	14 884	56 207	25 593	41 046
Grande Prairie Trail	4 423	201	14 868	22 376	4 070	3 336	11 126	9 821
Grand Trunk	0	0	0	0	2	6	0	0
Medicine Lodge	4 703	4 210	14 982	18 526	34 943	47 205	45 767	8 556
Obed Lake	0	308	10 753	0	14 522	1 791	22 078	16 451
Oldman Creek	90 102	9 063	38 248	28 946	24 714	317	15 931	1 780
Pioneer	0	0	7 010	45 502	3 345	13 422	0	0
Shining Bank East	5 273	109 545	302	0	2 117	0	5 425	102 514
Sundance Creek	224	0	0	10 491	52 786	105 354	30 554	146 308
Surprise Lake	0	0	0	0	1 772	0	3 424	4 055
Swanson	0	0	0	0	15 281	3 196	13 891	72 339
Tom Hill	27 901	17 815	36 192	136 169	24 662	84 934	25 482	33 313
Trout Creek	5 101	17 072	32 262	97 928	11 145	52 736	9 554	6 656

Table 6.42 FMU W5 SHS Harvest of primary volumes by LMU and H.D.A.

W5	Harvest Design Areas Volumes (m3)							
Beaver Meadows LMU	Period 1		Period 2		Period 3		Period 4	
H.D.A.	Con	Dec	Con	Dec	Con	Dec	Con	Dec
East Bank	1 764	0	1 935	0	38 970	4 199	34 665	16 399
Easyford	31 284	122 112	9 918	0	11 815	31 099	17 370	46 166
Hattonford	11 526	0	19 557	128 492	21 386	60 148	12 947	17 471
Keyhole	1 049	13 840	1 526	0	4 101	2 291	3 434	9 261
Lobstick	15 145	22 936	18 264	25 676	9 111	11 170	12 959	22 450
Lodgepole	7 644	43 467	2 331	0	7 270	20 719	1 546	14 777
Lost Elk Ridge	10 332	7 795	3 469	0	4 572	63 414	11 860	52 510
Mackay Lake	5 073	0	15 212	64 139	2 977	2 021	2 984	9 116
McLeod	45 729	0	50 127	0	22 127	23 197	21 647	30 386

Table 6.43 FMU W6 SHS Harvest of primary volumes by LMU and H.D.A.

FMU W6	Harvest Design Areas Volumes (m3)							
	Period 1		Period 2		Period 3		Period 4	
LMU / H.D.A.	Con	Dec	Con	Dec	Con	Dec	Con	Dec
Carrot Creek								
Nine Mile	38 304	110 908	138 404	0	36 795	2 047	28 437	8 515
North Rat Creek	53 560	0	16 353	168 949	0	2 611	16 962	3 653
Tower	17 292	15 325	4 208	5 176	3 095	13 630	33 779	16 404
Cynthia								
Bigoray	27 945	50 947	26 731	10 808	18 032	20 538	17 400	15 103
Chip Lake	7 182	0	356	0	145 052	92 767	77 759	24 565
Eta Lak	215 591	145 935	1 738	0	64 347	153 408	82 207	100 127
Granada	121 003	121 578	0	0	0	3 403	0	2 633
No Jack South	10 789	7 622	123 947	89 489	7 099	26 472	5 694	23 756
Paddy Creek	3 346	43 071	60 316	104 164	2 542	2 666	150 265	157 739
Sinkhole Lake	40 174	42 101	0	0	35 366	27 917	50 142	30 064
Wolf Lake								
Big Rock	48 577	27 250	112 462	9 825	5 594	0	37 307	0
Coyote Creek	5 148	14 780	90 954	5 948	1 063	657	64 801	4 923
Minnow Lake (N&S)	0	0	0	0	221 393	88 207	87 469	29 871
North Pembina	133 150	78 171	63 363	2 344	204 924	6 119	67 019	10 820
South Rat Creek	11 546	57 105	166 695	79 597	94 689	39 839	76 634	41 242
Zeta Lake	411 120	63 785	64 358	4 130	31 898	150	69 753	11 059

Table 6.44 Annual Harvest Volumes (FMA & Non-FMA) by Operator

FMA	**(Periods 1 and 2)**					
	Coniferous Volumes (m^3/yr)			**Deciduous Volumes (m^3/yr)**		
Company	**Primary**	**Incidental**	**Total**	**Primary**	**Incidental**	**Total**
Weyerhaeuser	99,576	58,823	158,399	220,866	62,159	283,024
Cold Creek TL	10,000	0	10,000	0	0	0
E2 MTU	889	0	889	1,500	0	1,500
W5 MTU	22,116	7,878	29,994	4,000	11,324	15,324
W6 MTU/CTP	18,252	0	18,252	0	17,591	17,591
ANC	69,021	0	69,021	0	0	0
Blue Ridge	30,190	0	30,190	0	0	0
EDFOR	33,016	30,415	63,430	0	0	0
ETP	3,069	0	3,069	0	0	0
Millar Western	1,120	0	1,120	0	0	0
Sub -Total	**287,248**	**97,116**	**384,364**	**226,366**	**91,074**	**317,439**

Non-FMA	**Coniferous Volumes (m^3/yr)**			**Deciduous Volumes (m^3/yr)**		
Company	**Primary**	**Incidental**	**Total**	**Primary**	**Incidental**	**Total**
Weyerhaeuser	630	1,549	2,179	23,758	1,150	24,908
Sub -Total	**630**	**1,549**	**2,179**	**23,758**	**1,150**	**24,908**
TOTAL	**287,877**	**98,665**	**386,543**	**250,124**	**92,223**	**342,348**

6.14.5 Combined Primary and Incidental AACs

Primary and incidental volumes have been difficult to manage over the years since the FMA was signed in 1997. Primary volumes were chargeable to the approved AAC while the incidental volumes were non-chargeable. To alleviate this problem, the proposal being put forward in this DFMP is to manage both as one AAC. In effect, both the primary and incidental volumes harvested from the FMA would be 100% chargeable.

Weyerhaeuser and EDFOR have a combined allocation of 100% of the incidental timber on the FMA, and have agreed in principle that this is the most efficient manner to handle the incidental component generated from the two primary land bases.

Theoretically, by the end of the decade (periods one and two), if the spatial harvest sequence has been followed relatively closely, the results should show that both cuts have been managed effectively. Table 6.45 summarizes the proposed annual allowable cut as described above.

Table 6.45 Total Conifer and Deciduous (Combined Primary and Incidental) Annual Allowable Cuts by Operator

FMA	(Periods 1 and 2)	
	Coniferous Volumes (m^3/yr)	Deciduous Volumes (m^3/yr)
Company	Total	Total
Weyerhaeuser	158,399	283,024
Cold Creek TL	10,000	0
E2 MTU	889	1,500
W5 MTU	29,994	15,324
W6 MTU/CTP	18,252	17,591
ANC	69,021	0
Blue Ridge	30,190	0
EDFOR	63,430	0
ETP	3,069	0
Millar Western	1,120	0
Sub -Total	**384,364**	**317,439**

Non-FMA	Coniferous Volumes (m^3/yr)	Deciduous Volumes (m^3/yr)
Company	Total	Total
Weyerhaeuser	2,179	24,908
Sub -Total	**2,179**	**24,908**
TOTAL	**2,179**	**24,908**

6.15 Conclusion

This timber supply analysis has focused on defining expected harvest levels that can reasonably be maintained over a long period of time (the next 160 years). The basis for this is largely the relative certainties of outcome inherent in current management practices, which are supported by a significant quantity of empirical evidence. This analysis purposely avoided speculation in the realm of potential management practices in terms of “what could be, or, what should be”. This is consistent with at least two major tenets of the management objective of demonstrating sustainability:

- Sustainability should be based on what we do know at present from an empirical perspective about the condition of the forest and our ability to manage it.
- Sustainability should resist making decisions and value judgments today regarding choices and decisions that future generations may or may not make regarding their values and uses of forests. In other words, we can not know today how future generations will value the impacts of today’s management practices that affect the state of the forest in their time.

It is important to make forest management decisions today that will not unduly affect choices and opportunities of future generations.

6.16 References

Remsoft. 2005. www.remsoft.com Site visited on July 7th, 2005

MOSEK 2005. www.mosek.com Site visited on July 7th, 2005

Appendix 6.1: Defining the Net Harvestable Land Base

Appendix 6.2: Developing Yield Forecasts

Appendix 6.3: Growth and Yield Monitoring Plan for the Pembina Forest Management Agreement Areas

Appendix 6.4: Marginal Stands

Appendix 6.5: Timber Supply Forecasting

Appendix 6.6: Map of Spatial Harvest Sequence

Appendix 6.7: Sensitivity Analysis

Appendix 6.8: Timber Allocation Tables

Appendix 6.9: Supporting Tabular Information

Appendix 6.10: Regeneration Lag Calculation

Appendix 6.11: 15/10 Utilization

Appendix 6.12: Supporting Maps

A. SHS by Disposition Holder (first 20 years)
B. Interior Older Forest at Year 0
C. Interior Older Forest at Year 0 Accounting for Seismics
D. Interior Older Forest at Year 10
E. Interior Older Forest at Year 10 Accounting for Seismics
F. Interior Older Forest at Year 50
G. Interior Older Forest at Year 50 Accounting for Seismics
H. Seral Stages at Year 0
I. Seral Stages at Year 10
J. Seral Stages at Year 50
K. Patch Size Classes at Year 0
L. Patch Size Classes at Year 10
M. Patch Size Classes at Year 50
N. Historical Cutovers
O. Marginal Stands