

C5 FOREST MANAGEMENT PLAN 2006–2026

APPENDIX 9A. SILVICULTURE

PLANNING LEVEL SILVICULTURE PRESCRIPTION — C5 FOREST MANAGEMENT UNIT

As described in the Alberta Forest Management Planning Standard (June 2005), a silviculture prescription is required to accompany a Forest Management Plan (FMP). The intent of a silviculture prescription, at this broad planning scale, is to serve the principles of *diligence*, *good science* and *commitment* in carrying out silviculture practices that link directly to achieving the pertinent FMP objectives, and the projections and assumptions of the regenerated yield as proposed in the Timber Supply Analysis. The resource manager is expected to know and understand the dynamics of the ecology they are intending to work within, and know the assumptions and projections that have been applied to the Timber Supply Analysis.

The following details the expectations of the planning level silviculture prescription in the context of the three principles mentioned above:

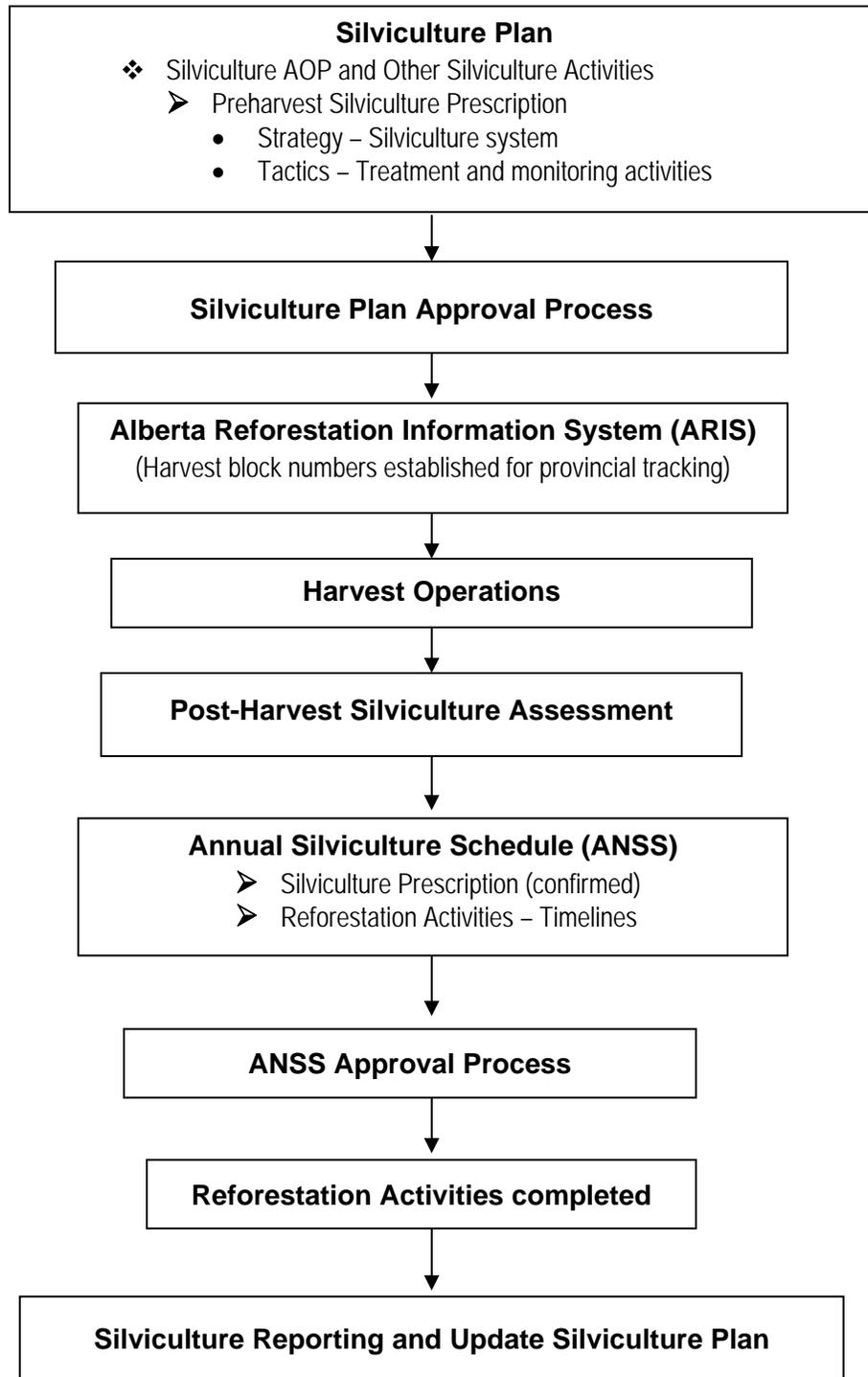
1. **Diligence**: In the context of the silviculture prescription, diligence is the amount of attention and effort the resource manager puts into understanding and addressing the dynamics involved in successfully establishing a regenerated stand. This regenerated stand is expected to meet the regenerated yield projections and assumptions used to calculate the annual allowable cut. Also, it is expected the silviculture prescription will capture, as much as possible, site limitations to establishing the regenerated stand, species proportions in mixedwood and pure stands, methods of establishing microsites for seedlings, transitions expected in the regenerated stand as it moves to maturity, and reforestation standards expected.
2. **Good Science**: A good silviculture prescription must work within a biological and ecological context. The application of good science should convey the expectation that a resource manager will use the most current and local expertise, and reference biological and ecological principles in order to guarantee success in achieving the regenerated yield objectives.
3. **Commitment**: The silviculture prescription, at this level of planning, communicates that the resource manager is firmly committed to achieving the regenerated yield objectives, and has created a detailed proposal that links to the regenerated yield curves. The silviculture prescription also becomes the benchmark to evaluate the commitment and success of the resource manager in maintaining the annual allowable cut through the next rotation.

The planning level silviculture prescription matrix for the C5 DFMP is contained in Table 1. The table is divided into conifer regenerated yield trajectories, with information specific to site limitations, stand proportion expectations and proposed treatment strategies. Some columns also contain proposed action items and timelines. The information in the table was generated from professional experience in this ecosystem, knowledge of species silvics, input from specialists and local forest staff, and specific recommendations from a Public Lands and Forests Division paper entitled “Porcupine Hills Harvesting and Silviculture Strategies: Minimizing the Risks to Successful Regeneration of Cutovers” (Klappstein, Barnhardt and Greenway, January 2005; see Appendix 9B).

This silviculture prescription is intended to serve as the benchmark for establishment of regenerated stands, and to achieve growth performance equivalent to or greater than the achievement proposed in the regenerated yield curves. A direct result of this level of achievement will be maintenance of the annual allowable cut. Further refinements and/or amendments to the Planning Level Silviculture Prescription strategies will be proposed through the annual silviculture plan.

Two flowcharts are included that provide a perspective on the management process of silvicultural activities for the C5 FMU. The Silvicultural Plan Process Flowchart illustrates the process for implementing an operational program; the Silvicultural Activities Flowchart provides a comprehensive summary of the kinds of activities encompassing reforestation activities in the province.

Silviculture Plan Process Flowchart



Silviculture Activities Flowchart

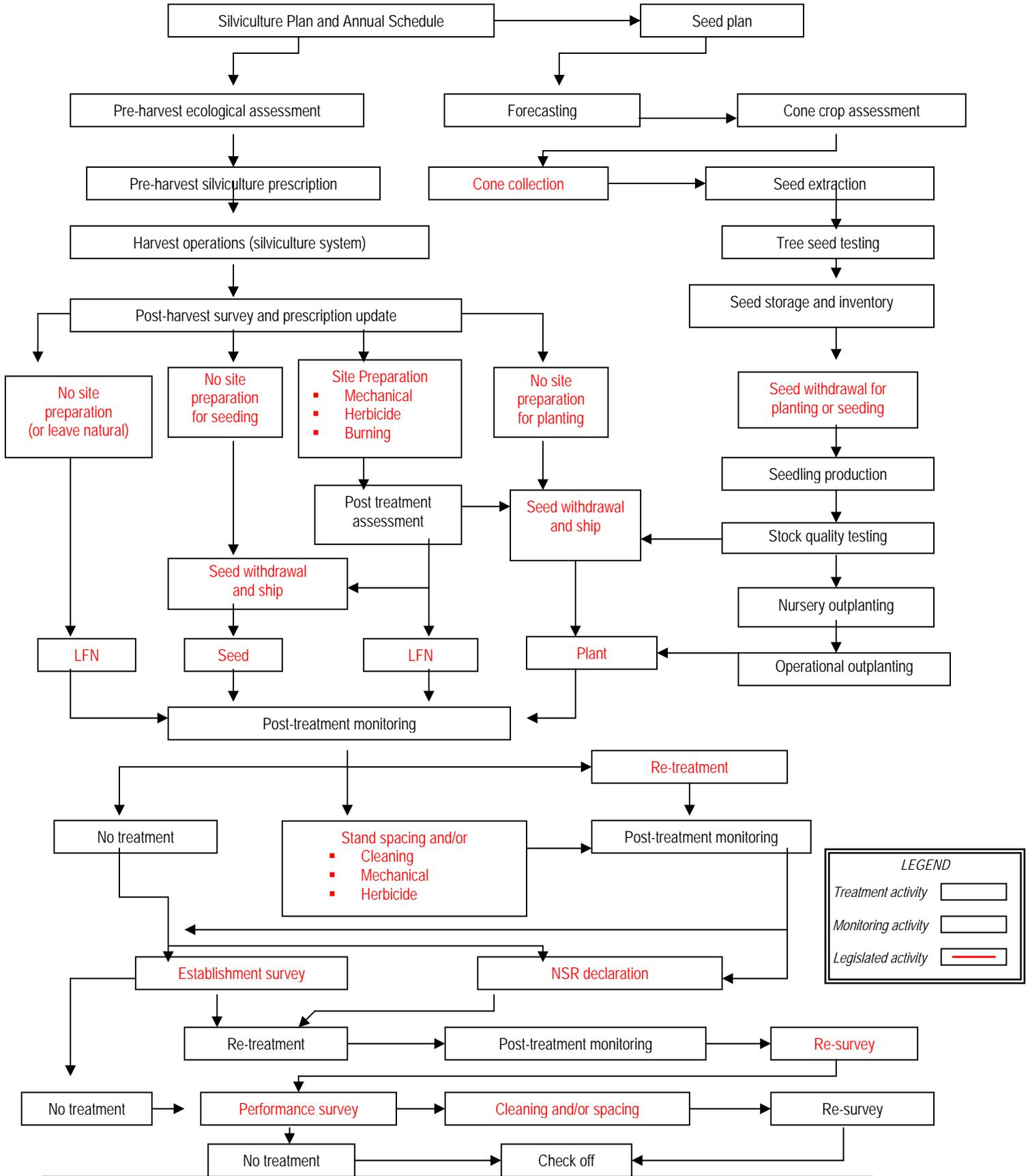


Table 1. C5 planning level silviculture matrix (2005).

1	2	3	4	5	6	7	8	9	10	11	12	13
Regenerated Yield Trajectory (leading + secondary species)	Strata Standard (C, CD, DC, D)	Transitions Toward Climax	Species Proportions	Limitations to Crop Establishment	Silviculture System	Site Prep	Seedling Establishment (includes LFN)	Seedling Density	Reforestation Stage Intervention	Post-Reforestation Stage Intervention	Seed/Vegetative Collection	Timing
YC1 - C-Fd	C	May be in a mix with Sw or PI, or remain pure. Climax in the Montane should be Fd-PI, but may also be Fd-Sw.	Pure conifer (> 80%), but variable between conifer species. Need to maintain Fd as a leading species in the regenerated stand, minimum >50%.	Winter desiccation (<i>chinook winds</i>), drought due to climate and grass matting (<i>most prevalent on south and west facing slopes</i>), low germination potential, seed availability, frost damage.	Partial cut, seed tree, shelterwood.	Site specific (<i>relative to aspect in the Porcupine Hills</i>). None, light drags, harrow, shallow disk trenching.	Plant Sw and Fd, and PI if not establishing via LFN. LFN for PI component if cone/seed source available and viable. Might also artificial seed PI.	Minimum 1400 stems/ha. May need to increase minimum stems/ha on south and west facing slopes.	Fill-in planting depending on significance of cumulative mortality.	None	Assess seed supply immediately. Cone collection planning to start in timber year 2005/2006. Operational supply of Fd seed to be maintained and replenish to maintain viability.	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.
YC2 - C-Px Montane, All	C	May be in a mix with Sw or Fd, or remain pure. Climax is usually PI-Fd.	Pure conifer (> 80%), but variable between conifer species. PI to be maintained as leading species (or Pw, Pf) in the regenerated stand, minimum >50%. Fd to be maintained in proportions as per parent stand.	Winter desiccation (<i>chinook winds</i>), drought, germination potential, cone/seed availability/viability, frost damage.	Clear cut, but leave seed tree/shade component in Fd.	Light or heavy drags, harrow, Hensley Teeth.	LFN for PI, Pw, Pf. Planting or artificial seeding in Pinus as contingency for poor cone/seed availability/viability. May have to plant Fd to maintain population.	Minimum 1600 stems/ha., preferred 1800 - 2000 stems/ha in establishment phase.	Fill-in plant if regen initially fails.	PCT (pre-commercial thin) or CT (commercial thin) depending on juvenile stand densities and productivity.	Assess seed supply immediately. Cone collection planning to start in timber year 2005/2006.	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.
YC3 - C-Px Sub-alpine AB	C	May be in a mix with Sw, Pw or Pf, or remain pure. Climax is pure PI.	Maintain leading species Pinus > 80%. Maintain associate conifer species, if feasible economically and ecologically, in the proportions found in the parent stand.	Winter desiccation (<i>chinook winds</i>), drought, germination potential, cone/seed availability/viability, frost damage.	Clearcut	Light or heavy drags, harrow, Hensley Teeth.	LFN for Pinus. Planting as contingency for poor cone/seed availability/viability. Planting and/or UP (understorey protection) to maintain associate conifer species.	Minimum 1600 stems/ha.	Fill-in plant if regen initially fails.	PCT or CT depending on juvenile stand densities and productivity.	Assess seed supply immediately. Cone collection planning to start in timber year 2005/2006.	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.

1	2	3	4	5	6	7	8	9	10	11	12	13
YC4 - C-Px Sub-alpine CD	C	May be in a mix with Sw, Pw or Pf, or remain pure. Climax is pure Pl.	Maintain leading species Pinus > 80 %. Maintain associate conifer species, if feasible economically and ecologically, in the proportions found in the parent stand.	Winter desiccation (<i>chinook winds</i>), drought, germination potential, cone/seed availability/viability, frost damage.	Clearcut	Light or heavy drags, harrow, Hensley Teeth.	LFN for Pinus. Planting or artificial seeding as contingency for poor cone/seed availability/viability. Planting and/or understory protection to maintain associate conifer species.	Minimum 1600 stems/ha., preferred 1800 - 2000 stems/ha in establishment phase.	Fill-in plant if regen initially fails.	PCT or CT depending on juvenile stand densities and productivity.	Assess seed supply immediately. Cone collection planning to start in timber year 2005/2006.	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.
YC5 - C-Sx Montane, All	C	Sw or Se in association with Fd and Pinus. Climax is Picea, with some Fd in small proportions, likely on north & east facing slopes.	Pure conifer (> 80%), but variable between conifer species. Picea to be maintained as leading species (Sw or Se) in the regenerated stand, minimum >50%. Fd to be maintained in proportions as per parent stand.	Winter desiccation (<i>chinook winds</i>), drought, germination potential related to satisfactory seedbed availability and soil moisture, cone/seed availability/viability, prevailing winds and seed cast, frost damage.	Clearcut, shelterwood	None; thinly developed soil profiles and slopes.	Planting of Picea species to compensate for risk of low germination potential due to potential for drought on sites. Planting of Fd to ensure maintenance of minimum proportions. Consider using an efficient plug due to droughtiness. Choose protected and elevated microsite to guard against frost damage. Should expect a significant amount of straight-planting, so choice of natural microsite is important to communicate to contractors.	Minimum 1600 stems/ha. in Picea species.	Fill-in planting depending on significance of cumulative mortality.	None	Affirm seed supply in 2005/2006. Maintain adequate supply of viable seed to support planting of Picea species to meet minimum densities recommended. Seed supply plan to be developed by the end of 2006/2007.	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.
YC6 - C-Sx & C-Fa/La Sub-alpine AB	C	May be a mix with Sw, Se, Fa & La present, or pure Sw. Climax is relatively the	Pure conifer (> 80%), but variable between conifer species. Picea to be maintained as leading species (Sw or Se) in the regenerated stand, minimum >50%.	Winter desiccation (<i>chinook winds</i>), germination potential related to satisfactory seedbed availability and soil moisture, cone/seed	Clearcut. Shelterwood could be considered on lee sites. Blowdown is a significant	Hensley Teeth (<i>mixing/spot microsite</i>) on upland. Production/hoed mound in low areas. Site	Planting of Picea species to compensate for risk of low germination potential due to droughtiness of sites. Consider using an	Minimum 1600 stems/ha.	Fill-in planting depending on significance of cumulative mortality.	None	Affirm seed supply in 2005/2006. Maintain adequate supply of viable seed to support planting	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.

1	2	3	4	5	6	7	8	9	10	11	12	13
		same, likely majority Sw.	Fa/La may be maintained through UP or planting depending on economical/ecological feasibility.	availability/viability, prevailing winds and seed cast, frost damage.	factor in this environment.	prep, if deemed necessary to raise the bed (as protection against frost), should be done as a spot treatment and be cognizant of thinly developed soil profiles, coarse soil textures and slopes.	efficient plug due to droughtiness and shallow soil profiles. Choose protected and elevated microsite to guard against frost damage. Should expect a significant amount of straight-planting, so choice of natural microsite is important to communicate to contractors.				of Picea species to meet minimum densities recommended. Seed supply plan to be developed by the end of 2006/2007.	
YC7 - C-Sx & C-Fa/La Sub-alpine CD	C	May be a mix with Sw, Se, Fa & La present, or pure Sw. Climax is relatively the same, likely majority Sw.	Pure conifer (> 80%), but variable between conifer species. Picea to be maintained as leading species (Sw or Se) in the regenerated stand, minimum >50%. Fa/La may be maintained through UP or planting depending on economical/ecological feasibility.	Drought, germination potential related to satisfactory seedbed availability and soil moisture, cone/seed availability/viability, prevailing winds and seed cast, frost damage, winter desiccation (chinook).	Clearcut, seed-tree.	Hensley Teeth (<i>mixing/spot microsite</i>) on upland. Production/hoemound in low areas. Site prep, if deemed necessary to raise the bed (as protection against frost), should be done as a spot treatment and be cognizant of thinly developed soil profiles, coarse soil textures and slopes.	Planting of Picea species to compensate for risk of low germination potential due to droughtiness of sites. Consider using an efficient plug due to droughtiness and shallow soil profiles. Choose protected and elevated microsite to guard against frost damage. Should expect a significant amount of straight-planting, so choice of natural microsite is important to communicate to contractors.	Minimum 1600 stems/ha. Depending on severity of site exposure, may opt to 2000 stems/ha. as a hedge against increased potential mortality.	Fill-in planting depending on significance of cumulative mortality.	None	Affirm seed supply in 2005/2006. Maintain adequate supply of viable seed to support planting of Picea species to meet minimum densities recommended. Seed supply plan to be developed by the end of 2006/2007.	This prescription to be applied to appropriate stands harvested in 2006/2007 and later.

NOTE: For the cutblocks harvested post 1991 and fall into the Yield Curve category YC-C-Re, these will have to be assigned to one of the above 7 yield trajectories, or a combination of these.

Column Explanations/Expectations

1. Regenerated Yield Trajectory: The regenerated stand should be pure or mixed, and may have a secondary species. Each regenerated yield trajectories should be found to contribute to the cut via the TSA.

2. **Strata Standard:** Alberta uses C, CD, DC and D as an active label/designation. Translate the Regenerated Yield Trajectory into one of these strata standards.
3. **Transitions Towards Climax:** Will the regenerated stand move through another stand structure before ending up at what is projected? May have implications on future cut calculations, balancing and initial silviculture prescriptions.
4. **Species Proportions:** If a mixedwood, what is expected between coniferous and deciduous content? In pure conifer, each species expected to contribute to the whole stand structure (i.e., Sw, Pl and Fd in the southern foothills). There are ecological implications here as well.
5. **Climatic/Site Limitations:** What factors in climate and onsite are expected to significantly increase the risk of **not** reaching the regenerated yield objective? These will become the justification (good science) for the treatments chosen.
6. **Silviculture System:** Formerly "harvest system", but now tied to regenerated yield achievement. Could be clearcut, shelterwood, seed-tree partial cut, or understory protection depending on the regenerated yield objective.
7. **Site Prep:** Linked to site limitation and/or species to be established. Could be raised bed, drag or mixing.
8. **Seedling Establishment:** How will the seedling be put on the site—planting, artificial seeding, LFN.
9. **Seedling Density:** Linked to the regenerated yield objective. This is one of the major indicators of silviculture commitment along with the proposal to plant a site.
10. **Reforestation Stage Intervention:** The reforestation state is year 0 to year 14. The objective is to get the regenerated stand to free to grow (FTG). In the reforestation stage, there is the establishment phase and the performance phase, and in each of these phases one might choose some type of intervention to ensure the objective is reached. This could include herbicide (chemical) or mechanical for grass, herbicide for competition, fill-in plant for mortality, etc. This is a major part of the reforestation commitment.
11. **Post-Reforestation Stage Intervention:** After year 14, could be pre-commercial thin, commercial thin, fertilization. Part of a longer-term commitment.
12. **Seed/Vegetative Collection:** Intentions for cone collection, seed collection/extraction/storage, cuttings, transplants, etc. Part of the detail required from the Planning Standard and in keeping with expectations of the Standards for Tree Improvement in Alberta (STIA).
13. **Timing:** Another major part of the commitment. When it is expected the silviculture task will be delivered.

PRE-HARVEST AND POST-HARVEST SILVICULTURE ASSESSMENTS IN SILVICULTURE PLANNING AND PRESCRIPTIONS

The Pre/Post-Harvest Silviculture Assessment is usually performed in advance of harvest and then applied again as a follow-up to harvest to confirm previous assumptions and projections, and flush out unexpected results and conditions that may affect achieving the reforestation objective. The Assessment is usually delivered in the form of a survey, with ground plots established in the parent stand that is about to become a cutblock, with measurements taken of various site and climate attributes. Data from this survey are analyzed and a silviculture assessment is made of the site. The trends, projections, measurements and observations made, matched to the reforestation objective, are then used to create and justify a Silviculture Prescription.

The Silviculture Prescription shows what site treatments are planned for the cutblock over time in attempting to achieve the objective and meet the Reforestation Standard. The same approach may be used in a post-harvest situation as confirmation of the pre-harvest result. Also, some cutblocks that did not receive a pre-harvest assessment, but still require a treatment prescription, could receive only a post-harvest assessment.

Pre-harvest Silviculture Assessments are expected to be delivered within an ecological perspective. Based on the concept that a plant community is a “group of plant species that co-exist within a given area”¹, the person doing the assessment should be able to move through a plant community and identify and measure the various characteristics of that community. For efficiency, those drivers deemed to have greater effect on the productivity objective are usually measured. The following are some of the assessment attributes or ecological characteristics that may be measured:

- dominant and co-dominant overstory species
- understory species
- tree species reproductive characteristics
- moisture regime
- nutrient regime
- soil structure, rooting depth, chemistry, texture
- groundwater movement (drainage class)
- depth to water, depth to gleying
- slope
- slope position
- aspect
- frost risk (cold air drainage potential), frost heave risk
- successional characteristics
- natural subregion
- vegetation competition potential
- type of vegetative competition expected

¹ *The Forest Site Interpretation and Silvicultural Prescription Guide for Alberta; Hinton Training Centre, Public Lands and Forests Division, SRD, 1995; pp: 7*

- cattle congregation areas that may affect reforestation
- map site topographical features: hills/slopes, watercourses, wildlife habitat characteristics, rare species location, historical sites.

The Pre-harvest Assessment is usually carried out by using plots for surveying the area of forest about to be cut. A random number of plots are calculated to adequately fill the area, then field personnel establish these plots and take the appropriate measurements. Field personnel are usually guided by a field manual and tally sheet, and should be experienced in this type of survey so there will be a greater likelihood of capturing all the relevant site measurements. All the information/data is gathered, summarized in the office (usually in spreadsheets), and then a Silviculture Prescription decision is made and recorded.

The Silviculture Prescription may have a direct effect on the silvicultural system chosen. The forest manager must understand how the choice of the silvicultural system can affect achievement of the silvicultural objective. A silviculture system is defined as a “cycle of activities by which a forest is harvested, regenerated and tended over time.”² The silviculture systems available for consideration include clearcutting, shelterwood, seed tree, selection cutting and patch cutting.

When undertaking a pre-harvest or post-harvest assessment, there are two publications that are to be considered as the standards for guidance and protocol in delivering these assessments. These publications are “A Field Guide to Ecosites of Southwestern Alberta” (Archibald, Klappstein and Corns) and “The Forest Site Interpretation and Silviculture Prescription Guide for Alberta” (Hinton Training Centre 1995). Another reference standard for all assessment work performed in C5 will be the “Natural Regions of Alberta” Map (August 2005) and the “Seed Zones of Alberta” Map (July 2005).

These publications and maps provide most of the data categories, general site information and expectations, administrative boundaries and procedures for diligent delivery of an on-site assessment. The intent in standardizing this material is to help ensure all forest and ecological managers on this landscape are working within the same protocols and parameters, thereby supporting consistency of application and result.

A forest manager is expected to apply his/her strategies and decisions in a diligent manner. The Pre-harvest/Post-harvest Assessment and the eventual Silviculture Prescription are the main products of that diligence. It is expected the forest manager will choose experienced and properly trained staff to deliver the field survey. It is also expected that the forest manager will choose effective, precise and defensible assessment strategies and mechanisms. Choosing not to do a silviculture assessment or to remain ignorant of the site characteristics and dynamics occurring will increase the risk of the reforestation objective not being met. Silviculture Prescriptions are required to be justified and auditable (i.e., when a silviculture prescription is proposed, it must be clearly articulated and detailed enough such that when these are audited, the person doing the audit is able to observe clearly the logic, intent and reasoning that were put into the prescription). The level of diligence within the Silviculture Prescription is directly related to the efforts and precision applied to the Silviculture Assessment.

² *The Forest Site Interpretation and Silvicultural Prescription Guide for Alberta; Hinton Training Centre, Public Lands and Forests Division, SRD; 1995; pp: 47*