Reforestation Standard of Alberta

Effective May 1, 2018 to April 30, 2019

Reforestation Standard of Alberta

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An official digital copy of Reforestation Standard of Alberta can be obtained by visiting the department's website at forestry.alberta.ca and use the following search term: "Reforestation Standard of Alberta".

The official Reforestation Standards of Alberta should be consulted for all purposes of interpreting and applying the standard.

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1 Version and improvement history

The Reforestation Standard of Alberta (RSA) became the standard for determining the level of reforestation success relative to approved forest management plans on May 1, 2010. Subsequent improvements to the standard are summarized below.

Date	Approved by	Improvement
May 1, 2011	Darren Tapp	*Section 3. MAI standards, declarations, subdivision of cutblocks, and balancing* Table 3-1. Summary of stratum declarations, subdivision of cutblocks, and balancing activities by Timber Year of Cut and regenerated yield based system commencement date has been updated to reflect additional FMUs. *Section 4. Establishment survey* Section 4.9.4 Plot assessment. A new tally sheet (Establishment Tally Sheet B) has been added to reflect the use of GPS for locating plots in the field (Appendix 3). These are plots that have had their plot locations pre-determined using GIS. For those plots located using a compass or GPS (as a compass) and distance measuring device, surveyors shall use Establishment Survey Tally Sheet A. Section 4.9.9 Acceptable tree stocking calculations. The Establishment survey Summary Sheet (Appendix 3) has been reformatted. Section 4.11 Opening status and stratum assignment. An intensive survey must be used to confirm a Let-It-Grow (LIG) treatment prescription. Section 4.14 Understory Protection Standards. Mixed aspen/spruce understory protection standards are being developed and will be available on the SRD website in the near future. *Section 5. Performance survey* Section 5.4.1.1 Standards for submission of openings to Alberta. A complete and final shape file must be submitted to Alberta by 31 January annually. Alberta will post a map of the annual program and send out letters of declaration by 28 February. Timber disposition holders are to return letters of declaration by 15 March annually. Table 5-9 Minimum sample size requirements by species composition strata. Douglas-fir has been added to the list of strata. The sample size is 15 for this stratum. Section 5.4.5.7 Field sample selection computer program. The Sample Selection Tool (v20110311p) and associated User's Manual is the standard for selecting Sample Units to sample in

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		the field. Section 5.6.2 Opening MAI and composition label compilation procedures. The RSA Compiler (v20110331pP and associated User's Manual is the Performance survey compilation standard for the Aerial Stratification and Non-photo Systems. The Microsoft Access file created by the compilation process shall be submitted to FMB as outlined in Sections 5.7.6.1 and 5.7.7.1 (Annual Reporting). This reporting requirement is reflected in the Reporting checklist and validations (Appendix 20). *Appendices* Appendix 2 Acceptable tree species. A complete list of acceptable tree species by FMA and FMU is available. Appendix 7 Reforestation Stocking Survey Reporting Cover Page has been updated to include the listing of opening numbers for which regeneration survey audits were completed. Appendix 17 Compiled GYPSY input variables description and data dictionary. The description of the input variables (stand age, density, total age, site index, percent stocking, and basal area) was part of the 2010 RSA (Section 5.6.2.2). This description can now be found in Appendix 17. Appendix 19 Opening MAI and label compilation procedures and data dictionaries. The description of the compilation procedures (computing sampled strata-level MAI, applying sampled strata-level MAI to population of openings, computing area-weighted MAI for openings, and generating area-weighted strata composition labels for openings) was part of the 2010 RSA (Section 5.7). This description can now be found in Appendix 19. Appendix 21 Glossary. Terms have added to the Glossary.
May 1, 2012	Darren Tapp	*Section 2. General reforestation survey standards* Section 2.1. Interpreter and field surveyor qualifications: Clarification of what is meant by 'under the direct supervision of a RFP or AVI Level III Interpreter'. *Section 4. Establishment survey* Section 4.3. Timing: Table 4-1 Establishment survey timing and opening eligibility by Timber Year of Cut was expanded to the 2017/2018 Timber Year of Cut. Section 4.9.7. Establishment Survey Field Map Sheet: Table 4-6. Establishment Survey Field Map Sheet information by Establishment survey type was added. Section 4.14. Understory protection standards: This section of the RSA was removed. *Section 5. Performance survey* Section 5.3. Timing: Table 5-1. Aerial photography acquisition

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		timing and opening eligibility by Timber Year of Cut expanded to the 2011/2012 Timber Year of Cut. Table 5-2. Aerial photography acquisition timing and opening eligibility by Timber Year of Cut expanded to the 2011/2012 Timber Year of Cut. Section 5.4.1.1. Standards for submission of openings to Alberta: Beginning in the 2013/2014 Timber Year, timber disposition holders will be responsible for organizing and managing their own aerial photography acquisition program. Section 5.4.1.2. Standards for aerial photography: New standards for digital photography for RSA stratification have been added. *RSA Compiler changes* A 'Warning' to the user to recompile upon editing data was added. PLOT_ID field length bug was fixed. PLOT_ID field leading zero auto-populate configuration bug was fixed. Stratum character length limitation was fixed. Computing culmination MAI where the primary species type is not present was resolved. Species group duplicate for top height was fixed. GYPSY COM DLL troubleshooting tips were added to the User's Manual.
May 1, 2013	Darren Tapp	Results from the recent Alberta Regeneration Information System (ARIS) Data Review indicate an unacceptable level of reporting of Mean Annual Increment (MAI) metrics for ineligible openings. Ineligibility may result from having multiple Performance surveys reported, the wrong methodology used to complete the survey or Performance survey results reported when a Performance survey was not required. Where openings are included in an Aerial Stratification Performance survey program and subsequently found to be ineligible, the population of openings across which the MAI results are applied is then known to have incorrect MAI values. Erroneous MAI values result as the Sample Unit selection weighting becomes incorrect when openings are removed, and/or if Sample Units within ineligible openings were selected for field sampling, as these data are not eligible to contribute to the MAI estimates. Ensuring the sampling population is accurately defined is a fundamental requirement for the sub-sampling approach used in the RSA aerial programs. It is imperative that NO changes be made to any Aerial Stratification Performance survey program population once the Sample Selection Tool has been run. Effective 1 May 2013, should any changes be necessary to sample populations once results are reported to the department, the program results will be deemed unacceptable, and each program shall be required to be re-run to ensure MAI results are

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		reported appropriately. The date of the submission of the re-run program results to ARIS and FMB shall be deemed the date of the acceptable survey results are completed as prescribed by *Timber Management Regulation 141*.7 and late survey submissions will be subject to a non-compliance investigation. *General* Understory Protection Establishment Survey Standards, to be available shortly, will be an amendment to the 2013 RSA. Effective 1 May, 2014 the Understory Protection Establishment Survey Standards will be located in Section 7 of the RSA. The Section 3.2.2 header was changed from Declarations to Opening declarations and MAI Standards assignment Clarification provided around declarations, MAI assignment, and how they will be used. *Establishment survey standard* Section 4.4 was divided into two sub-sections: Section 4.4.1 Broad Cover Group strata and Section 4.4.2 Regenerated yield class strata. This is the first year openings declared to regenerated yield strata are eligible for Establishment surveys. The Establishment Survey Technical Working Group (ESTWG), composed of government and industry representatives, is task with developing new Establishment survey standards that link to Performance surveys. New Establishment survey standards should be available for 1 May 2014. In the interim openings declared to a regenerated yield class stratum, timber disposition holders have the option to either wait one year to complete Establishment surveys (using outcomes from the ESTWG) or complete Establishment surveys to the broad cover group standards ("C", "CD", "DC", "D") based on the yield stratum declarations as mapped to the broad cover groups and report on the leading coniferous tree species group based on acceptable tree stocking. Reconnaissance walk-through and Intensive surveys are acceptable methods for confirming a Let-it-Grow (LIG) treatment prescription. The Reconnaissance aerial survey is not an acceptable method for confirming a LIG treatment prescription. *Performance survey standard* Effective 1 May, 2013, the department is no longer taking requests for the acquisition of aerial photography for future Performance surveys. Timber Disposition holders are responsible for managing their own photo acquisition program. The department will, however, facilitate the 2013 photo acquisition program, as described in the 2012 RSA, for requests made by January 31, 2013. Table 1-1 was updated to reflect change in department's

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		responsibilities for photo acquisition. Clarification provided to Section 5.4.1.1 Standards for submission of openings to Alberta. To facilitate the audit of opening boundaries changes, a shape file used to identify openings for photo acquisition is required. This has been a requirement since the 2011 RSA for timber disposition holder managing their own program. Shape files must be included with the Performance survey package reported to the Forest Management Branch on or before 15 May. Section 5.7.6.1.1 and Figure 5-6 have been updated to reflect this requirement. In addition, this requirement has been added to the Aerial Stratification and Non-photo System Performance survey reporting checklist and validation (Appendix 20). Section 5.4.1.3 Process for distributing negatives: repealed as of 1 May, 2013 as all departmental coordinated RSA photographs are digital. Section 5.4.7.1 Field and plot layout and Section 5.5.4.4 Plot layout: Locating plots in the field for audit purposes has been problematic with approximately 20% of plots not locatable during inspections. This has implications for the department verification of Performance survey results. A 19 month plot centre marker requirement or submission of results by the fall of each year is required. Annual Reporting -- Aerial Stratification System Section 5.7.6.1 and Non-photo System Section 5.7.7.1: Each program must be reported as one package (all required elements together). Where more than one program is being reported on a single medium, each must be clearly identified and in separate folders. Section 5.7.6.1.4 Softcopy: Requirement for submission of Softcopy project files. Appendix 22. FMA and FMU specific Landbase Designation Code and Mean Annual Increment Standard: Supplemental document to the RSA, which will be available on the department's webpage by June 15, 2013. *RSA Compiler* Enabled the import of Sample Selection Tool output files for newer Excel® version files (XLSM or XLSX extensions). Section 5.4.1.2 Standards for aerial photography: Aerial photography acquired for the purpose of Performance surveys must be digital and to the standards described in the RSA. Conventional aerial photography acquired on or after 1 May, 2014 and used for Performance surveys will not be acceptable. Section 5.4.3.1 Recording administrative information: Section 5.3.1.1 Imagery: "RGBI" will be added as an eligible code for EMULSION for digital photography.
May 1, 2014	Darren Tapp	*Establishment surveys*

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		In addition to meeting the criteria for acceptable seedlings, seedlings must be on-site for a minimum of one growing season (Section 4.5). Seedling or advanced regeneration originating from layering is acceptable (Section 4.5). Understory Protection Establishment Survey Standard (Section 7). *Performance surveys* Acquisition of conventional aerial photography is no longer permitted. The standard is digital aerial photography only, as describe in the RSA (Section 5.4.1.2). Enhanced strata (i.e., tree improvement) must be its own population for sampling (Section 5.4.3.2.1). Density class criterion for Dense under the Aerial Stratification System is >5,000 (Section 5.4.3.4.2, Table 5-5). Sample design for the Aerial Stratification System uses stratified random sampling (Section 5.4.5). Rare strata standards, defined as less than 10% of total annual area (ha) requiring Performance surveys and less than 100 ha, are no longer aggregated for field sampling (Section 5.4.5.4). In addition to meeting the criteria for acceptable seedlings, seedlings must be on-site for a minimum of one growing season (Sections 5.4.7.2.1.1, 5.4.7.2.2.1, 5.5.4.5.1.1, 5.5.4.5.2.1, and 5.8.2.1). Acceptance audit completed by the Forest Management Branch (Section 5.7.10).
May 6, 2015	Darren Tapp	The sample size standard for Aerial Stratification System Performance surveys will remain unchanged for the 2015/2016 timber year. However, stakeholders are advised that there will be a new sample size standard for Performance surveys completed using Aerial Stratification System effective 1 May, 2016. In order to facilitate this move to a new sample size standard, the department will provide a version of the Sample Selection Tool to stakeholders by 31 August, 2015 to aid in the planning of Performance survey programs for the 2016/2017 timber year. *General* The RSA has been re-formatted to meet Environment and Sustainable Resource Development formatting requirements for directives. Acceptable trees: On-site requirement increases from a minimum of one to a minimum of two growing seasons. This applies to both Establishment and Performance surveys. *Section 3 MAI standards, declarations, subdivision of openings, and strata balancing*

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		Section 3.1 Developing MAI standards: Clarification about tree species lists requirements. Section 3.2.1 Timing: Table 3-1 Summary of stratum declarations, subdivision of openings, and balancing activities by Timber Year of Cut and regenerated yield based system commencement date no longer applies so was removed from the RSA. Section 3.2.3 Subdivision of openings: Areas within openings containing understory protection (UP) or enhanced forest management (EFM) with forest management plan regenerated yield assumptions must be subdivided and a new opening created and reported. Clarification on how to allocate roads, landings, and backlines to UP or clearcut areas during subdivision of openings. Section 3.2.4 Strata balancing: The timing of strata balancing based on Broad Cover Group or forest management plan specific yield class strata described in Table 3-2 Requirements for strata balancing no longer applies so was removed from the RSA. Clarification of procedures for strata balancing (pooling of openings, balance table, balance tolerance, and reporting requirements) was added to the RSA. *Section 5 Performance survey* Section 5.4.3.2.1 Enhance Forest Management: 'Bare ground' planting is used to describe openings eligible for inclusion in the enhanced forest management tree improvement population Sections 5.7.6.1 and 5.7.7.1 Annual Reporting: Report required elements for Aerial Stratification and Non-photo Performance surveys to the Reforestation Standard Analyst, Forest Resource Analysis The tree species code for White bark pine is used inconsistently in the RSA (e.g., 'Pa' in the Interp 1 and 2 data dictionaries and 'Pw' in the Ground 3 – 6 data dictionaries). The tree species code for White bark pine was changed to 'Pw' for all data dictionaries and tables in the RSA.
May 1, 2016	Darren Tapp	*General* The RSA has been re-formatted to meet Alberta Agriculture and Forestry formatting requirements. A version and improvement history section (Section 1) has been added. Acceptable trees: On-site requirement remains at 2-growing seasons for the 2016/2017 timber year. This applies to both Establishment and Performance surveys.

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		Height shall be measured as the tree lies perpendicular from the upper most live bud to the ground (or vice versa) for all trees regardless of lean from vertical. Surveys completed using compass and distance measuring device require plot locations to be GPS. Plots centres shall be clearly located in the ground in such a way that they can be located for auditing purposes. Plots shall be marked: • In the ground at the exact location where plot centre is used to measure the plot radius. In all cases, plot centre shall be marked with all-weather flagging (e.g., winter weight, blue in color preferably) attached to a wooden stick, nail, or pig-tail or in a shovel slit in the ground at plot centre. • Where nails or shovel slit is used to mark plot centre, plots shall also be marked at eye-level using all-weather flagging marked the plot number attached to a sturdy tree branch closest to plot centre to allow for easy identification of the location of the plot centre. To determine if a tree is inside the plot, surveyors and auditors are to measure from the point where the plot centre marker enters the ground to the point of germination. The germination point is the point at which the coniferous and deciduous tree takes root and becomes established. For stem sprouts in trembling aspen and balsam poplar, the germination point is the point at which the sprout has originated on the original stump. If estimation is required, then assume the geometric centre of the main stem. Count a tree as within the plot when its point of germination is inside the plot even if the tree is leaning outside. Conversely, do not count a tree leaning into the plot but with its point of germination outside the plot. Clock re-set or disturbance date shall also be used when determining opening eligibility for surveys. *Section 4 MAI standards and tree species* • Standards for landbase designation codes that reflect the four letter ARIS stakeholder code, two digit AAC approval year, FMP strata numbered sequentially and requirement for tree species lists have been added. *Section 5 Stratum declarations, subdivision of openings and strata balancing* • Table 5-1 Summary of stratum declarations, subdivision of openings, and balancing activities by timber year of

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		cut and regenerated stratum and yield based system commencement date was put back into the RSA. *Section 6 Establishment survey standard* • Section 6.13 Survey quality. The provincial QA/QC for Establishment surveys (training, field checks and data validation) remains as status quo. A provincial quality assurance quality control program will accompany the new Establishment assessment standards planned for 2017. *Section 7 Understory Protection Establishment Survey Standard* • Requirement to submit stratification results to FMB at least one year prior to the survey being completed was removed. • Stratification results are now required to accompany the survey submission package to the AAF area office. • Calculation of opening-specific CUP and total opening-level stocking must be included with the submission to the AAF areas office. • Opening-specific stratification metrics must be included with the submission to the AAF area office. *Section 8 Performance survey standard* • Clarification on: o Shape files used for photo acquisition (Section 8.4.1.1) o Re-drawing opening boundaries (Section 8.4.3.1.1) o Bare ground planting (Section 8.4.3.3.1) o Measuring DBH for top height trees (Sections 8.4.7.2.2.2 and 8.5.4.5.2.2) • The addition of the option to complete an assessment of stocking (optional) when stratifying the Net Assessment Area into Sample Units (Section 8.4.3.5.4.11). A data dictionary (Interp3) was added to Appendix 11. • A new Sample Selection Tool (v20150825a). • New digital folder and file nomenclature (Section 8.7.5) • New quality assurance reporting requirements (Sections 8.7.6.1.8 and 8.7.7.1.3). *Section 10 Quality assurance standard* • New section Quality assurance in Section 10 applies to Aerial Stratification and Non-photo Performance surveys. Provincial quality assurance for Establishment surveys will be added in 2017.

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		Therefore, reforestation obligation holders remain accountable for documenting and implementing quality control systems for Establishment surveys that includes field auditing and data validation. Surveyor training for Establishment and Performance surveys remains the responsibility of the obligation holder.
1 May, 2017	Darren Tapp	*Section 7 Understory Protection establishment survey standard* • All references to this survey standard being the pilot phase have been removed. • The 50% audit requirement remains, but is now to be in place for at least the first three years that a timber disposition holder or forestry consultant carries out the standard. The 50% audit requirement will be re-assessed on a case-by-case basis after the three-year implementation period. • Additional direction has been added to clarify how stocking is to be calculated if the opening is to be re-declared to a non-understory protection stratum. • Additional plot stocking combinations were added (map symbols) to aid this calculation. • Direction has been added to clarify reporting requirements for understory protection openings that are being re-declared to non-understory protection strata. *Section 8 Performance survey standard* • *General Specifications for Acquiring Aerial Photography* replace the *General Specifications for Mapping*. • The requirement to collect shrub cover information repealed. Place holder required so eligible code is 0 (zero). • When making a request to use the Non-photo System (performance survey is due) skid clearance date is needed in addition to opening, disposition, and net harvested ha. • Clarification: Table 8-17. The table is now consistent with the following requirement: *Where the entire NAA is between 0.1 and 1.9 ha in size, the minimum number of plots to establish in the Sampling Unit is 13 Basic plots and four (4) Detailed plots.* • Digital folder/file nomenclature – requirement to include FMA or FMU. e.g., 1_WBLL_W6_2016-17_as_acquisition • Image, model, surface, and project files are no longer required to be submitted **but** must be made available upon request (using the folder/file nomenclature above and external hard drive medium) for audit purposes. • Remaining required elements (shape files, sample

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		selection, compiler file, field maps, quality assurance, summary report, and checklist) must be submitted via email using zip file format to the following email address: **AF_RSA@gov.ab.ca.** • Allocation of plots in the Summary report repealed. • Requirement for performance survey stratification qualified auditors to have participated in the department's RSA stratification training workshop in 2009 repealed. *Section 10. Quality assurance standard* • Clarification provided on performance survey field data quality standard. Standard remains relatively the same as the date quality standards first implemented in the 2016/2017 timber year.
1 May, 2018	Darren Tapp	1. Understory Protection Establishment Survey Standards a. Section 7.7 – Acceptable Trees (new criterion) i. Added a requirement that acceptable trees must be expected to survive until final stand harvest (deciduous trees that are older than the reforestation clock start date for the opening shall not be considered acceptable trees). ii. This change is consistent with the requirements of the UP performance survey b. Section 7.14.3 – Stewardship Reporting (new section) i. Added a requirement for disposition holders to roll up and report on UP establishment survey stocking status outcomes (SR, NSR, SRR, NSRR or re-declared to non-UP stratum) in the appropriate Stewardship Report. ii. This change is consistent with the requirements of the UP performance survey 2. New Understory Protection Performance Survey Standards 3. Section 10 (QA/QC): a. Outcome-based data quality standards (±10% C and D MAI or 0.2 m3/ha/yr, whichever is greater; MAI need to be within tolerance); b. Evaluation of surveyor competencies (does not

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		determine pass/fail but shall be used to provide feedback to the surveyor on quality of survey. 4. Clarification on survey timing: "No sooner than x and no later than y years after the end of the timber year of cut based on skid clearance date *or disturbance date in ARIS, whichever is more recent"*. 5. Re-define advance growth to include not only prior to harvest *but also prior to disturbance date* (conservative but the best we can do for now when there is potentially two cohorts of seedlings). 6. New Sample Selection Tool – necessary to accommodate the need for extra contingency Sample Units. 7. New Compiler – necessary to accommodate new FOMP processes for performance survey inspections (export to tablets; import from tablet to Audit Tool; changes to reports). 8. Best practice: higher-level stratification on true Hw (management objective is D) versus accidental Hw (management objective likely C). 9. Updates to Appendix 1 (FMA and FMU MAI and Landbase designation code excel spreadsheet) and Appendix 3 (FMA and FMU acceptable tree species). Update necessary to account for recent FMP approvals. 10. Update to definition of SKID_YEAR in the data dictionaries to incorporate disturbance date. 11. Clarification on permissions to reproduce RSA – permission not necessary as long as due diligence is exercised to ensure the accuracy of the RSA produced and Crown copyright is acknowledged. Clarification needed because multiple copies are commercially reproduced for training purposes.

2 About the Reforestation Standard of Alberta

2.1 Forest regeneration standards in Alberta: a historical perspective

Sustained yield management, and therefore reforestation, has been a requirement in Alberta since the *Forests Act* of 1949 was passed. The first Alberta Regeneration Survey Standard was developed in 1972. This standard required the completion of a regeneration survey by the seventh year post harvest and used the stocked plot method to determine forest regeneration success. A cutblock was considered regenerated when 40% of mil-acre plots or more were stocked with at least one spruce or pine. This was later changed to 80% of mil-hectare plots or more stocked with at least one two year old or older pine or three year old or older spruce.

In 1985, juvenile stand surveys were conducted in a sample of cutblocks considered stocked for at least 10 years. The results suggested low survival of what were considered 'established' seedlings and those seedlings that had survived were impacted by competing vegetation. These findings were used to develop new forest regeneration standards in 1991. These standards not only included strata stocking requirements for conifer, mixedwoods, and deciduous but also required minimum height standards be met by year 8 (Establishment) and free-to-grow (FTG) standards for coniferous trees be met by year 14 (Performance). These standards also established surveyor qualifications. The FTG requirement was a competition free cylinder around each conifer crop tree. FTG required a coniferous crop tree to be free of deciduous trees and shrubs greater than two-thirds its height within 1 m radius of its stem.

A review of the 1991 forest regeneration standards by the Regeneration Survey Task Force, consisting of representatives from Alberta and the forest industry was completed in March 2000 at which time the *2000 Regeneration Standards* were adopted. The number of strata was increased to four (C: coniferous; CD: coniferous-leading mixedwood; DC: deciduous leading mixedwood; and D: deciduous), the minimum coniferous crop tree height was 30 cm, conditional coniferous seedlings designation was no longer available for C, CD, and DC, and a new status was introduced for the D Standard (Conditional Satisfactorily Restocked or CSR). In addition, changes were made to the FTG requirements and the concept of let-it-grow (LIG) was introduced for Establishment surveys. LIG is a retreatment strategy whereby an opening that is found to be not satisfactorily restocked (NSR) with acceptable trees may be in a 'satisfactorily restocked (SR) like condition' when under height trees are present and considered. Under LIG, the opening is considered NSR; however, retreatment may not be necessary.

In April 2003, several changes to the survey protocol and to the FTG criteria were made permitting greater levels of vegetation to be retained adjacent to coniferous crop trees that are growing well. The revised standards became effective 1 May, 2003. In 2005, a review of natural sub-region boundaries was completed and regeneration standards were updated accordingly. These revised standards became effective 1 May, 2006. Changes to regeneration surveyor certification requirements and enhanced quality control and quality assessment were made in 2007.

In 2001, the Alberta Reforestation Standards Science Council (ARSSC) was charged with providing to Alberta qualitative scientific advice regarding the improvement of reforestation

policy. The ARSSC proposed a number of guiding principles[1], which it believed must be followed in establishing reforestation standards for public forests in Alberta. In adopting these principles, the ARSSC gave special attention to the issue of connecting regeneration standards to the growth and yield of regenerating forests and emphasized the importance of Management by Objective (MBO) as part of a long-term management strategy. MBO (or Model II) represented a move towards forest level assessments of growth linked to the assumptions made in the forest management plan (FMP).

In 2004, a consultant retained by the Alberta Forest Products Association (AFPA) developed a framework to more formally link reforestation standards to long-term timber yields (i.e., Annual Allowable Cut or AAC). In consultation with Alberta, the forest industry, and silviculture experts, *A Framework for Reforestation Standards Linked to Growth and Yield* was published. Alberta acknowledged the document as a reasonable approach for developing alternative regeneration standards that would ultimately replace the established provincial reforestation standards.

In 2005, Alberta and a forest industry technical committee began working on developing Alternative Regeneration Standards (ARS). These standards were to provide a science-based quantitative link between managed stand yields and strata assumed in the FMP and reforestation standards. The attainment of these standards will be a key early indicator of the successful development of the managed forest conditions (i.e., desired future forest) forecasted in the FMP. Managed stands meeting or exceeding FMP specific ARS demonstrates sustainability of the Annual Allowable Cut (AAC) and maintenance of strata for biodiversity (coarse filter) at the landscape level. The ARS approach was formally adopted on 1 May, 2009 and became the provincial standard on 1 May, 2010. In 2010, the ARS were renamed the Reforestation Standard of Alberta (RSA).

2.2 Purpose

The RSA is designed to determine the forest regeneration status of young managed stands relative to an assumed future condition. The standard provides detailed descriptions of the office and field procedures and imparts practical aids and tools to assist timber disposition holders in conducting forest regeneration assessments. The information obtained by using the RSA is intended to support a wide variety of activities including regulatory requirements, planning applications, forest regeneration monitoring, decision making, and public reporting.

The RSA describes the procedures for developing mean annual increment (MAI) standards, making declarations, subdividing openings, strata balancing, conducting and reporting on Establishment and Performance surveys, strata and yield reconciliation. The RSA is designed to have procedures that are repeatable, robust, simple, unambiguous, technically defensible, and produce consistent results while maintaining operational efficiency.

Specifically, the RSA:

- Provides the standards and procedures to assess the level of reforestation success in managed stands following harvest;

[1] Alberta Reforestation Standards Science Council. 2001. *Linking regeneration standards to growth and yield and forest management objectives,* Prepared for the Minister of Sustainable Resource Development. 29 August, 2001. 57 p. For a digital copy of this document, visit the AAF website (forestry.alberta.ca) and use the following search term: "Alberta Reforestation Standards Science Council".

- Enables the assessment of each opening to determine the adequacy of stocking, survival, growth, and tree species composition (Establishment survey and D Standard CSR/NSR Performance survey); and,

- Assesses reforestation performance of each opening relative to the yields and strata assumed in the FMP (Establishment and Performance surveys).

2.3 Reforestation terms of reference

The *Forests Act, Timber Management Regulation, Alberta Regulation 60/1973 with amendments up to and including Alberta Regulation 76/2010* provide the statutory authority for reforestation (Part 6) on public forested lands in Alberta. Specific sections within the *Timber Management Regulation* pertain to the requirements for reforestation, regeneration surveys, and reporting. The discussion that follows should be used as general guidance and is not legal interpretation.

The *Timber Management Regulation* 141.1(1) requires timber disposition holders with reforestation responsibility to reforest within two years after the end of the year of cut, and reforest to a level to ensure that the reforestation standard will be met.

The *Timber Management Regulation* 144.2 (1), (2), and (3) requires timber disposition holders to comply with rules governing the source and type of tree seed and vegetative propagules used to reforest public land. These rules are described in the Alberta Forest Genetic Resource Conservation and Management Standards (FGRMS)[2].

The *Timber Management Regulation* 141.2(1) enables the director to establish reforestation requirements including requirements for establishment and performance surveys and the methods and timing of conducting surveys. The director must publish the reforestation requirements (*Timber Management Regulation* 141.2(2)).

The *Timber Management Regulation* 141.3(1) enables the Minister to establish qualifications for certification for persons undertaking specified reforestation operations on public land. Timber disposition holders shall ensure persons undertaking reforestation operation on their behalf are qualified (*Timber Management Regulation* 141.3 (2)).

Timber disposition holders shall submit to the director an establishment survey (*Timber Management Regulation* 141.6(1)) and a performance survey (*Timber Management Regulation* 141.7(1)).

If the reforestation standard is not met by the end of the year in which the establishment survey is required to be submitted to the director, timber disposition holders are required to re-treat the area before the end of the following year using methods and operations approved by the director (*Timber Management Regulation* 141.6(2)).

If, in the opinion of the director, the results of the performance survey are acceptable, reforestation is completed and no further reforestation treatments or surveys are required (*Timber Management Regulation* 141.7(2)).

[2] For a digital copy of this document, visit the AAF website (forestry.alberta.ca) and use the following search term: "Alberta Forest Genetic Resource Conservation and Management Standards".

Timber disposition holders responsible for carrying out reforestation shall submit to the director in a form acceptable to the director and by May 15 annually, a complete and accurate report summarizing the preceding year's reforestation program (*Timber Management Regulation* 143.2(2)).

The *Timber Management Regulation* 115.1(1) defines the period of time which survey records shall be retained. This period of time is five (5) years. This section of the *Timber Management Regulation* also requires the timber disposition holder make any records available upon request for purposes of audit or examination by a forest officer, the director, the Minister, or a person authorized by the Minister.

Figure 2-1 summarizes the reforestation terms of reference in a timeline.

Figure 2-1. Reforestation timeline[3].

[3] The timing of the D Standard CSR/NSR Performance surveys is not included on the timeline. See Section 5.8 for the timing requirement for this survey.

2.4 Scope and applicability

Reforestation surveys conducted by timber disposition holders and the Forest Resource Improvement Association of Alberta (FRIAA) on public land for the purpose of fulfilling obligations of the Forests Act, *Timber Management Regulation*, shall be completed in accordance with the procedures described in this standard unless otherwise specified by Alberta. The RSA is the reforestation standard for public lands unless otherwise approved by Alberta. As the reforestation standard is currently in a refinement period and annual updates to the standard may be required. This version of the RSA is valid for the Timber Year beginning May 1, 2018 and supersedes all other reforestation standards previously approved by Alberta.

2.5 Important dates

Table 2-1 describes important RSA milestones dates within a Timber Year.

Table 2-1. Important milestones within a Timber Year.

Milestone	Description
1 May	Timber Year begins.
30 April	Timber Year ends. Last date for timber disposition holders to complete surveys for reporting by 15 May.
15 May	Final submissions of annual reforestation activities to ARIS. Last date to report Establishment and D Standard CSR/NSR Performance surveys to Alberta Agriculture and Forestry area offices. Last date to report Aerial Stratification and Non-photo Systems Performance surveys to the Forest Management Branch.

2.6 Organization of the RSA

The reforestation timeline (Figure 2-1) was used to organize the RSA. The RSA is divided into nine main sections.

Section 3 describes the standards for:

- Qualified interpreters and field surveyors; and,
- Global Positioning System (GPS).

Section 4 describes the procedures for:

- Developing MAI standards; and,
- Acceptable tree species lists

Section 5 describes the procedures for:

- Declaring openings to regenerated yield strata;
- Subdividing openings; and,
- Strata balancing.

Section 6 describes the timing, stocking standards, and procedures for completing Establishment surveys[4] including:

- Reconnaissance (aerial and walk-through) assessments; and,
- Intensive surveys.

Section 7 refers to the timing, requirements, and procedures for completing Understory Protection Establishment surveys.

Section 8 describes the timing, requirements, and procedures for completing Performance surveys using the:

- Aerial Stratification System.
- Non-photo System.

Section 9 describes the timing, requirements, and procedures for completing D Standard Conditionally Satisfactorily Restocked (CSR) and Not Satisfactorily Restocked (NSR) Performance surveys.

Section 10 describes the timing, requirements, and procedures for completing Understory Protection Performance surveys.

Section 11 describes the requirement for a quality assurance and quality control (QA/QC) program that address the following:

- Training;
- Aerial photography interpretation quality assessments;
- Field quality assessments; and,
- Data quality assessments.

The appendices include information about FMA holders, acceptable tree species, Establishment and Performance survey sheets, statistical accuracy and number of sample plots for stocking surveys, summary of line and plot spacing, reforestation survey reporting cover page, Forest Areas, examples of net downs and hierarchical delineation of Sampling Units, mixedwood pattern, data dictionaries, Performance survey checklist, glossary, and Landbase Designation Code and Mean Annual Increment Standards.

[4] Applies to all silviculture systems except Understory Protection.

3 General reforestation survey standards

These general reforestation standards apply to both Establishment and Performance surveys, as described in this Reforestation Standard of Alberta.

3.1 Interpreter and field surveyor qualifications

The Forests Act, *Timber Management Regulation*, Section 141.3 (1, 2, and 3), enables the Minister to:

(1) Establish the qualifications for persons undertaking specified reforestation operations on public land;

(2) Require timber disposition holders to ensure all persons undertaking reforestation operations have applicable certification resulting from the meeting of those qualifications; and,

(3) Refuse to accept the validity of reforestation operations if they are undertaken by a person who does not have the applicable certification.

Alberta deems the following as meeting the requirements for certification:

Field surveyors

- Establishment and Performance field surveys shall be completed by Regulated Forestry Professionals (RFP) or under the direct supervision of an RFP; and,
- Qualified surveyors are individuals who have successfully completed Establishment and Performance survey training.

Direct supervision by a RFP includes the RFP:

- Overseeing the surveys as they occur; and,
- Overseeing (i.e., direct authority over) and taking responsibility for the performance of surveyors; and,
- Providing direction and feedback to surveyors in a timely manner; and,
- Ensuring surveys conducted under their direct supervision are complete and accurate.

Interpreters

- Stratification of regenerating openings using Softcopy shall be completed by an Alberta Vegetation Inventory (AVI) Level 2 interpreter or under the direct supervision of an AVI Level 2 interpreter; and,
- Qualified interpreters are individuals who have successfully completed stratification training.

Direct supervision by an AVI Level 2 Interpreter includes:

- Overseeing the stratification and interpretation as they occur; and,
- Overseeing (i.e., direct authority over) and taking responsibility for the performance of interpreters; and,
- Providing direction and feedback to interpreters in a timely manner; and,
- Ensuring stratification and interpretation being conducted under their direct supervision are complete and accurate.

Notification of qualified interpreters and surveyors

Timber disposition holders responsible for completing Establishment surveys, Understory Protection Establishment surveys, D Standard Performance CSR/NSR surveys, Understory Protection Performance surveys shall list the names (first and last) of qualified surveyors on the Reforestation Survey Reporting Cover Page (Appendix 8).

Timber disposition holders responsible for completing Performance surveys (Aerial Stratification and Non-photo Systems) shall list the names (first and last) of qualified interpreters and surveyors on the Performance survey Checklist (Appendix 21).

3.2 Global Positioning System

The use of Global Positioning System (GPS) for Establishment and Performance stocking surveys is permitted and required for Performance surveys completed using the Aerial Stratification and Non-photo Systems. Where GPS is used as the method for locating the Point of Commencement (POC), Tie Point (TP), and sample plot centres while conducting Establishment and/or Performance surveys,

- Regeneration surveyors must receive GPS training in order to be deemed qualified;
- The accuracy of GPS receivers shall be 10 metres horizontally at a 95% confidence level; and,
- All data must be spatially referenced to North American Datum for 1983 (NAD 83) and projected in Universal Transverse Mercator (UTM) Zone 11 or 12.

GPS best practices include:

- The recommendation that GPS receivers be set to position or record in 3D mode (i.e., simultaneous observations to a minimum of four satellites); and,
- The recommendation that during static point-mode surveys, the minimum recording duration at each survey point should be 30 seconds with a minimum of 15 individual position fixes during this period.

4 MAI standards and tree species

Section 4 describes the procedures for developing stratum specific Mean Annual Increment (MAI) standards and the requirement for tree species lists.

4.1 Developing MAI standards

Development of MAI standards is a mandatory component of the forest management planning process. Once developed and approved, the MAI standards will apply to all reforestation obligation holders covered by the Forest Management Plan (FMP). Should multiple Timber Supply Analyses (TSA) be included in the FMP (i.e., a TSA run for each FMU within a FMA), then the MAI standards shall reflect each TSA.

The development of MAI standards is the responsibility of the Forest Management Agreement (FMA) holder. The number of MAI standards shall reflect the number of regenerated yield strata assumed in the FMP to a minimum of the Base 10 strata. Separate strata are required for Enhanced Forest Management (EFM), as outlined in the Forest Management Planning Standard (2006).

For non-FMA Forest Management Units (FMU), the department shall develop the MAI standards. Generally, the non-FMA FMU MAI standards shall reflect the Base 10 strata.

Each regenerated yield stratum assumed in the FMP shall have a coniferous and deciduous MAI. MAI shall be at culmination age (i.e., maximum productivity) for the primary management tree species (coniferous, C, or deciduous, D) of concern. The MAI of the secondary management tree species (C or D) of concern shall be coincident with the culmination age of the primary management tree species of concern.

In addition, MAI standards shall be based on:

- 15 cm stump diameter, 10 cm top diameter, 30 cm stump height, and 3.66 m log length utilization standard;
- Gross merchantable volume (i.e., not reduced for cull); and,
- Yields adjusted for regeneration lag.

Whether or not some regenerated yield strata are amalgamated from the Base 10 strata during the FMP development process, all Base 10 strata must have unique landbase declaration codes for proper accounting. Where two of the Base 10 strata are amalgamated in the FMP, unique landbase declaration codes will be assigned to each stratum and the two resulting strata shall share the same MAI standard.

For those openings previously declared to a Broad Cover Group (BCG) stratum (i.e., C, CD, DC, and D), MAIs shall be developed once during the First Approximation process and based on the current approved TSA. BCG MAI shall be calculated by area-weighting the FMP specific regenerated yield class strata.

Landbase designation codes are required for each regenerated strata (minimum Base 10 Strata plus EFM strata). The naming convention for landbase designation codes shall be:

1) The three or four letter ARIS stakeholder code (e.g., WBLL); and,

2) The two digit AAC approval year (e.g., 16 for 2016); and,

3) The two digit FMP regenerated yield stratum ordered as follows:

   01 – Deciduous
   02 – Hardwood/Pine
   03 – Hardwood/Spruce
   04 – White spruce/Hardwood
   05 – Pine/Hardwood
   06 – Black spruce/Hardwood
   07 – White spruce
   08 – Pine
   09 – Black spruce
   10 – Douglas fir

   EFM strata shall be ordered from 11 onward.

4.2 Approved tree species

The tree species list shall include those tree species used to develop FMP specific regenerated yield strata and MAI standards.

At the time of MAI standard development, FMA holders shall submit a tree species list for approval. The department shall develop a tree species list for non-FMA FMUs.

The current approved tree species lists by FMA and FMU are shown in Appendix 3. These tree species lists help define an acceptable tree in establishment and performance surveys for the respective forest management unit. Tree species exceptions related to growth and yield model limitations are noted in the survey procedures.

5 Stratum declarations, subdivision of openings and strata balancing

Section 5 describes the procedures for making declarations (reforestation objectives), subdividing openings, and strata balancing annual populations of openings. The procedures for making declarations and balancing described below replace those procedures described in Directive 2005-01.

5.1 Timing

Declarations of regenerated yield strata, subdivision of openings, and strata balancing shall be completed no later than one year following the end of the Timber Year of Cut (Figure 5-1).

Timber Year		Description	Required activities and ARIS submissions
0	May	May 1	1. Create openings (Operator code, AOP area, skid clearance date) 2. Make regenerated yield class 'preliminary' stratum declarations 3. In ARIS, populate X_OPEN, X_HARVST, X_REFRES tables
	Jun	Timber Year of Cut	
	Jul		
	Aug		
	Sep		
	Oct		
	Nov		
	Dec		
	Jan		
	Feb		
	Mar		
	Apr	April 30	
1	May	May 1 - REFORESTATION START CLOCK DATE	Activities completed in Timber Year 0 must be reported to ARIS by 15 May
	Jun	1st year following the Timber Year of Cut	1. Subdivide cutblocks (if necessary) 2. Balance (mandatory) 3. Make regenerated yield class stratum declarations 4. In ARIS, populate X_OPEN, X_HARVST, X_REFRES tables
	Jul		
	Aug		
	Sep		
	Oct		
	Nov		
	Dec		
	Jan		
	Feb		
	Mar		
	Apr	April 30	
2	May	May 1	Activities completed in Timber Year 1 must be reported to ARIS by 15 May
	Jun	2nd year following the Timber Year of Cut	
	Jul		
	Aug		
	Sep		
	Oct		
	Nov		
	Dec		
	Jan		
	Feb		
	Mar		
	Apr	April 30	

Figure 5-1. Stratum declaration, subdivision of openings, and balancing timeline.

However, the transition from the Alberta Regeneration Survey Manual to the management by objective system (stratum and growth) varies by FMA and FMU and by Timber year of Cut. Table 5-1 describes the appropriate transition procedures when making stratum declarations, subdividing openings, and balancing. Appendix 2 lists FMA holders by FMA number.

Table 5-1. Summary of stratum declarations, subdivision of openings, and balancing activities by Timber year of cut and regenerated stratum and yield based system commencement date.

RSA Start date	Activity	Timber Year of Cut 2008/2009	2009/2010	2010/2011	2011/2012	FMA	FMU
1 May, 2008	Preliminary stratum declarations to:	Yield class stratum*	Yield class stratum	Yield class stratum by April 30, 2011	Yield class stratum by April 30, 2012	9100029 8900026 7500020 9900037 8800025 9000028 9700032 9200030 0900046 6900016	R10 (non-FMA portions) S20 (non-FMA portions)
	Cutblocks eligible for subdivision?	Yes	Yes	Yes by April 30, 2012	Yes by April 30, 2013		
	Balance to:	BCG	BCG	Yield class stratum by April 30, 2012	Yield class stratum by April 30, 2013		
	Stratum declarations to:	Yield class stratum	Yield class stratum	Yield class stratum by April 30, 2012	Yield class stratum by April 30, 2013		
1 May, 2009	Preliminary stratum declarations to:	BCG	Yield class stratum	Yield class stratum by April 30, 2011	Yield class stratum by April 30, 2012	0200041 9700034 0600043	S10, S14
	Cutblocks eligible for subdivision?	No	Yes	Yes by April 30, 2012	Yes by April 30, 2013		
	Balance to:	BCG	BCG	Yield class stratum by April 30, 2012	Yield class stratum by April 30, 2013		
	Stratum declarations to:	BCG	Yield class stratum	Yield class stratum by April 30, 2012	Yield class stratum by April 30, 2013		
1 May, 2010	Preliminary stratum declarations to:	BCG	BCG	Yield class stratum by April 30, 2011	Yield class stratum by April 30, 2012	0900044 0900045 0200039 0100038 0200040 9700033 9700036	A6, A9, A10, A11, A12, A13, B11, B52, C4, C5, C51, C52, E8, E9, E10, F10, F11, F14, F20, F23, F51, H1, G9, G10, G11, G12, G13, G14, G53, G54, L9, L51, P1, P7, P8, P14, P51, P52, P53, S9, S16, S14, S52, W51
	Cutblocks eligible for subdivision?	No	No	Yes by April 30, 2012	Yes by April 30, 2013		
	Balance to:	BCG	BCG	Yield class stratum by April 30, 2012	Yield class stratum by April 30, 2013		
	Stratum declarations to:	BCG	BCG	Yield class stratum by April 30, 2012	Yield class stratum by April 30, 2013		

* FMA and non-FMA FMU specific.

5.2 Opening declarations and MAI Standards assignment

An opening declaration is composed of a landbase designation code and an associated stratum declaration. Currently, two types of opening declarations are required:

(1) Declaration made by the end of the Timber Year of Cut, and,

(2) Declaration made no later than one year following the end of the Timber Year of Cut.

Declarations may be changed at any time up until the end of the timber year following the Timber Year of Cut.

Obligation holders must ensure that the correct FMA or FMU specific landbase designation and stratum declaration codes are used when making and submitting opening declarations to ARIS. FMA and FMU specific landbase designation and stratum declaration codes are described in Appendix 1.

It is the location of the opening within a FMA or FMU that determines the appropriate landbase designation code.

Box 1: Making declarations using FMA or FMU specific landbase designation codes

A timber disposition holder has a FMA (FMA 1) but also operates as a deciduous quota holder in an adjacent FMA belonging to another timber disposition holder (FMA 2). The landbase designation codes for the two FMAs are as follows:

FMA 1	***FMA 2***	***Stratum***	***Stratum declaration***
RCTL0101	*HSML9901*	*Deciduous*	*D*
RCTL0102	*HSML9902*	*Hardwood/Pine*	*DC*
RCTL0103	*HSML9903*	*Hardwood/Spruce*	*DC*
RCTL0104	*HSML9904*	*White spruce/Hardwood*	*CD*
RCTL0105	*HSML9905*	*Pine/Hardwood*	*CD*
RCTL0106	*HSML9906*	*Black spruce/Hardwood*	*CD*
RCTL0107	*HSML9907*	*White spruce*	*C*
RCTL0108	*HSML9908*	*Pine*	*C*
RCTL0109	*HSML9909*	*Black spruce*	*C*

The timber disposition holder cuts two aspen stands, one in his FMA (FMA 1) and one in FMA 2. When declaring these openings in ARIS, the timber disposition holder will use the following landbase designation codes for the two openings:

RCTL0101 *for the opening cut in FMA 1 (the FMA belonging to the timber disposition holder); and,*
HSML9901 *for the opening cut in FMA 2.*

Declarations cannot be changed in ARIS after the end of year following the end of the Timber Year of Cut. Coniferous (C) and deciduous (D) MAI standards are assigned to each opening once final declarations are made in ARIS. The C and D MAI standard represents the average yield for the stratum assumed in the TSA.

Landbase designation codes may be changed after the completion of Establishment Assessments; however, obligation holders will be held to the original declaration and associated stratum and growth when outcomes are evaluated (reconciled) following Performance surveys over a quadrant. During strata reconciliation, a population of openings is assessed against the original declarations to determine if regenerated yield strata targets and MAI standards were attained. Landbase designation code and MAI standards are described in Appendix 1.

5.3 Subdivision of openings

The general procedures for the initial creation of openings in ARIS are as follows:

- Assign numbers for openings based on their centroid location (meridian, range, township, section, and grid coordinate).
- Populate the ARIS Opening Table (X_OPEN), Reforestation Responsibility Table (X_REFRES), Harvest Table (X_HARVST), and all mandatory elements within these tables including:
    - Completed silviculture activities (i.e., Leave for Natural , site preparation, planting, and stand tending); and,
    - Declaration based on FMA or FMU specific regenerated yield stratum.
- Submit all opening information (above) to ARIS by the end of the Timber Year of Cut (Figure 5-1).

Subdividing openings is permitted (but not required with two exceptions) in order to facilitate the balancing tolerances for the regenerated yield strata. Subdivision of openings is required where understory protection (UP) or enhanced forest management (EFM) have occurred at the sub-opening level, as described below.

When subdividing openings, the following rules apply:

- Openings created by subdivision shall have a minimum area of two (2) ha;
- Subdivision may be made once, and must be completed no later than one year following the end of the Timber Year of Cut; and,
- Openings may be subdivided into as many individual openings as required to balance (silviculture) objectives.
- Openings with more than one regenerated yield stratum objective must be subdivided, as follows:
    - Openings with UP and with at least two (2) ha of contiguous clearcut harvesting must be subdivided with the clearcut harvesting area and UP area as separate openings.

- Roads, landings, and backlines clearly in the UP area shall be included in the UP portion of subdivided openings. Roads and landings clearly in the clearcut area shall be included in the clearcut portion of subdivided openings. Roads, landings, or backlines shared by the clearcut and UP area may be included in either the UP portion or clearcut portion of subdivided openings.

- Openings containing at least two (2) ha of contiguous EFM (tree improvement, thinning, fertilization, drainage) must be subdivided by EFM and non-EFM regenerated yield class stratum where applicable.

The procedures for subdividing openings shall be as follows:

- Where the opening is subdivided during the year following the Timber Year of Cut, previously reported silviculture activities that no longer apply to the original opening shall be deleted or amended.

- The original opening along with corresponding subdivided openings shall be reconciled with respect to opening numbers, opening type (e.g., UP or CC for subdivided UP openings), silviculture treatments, and areas.

- The activities shall be submitted in spreadsheet form to the department for deletion or amendment in ARIS. The spreadsheet shall identify the opening(s) requiring changes and any corresponding silviculture treatment information (type and area) required to be deleted or amended.

- Timber disposition holders shall reconcile ARIS treatment records to ensure complete and accurate information is provided.

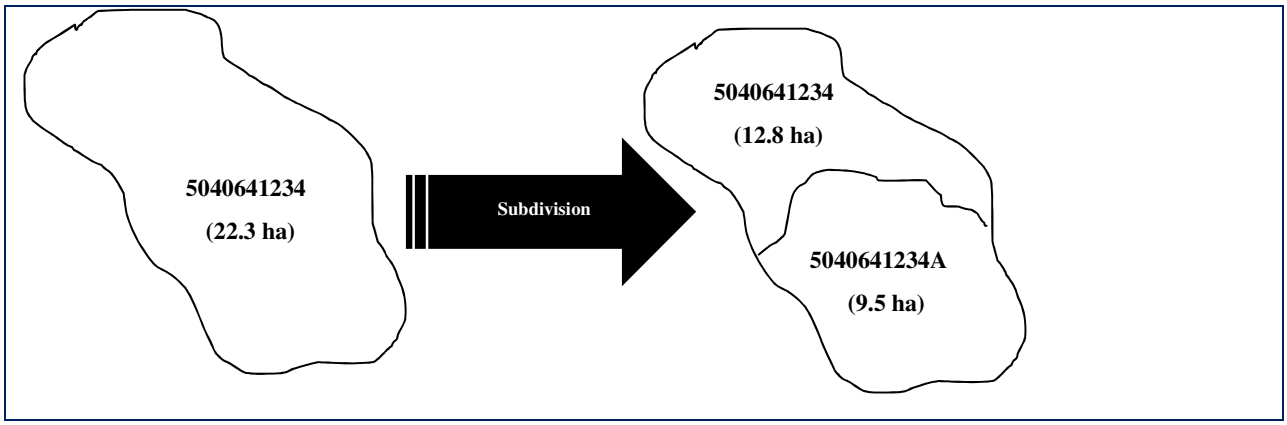
- Subdivisions shall be made no later than one year following the end of the Timber Year of Cut (Figure 5-1).

- Two labelling options may be used when subdividing openings. Each opening number must be unique.

Option 1: Use the appropriate numeric sequence for assigning opening numbers to create the opening in ARIS. Subdivide the opening by adding the letter 'A' to the end of the numeric sequence to create a second opening. To further subdivide openings, use the same numeric sequence and append alpha characters letters 'B' through 'Z'.

Box 2: Subdivision of openings – Option 1 example.

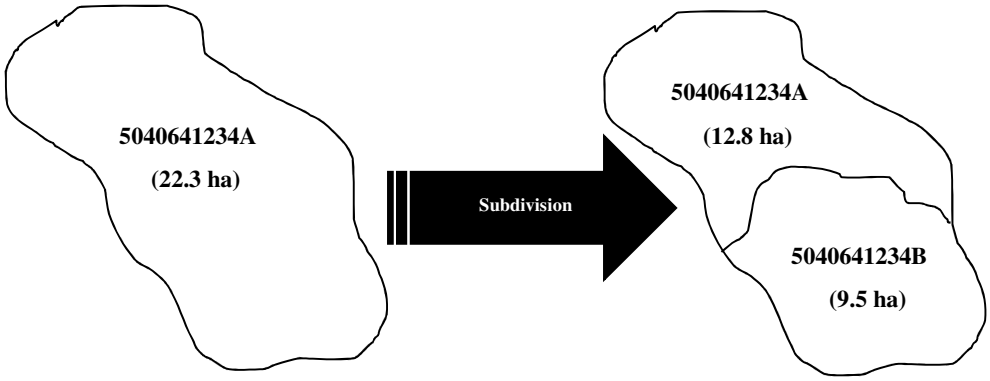
If 5040641234 was the numeric sequence used in the AOP and to create the opening in ARIS at year zero (Timber Year of Cut), subdividing the opening by adding the letter 'A' will create two unique openings in ARIS:



Option 2: Use the appropriate numeric sequence for assigning opening numbers and append the letter 'A' to the end to create the opening in ARIS. Subdivide the area by adding the letter 'B' to the end of the numeric sequence to create a second opening. To further subdivide openings, use the same numeric sequence and append alpha characters letters 'C' through 'Z'.

Box 3: Subdivision of openings – Option 2 example.

If 5040644321A was the numeric sequence used in the AOP and to create the opening in ARIS at year zero (Timber Year of Cut), subdividing the opening by adding the letter 'B' will create two unique openings in ARIS:



- Subdivided openings created in ARIS that remain unused due to changes in plans shall be deleted.
- Subdivided openings created from a single opening will retain the same Opening Table, (X_OPEN), Reforestation Responsibility Table (X_REFRES), and Harvesting Table (X_HARVST) information, except for UP openings. Annual Operating Plan (AOP) area remains the same as the approved AOP area of the original opening. Net harvest area (or

updated area with a disturbance, if applicable) and stratum declaration are the exceptions.

- The silviculture activities in ARIS shall correspond to the appropriate subdivided opening.
- Once subdivided openings are submitted to ARIS, subsequent subdivisions shall not be permitted.
- Openings remaining undivided one year after the end of the Timber Year of Cut shall be deemed complete and final; subsequent subdivision shall not be permitted.
- Declarations to regenerated yield strata and Net Harvest Area information for all openings shall be completed no later than one year following the Timber Year of Cut.
- The perimeter of each opening created by subdividing shall be determined using mapping-grade or better GPS. GPS standards of accuracy shall be 5 m horizontal accuracy at a 95% confidence level. Physical perimeter marking (i.e., high stumps) is not required.
- Maps illustrating the subdivided openings shall be reported in the Silviculture Schedule of the Annual Operating Plan (AOP).
- Digital files of openings, in a format acceptable to department, must be made available to department upon request.

5.4 Strata balancing

Reforestation obligation holders are required to reforest harvested areas to regenerated yield strata using transition assumptions as planned in the approved forest management plan. Therefore, the strata specific area harvested (i.e., the responsibility created) must balance with the strata specific area declared (i.e., the asset from declarations). A balance is required in order to properly adjudicate strata and growth reconciliation after the completion of Performance surveys.

Procedures

- Using the approved Alberta Vegetation Inventory (AVI), convert AVI polygons to the FMP specific TSA regenerated yield strata based on the timber supply analysis (TSA) transition assumptions (e.g., 'net landbase' of the FMP).
- Overlay the opening boundaries for all areas harvested during a given Timber Year (the population). Obligation holders operating within the same TSA may pool openings. Obligation holders pooling openings for balancing purposes shall do so on a quadrant basis for a minimum of one quadrant.
- Opening area (ha) accounting for strata balancing purposes shall use Net Harvested Hectares only.
- Where the intersection of the TSA regenerated yield group boundary and the opening boundary results in strata area ≥2.0 ha, the following rules apply:
    - Regenerate yield class strata ≥2.0 ha are not eligible for aggregation with other regenerated yield class strata ≥2.0 ha;

- Assign TSA regenerated yield strata to each polygon based on TSA transition assumptions.

- Openings may be subdivided into more than one opening (see Section 5.3) to assist with balancing of regenerated yield class strata.

- Where the intersection of the TSA regenerated yield stratum boundary and the opening boundary results in strata area <2.0 ha, the following rules apply:

  - Regenerated yield strata <2.0 ha within an opening are eligible for aggregation;

  - Regenerated yield strata eligibility for aggregation shall be from the stratum with the smallest area <2.0 ha to the stratum with the largest area <2.0 ha;

  - Beginning with the stratum with the smallest area <2.0 ha, aggregation must be with the next most common regenerated yield stratum regardless of size (ha), as defined in Figure 5-2;

  - To be eligible for aggregation, the total area for the regenerated yield stratum must be <2.0 ha (e.g., three 1.0 ha Sb and one 12.0 ha Pl polygons within an opening result in no aggregation of the Sb stratum because there are a total of 3.0 ha of Sb and 12.0 ha of Pl); and,

  - All aggregations must be accounted for as the purpose of aggregation is to help facilitate operational needs and not to enable strata conversions.

  - Assign a TSA regenerated yield stratum to each aggregated polygon based on TSA transition assumptions.

  - Openings may be subdivided into more than one opening (see Section 5.3) to assist with balancing of regenerated yield class strata.

- Aggregating strata is not to enable strata conversions. If the department deems these strata balancing processes as being misused, the department will revoke its use.

- Annual populations of openings and associated regenerated yield class strata must be balanced. Tolerance by regenerated yield stratum is ±5% or ±10 ha whichever is greater.

- Annual balanced population of openings and associated yield strata shall be reported to:

  - ARIS by the end of the year (May 15) following the end of the Timber Year of Cut; and,

  - Regional offices by the end of the year (April 30) following the end of the Timber Year of Cut. Documentation shall include:

    - RFP validated letter declaring the report as complete, accurate, and balanced; and,

    - The balance table (Figure 5.3) or as approved by the department.

    - Letters and tables may be in digital or hardcopy form.

  - The department may, from time to time, audit balanced populations by comparing

annual population of openings submitted to ARIS with the same population openings reported to Regional offices in balance tables.

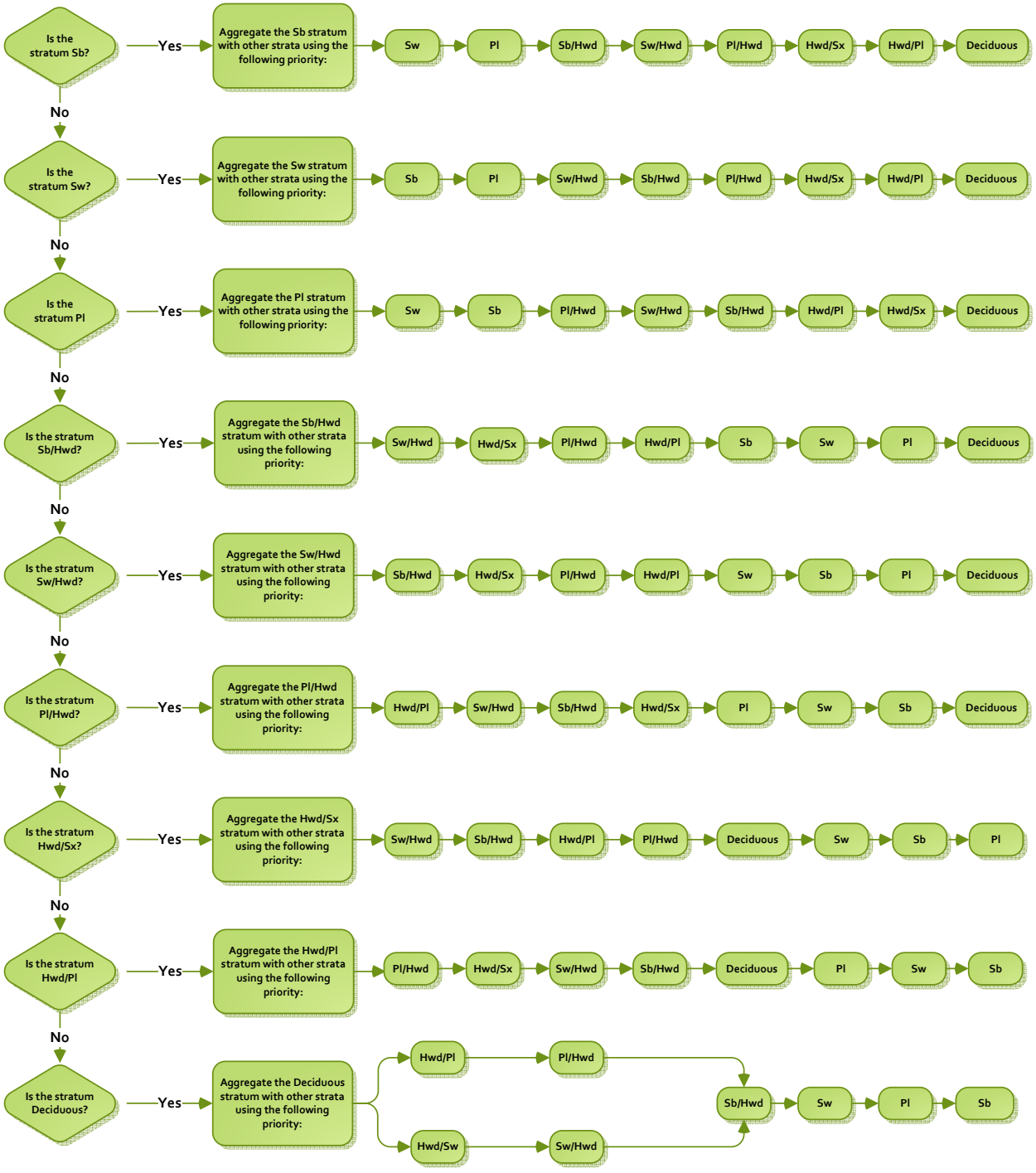


Figure 5-2. Aggregation priorities by Base 10 stratum.

Regenerated Yield Class Declaration Balance Table

Forest Company: ___________________________

SYU:

Date:

				Natural and Regenerated Yield Class Stratum Area (ha.)																					
				Deciduous		Hardwood/Pine		Hardwood/Sw		Sw/Hardwood		Pine/Hardwood		Sb/Hardwood		Sw Pure		Pine Pure		Sb pure		Fd Pure		TOTAL	
Timber Disposition	Cutblock Opening Number	Operator Field Number	Net Harvest Area	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
																								0.0	0.0
																								0.0	0.0
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TOTAL			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
PLUS/MINUS					0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		

Figure 5-3. Balance table

6 Establishment survey standard

The *Timber Management Regulation (122.1(1) a)* defines an Establishment survey as a survey conducted on an area to be reforested to determine if regeneration is established according to reforestations standards.

The following Establishments survey standards are interim standards until new standards are developed.

6.1 Purpose

Establishment surveys determine the level of success of early silviculture activities in harvested areas. Site occupancy is the predominant parameter used to determine the level of regeneration success. Site occupancy is the degree to which trees utilize a site's available growing space. Sufficient numbers of trees are necessary to fully utilize the site's water and nutrient resources to maintain timber productivity. Site occupancy or the presence of a vegetation community is also integral to maintaining healthy ecosystems.

Site occupancy is assessed using stocking. Stocking is the frequency or percentage of a sample within an opening that contains acceptable tree regeneration. In Alberta, 100% of the harvested area within an opening shall be regenerated. Openings are deemed sufficiently regenerated if stocking is 80% or greater after an Establishment survey.

These Establishment survey standards apply to all silviculture systems except Understory Protection. Understory Protection Establishment survey standards are described in Section 7.

6.2 Objectives

The objectives of the Establishment survey are:

- To determine and document the reforestation status of each opening;
- To assess species composition and distribution of seedlings, suckers, and advanced growth with high potential for survival and future growth;
- To identify areas and conditions in openings where regeneration success has been inhibited or is unlikely to meet the species composition, density, and distribution targets for seedlings, suckers, and advanced growth at the required survey timing;
- To minimize survey time and effort where the level of regeneration success within an opening (either adequate or inadequate) is evident; and,
- To focus field resources on intensively sampling openings where the level of regeneration success is uncertain.

6.3 Timing

Establishment surveys shall be completed no sooner than four (4) years and no later than eight (8) years after the end of the Timber Year of Cut or disturbance date, whichever is more recent, for all openings (Table 6-1). The timing of Establishment surveys is scheduled to determine reforestation treatment success.

6.4 Strata standards

6.4.1 Broad Cover Group strata

The Establishment survey uses Broad Cover Group (BCG) strata standards to determine the level of regeneration success. The BCG strata are:

- Coniferous (C);
- Coniferous-leading mixedwood (CD);
- Deciduous-leading mixedwood (DC); and,
- Deciduous (D).

Each BCG stratum standard has minimum coniferous tree, deciduous tree, and total stocking requirements, which, are harvest date and, in some cases, ecoregion specific (Table 6-2).

6.4.2 Regenerated yield strata

Openings were first declared to regenerated yield strata beginning 1 May, 2008 (Table 5-1). Effective 1 May, 2013, openings with skid clearance dates between 1 May, 2008 and 30 April, 2010 are eligible for Establishment surveys (Table 6-1). Although work is on-going to develop regenerated yield class strata standards, there are no finalized standards to date.

Thus, the following options are available to timber disposition holders who have openings declared to a regenerated yield stratum and are eligible for Establishment survey:

- Defer completing Establishment surveys on openings declared to regenerated yield strata by one year ; or,
- Complete and report Establishment surveys to the BCG standards, as described in Table 6-2. The BCG standard for the opening is based on the stratum declaration code in ARIS (e.g., C-2000). In addition, to assist with assigning openings to strata in the next TSA, surveyors shall identify and report on the Establishment Survey Summary Sheet the leading coniferous tree species group (PL, SW, or SB) present in the opening based on acceptable tree stocking.

Table 6-1. Establishment survey timing and opening eligibility by Timber Year of Cut or disturbance date, whichever is more recent.

Timber Year	Timber Year of Cut eligibility 2001 2002	2002 2003	2003 2004	2004 2005	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012	2012 2013	2013 2014	2014 2015	2015 2016	2016 2017	2017 2018	Complete by	Report by
2009/2010	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	April 30, 2010	May 15, 2010
2010/2011	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	April 30, 2011	May 15, 2011
2011/2012	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	April 30, 2012	May 15, 2012
2012/2013	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	April 30, 2013	May 15, 2013
2013/2014	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	April 30, 2014	May 15, 2014
2014/2015	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	April 30, 2015	May 15, 2015
2015/2016	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	April 30, 2016	May 15, 2016
2016/2017	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	April 30, 2017	May 15, 2017
2017/2018	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	April 30, 2018	May 15, 2018
2018/2019	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	April 30, 2019	May 15, 2019
2019/2020	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	April 30, 2020	May 15, 2020
2020/2021	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	April 30, 2021	May 15, 2021
2021/2022	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	April 30, 2022	May 15, 2022
2022/2023	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	April 30, 2023	May 15, 2023

Y = Openings with harvest dates within the specific Timber Year of Cut are eligible for Establishment surveys during the specified Timber Year.
N = Openings with harvest dates within the specific Timber Year of Cut are not eligible for Establishment surveys during the specified Timber Year.

Table 6-2. Establishment survey minimum stocking by Broad Cover Group Standard.

	Harvest date	Minimum coniferous tree stocking (%)	Minimum deciduous tree stocking (%)	Minimum total tree stocking (%)
C Standard	Areas harvested after May 1, 2000 in Subalpine, Montane, Upper Boreal, Highlands, and Upper Foothills	80	0	80
	Areas harvested after May 1, 2000 in Central Mixedwood, Dry Mixedwood, Northern Mixedwood, Lower Boreal Highlands, and Lower Foothills	70	0	80
CD Standard	Areas harvested after May 1, 2000	50	30	80
DC Standard	Areas harvested after May 1, 2000	30	50	80
D Standard	Areas harvested after March 1, 1991	0	60	80

6.5 Acceptable trees

Stocking status of each opening shall be determined by assessing the spatial distribution of acceptable trees.

An acceptable tree is an individual seedling, sucker, coppice (collectively SDL), or advanced (ADV) regeneration that:

- Is alive; and,
- Is an acceptable tree species (TSA or FMA or FMU specific; see Appendix 3); and,
- Has been on site for a minimum of two growing seasons; and,

- Originated from seed, suckering, coppice[5], or layering (Sb); and,
- Achieved the minimum coniferous or deciduous tree height requirement at time of survey (Table 6-3).

A growing season is defined as the period between 21 June and 1 August annually.

In addition to the criteria above,

- Coniferous tree species shall have:
    - A well-defined stem, and
    - Two or fewer stems originating at the base of the tree; and,
- White and Engelmann spruce and fir trees shall have a live-crown ratio[6] of 0.33 or greater.

Seedling (SDL) is defined as those trees that established post-harvest or post disturbance date (as reported in ARIS), whichever is more recent.

Advance growth (ADV) is defined as those trees that were established in advance of harvest and probably will be alive when the stand is harvested next. For openings with disturbance dates in ARIS, seedlings established naturally or artificially between the original skid clearance date and the disturbance date shall also be considered and recorded as ADV.

For Establishment surveys completed in openings declared to regenerated yield strata, only acceptable trees shall be used to determine the leading coniferous tree species group.

Table 6-3. Establishment survey minimum acceptable coniferous and deciduous tree height requirements by Broad Cover Group Standards and Natural Subregion.

Strata Standard	Natural Sub-region	Minimum acceptable coniferous tree height (cm)	Minimum acceptable deciduous tree height (cm)
C, CD, DC, D Standards	Central Mixedwood, Dry Mixedwood, Northern Mixedwood, Lower Boreal Highlands, Lower Foothills	30*	130
	Subalpine, Montane, Upper Boreal Highlands, Upper Foothills	30* 15 (Douglas-fir only)	80

* 30 cm minimum acceptable coniferous tree height requirement applies to: Sw, Se, Sb, Fb, Fa, Pl, Pj, Pw, Pf, La, Lt. and Lw.

[5] Each stem originating from coppice growth may be considered a separate acceptable tree.

[6] Live crown ratio is the proportion of total stem length that is covered by living branches. It is expressed as a percentage or decimal of the total tree height. Live crown ratio is a useful indicator of the status of the tree in relation to vigor, photosynthetic leaf area, and is inversely related to stocking density. It is assumed that live crown ratio must be greater than 0.3 (30%) in order for the tree to release well.

Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

6.6 Under height trees

If acceptable trees are not present in the opening or portions of the opening, then under height trees, if present, may be assessed to confirm a 'Let-it-grow'[7] (LIG) treatment prescription (see Section 6-11).

Under height trees have all the characteristics of acceptable trees except that the minimum coniferous or deciduous tree height requirements (Table 6-3) are not met.

The minimum height requirements for under height trees are:

- 15 cm for coniferous trees (Sw, Se, Sb, Fb, Fa, Pl, Pj, Pw, Pf, La, Lt, and Lw); and,
- 30 cm for deciduous trees (Aw, Pb, and Bw).

In order for Douglas-fir (Fd) trees to be tallied as under height, Douglas-fir must be:

- An acceptable tree species (TSA or FMA or FMU specific; see Appendix 3);
- A minimum of 10 cm in height; and,
- On site for a minimum of two (2) growing seasons (a growing season is defined as the period between June 20 and August 1 annually).

Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

For Establishment surveys completed in openings declared to regenerated yield strata, under height trees shall not be used to determine the leading coniferous tree species group.

6.7 Choice of Establishment survey method

Openings due for Establishment surveys shall be assessed once, at a minimum, using the following survey methods:

- Reconnaissance survey (Section 6-8); and/or,
- Intensive Survey (Section 6-9).

Both survey methods determine adequacy of regeneration (stocking and consistent with mil hectare stocking). Results from Reconnaissance surveys shall be used to determine if subsequent Intensive surveys are necessary.

[7] Advanced notification of the intent to declare a LIG treatment to Alberta is not required.

6.8 Reconnaissance surveys

6.8.1 Procedures

Reconnaissance surveys are visual evaluations of openings by qualified surveyors to determine stocking (consistent with mil hectare stocking). A visual assessment of an opening can be performed by walking through or flying over the opening.

Reconnaissance fly-over (aerial) surveys are not an acceptable method for confirming a LIG treatment prescription. LIG treatment prescriptions must be confirmed by completing Reconnaissance walk-through surveys or Intensive surveys.

Interpretation of aerial photographs shall not be an acceptable method for conducting Reconnaissance surveys.

The entire opening shall be evaluated to adequately assess the spatial distribution of acceptable coniferous and deciduous trees. Reconnaissance surveys shall have opening level information recorded in the Acceptable Stocking Summary component of the Establishment Survey Summary Sheet (Appendix 4) including:

- Acceptable coniferous (C) tree stocking (%);
- Acceptable deciduous (D) tree stocking (%);
- Total stocking (%) of acceptable trees; and,
- An estimate of area (ha) classified as poorly stocked.

For openings declared to a regenerated yield stratum, the leading coniferous tree species group (PL, SW, and SB) shall be reported based on acceptable tree stocking.

While conducting Reconnaissance surveys, surveyors shall delineate areas:

- Classified as ‘natural deletions’ (Section 6.9.3);
- Classified as a land-use disposition (Section 6.9.3); and,
- That have poor stocking or may require future silviculture treatments.

The area (ha) of the natural deletion or land use disposition shall be withdrawn from the area (ha) of the opening.

Where there are natural deletions or land use dispositions, these shall be reported using the Establishment Survey Field Map Sheet (Appendix 4) or produced using a GIS (i.e. block map).

Where there are no natural deletions, land use dispositions, or areas of poor stocking to report for openings, the submission of an Establishment Survey Field Map Sheet to the department is not required.

For Reconnaissance walk-through surveys, in addition to the above requirements for delineating natural deletions, land use dispositions, and poorly stocked area, surveyors shall record their traverse throughout the opening. Acceptable methods for recording the traverse include:

- Using GPS track log (preferred); and,
- Hand drawn, to scale, on the Establishment Survey Field Map Sheet.

Surveyors shall make notes describing the tie point, traverse (bearings and distance) and decisions related to the stocking and stratum determination. On the map submitted to the department, surveyors must distinguish the traverse from the opening boundary and any land use or natural deletions. It is recommended that surveyors use a series of dots (i.e., ••••••••) to record the traverse on a map.

6.8.2 Outcome and next course of action

Subject to the outcome of Reconnaissance surveys, openings shall be assigned to one of the following categories:

- Total acceptable tree stocking is <70.0%;
- Total acceptable tree stocking is 70.0% or greater but not more than 83.9%; or,
- Total acceptable tree stocking is ≥84% but not more than 100.0%.

Where total acceptable tree stocking for the opening is <70% or ≥84% (above), an Intensive survey is not required.

Where total acceptable tree stocking for the opening is 70.0% or greater but not more than 83.9% (above), an Intensive survey is required (Section 6-9). The results from the Intensive survey shall be used to report the stocking and status of the opening to the department.

6.9 Intensive survey

Intensive surveys shall be conducted:

- In lieu of Reconnaissance surveys; or,
- When the total acceptable tree stocking assessed by Reconnaissance surveys for openings is determined to be 70.0% or greater but not more than 83.9%; or,
- To confirm LIG treatment prescriptions.

Intensive surveys use systematic survey methods to collect specific data for trees present in 10 m^2 (1.78 m radius) plots. The procedures for conducting Intensive surveys are:

(1) Determine the sample intensity (i.e., number of plots);

(2) Calculate the survey grid line and plot spacing;

(3) Layout transects and plots in the field; and,

(4) Assess each plot.

6.9.1 Determining the sample intensity

Sample intensity requirements are described in Table 6-4. The statistical accuracy of total acceptable tree stocking, based on these sample intensities, varies by opening size (ha) but is generally within 10 to 15% with a 95% confidence (Appendix 5 and 6).

Table 6-4. Number of sample plots required by opening area (ha) category.

Opening area (ha)	Number of sample plots required
0.1 – 1.9	Establish a minimum of 12.4 plots per hectare.
2.0 – 4.0	Establish a minimum of 41 plots per opening or as many as are needed to cover the opening. Optional: If stocking is between 73.0% and 79.9%, increase the number of plots to 54.
4.1 – 24.0	Establish a minimum of 64 plots per opening or as many as needed to cover the opening. Optional: If stocking is between 73.0% and 79.9%, increase the number of plots to 84.
> 24.0*	2.77 plots per hectare.

*To determine the number of sample plots needed for openings larger than 24 ha, multiply the net opening area by 2.77 and round the product up to the nearest whole number.

Box 4: Calculating the minimum number of plots to establish.

Opening area: 26.4 ha

Required number of plots per hectare (from Table 6-4): 2.77

Number of sample plots: 26.4 ha × 2.77 = 73.13

Product rounded up to the nearest whole number: 74

Minimum number of plots to establish: 74

6.9.2 Calculating the survey grid line and plot spacing

When calculating line and plot spacing, two methods may be used:

(1) Square spacing; and,

(2) Rectangular spacing.

Square spacing

Square spacing is a grid pattern where the distance between lines equals the distance between plots. When the total number of plots is determined and the area of the opening is known, the survey grid (plot and line spacing) can be calculated using the following formula:

$$\text{Plot spacing} = \sqrt{(Opening\ Area\ (ha)\ x 10{,}000\ m^2 / ha) / required\ \#\ of\ Plots}$$

Box 5. Square spacing example.

For surveys on a 12.1 ha opening, calculate a square survey grid.

From Table 6-4, a 12.1 ha opening requires a minimum of 64 plots be established.

Calculate the plot spacing:

$$Plot\ Spacing = \sqrt{(12.1 x 10{,}000 / 64} = \sqrt{1890.625} = 43.48$$

Round off to the nearest 0.1 m: line spacing = 43.5 m & plot spacing = 43.5 m

Appendix 7 lists calculated square line and plot spacing for openings of various sizes. For openings 24 ha or larger, a 60 m × 60 m square grid shall be used.

Rectangular spacing

Rectangular spacing occurs when the line spacing differs from plot spacing. The line spacing shall not be greater than twice the plot spacing. For openings 24 ha and larger, a 60 m × 60 m square grid must be used.

To calculate rectangular spacing, the desired line spacing is selected then the plot spacing needed to achieve the correct number of plots is calculated.

Box 6. Rectangular spacing example.

For surveys on a 3.9 ha opening; calculate a rectangular survey grid, assuming a line spacing of 35 m.

A 3.9 ha opening requires that a minimum of 41 plots be established (Table 6-4).

$$\text{Plot spacing x line spacing} = \frac{\text{Opening Area (ha) x 10,000 (m2 /ha)}}{\text{Required \# plots}}$$

$$\text{Plot spacing x 35 m} = \frac{\text{3.9 ha x 10,000 m2 /ha}}{\text{41 plots}}$$

Plot spacing = 951.22 m2 / 35 m

Plot spacing = 27.1777 m

Round off to the nearest 0.1 m: line spacing = 35.0 m & plot spacing = 27.2 m

6.9.3 Laying out transects and plots in the field

For each opening to be surveyed, the methods to locate plots in the field shall be either:

(1) Compass and horizontal distance measuring device with GPS x and y coordinates captured at each plot location; or,

(2) GPS to navigate to pre-determined plot locations generated using a GIS.

When locating plots in the field using the compass and horizontal measuring device method (methods 1), control line(s) must be used and shall be established as follows:

- Establish one control line parallel to the long axis of the opening (Figure 6-1). Additional parallel control lines shall be established every 400 metres where opening width exceeds 400 m.
- The control line is best placed to coincide with the grid to enable points along the control line to be used as plot centres. Reference the control line in relation to the opening boundary to enable accurate mapping of the sample plot locations.
- Starting from the opening edge, the first survey line shall be located at one-half the interline distance. Each additional survey line is marked at the exact interline distance.
- Survey line intervals on the control line shall be double flagged using two different colours. The line and plot number shall be clearly written on the flagging.
- Beginning at the control line, the remaining individual plots shall be located at the required line and plot spacing. All measured distances must be based on horizontal or surface projections.

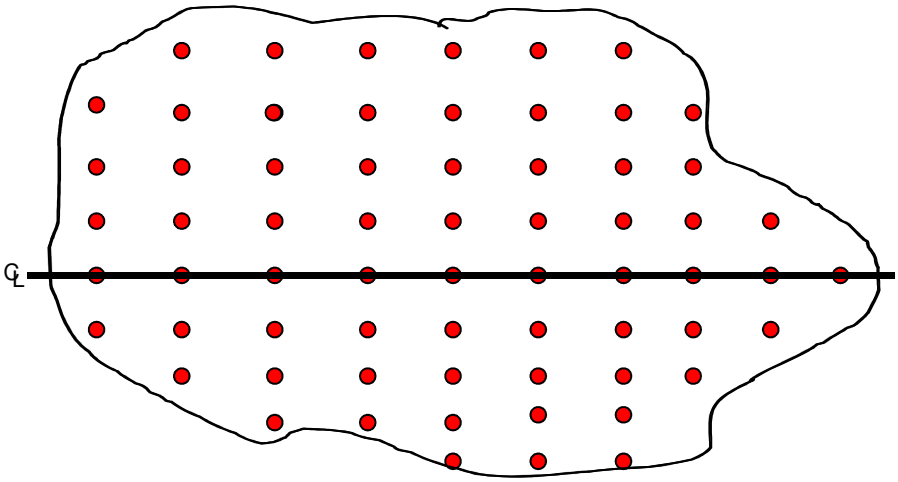


Figure 6-1. Sample plot distribution diagram.

When locating plots in the field using the GPS to navigate to pre-determined plot locations method (method 2 above), a control line is not required.

Plots to delete

Areas within openings where plots are unnecessary include those under a land-use disposition or those classified as a landbase deletion, as defined in the applicable FMP.

Examples of land use deletions include:

- Miscellaneous lease (MLL) (e.g. campsite, sand and gravel);
- Pipeline Agreement (PLA);
- Licence of Occupation Road (LOC);
- Well site;
- Archaeological and historic sites; and,
- Permanent sample plots (PSP) or other research areas (ISP, DNR, and PNT).

Examples of ‘natural’ deletions include:

- Riparian areas and treed buffers (no stumps encountered; 0.05 ha or larger); and,
- Treed patches within openings (no stumps encountered; 0.5 ha or larger).

Plots landing on seismic lines shall not be deleted unless seismic lines have been removed from the contributing landbase (FMP specific). Surveyors shall confirm with the obligation holder whether plot landing on seismic lines are deleted.

Where, prior to beginning the survey, an area is known to be within a land-use disposition or a FMP landbase deletion, the area shall be deleted from the opening and the grid shall be calculated using the reduced opening area.

As plots are being located in an opening, any plot landing in a deletion area may be established for grid reference purposes but shall not be measured. If the area of the deletion is correct, the proper number of plots to fill the opening should be obtained without moving any plots.

Plots landing on seismic lines shall not be moved or deleted unless the area of the seismic line has been removed from the opening (i.e., FMP landbase deletion).

Relocating plots

Where surveyors encounter new dispositions or natural deletions whose areas were not deleted from the opening area at the time the grid was calculated, may set the line and plot spacing to a wider spacing to avoid the deletion. This will achieve the required number of plots. In these cases, the plot shall be moved half the plot distance toward the next plot to achieve the required number of plots.

Should the plot continue to land on the disposition or natural deletion, surveyors shall continue to move at one half the plot distance intervals until a plot is established. The plot following a moved plot remains at the calculated line and plot spacing for the opening.

Adding plots

A minimum number of plots shall be established within each opening to achieve the desired sampling precision (Table 6-4). If additional plots are required to make up this minimum number or if intensifying the number of plots to confirm stocking in the 73.0% to 79.9% range (optional), they should be located as follows:

- Halfway between every third survey line (i.e., halfway between and parallel to the third and fourth survey lines, sixth and seventh lines).
- Plot spacing shall be the same on additional lines as for the original lines to facilitate delineation of stocked or poorly stocked areas.
- Where every third line does not add the required number of plots, proceed to add lines between other survey lines until the required number of plots is reached. Lines shall be marked on the control line and numbered sequentially (no letters).
- Lines added using the compass and distance measuring device method (this also applies to GPS when used as a compass and distance measuring device) shall be given the next number in the sequence. Use only whole positive numbers.
- Plots added using GPS as waypoints shall be given unique, whole positive numbers.

Plot layout

- The size of the sample plot shall be 10 m^2;
- The shape of the sample plot shall be circular and have a radius of 1.78 m;
- The centre of the circle and the plot centre shall be a common point;

- Plot centres shall be clearly located in the ground in such a way that they can be re-located for auditing purposes. Plots shall be marked,

    (1) In the ground at the exact location where plot centre is used to measure the plot radius. In all cases, plot centre shall be marked with all-weather flagging (e.g. winter weight, blue in colour preferably) attached to a wooden stick, nail, or pig-tail or in a shovel slit in the ground at plot centre. The plot number shall be written legibly on the flagging using a black, waterproof marker pen; and,

    (2) Where nails or shovel slit is used to mark plot centre, plots shall also be marked at eye-level using all-weather flagging marked with the plot number attached to a sturdy tree branch closest to plot centre to allow for easy identification of the location of the plot centre.

6.9.4 Plot assessment

Intensive surveys shall have plot level assessments (Table 6-5) for the presence of an acceptable coniferous and/or deciduous tree recorded on the Establishment Survey Tally Sheet (Appendix 4). The type of tally sheet will depend on the method for laying out plots in the field, as described in Section 6.9.3. Method '1' shall use the Establishment Survey Tally Sheet A while method '2' shall use Establishment Survey Tally Sheet B.

Where an acceptable coniferous or deciduous tree is not present in the plot, surveyors may assess the plot for the presence of under height trees. Only seedlings (not advanced regeneration) shall be recorded. This information shall be used to confirm a LIG treatment prescription.

To facilitate field checking, acceptable or under height trees that contributed to coniferous or deciduous stocking shall be marked with flagging.

Coniferous and deciduous trees shall be assessed separately. The species of the acceptable tree which stocks the plot shall be recorded. Where an acceptable tree is not present in the plot, surveyors may record the species of the under height coniferous and/or deciduous tree, if present.

Table 6-5. Summary of Intensive survey plot-level assessments.

Required assessment - all plots
Plot stocked with an acceptable coniferous tree.
Plot stocked with an acceptable deciduous tree.
Optional assessment to confirm LIG – all plots
For plots not stocked with an acceptable coniferous or deciduous tree, determine if the plot is stocked with a coniferous tree that is below the minimum height for an acceptable coniferous tree. Only include coniferous trees ≥ 15 cm in height (Douglas-fir ≥10 cm and on-site for a minimum of two growing seasons).
For plots not stocked with an acceptable coniferous or deciduous tree, determine if the plot is stocked with a deciduous tree which is below the minimum height for an acceptable deciduous tree. Only include deciduous trees ≥ 30 cm in height.

To determine if a tree is inside the plot, measure from the point where the plot centre marker enters the ground to the point of germination. If the point of germination is within 1.78 m (horizontal distance) of the plot centre, then the tree stem is in the plot.

The germination point is the point at which the coniferous or deciduous tree takes root and becomes established. For stem sprouts in trembling aspen or balsam poplar, the germination point is the point at which the sprout has originated on the original stump. If estimation is required, then assume the geometric centre of the main stem. Count a tree as within the plot when its point of germination is inside the plot even if the tree is leaning outside. Conversely, do not count a tree leaning into the plot but with its point of germination outside the plot.

6.9.5 On-site stocking confirmation (optional)

If after completing the Intensive survey and while still at the opening, surveyors may choose to calculate the total acceptable tree stocking for the opening. If the total acceptable tree stocking is between 73.0% and 79.9%, surveyors have the option to increase the number of plots to confirm the stocking. The required number of plots to confirm stocking are described in Table 6-4. The method for adding plots to achieve the required number of plots to confirm stocking is described in Section 6.9.3.

6.9.6 Adding columns to the Establishment Survey Tally Sheet

Timber disposition holders may choose to add columns to the Establishment Survey Tally Sheet to record other information that they feel relevant to collect while conducting the Intensive survey. As well, timber disposition holders may choose to add specific data sets to a ‘tailored’ version of the tally sheet. Any data recorded in added columns do not form any part of the requirements of the Establishment survey and are not considered mandatory by the department.

6.9.7 Establishment Survey Field Map Sheet

Field maps shall be drawn on the Establishment Survey Field Map Sheet (Appendix 4) or produced in an acceptable digital format (i.e., GIS block maps) and submitted to the department. Plots shall be drawn on the map as surveyors progress through the opening. This will assist surveyors with mapping certain features of the opening and the status of the plots surveyed. All maps submitted shall have the applicable information for each opening surveyed, as shown in Tables 6-6 and 6-7.

Table 6-6. Establishment Survey Field Map Sheet information by survey type.

Item*	Reconnaissance survey		
	Aerial	Walk-through	Intensive survey
Opening boundary	✓	✓	✓
Disposition holder	✓	✓	✓
Disposition	✓	✓	✓
Opening number	✓	✓	✓
Field number	✓	✓	✓
Map scale	✓	✓	✓
Location of tie points		✓	✓
Location and bearing of control lines			✓
Location of survey lines and plots			✓
Line and plot numbers			✓
Line and plot spacing			✓
Plot stocking status symbols			✓
GPS make, model, and coordinate system (if used)	✓	✓	✓
Traverse		✓	
Location and size of land use and natural deletions	✓	✓	✓
Delineation of poorly stocked areas	✓	✓	✓
North arrow	✓	✓	✓

* Methods can vary within and between survey types (i.e., compass or GPS), which can affect map requirements. See Sections 4.8 and 4.9 for specific details.

Table 6-7. Intensive survey map symbols and definitions.

Symbol	Definition	Symbol	Definition
	Not cut or deleted plot		Not stocked
	Stocked with an acceptable coniferous tree species		Stocked with an under height coniferous tree
	Stocked with an acceptable deciduous tree species		Stocked with an under height deciduous tree
	Stocked with both acceptable coniferous and deciduous tree species		Stocked with a coniferous and deciduous tree species which are both under height

6.9.8 Identifying areas with poor stocking

In addition to plot locations and symbols, the map for the Intensive survey shall identify poorly stocked areas that are 4 ha or larger. Stocking is determined by the presence of an acceptable tree within each 10 m^2 plot.

Delineating poorly stocked areas 4 ha in size or larger is based on a moving average-of-plot status where areas not meeting the stocking requirement are assessed using perpendicular rows across the opening.

The following procedure shall be used for Intensive surveys to delineate poorly stocked areas.

Identify poorly stocked areas within a generally stocked opening by:

- Starting at one corner of the opening, proceed along the survey lines and examine five plots at a time. After the first five plots have been examined, drop the first plot in the line and add one plot on the end (running average of five plots). Continue progressing to the end of the line until the last five plots have been assessed.

- A survey line section of five plots shall be considered stocked if four of the plots are stocked. All stocked plots should be considered regardless of coniferous or deciduous status.

- A survey line section of five plots shall be considered poorly stocked if it contains zero to three stocked plots.

- If there are fewer than five plots in a line, all plots shall be stocked in order to call the section stocked.

- If there are more than five plots in a line, the beginning of the first poorly stocked five-plot section and the end of the last poorly stocked five-plot section should be marked to select the poorly stocked portion of the survey line.

After each line is assessed and marked, draw a boundary around the marked areas to identify the locations of the suspected poorly stocked areas. The same procedure must be repeated by running the five-plot, moving average perpendicular to the first direction. An area shown to be poorly stocked in both directions shall be considered the poorly stocked area.

Identifying stocked areas within a generally poorly stocked opening:

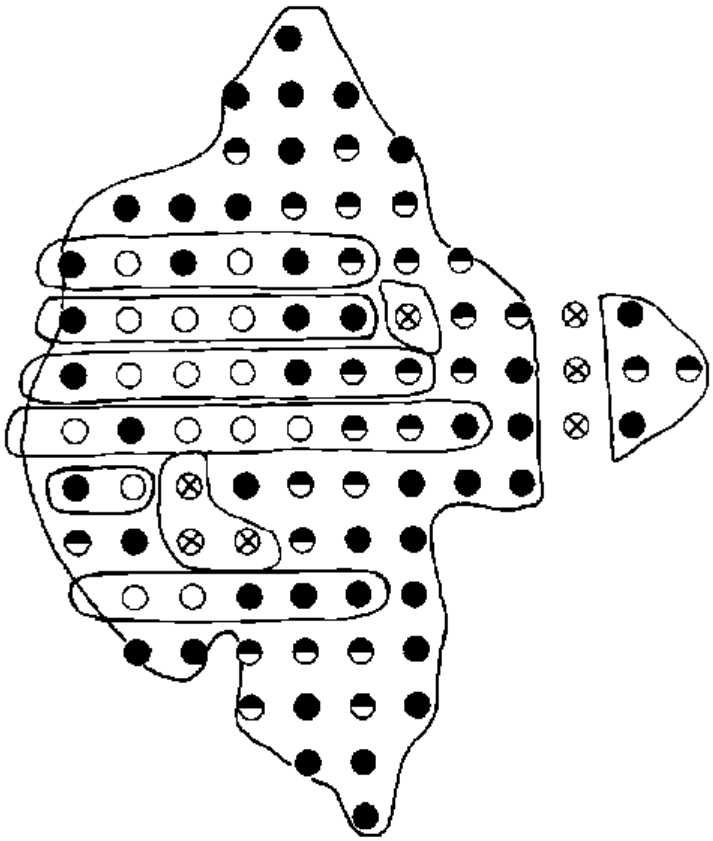
- The procedure is the same as for identifying poorly stocked areas in a stocked opening, except a five plot section is considered stocked only when all the plots are stocked (i.e., 100% stocked).

- The procedures described above should not be used to delineate stocked or poorly stocked areas that are smaller than 4 ha. There should be a minimum of 10 plots in the sub-unit. This is necessary where the number of plots is very small. In these situations a high probability exists that the area will be classified incorrectly.

Some logical adjustments may be made around the border of the poorly stocked area. When the above procedure has been completed, calculate the area (ha) of each poorly stocked area to determine if any are greater than 4 ha.

Poorly stocked areas over 4 ha in size shall be mapped in a manner acceptable to Alberta. The area of a poorly stocked patch shall be recorded in the “Poorly Stocked Area (ha)” line on the Establishment Survey Summary Sheet.

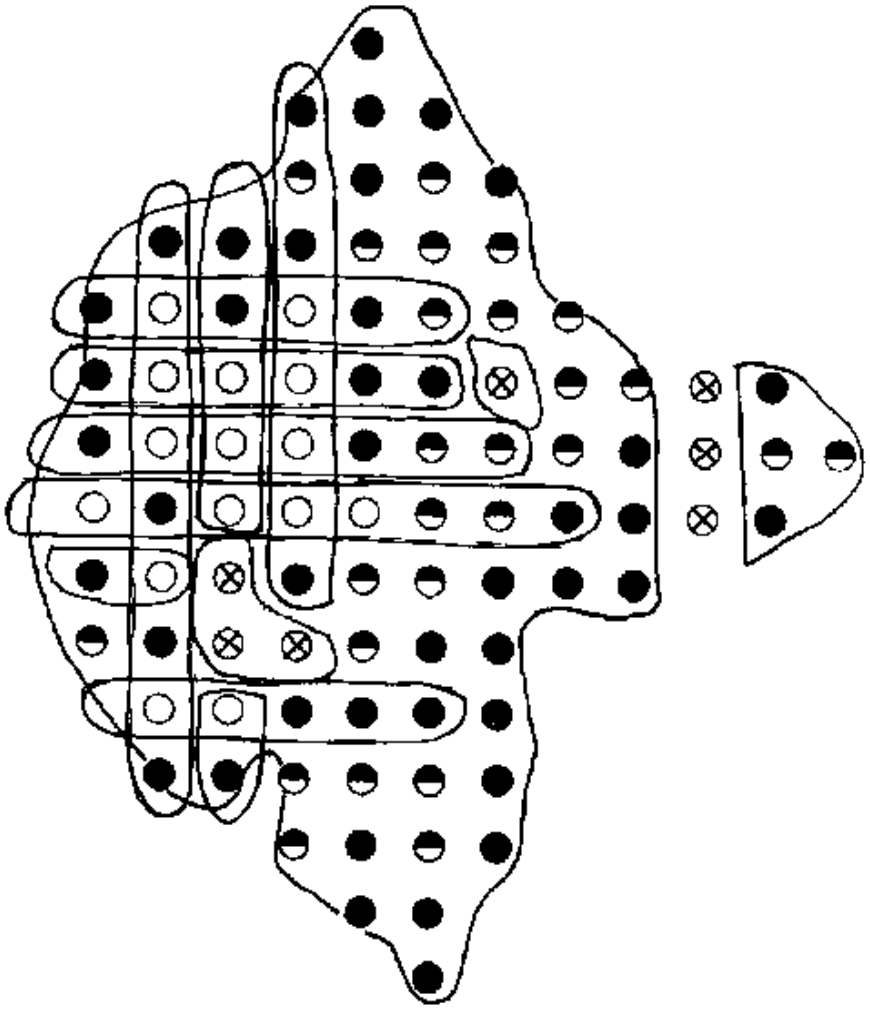
The following are examples of delineating poorly stocked areas larger than 4 ha.



Step 1: Example of west to east delineation of suspected poorly stocked area

CD – ESTABLISHMENT SURVEY

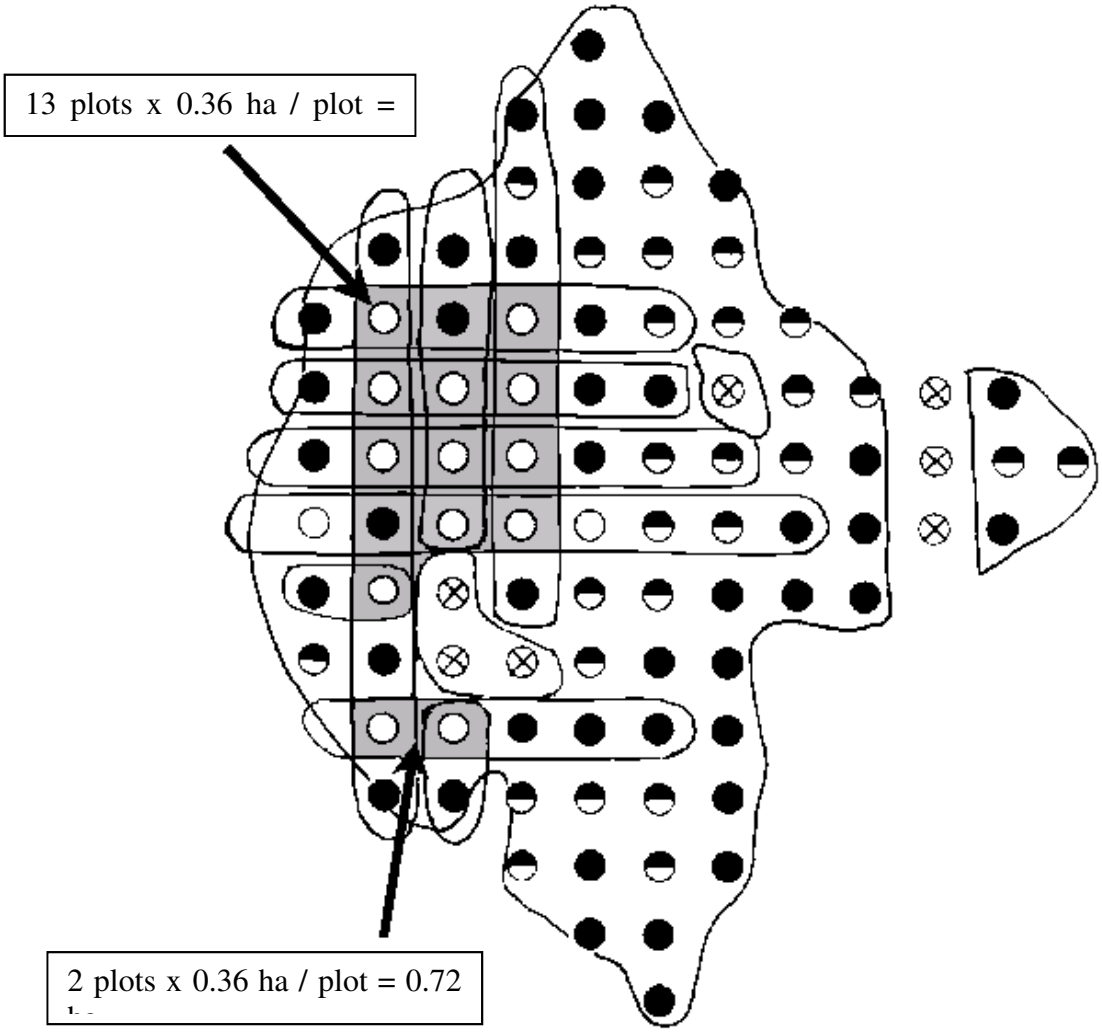
Opening Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
Poorly stocked	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
	Stocking Percent	= 82.14%



Step 2: North to south delineation of suspected poorly stocked area

CD – ESTABLISHMENT SURVEY

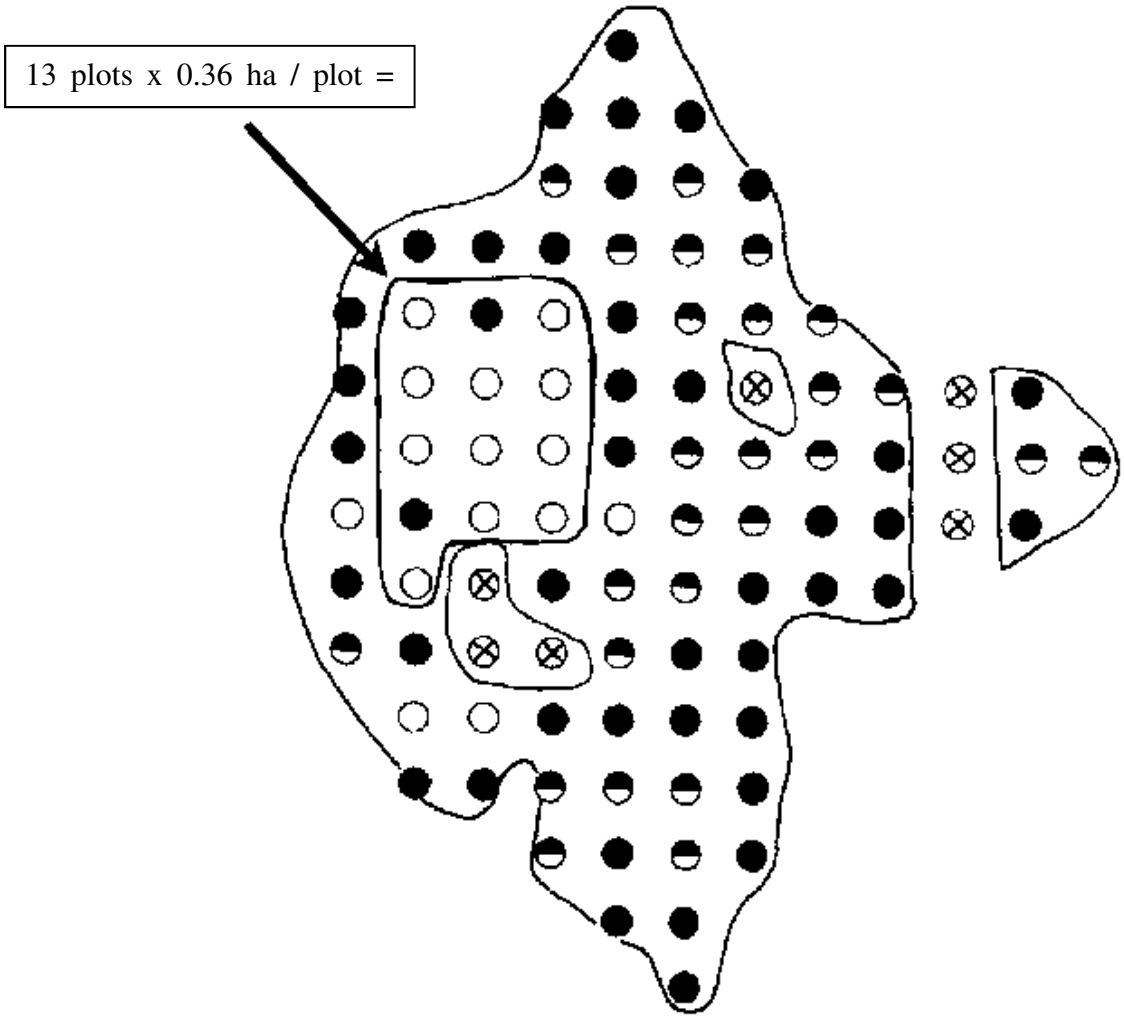
Opening Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
Poorly stocked	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
	Stocking Percent	= 82.14%



Step 3: Overlapping area following east-west and north-south delineation of suspected poorly stocked area (shaded area).

CD – ESTABLISHMENT SURVEY

Opening Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
Poorly stocked	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
	Stocking Percent	= 82.14%



Step 4: Poorly stocked area greater than 4.0 ha identified on the opening map.

CD – ESTABLISHMENT SURVEY

Opening Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
Poorly stocked	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
	Stocking Percent	= 82.14%

6.9.9 Acceptable tree stocking calculations

Information about acceptable tree stocking shall be compiled for each opening on the Establishment Survey Summary Sheet including:

- Number of plots stocked with an acceptable coniferous (C) tree;
- Number of plots stocked with an acceptable deciduous (D) tree;
- Number of plots stocked with both an acceptable coniferous and deciduous (CD) tree;
- Number of plots stocked with an under height C tree;
- Number of plots stocked with an under height D tree;
- Number of plots stocked with both and under height CD tree;
- Number of plots not stocked;
- Number of plots landing in areas not cut or within a deletion; and,
- Total number of eligible plots to calculate stocking.

Based on these values (above), Coniferous, Deciduous, and Total Stocking (%) shall be calculated as follows, regardless of strata standard:

- A plot containing an acceptable coniferous tree shall count once towards the calculation of Coniferous tree stocking, thus Coniferous tree stocking (%) shall be calculated by dividing the number of plots stocked with an acceptable coniferous tree by the total number of eligible plots and then multiplying by 100;
- A plot containing an acceptable deciduous tree shall count once towards the calculation of Deciduous tree stocking, thus Deciduous tree stocking (%) shall be calculated by dividing the number of plots stocked with an acceptable deciduous tree by the total number of eligible plots and then multiplying by 100;
- A plot containing an acceptable tree (coniferous, deciduous, or both) shall count once towards the calculation of Total stocking, thus Total stocking (%) shall be calculated by dividing the number of plots stocked with an acceptable tree by the total number of eligible plots and then multiplying by 100.

For any opening, Coniferous, Deciduous, and Total stocking shall not exceed 100%. For example, if all plots in an opening contain an acceptable coniferous tree and an acceptable deciduous tree, then Coniferous, Deciduous, and Total stocking shall be recorded as follows:

Coniferous stocking: 100%

Deciduous stocking: 100%

Total stocking: 100%

Calculating Coniferous, Deciduous, and Total stocking using the methods described above are effective for Establishment surveys conducted on or after 1 May, 2010.

6.10 Damage and site conditions

The extent of damage to acceptable trees by insects, disease, and animals may be recorded for the opening using the Establishment Survey Summary Sheet (Appendix 4). Space is also provided to record opening summary information specific to site conditions.

Recording damage and site condition information is optional but may be very important for determining why a particular opening may have failed the stocking standard.

6.11 Opening status and stratum assignment

Based on the results from an Establishment survey, opening stocking status can only be Satisfactorily Restocked (SR) or Not Satisfactorily Restocked (NSR). Effective May 1, 2010 the Conditionally Satisfactorily Restocked (CSR) status cannot be used for openings assessed to the D Standard.

There are three primary requirements for achieving a SR status for openings:

1) The Total Stocking (%) for the opening must be:

    - 84% or greater after a Reconnaissance survey, or
    - 80% or greater after an Intensive survey; and,

2) Minimum stocking (%) requirements for Coniferous and Deciduous must be met (Table 6-2); and,

3) The opening has no contiguous poorly stocked areas exceeding four (4) hectares.

Where the opening is SR to the declared stratum, the opening **must** be reported as SR and SR to the declared stratum.

Several options are available to timber disposition holders for reporting the status of openings deemed NSR to the declared stratum following Establishment surveys including:

1) Where the opening is SR to a stratum other than the declared stratum and the timber disposition holder deems the stratum change to be acceptable, the timber disposition holder may submit a declaration to the department indicating the opening stratum assignment is acceptable to the new stratum.

    Timber disposition holders shall use the Establishment Survey Summary Sheet (Appendix 4) to briefly describe the rationale for the decision.

    No re-treatment or re-balancing of stratum area is required.

    Timber disposition holders shall report the current stratum to ARIS and declare the opening as SR.

    Timber disposition holders may consider the following examples of factors when making this decision:

    - The area of the opening;

- The total area by stratum of all openings surveyed to date in the five-year current Cut Control Quadrant; and,

- The expected development of the opening relative to performance survey targets and objectives.

2) Where the opening is SR to a stratum other than the declared stratum and the timber disposition holder deems the stratum change to be undesirable, the timber disposition holder shall report the opening as Not Satisfactorily Restocked (NSR).

3) Where the opening is NSR to all strata stocking standards, the timber disposition holder shall report the opening as NSR.

Openings reported as NSR require retreatment using methods and operations approved by the director (TMR 141.6(2)).

Timber disposition holders may choose "Let-It-Grow" (LIG) as a retreatment prescription in cases where information has been collected for under height trees (as defined in Section 6-6) present at time of a Reconnaissance walk-through Establishment survey or an Intensive Establishment survey. In order to use LIG, the addition of total acceptable tree stocking and under height tree stocking shall be 80% or greater.

Advance notification of the intent to declare a LIG retreatment to the department is not required.

Box 7. Calculating stocking using under height trees to inform a LIG retreatment prescription.

Plots stocked with an acceptable C tree	*15*	*Percent of plots = 10.6%*
Plots stocked with an acceptable D tree	*25*	*Percent of plots = 17.7%*
Plots stocked with both an acceptable C and D trees	*35*	*Percent of plots = 24.8%*
Plots stocked with an under height (UH) C tree	*10*	*Percent of plots = 7.1%*
Plots stocked with an UH D tree	*20*	*Percent of plots = 14.2%*
Plots stocked with both an UH C and UH D tree	*30*	*Percent of plots = 21.3%*
Plots not stocked	*6*	*Percent of plots = 4.3%*
Plots in areas not cut or deleted	*1*	
Total (excluding plots in areas not cut or deleted)	*141*	

Acceptable tree stocking (reported to ARIS)
Acceptable coniferous tree stocking = 10.6% + 24.8% = ***35.4%***
Acceptable deciduous tree stocking = 17.7% + 24.8% = ***42.5%***
Total stocking of acceptable trees = 10.6% + 17.7% + 24.8% = ***53.1%***

Tree stocking to confirm LIG
Total stocking (acceptable and UH trees) = 10.6% + 17.7% + 24.8% + 7.1% + 14.2% + 21.3% = ***95.7%***

6.12 Reporting

Establishment surveys conducted by timber disposition holders shall be reported to Alberta Agriculture and Forestry (A and F) regional offices on or before 15 May following the Timber Year in which they are completed.

Reporting of Establishment survey sheets shall be hardcopy (paper) or digital. A complete and validated Reforestation Survey Reporting Cover Page (Appendix 8) must accompany all reporting of Establishment survey information to A and F regional offices.

For those timber disposition holders who harvest more than 30,000 m^3 annually, the Reforestation Survey Reporting Cover Page must be validated by the Regulated Forestry Professional (RFP) of the timber disposition holder. Validated work is work that has been prepared by or reviewed and approved by an RFP. The RFP who validates work must have done the work, contracted the work, or supervised those who did the work. The validating RFP is accountable for ensuring the reporting of Establishment survey information is complete, accurate, and on time.

For those timber disposition holders who harvest less than 30,000 m^3 annually, the Reforestation Survey Reporting Cover Page must be signed by the timber disposition holder. By signing the Reforestation Survey Reporting Cover Page, the timber disposition holder is stating that the Establishment survey information is complete, accurate, and on time.

The Reforestation Survey Reporting Cover Page (with RFP validation or signature, where appropriate) may be submitted digitally, but shall be in a proprietary file format (e.g., Adobe Acrobat) for digital signature protection.

6.12.1 Reconnaissance surveys

An acceptable Reconnaissance survey reporting package for each opening shall include, at a minimum, a completed Establishment Survey Summary Sheet.

An Establishment Survey Field Map Sheet is required for Reconnaissance surveys when:

- There are NSR areas and/or natural deletions and/or land-use dispositions delineated;
- A ‘Walk-through’ survey has been completed.

6.12.2 Intensive surveys

An acceptable Intensive survey reporting package for each opening contains:

- A completed Establishment Survey Summary Sheet;
- A completed Establishment Survey Tally Sheet; and,
- A completed Establishment Survey Field Map Sheet or other acceptable formats (see Section 6.9.7).

6.12.3 ARIS submissions

For Establishment surveys, results submitted to the Alberta Regeneration Information System (ARIS) for each opening shall include:

- Status;
- Stratum;
- Acceptable coniferous tree stocking (%);
- Acceptable deciduous tree stocking (%); and,
- Acceptable total stocking (%).

For Establishment surveys completed in openings declared to regenerated yield strata, the leading coniferous tree species group shall not be reported to ARIS at this time.

Where a Reconnaissance survey and an Intensive survey are completed for the same opening (i.e., total stocking after a Reconnaissance survey is between 70% and 84%), **only** the results from the Intensive survey shall be reported to the department and submitted to ARIS.

Where a Reconnaissance survey and an Intensive survey are completed for an opening for internal audit or calibration purposes, only the results from the Intensive survey shall be reported to the department and submitted to ARIS.

6.13 Survey quality

Alberta requires Establishment survey information be complete and accurate. Timber disposition holders shall ensure quality control systems are developed and being used (required since 1 May, 2008). Quality control systems must include surveyor training, field auditing, and data validation (see Section 11 Quality assurance principles and components for details on the required elements of a quality assurance system for Establishment surveys; see section 11.3 for additional requirements).

Surveyors shall receive training specific to the FMA or FMU to ensure appropriate measurements are made and recorded.

Audits of openings and/or surveyors shall be conducted using check surveys carried out by qualified surveyors and appropriate for the Establishment survey type. A sample of openings declared SR by means of Reconnaissance survey shall have an Intensive survey to confirm the stocking.

Audits shall focus on openings where the risk of error is highest.

7 Understory Protection Establishment Survey Standard

7.1 Population/ Applicability

This survey protocol shall be used on all Understory Protection (UP) openings that are eligible for an establishment survey. Understory Protection openings must have been harvested with planned strip cuts (or other approved method) designed to protect sub-merchantable coniferous understory trees. The understory trees protected during UP harvesting are assumed to be merchantable and available for harvest at the next stand entry.

This survey protocol shall not be used to assess openings harvested with Understory Avoidance techniques. Openings harvested via understory Avoidance shall be assessed with the 'standard' RSA establishment survey standard.

Understory Protection openings harvested on or after May 1, 2013 must have been approved as 'Understory Protection' in an Annual Operating Plan (AOP) and have been designated as 'Understory Protection' in the Alberta Regeneration Information System (ARIS) with the correct codes[8] and an approved UP landbase designation code (see Section 5).

All UP openings harvested on or after May 1, 2015 must have been appropriately subdivided so as to not contain any contiguous clearcut areas ≥ 2 ha in size (see Section 5 for further explanation/ requirements).

This establishment survey protocol shall be used on all partially harvested openings with ≥2 ha of Understory Protection (planned strip cuts). This requirement applies even if openings have been declared to a non-UP harvest system in ARIS (e.g., shelterwood (SW)), provided at least 2 ha of the opening was harvested with planned strip cuts. Openings with <2 ha of strip cuts shall use the 'standard' RSA establishment survey protocols (Section 6).

7.2 Objectives

The objectives of Understory Protection establishment surveys are:

- Determine and document the reforestation status of each opening;
- Document the presence and distribution of retained coniferous trees across the entire opening;
- Document the presence and distribution of regenerating seedlings and suckers across the entire opening; and
- Identify areas and conditions in openings where regeneration success has been inhibited or is unlikely to meet the density and/ or distribution targets for regeneration at the time of the performance survey.

[8] Opening Type = PC and Harvest System = UP

7.3 Terminology

This Understory Protection establishment survey protocol contains some terms that are not common in 'standard' forestry operations. Terms used in this protocol are defined in Table 7-1 and an example Understory Protection opening is shown in Figure 7-1.

Table 7-1. Understory Protection terms and definitions

Term	Definition
Backline	Clearcut trail that surrounds an Understory Protection area. The harvesting equipment travels in this corridor in order to navigate between extraction trails.
Buffer	Corridor where no timber harvesting takes place.
C^{UP}	Acceptable coniferous trees that were protected during Understory Protection harvesting. These trees are greater than or equal to an SYU-specific minimum height threshold (see Section 7.6.3).
$C^{REGEN+D}$	Acceptable coniferous trees below the SYU-specific minimum height threshold, plus all acceptable deciduous trees throughout the opening.
Extraction trail	Clearcut trail where all trees have been removed. The corridor in which the harvesting equipment travels, adjacent to the protected areas.
Protected area	Reach areas and buffers.
Reach area	Corridor where the harvesting equipment reaches in to remove merchantable trees. The harvesting equipment does not travel in this corridor.
Understory Protection (UP) area	Area where understory trees were protected through the use of planned strip cuts or other approved harvesting methods. The UP area contains all components of Understory Protection harvesting, including extraction trails, reach areas, buffers, embedded or adjacent roads, landings and backlines and any embedded or adjacent clearcut areas less than two hectares in size. The UP area includes both protected and unprotected areas.
Unprotected area	Extraction trails, backline, roads, landings and embedded or adjacent clearcut areas less than 2 ha in size.

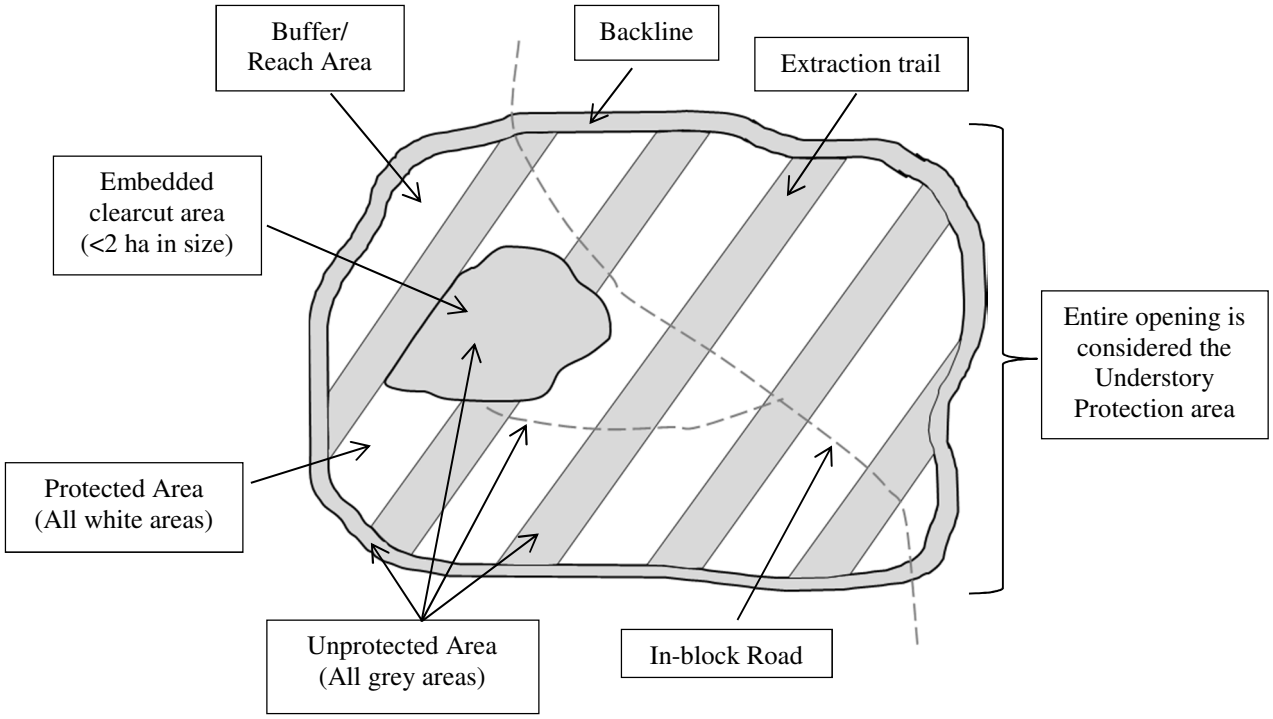


Figure 7-1. **Example Understory Protection opening**

7.4 Opening Stratification

Prior to undertaking establishment surveys, all Understory Protection openings must be stratified into protected and unprotected area.

7.4.1 Opening Stratification Timing

Opening stratification can be completed any time before establishment surveys are undertaken. The results of the opening stratification shall be submitted as part of the required reporting package submitted annually by May 15 to the Agriculture and Forestry Regional office (Section 7.14).

7.4.2 Opening Stratification Standards

All Understory Protection openings shall be stratified into protected and unprotected area. The protected area includes all reach areas and buffers (Table 7-1). The unprotected area includes all extraction trails, embedded or adjacent roads, landings and backlines and any embedded or adjacent clearcut areas less than two hectares in size (Table 7-1). Timber disposition holders are not required to report on the area/ proportion of each individual disturbance type (reach area, extraction trail, roads, etc.) within openings.

Stratification shall be completed for each Understory Protection opening and shall include all the following metrics:

- Area (ha) in protected area;
- Area (ha) in unprotected area;

- Proportion of opening (%) in protected area; and
- Proportion of opening (%) in unprotected area.

Stratification may be completed using any method that is acceptable to Alberta. Acceptable stratification methods include, but are not limited to:

- Leaf-off or leaf-on update aerial photography[9];
- Global Positioning System (GPS) mounted on harvesting equipment; or
- Field-based transects.

A description of the proposed stratification method must be submitted to Forest Management Branch for approval at least 60 days before its intended use. All stratification methods must assess the entire Understory Protection opening and must be approved in writing prior to use. If the same method is to be used in multiple years, approval is only required prior to the first year of use unless a change in methodology is being considered.

Copies of all aerial photos, maps or field data used to stratify Understory Protection openings must be submitted along with the area and proportion breakdowns as part of the annual May 15 reporting package submitted to the Agriculture and Forestry Regional office (Section 7.14).

7.5 Understory Protection Establishment Survey Timing

Understory Protection establishment surveys shall be completed no sooner than four years and no later than eight years after the end of the Timber Year of Cut for all openings (Table 7-2). The timing of Understory Protection establishment surveys is scheduled to determine UP treatment success and reforestation status.

Table 7-2. Establishment survey timing and opening eligibility by Timber Year of Cut

Timber Year of Survey	Timber Year of Cut Eligibility																	Complete by	Report by
	2002 2003	2003 2004	2004 2005	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012	2012 2013	2013 2014	2014 2015	2015 2016	2016 2017	2017 2018	2018 2019		
2010/2011	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	April 30, 2011	May 15, 2011
2011/2012	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	April 30, 2012	May 15, 2012
2012/2013	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	April 30, 2013	May 15, 2013
2013/2014	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	April 30, 2014	May 15, 2014
2014/2015	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	April 30, 2015	May 15, 2015
2015/2016	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	N	April 30, 2016	May 15, 2016
2016/2017	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	N	April 30, 2017	May 15, 2017
2017/2018	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	N	April 30, 2018	May 15, 2018
2018/2019	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	N	April 30, 2019	May 15, 2019
2019/2020	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	N	April 30, 2020	May 15, 2020
2020/2021	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	N	April 30, 2021	May 15, 2021
2021/2022	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	N	April 30, 2022	May 15, 2022
2022/2023	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	N	April 30, 2023	May 15, 2023
2023/2024	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	April 30, 2024	May 15, 2024

[9] Minimum standards for update photography are: 30cm digital direct, 4 band (RGB) resolution captured with IMU/GPS.

7.6 Understory Protection Establishment Survey Stocking Standards

Understory Protection openings each have two separate stocking standards: C^{UP} stocking and total opening-level stocking. For an UP opening to be considered Satisfactorily Restocked (SR), the opening must achieve both the C^{UP} and total opening-level stocking standards.

7.6.1 C^{UP} Stocking Standards

C^{UP} stocking standards must be developed by each timber disposition holder undertaking Understory Protection harvesting. The C^{UP} stocking standard shall be Sustained Yield Unit (SYU)-specific and is expected to be directly linked to the assumptions made during the development of UP yield curves. If timber disposition holders elect to develop multiple UP yield curves, each yield curve shall have an associated C^{UP} stocking standard.

Trees that contribute to the determination of C^{UP} stocking shall be acceptable coniferous trees that meet or exceed the SYU-specific minimum height threshold (Section 7.6.3).

The C^{UP} stocking standard will apply to the entire UP opening, but will be area-weighted to the proportion of the opening where understory was protected (reach areas and buffers, see Section 7.4). As such, C^{UP} stocking standards will vary among openings due to differing proportions of observed protected vs. unprotected areas.

The calculation of opening-specific C^{UP} stocking standards shall be included in the opening stratification results that are required as part of the annual May 15 reporting package submitted to the Agriculture and Forestry Regional office (Section 7.14).

All stocking standards shall be rounded up to the nearest whole number.

All C^{UP} stocking standards must be approved in writing by Forest Management Branch prior to use.

Box 7-1: How to calculate the C^{UP} stocking standard

Opening A		*Opening B*	
C^{UP} stocking standard for SYU:	*75%*	*C^{UP} stocking standard for SYU:*	*75%*
% of opening in protected area:	*55%*	*% of opening in protected area:*	*40%*
C^{UP} stocking standard for opening A:	*42%*	*C^{UP} stocking standard for opening B:*	*30%*
(0.75 x 0.55 = 0.4125 = 42%)		*(0.75 x 0.40 = 0.30 = 30%)*	

7.6.2 Total Opening-Level Stocking Standards

The total opening-level stocking standard is the minimum total tree stocking required across an entire UP opening.

This stocking metric includes acceptable coniferous trees above the minimum height threshold (C^{UP}, Section 7.6.1), as well as acceptable coniferous trees below the minimum height threshold (and above the minimum acceptable coniferous tree height specified in Table 7-3) and acceptable deciduous trees across the entire opening ($C^{REGEN+D}$). To calculate total opening-level stocking, both the C^{UP} and $C^{REGEN+D}$ metrics shall be area-weighted to the proportion of the opening that was protected or unprotected, respectively, and the values shall be added together.

The calculation of opening-specific total opening-level stocking standards shall be included in the opening stratification results that are required as part of the annual May 15 reporting package submitted to the Agriculture and Forestry Regional office (Section 7.14).

All stocking standards shall be rounded up to the nearest whole number.

See example calculations below.

Box 7-2: How to calculate the total opening-level stocking standard

Opening A		*Opening B*	
C^{UP} stocking standard for SYU:	75%	C^{UP} stocking standard for SYU:	75%
% of opening in protected area:	55%	% of opening in protected area:	40%
C^{UP} stocking standard opening A:	**42%**	**C^{UP} stocking standard opening B:**	**30%**
(0.75 x 0.55 = 0.4125 = 42%)		(0.75 x 0.40 = 0.30 = 30%)	
$C^{REGEN+D}$ stocking expectation:	80%	$C^{REGEN+D}$ stocking expectation:	80%
% of opening in unprotected area:	45%	% of opening in unprotected area:	60%
$C^{REGEN+D}$ stocking expectation opening A:	**36%**	**$C^{REGEN+D}$ stocking expectation opening B:**	**48%**
(0.80 x 0.45 = 0.36 = 36%)		(0.80 x 0.60 = 0.48 = 48%)	
Total opening-level stocking standard:	**78%**	**Total opening-level stocking standard:**	**78%**
(42% + 36% = 78%)		(30% + 48% = 78%)	

There is no minimum stocking standard associated with $C^{REGEN+D}$ trees. However, unless otherwise approved, the $C^{REGEN+D}$ stocking expectation to be used in the calculation of total opening-level stocking standards shall be 80% in the unprotected area.

7.6.3 Minimum Height Thresholds

In order to differentiate between trees that will contribute to C^{UP} stocking from those that will contribute to $C^{REGEN+D}$ stocking, all timber disposition holders must develop one or more minimum height thresholds. All acceptable coniferous trees that meet or exceed the minimum height threshold will contribute to C^{UP} stocking, whereas acceptable coniferous trees below the minimum threshold and above the minimum acceptable coniferous tree height (Table 7-3) will

contribute to $C^{REGEN+D}$ stocking. All acceptable deciduous trees that achieve at least the minimum acceptable deciduous tree height (Table 7-3) will contribute to $C^{REGEN+D}$ stocking.

Minimum height thresholds must be directly linked to the assumptions made during the development of UP yield curves. Depending on the UP yield assumptions, each C^{UP} stocking standard may require an individual minimum height threshold.

All minimum height thresholds must be approved in writing by Forest Management Branch prior to use.

Table 7-3. **Minimum acceptable coniferous and deciduous tree height requirements**

Tree Species Group	Minimum Acceptable Height (cm)
Coniferous	30
Deciduous	130

7.7 Acceptable Trees

The C^{UP} and total opening-level stocking status of each UP opening shall be determined by assessing the spatial distribution of acceptable trees.

An acceptable tree is an individual seedling, sucker, coppice or advanced regeneration that:

- Is alive; and
- Is an acceptable tree species (SYU-specific, Appendix 3); and
- Has been on site for a minimum of two growing seasons[10]; and
- Originated from seed, suckering, coppice or layering (Sb); and
- Achieved the minimum coniferous or deciduous tree height requirement at the time of survey (Table 7-3); and
- Is expected to survive until final stand harvest (deciduous trees that are older than the reforestation clock start date of the opening shall not be considered acceptable trees).

In addition to the criteria above,

- Acceptable coniferous trees shall have:
    - A well-defined stem; and
    - Two or fewer stems originating at the base of the tree; and

[10] A growing season is defined as the period between June 21 and August 1 annually

- White and Engelmann spruce and fir trees shall have a live-crown ratio[11] of 0.33 or greater.

- Acceptable C^{UP} trees must also achieve the following:
  - Meet or exceed the minimum height threshold (Section 7.6.3); and
  - Have less than 25% of the live crown lost due to top breakage; and
  - Have no bole scars (bark removed to cambium) greater than 10 cm in length (vertical) or greater than 20% of the bole circumference.

7.8 Choice of Establishment Survey Method

Understory Protection openings due for an establishment survey shall be assessed once, at minimum, using the following survey methods:

- Aerial reconnaissance survey; and/ or
- Intensive survey.

Both survey methods determine the adequacy of the Understory Protection treatment and the post-harvest regeneration. Results from aerial reconnaissance surveys shall be used to determine if subsequent intensive surveys are necessary.

Intensive survey protocols shall be used as the quality assessment and quality control (QA/QC) procedure for timber disposition holders to 'field check' the results of aerial reconnaissance surveys.

Because regenerating Understory Protection stands are complex, a minimum of 50% of openings assessed with an aerial reconnaissance survey must also receive an intensive survey to confirm the survey observations. This requirement will be in place for at least the first three years that a timber disposition holder or forestry consultant carries out the UP establishment survey protocol. The 50% audit requirement will be reassessed on a case-by-case basis following the initial three year implementation period (see also Section 7.15).

7.9 Aerial Reconnaissance Surveys

7.9.1 Procedures

Aerial reconnaissance surveys are visual evaluations of openings by qualified surveyors to determine C^{UP} and total opening-level stocking. This survey is conducted by flying over the opening.

[11] Live crown ratio is the proportion of total stem length that is covered by living branches. It is expressed as a percentage or decimal of the total tree height. Live crown ratio is a useful indicator of the status of the tree in relation to vigour and photosynthetic leaf area, and is inversely related to stocking density. It is assumed that live crown ratio must be greater than 0.33 (33%) in order for the tree to release well.

The entire opening shall be evaluated to adequately assess the spatial distribution of acceptable coniferous and deciduous trees. Aerial reconnaissance surveys shall have opening level information recorded in the Acceptable Stocking Summary component of the Understory Protection Establishment Survey Summary Sheet (Section 7.16) including:

- Acceptable C^{UP} stocking (%);
- Acceptable total opening-level stocking (%); and
- An estimate of the area (ha) classified as poorly stocked.

While conducting aerial reconnaissance surveys, surveyors shall delineate areas:

- Classified as land-use dispositions (Section 7.10.3.1);
- Classified as natural deletions (Section 7.10.3.1); and
- That have poor C^{UP} and $C^{REGEN+D}$ stocking and as a result, may require future silviculture treatments.

The area (ha) of any natural deletions or land-use dispositions shall be withdrawn from the area of the opening.

Where there are natural deletions, land-use dispositions or poorly regenerated areas, these shall be reported using the Understory Protection Establishment Survey Field Map Sheet (Section 7.16) or produced using GIS (i.e., a block map).

Where there are no natural deletions, land-use dispositions or areas of poor stocking to report for an opening, the submission of an Understory Protection Establishment Survey Field Map Sheet is not required.

7.9.2 Outcome and Next Course of Action

Subject to the outcome of an aerial reconnaissance survey, Understory Protection openings shall be assigned to one of the following categories:

a. C^{UP} stocking and total opening-level stocking are both significantly below their respective stocking standards (at least 10 percentage points below the standard); or

b. C^{UP} stocking and/ or total opening-level stocking are slightly above or slightly below their respective stocking standards (less than 10 percentage points below the standard, and less than 4 percentage points above the standard); or

c. C^{UP} stocking and total opening-level stocking are both significantly greater than their respective stocking standards (at least 4 percentage points above the standard).

See examples below.

Box 7-3: C^{UP} and total opening-level stocking standard outcomes

Example 1 – C^{UP} stocking standard is 42%

Survey results are:

- *Clearly below C^{UP} stocking standard (scenario a above): 32% stocking or lower*
- *Slightly above/ below C^{UP} stocking standard (scenario b above): greater than 32% stocking but less than 46% stocking*
- *Significantly above C^{UP} stocking standard (scenario c above): 46% stocking or greater*

Example 2 – Total opening-level stocking standard is 78%

Survey results are:

- *Clearly below total opening-level stocking standard (scenario a above): 68% stocking or lower*
- *Slightly above/ below total opening-level stocking standard (scenario b above): greater than 68% stocking but less than 82% stocking*
- *Significantly above total opening-level stocking standard (scenario c above): 82% stocking or greater*

Where C^{UP} stocking and total opening-level stocking for an opening is scenario 'a' or 'c' above, an intensive survey is not required.

Where C^{UP} stocking or total opening-level stocking for an opening is scenario 'b' above, an intensive survey is required (Section 7.10). The results from the intensive survey shall be used to report the opening stocking and status to Alberta.

7.10 Intensive Surveys

Intensive surveys shall be conducted:

- In lieu of aerial reconnaissance surveys; or
- When the C^{UP} and/ or total opening-level stocking assessed by an aerial reconnaissance survey is in the 'grey' area between Satisfactorily Restocked (SR) and Not Satisfactorily Restocked (NSR) (less than 10 percentage points below, and less than 4 percentage points above the stocking standard); and/ or
- As the QA/QC procedure for timber disposition holders to 'field check' the results of aerial reconnaissance surveys[12].

[12] During at least the first three years that a timber disposition holder or forestry consultant implements this survey protocol, a minimum of 50% of openings assessed with aerial reconnaissance surveys must also receive an intensive survey to verify the survey observations (see also Section 7.15).

Intensive surveys use systematic survey methods to collect data in 10 m^2 (1.78 m radius) and 50 m^2 (3.99 m radius) nested plots. The 10 m^2 and 50 m^2 plots shall share a common plot centre. The procedures for completing intensive surveys are:

- Determine the sampling intensity (i.e., number of plot centres required);
- Calculate the survey grid line and plot centre spacing;
- Layout transects and plot centre locations in the field;
- Assess the 10 m^2 and 50 m^2 plots; and
- Calculate C^{UP} and total opening-level stocking.

7.10.1 Determining Sample Intensity

Sample intensity requirements are specified in Table 7-4. The statistical accuracy of total opening-level acceptable tree stocking, based on these sample intensities, varies by opening size but is generally within 10 to 15% with a 95% confidence (Appendix 5 and 6).

Table 7-4. Number of sample plot centres required by opening area (ha)

Opening Area (ha)	Number of plot centres required
0.1 – 1.9	Minimum of 12.4 plot centres per hectare
2.0 – 4.0	Minimum of 41 plot centres per opening Optional: If stocking is 7 percentage points or less below the standard, increase the number of plot locations to 54
4.1 – 24.0	Minimum of 64 plot centres per opening Optional: If stocking is 7 percentage points or less below the standard, increase the number of plot locations to 84
>24.0*	2.77 plot centres per hectare

*To determine the number of sample plot centres needed for openings > 24 ha in size, multiply the net area by 2.77 and round the product up to the nearest whole number.

Note that because this survey protocol utilizes nested plots, the number of plot centres required refers to the number of plot locations. Both a C^{UP} and a $C^{REGEN+D}$ plot must be completed at every plot centre location.

Box 7-4: Calculation of the minimum number of plot centre locations.

Opening area: 26.4 ha

Required number of plot centre locations (from Table 7-2): 2.77 per hectare

Number of sample plot centre locations: 26.4 ha x 2.77 = 73.13

Round up to nearest whole number: 74

Minimum number of plot centre locations required: 74

7.10.2 Calculating Survey Grid Line and Plot Centre Spacing

When calculating line and plot centre spacing, two methods may be used:

- Square spacing; or
- Rectangular spacing.

Square spacing

Square spacing is a grid pattern where the distance between lines equals the distance between plot centres. When the total number of plot centres is determined and the area of the opening is known, the survey grid (plot and line spacing) can be calculated using the following formula:

Plot center spacing = $\sqrt{(Opening\ Area\ (ha)\ x 10{,}000\ m^2\ /\ ha)\ /\ required\ \#\ of\ Plots}$

Box 7-5: Calculation of square spacing

Opening area: 12.1 ha, calculate a square survey grid.

From Table 7-4, a 12.1 ha opening requires a minimum of 64 plot centre locations.

Calculate the plot spacing:

Plot spacing = $\sqrt{(\text{Opening Area (ha)} \times 10{,}000\ \text{m}^2/\text{ha})\ /\ \text{required \# of plot centre locations}}$

Plot spacing = $\sqrt{(12.1 \text{x} 10{,}000/64} = \sqrt{1890.625} = 43.48$

Round off to nearest 0.1m; line spacing = 43.5 m and plot centre spacing = 43.5 m

Appendix 7 lists calculated square line and plot centre spacing for openings of various sizes. For openings 24 ha or larger, a 60 m × 60 m square grid shall be used.

Rectangular spacing

Rectangular spacing occurs when the line spacing differs from plot centre spacing. The line spacing shall not be greater than twice the plot centre spacing. To calculate rectangular spacing, the desired line spacing is selected then the plot centre spacing needed to achieve the correct number of plots is calculated using the following formula:

$$\text{Plot centre spacing} \times \text{line spacing} = \frac{\text{Opening area (ha) x 10,000 m}^2/\text{ha}}{\text{Required \# of plot centre locations}}$$

For openings 24 ha and larger, a 60 m × 60 m square grid must be used.

Line and plot centre spacing shall be recorded on the Understory Protection Establishment Survey Summary Sheet (Section 7.16).

Box 7-6: Calculation of rectangular spacing

Opening area: 3.9 ha, calculate a rectangular survey grid assuming a line spacing of 35 m.

From Table 7-4, a 3.9 ha opening requires a minimum of 41 plot centre locations.

Calculate the plot spacing:

$$\text{Plot centre spacing x line spacing} = \frac{\text{Opening area (ha) x 10,000 (m}^2\text{/ha)}}{\text{Required \# plot centre locations}}$$

$$\text{Plot centre spacing x 35 m} = \frac{\text{3.9 ha x 10,000m}^2\text{/ ha}}{\text{41 plots}}$$

$$\text{Plot centre spacing} = \frac{951.22}{35} = 27.1777 \text{ m}$$

7.10.3 Laying Out Transects and Plot Centre Locations in the Field

For each UP opening to be surveyed, one of two methods may be used to establish plot centre locations in the field:

1. Compass and horizontal distance measuring device; or
2. GPS to navigate to pre-determined plot locations generated using GIS.

When locating plot centres in the field using methods '1' (above), control line(s) must be used and shall be established as follows:

- Establish one control line that is offset approximately 20-30° from the orientation of the UP extraction trails (Figure 7-2). Additional parallel control lines shall be established every 400 metres where opening widths exceed 400 m.
- The control line should be as close as possible to parallel to the long axis of the opening, wherever possible.
- The control line is best placed to coincide with the grid to enable points along the control line to be used as plot centres. Reference the control line in relation to the opening boundary to enable accurate mapping of the sample plot locations.

- Starting from the opening edge, the first survey line shall be located at one-half the interline distance. Each additional survey line is marked at the exact interline distance.

- Survey line intervals on the control line shall be double flagged using two different colours. The line and plot number shall be clearly written on the flagging.

- Beginning at the control line, the remaining individual plot centres shall be located at the required line and plot centre spacing. All measured distances must be based on horizontal or surface projections.

Note that the actual orientation angles of the control line(s)/ survey lines are not critical, provided neither the control line(s) nor the survey lines follow the UP extraction trails.

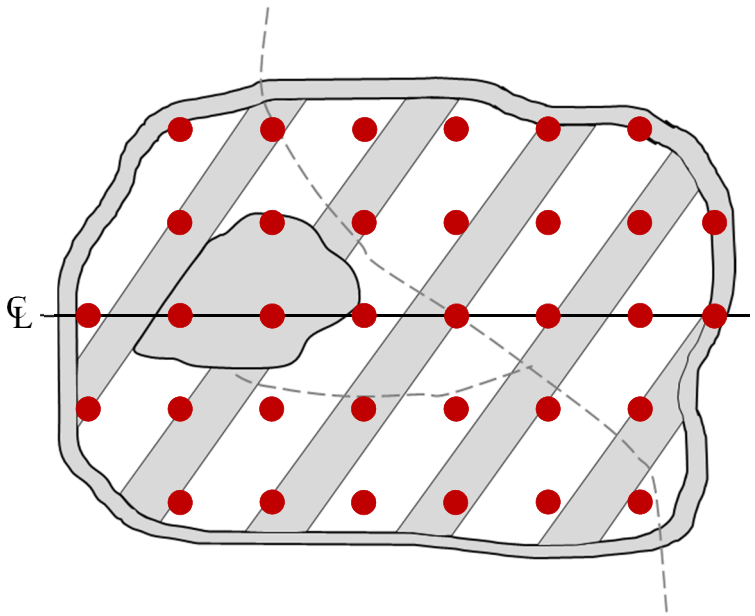


Figure 7-2. Sample plot centre distribution diagram

When locating plot centres in the field using method '2' (above), a control line is not required.

7.10.3.1 Deleting Plot Centre Locations

Areas within openings where plots are unnecessary include those areas under a land-use disposition or classified as a natural deletion, as defined in the applicable Forest Management Plan.

Examples of land-use deletions include:

- Miscellaneous Lease (MLL) (e.g., campsite, sand and gravel);
- Pipeline Agreement (PLA);
- Licence of Occupation (LOC) road;
- Well Site (MSL);
- Archaeological and historic sites; and
- Permanent Sample Plots (PSP) or other research areas (ISP, DNR, PNT).

Examples of natural deletions include:

- Riparian areas (no stumps encountered; ≥0.05 ha); and
- Treed retention patches within openings (no stumps encountered; ≥0.5 ha).

The uncut buffers that are part of an Understory Protection harvest are not considered natural deletions.

Where, prior to beginning the survey, an area is known to be within a land-use disposition or natural deletion, the area shall be deleted from the opening and the plot centre spacing shall be calculated using the reduced area.

As plot centres are being located in an opening, any plot location landing in a deletion area may be established for grid reference purposes but shall not be measured. If the area of the deletion is correct, the proper number of plot centres to fill the opening should be obtained without moving any plots.

Plot centres landing on seismic lines shall not be moved or deleted unless the area of the seismic line has been removed from the opening (i.e., FMP landbase deletion).

7.10.3.2 Moving Plot Centre Locations

Where surveyors encounter new land use dispositions or natural deletions whose areas were not deleted from the opening area at the time the grid was calculated, the line and plot centre spacing may be set to a wider spacing to avoid the deletion and still achieve the required number of plot locations. In these cases, the plot centre shall be moved half the plot spacing distance toward the next plot centre location.

Should the plot location continue to land on the disposition or natural deletion, surveyors shall continue to move at one half the plot centre distance intervals until a plot can be established. The plot following a moved plot is to remain at the calculated line and plot centre spacing for the opening.

7.10.3.3 Adding Plot Centre Locations

A minimum number of plot centres shall be established within each opening to achieve the desired sampling precision (Table 7-4). If additional plot centres are required to make up this minimum number or if additional plot centres are added to confirm stocking that is just below the stocking standard (optional), they should be located as follows:

- Halfway between every third survey line (i.e., halfway between and parallel to the third and fourth survey lines, sixth and seventh lines, etc.).
- Plot centre spacing shall be the same on additional lines as for the original lines to facilitate delineation of stocked or poorly stocked areas.
- Where every third line does not add the required number of plot centres, proceed to add lines between other survey lines until the required number of plot centres is reached. Lines shall be marked on the control line and numbered sequentially (no letters).
- Lines added using the compass and distance measuring device method (this also applies to GPS when used as a compass and distance measuring device) shall be given the next number in the sequence. Use only whole positive numbers.
- Plot centres added using GPS as waypoints shall be given unique, whole positive numbers.

7.10.3.4 Plot Layout

Both a C^{UP} and a $C^{REGEN+D}$ plot shall be established at every plot centre location when conducting intensive Understory Protection establishment surveys.

C^{UP} plots shall be 50 m^2 in size, with a plot radius of 3.99 m.

$C^{REGEN+D}$ plots shall be 10 m^2 in size, with a plot radius of 1.78 m.

In addition, the following is required for all plot locations:

- All plots shall be circular;
- The centre of the circle and the centres of both the C^{UP} and $C^{REGEN+D}$ plots shall be a common point;
- Plot centres shall be clearly marked in the field (e.g., wooden stick anchored in the ground) and must be sufficiently robust to last up to 18 months in the field;
- Flagging shall be attached to the centre marker with the plot identification number written legibly on the flagging using a black, waterproof marker pen; and
- To facilitate field checking, acceptable coniferous and deciduous trees that contributed to C^{UP} or $C^{REGEN+D}$ stocking shall be marked with flagging.

7.10.4 Assessing Plots

Assessments of C^{UP} and $C^{REGEN+D}$ plots shall be completed to determine the presence of acceptable coniferous and/ or deciduous trees (Table 7-5). Each plot type shall be assessed

separately and the results of each plot shall be recorded on the Understory Protection Establishment Survey Tally Sheet (Section 7.16).

The type of tally sheet will depend on the method that was used for laying out plots in the field, as described in Section 7.10.3. Methods '1' and '2' shall use the Understory Protection Establishment Survey Tally Sheet A, while method '3' shall use the Understory Protection Establishment Survey Tally Sheet B.

Table 7-5. Summary of intensive survey plot assessments

Required – C^{UP} plots (3.99 m radius)
Plot stocked with an acceptable coniferous tree that meets or exceeds the minimum height threshold
Required – $C^{REGEN+D}$ plots (1.78 m radius)
Plot stocked with an acceptable coniferous tree that meets or exceeds the minimum height threshold[13]
Plot stocked with an acceptable coniferous tree below the minimum height threshold, but greater than or equal to the minimum acceptable coniferous tree height (Table 7-3)
Plot stocked with an acceptable deciduous tree greater than or equal to the minimum acceptable deciduous tree height (Table 7-3)
Optional - $C^{REGEN+D}$ plots (1.78 m radius)
For plots not stocked with an acceptable coniferous or deciduous tree, determine if the plot is stocked with a coniferous tree that is below the minimum height for an acceptable coniferous tree (Table 7-3). Only include coniferous trees ≥15 cm in height (≥10 cm for Douglas-fir) that have been on-site for a minimum of two growing seasons.
For plots not stocked with an acceptable coniferous or deciduous tree, determine if the plot is stocked with a deciduous tree that is below the minimum height for an acceptable deciduous tree (Table 7-3). Only include deciduous trees ≥30 cm in height.

Note that under-height trees cannot contribute toward the calculation of C^{UP} or total opening-level stocking in UP openings. Timber disposition holders may wish to collect this information in case a UP opening does not achieve the UP stocking standards and requires assessment using the 'standard' RSA establishment survey protocols.

To determine if a tree main stem is inside a plot, surveyors are to measure from the point where the plot centre marker enters the ground to the tree in question. Depending on the type of plot being assessed, the specific rules to determine whether a tree is inside the plot are:

[13] This metric is required to be collected in the 1.78 m radius plot in case the opening does not achieve the UP stocking standards and requires assessment using the 'standard' RSA establishment survey protocols. In this situation, only C^{UP} trees located within the 1.78m radius plots would contribute toward coniferous and total acceptable tree stocking.

- C^{UP} plot: if any part of the tree is within the plot radius (3.99m), then the tree is in the plot.

- $C^{REGEN+D}$ plot: if the point of germination is within the plot radius (1.78m), then the tree is in the plot.

The point of germination is the point at which the coniferous or deciduous tree takes root and becomes established. For trembling aspen and balsam poplar stem sprouts, the point of germination is the point at which the sprout has originated on the original stump. If estimation is required, then assume the geometric centre of the main stem. For the $C^{REGEN+D}$ plots, count the tree as within the plot when its point of germination is inside the plot, even if the tree is leaning outside. Conversely, do not count a tree leaning into the plot but with its point of germination outside the plot.

7.10.5 Adding Columns to the Survey Tally Sheet

Timber disposition holders may choose to add columns to the Understory Protection Establishment Survey tally sheet to record other relevant information. Any data recorded in added columns do not form part of the requirements of the Understory Protection establishment survey and are not required to be submitted to Alberta.

7.10.6 On-Site Stocking Confirmation (Optional)

After completing an intensive survey and while still at the opening, surveyors may choose to calculate C^{UP} and total opening-level stocking (Section 7.10.7). If C^{UP} or total opening-level stocking is slightly below the stocking standard (7 percentage points or less), surveyors have the option to increase the number of plots to confirm the stocking assessment. The required number of plots to confirm stocking is described in Table 7-4. The method for adding plots is described in Section 7.10.3.3.

7.10.7 Calculating Acceptable Tree Stocking

Understory Protection openings must each have two separate stocking results calculated and reported: C^{UP} stocking and total opening-level stocking. For an opening to be considered SR, the opening must achieve both the C^{UP} and total opening-level stocking standards.

Information about acceptable C^{UP} and total opening-level stocking shall be compiled for each opening on the Understory Protection Establishment Survey Summary Sheet (Section 7.16) including:

- Number of C^{UP} plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold;

- Number of C^{UP} plots not stocked;

- Number of $C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold;

- Number of $C^{REGEN+D}$ plots stocked with an acceptable coniferous tree that is below the minimum height threshold;

- Number of $C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold and an acceptable coniferous tree that is below the minimum height threshold;
- Number of $C^{REGEN+D}$ plots stocked with an acceptable deciduous tree;
- Number of $C^{REGEN+D}$ plots stocked with both an acceptable coniferous tree that is below the minimum height threshold and an acceptable deciduous tree;
- Number of $C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold and an acceptable deciduous tree;
- Number of $C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold, an acceptable coniferous tree that is below the height threshold and an acceptable deciduous tree;
- Number of $C^{REGEN+D}$ plots not stocked;
- Number of plot centre locations where both the C^{UP} and $C^{REGEN+D}$ plots are stocked with acceptable trees;
- Number of plot centre locations landing in areas not cut, within deletions or land-use dispositions; and
- Total number of eligible plot centre locations to calculate stocking.

Based on these values, C^{UP} stocking and total opening-level stocking shall be calculated as follows, regardless of the stocking standard.

7.10.7.1 Calculating C^{UP} Stocking

A C^{UP} plot (3.99 m radius) containing an acceptable coniferous tree that meets or exceeds the minimum height threshold shall count once towards the calculation of C^{UP} stocking. Therefore, C^{UP} stocking shall be calculated by dividing the total number of C^{UP} plots stocked with an acceptable C^{UP} tree by the total number of eligible plot locations and then multiplying by 100.

C^{UP} stocking is also required to be calculated in the $C^{REGEN+D}$ plots (1.78 m radius) and shall be calculated the same manner as described above.

Both calculations of C^{UP} stocking shall be reported on the Understory Protection Establishment Survey Summary Sheet (Section 7.16); however, only the C^{UP} stocking recorded in the 50 m^2 C^{UP} plots will be reported to ARIS as the official C^{UP} stocking result. The C^{UP} stocking recorded in the $C^{REGEN+D}$ plots will be used for information only and may contribute to future refinements of this survey protocol.

7.10.7.2 Calculating Total Opening-Level Stocking

A $C^{REGEN+D}$ plot (1.78 m radius) containing an acceptable coniferous tree that is below the minimum height threshold, an acceptable deciduous tree or both shall count once towards the calculation of total opening-level stocking.

A C^{UP} plot (3.99 m radius) containing an acceptable coniferous tree that meets or exceeds the minimum height threshold shall count once towards the total opening-level stocking.

Each plot centre location may only count once toward total opening-level stocking. Therefore, the number of plot locations where both the C^{UP} and $C^{REGEN+D}$ plots are stocked with acceptable trees must be subtracted from the calculation of total opening-level stocking (this will eliminate double counting of plot centre locations).

Therefore, total opening-level stocking shall be calculated by adding the number of stocked $C^{REGEN+D}$ plots to the number of stocked C^{UP} plots, subtracting the number of plot centre locations where both the $C^{REGEN+D}$ and C^{UP} plots were stocked, dividing by the total number of eligible plot centre locations and then multiplying by 100.

See example stocking calculation in Table 7-6.

Table 7-6. Example C^{UP} and total opening-level stocking calculation

Survey Metric	# Plots	% Plots
C^{UP} plots stocked with acceptable C^{UP} tree	58	41.1
C^{UP} plots not stocked	83	58.9
$C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree	17	12.1
$C^{REGEN+D}$ plots stocked with an acceptable C tree	43	30.5
$C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree and an acceptable C tree	8	5.7
$C^{REGEN+D}$ plots stocked with an acceptable D tree	25	17.7
$C^{REGEN+D}$ plots stocked an acceptable C and D tree	12	8.5
$C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree and an acceptable D tree	3	2.1
$C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree, an acceptable C tree and an acceptable D tree	1	0.7
$C^{REGEN+D}$ plots not stocked with an acceptable C or D tree	32	22.7
Plot centre locations with stocked C^{UP} and $C^{REGEN+D}$ plots	42	29.8
Plot centre locations in areas that were not cut or deleted	1	-
Total eligible plot centre locations	141	-
Acceptable Stocking:		
C^{UP} stocking (in C^{UP} plots) = **41.1%***		
C^{UP} stocking (in $^{CREGEN+D}$ plots) = 12.1+5.7+2.1+0.7 = 20.6%		
Total opening-level stocking =41.1+30.5+5.7+17.7+8.5+2.1+0.7-29.8 =**76.5% ***		

*Results reported to ARIS

7.10.7.3 Calculating Coniferous, Deciduous and Total Stocking for Openings Being Re-Declared to Non-UP Strata

If an opening fails to achieve the reduced C^{UP} stocking standard (Sections 7.13.5 and 7.13.6), the opening must then be re-declared to a non-UP stratum. In this situation, acceptable coniferous, deciduous and total stocking must be determined for the opening using the 'standard' establishment survey protocols (Section 6). Only trees recorded in the $C^{REGEN+D}$ plots may be used in these calculations.

The following calculations are only required if re-declaration to a non-UP stratum is being requested.

Acceptable Coniferous Stocking:

A $C^{REGEN+D}$ plot (1.78m radius) containing an acceptable C^{UP} or C tree shall count once towards the calculation of acceptable coniferous tree stocking. Therefore, coniferous tree stocking (%) shall be calculated by adding the number of $C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree, plots stocked with an acceptable C tree, and plots stocked with both C^{UP} and C trees, dividing by the total number of eligible plots and then multiplying by 100.

Acceptable Deciduous Stocking:

A $C^{REGEN+D}$ plot containing an acceptable D tree shall count once towards the calculation of acceptable deciduous stocking. Therefore, deciduous tree stocking (%) shall be calculated by dividing the number of $C^{REGEN+D}$ plots stocked with an acceptable deciduous tree by the total number of eligible plots and then multiplying by 100.

Acceptable Total Stocking:

A $C^{REGEN+D}$ plot containing an acceptable tree (C^{UP}, coniferous, deciduous or some combination of the three) shall count once towards the calculation of total stocking. Therefore, total stocking (%) shall be calculated by dividing the number of $C^{REGEN+D}$ plots stocked with an acceptable tree by the total number of eligible plots and then multiplying by 100.

For any opening, coniferous, deciduous and total stocking shall not exceed 100%.

Box 7-7: Calculation of acceptable coniferous, deciduous and total stocking for an opening being re-declared to a non-UP stratum

	# plots	***% plots***
$C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree	*18*	*13.7%*
$C^{REGEN+D}$ plots stocked with an acceptable C tree	*25*	*19.1%*
$C^{REGEN+D}$ plots stocked with acceptable C^{UP} and C trees	*12*	*9.2%*
$C^{REGEN+D}$ plots stocked with an acceptable D tree	*41*	*31.3%*
$C^{REGEN+D}$ plots stocked with acceptable C^{UP} and D trees	*5*	*3.8%*
$C^{REGEN+D}$ plots stocked with acceptable C and D trees	*21*	*16.0%*
$C^{REGEN+D}$ plots stocked with acceptable C^{UP}, C and D trees	*3*	*2.3%*
Plots not stocked	*6*	*4.6%*
Plot locations in areas not cut or deleted	*1*	
Total eligible plots	*131*	

Acceptable tree stocking (reported to ARIS)
Acceptable coniferous tree stocking = 13.7+19.1+9.2+3.8+16.0 +2.3= ***64.1%***
Acceptable deciduous tree stocking = 31.3+3.8+16.0+2.3 = ***53.4%***
Total stocking of acceptable trees = 13.7+19.1+9.2+31.3+3.8+16.0 +2.3= ***95.4%***

This opening could be re-declared to either a CD or DC stratum

7.11 Understory Protection Establishment Survey Map Sheet

Field maps shall be drawn on the Understory Protection Establishment Survey Field Map Sheet (Section 7.16) or produced in an acceptable digital format (i.e., GIS block maps) and submitted to Alberta. Plots shall be drawn on the map as surveyors progress through the opening. This will assist surveyors with mapping certain features of the opening and the status of the plots surveyed. All maps submitted to Alberta shall contain all required information for each surveyed opening per Table 7-7.

If an intensive survey is completed, the map symbols shown in Table 7-8 shall be used. The larger exterior symbols indicate the status of the C^{UP} plot and the smaller interior symbols show the status of the $C^{REGEN+D}$ plots. A large and small symbol must be displayed at every plot location.

Table 7-7. Map sheet information requirements by survey type

Item	Survey Type	
	Aerial	Intensive
Opening boundary	✓	✓
Disposition holder	✓	✓
Disposition	✓	✓
Opening number	✓	✓
Field number	✓	✓
Map scale	✓	✓
Location of tie points		✓
Location and bearing of control lines		✓
Location of survey lines and plots		✓
Line and plot numbers		✓
Line and plot centre spacing		✓
Plot stocking status symbols		✓
GPS make, model and coordinate system (if used)	✓	✓
Location and size of land-use and natural deletions	✓	✓
Delineation of poorly stocked areas	✓	✓
North arrow	✓	✓

Table 7-8. Intensive survey map symbols and definitions

Symbol	Definition
	Plot centre location not cut or deleted
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot not stocked
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable C tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable C^{UP} tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with both an acceptable C^{UP} tree and an acceptable C tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable C^{UP} tree and an acceptable D tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable C^{UP} tree, an acceptable C tree and an acceptable D tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable D tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with both an acceptable C tree and an acceptable D tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot not stocked
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable C tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable C^{UP} tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with both an acceptable C^{UP} tree and an acceptable C tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable C^{UP} tree and an acceptable D tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable C^{UP} tree, an acceptable C tree and an acceptable D tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable D tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with both an acceptable C tree and an acceptable D tree

7.11.1 Identifying Areas with Poor Stocking

In addition to plot centre locations and symbols, the map completed as part of an intensive survey shall identify any poorly stocked areas that are 4 ha or larger. Stocking is determined by the presence of an acceptable tree within the 10 m^2 $C^{REGEN+D}$ plot or the 50 m^2 C^{UP} plot at each plot centre location.

Delineating poorly stocked areas 4 ha or larger is based on a moving average-of-plot status where areas not meeting the plot stocking requirement are assessed using perpendicular rows across the opening.

The following procedure shall be used for intensive surveys to delineate poorly stocked areas.

Identify poorly stocked areas within a generally stocked opening by:

- Starting at one corner of the opening, proceed along the survey lines and examine five plot centre locations at a time. After the first five plot centre locations have been examined, drop the first plot centre in the line and add one plot centre on the end (running average of five plot centre locations). Continue progressing to the end of the line until the last five plot centre locations have been assessed.

- A survey line section of five plot centre locations shall be considered stocked if four of the plots are stocked. All stocked plots should be considered regardless of coniferous or deciduous status.

- A survey line section of five plot locations shall be considered poorly stocked if it contains zero to three stocked plots.

- If there are fewer than five plot locations in a line, all plot locations shall be stocked in order to call the section stocked.

- If there are more than five plot locations in a line, the beginning of the first poorly stocked five-plot section and the end of the last poorly stocked five-plot section should be marked to select the poorly stocked portion of the survey line.

After each line is assessed and marked, draw a boundary around the marked areas to identify the locations of the suspected poorly stocked areas. The same procedure must be repeated by running the five-plot centre location, moving average perpendicular to the first direction. An area shown to be poorly stocked in both directions shall be considered the poorly stocked area.

Identify stocked areas within a generally poorly stocked opening by:

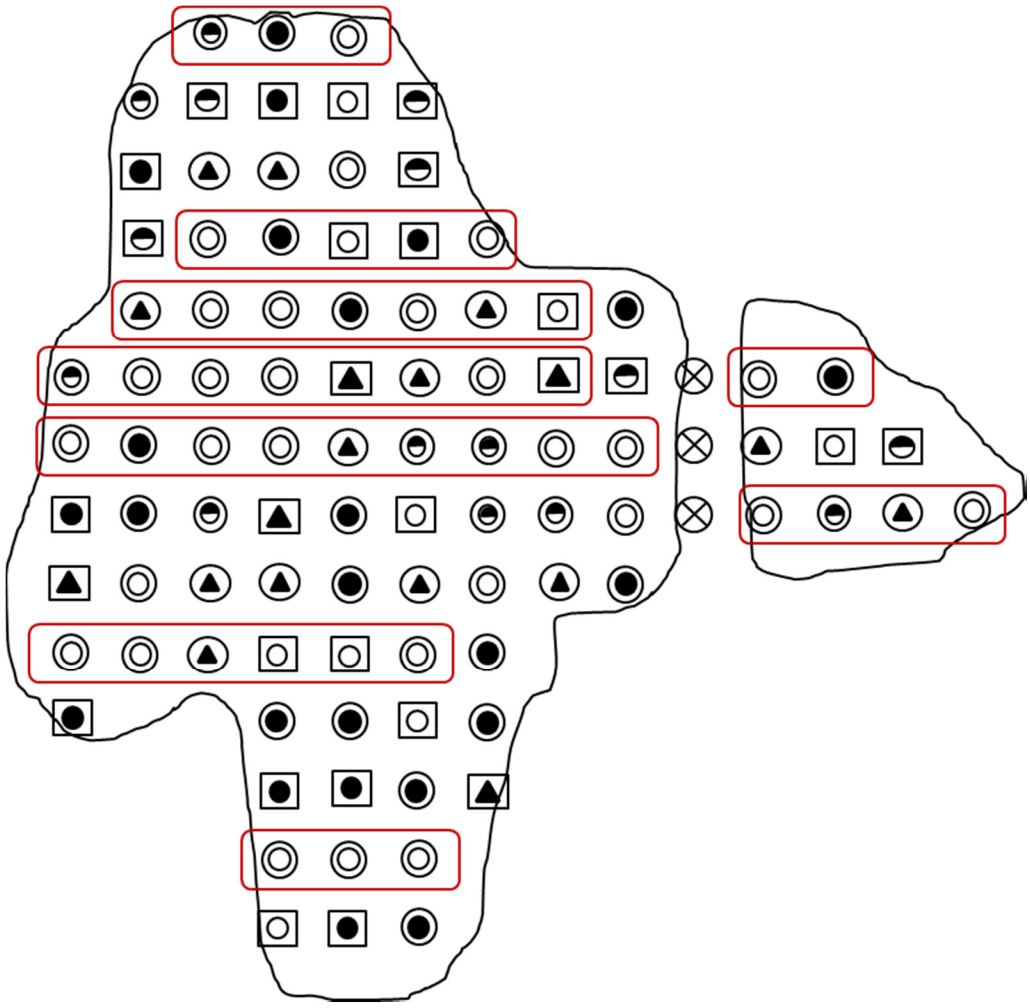
- The procedure is the same as for identifying poorly stocked areas in a stocked opening, except a five plot centre section is considered stocked only when all the plot locations are stocked (i.e., 100% stocked).

- The procedures described above should not be used to delineate stocked or poorly stocked areas that are smaller than 4 ha. There should be a minimum of 10 plot centre locations in the sub-unit. This is necessary where the number of plots is very small. In these situations a high probability exists that the area will be classified incorrectly.

Some logical adjustments may be made around the border of a poorly stocked area. When the above procedure has been completed, calculate the area (ha) of each poorly stocked area to determine if any are greater than 4 ha.

Poorly stocked areas over 4 ha in size shall be mapped in a manner acceptable to Alberta. The area of a poorly stocked patch shall be recorded in the 'Poorly Stocked Area (ha)' area on the Understory Protection Establishment Survey Summary Sheet (Section 7.16).

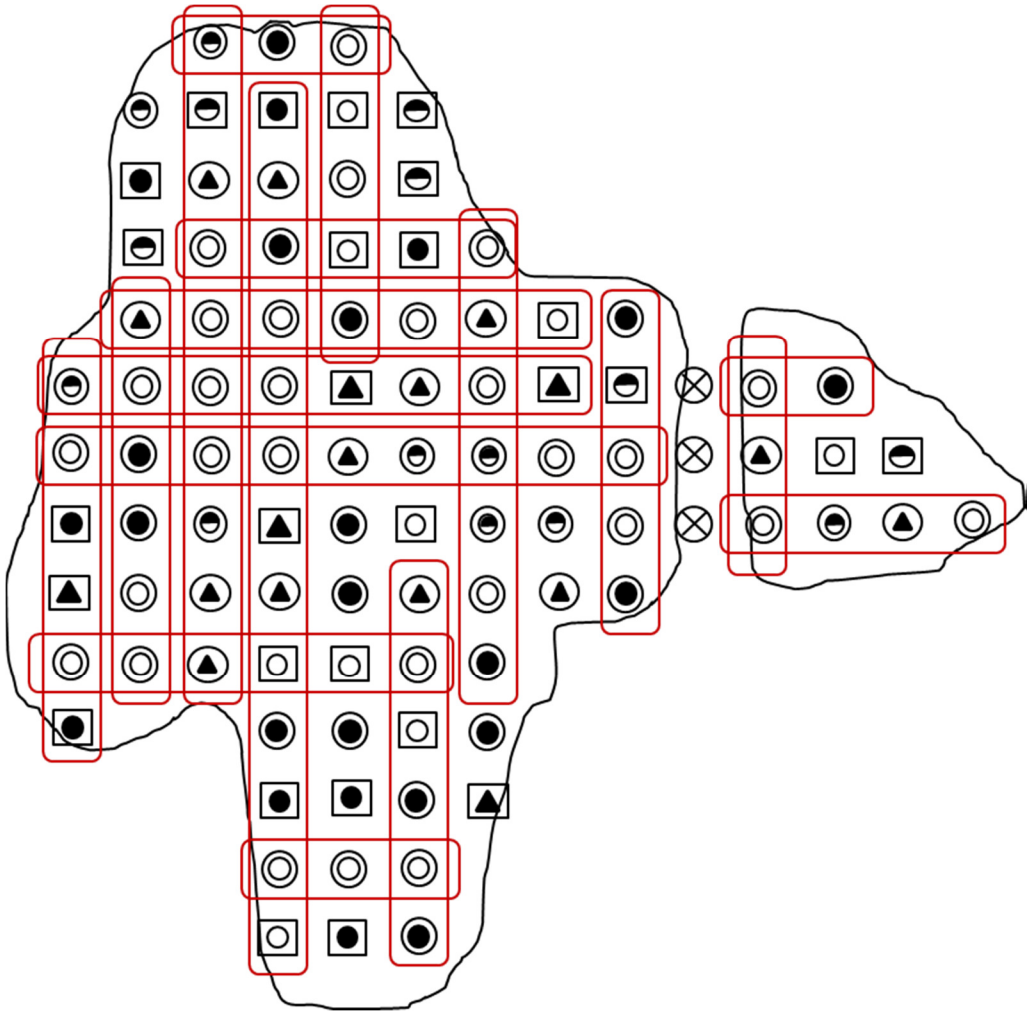
The following are examples of delineating poorly stocked areas larger than 4 ha.



Step 1: Example of west to east delineation of suspected poorly stocked areas

Opening Area:	33.9 ha
Valid Plot Centre Locations:	94 plots
Grid 60 x 60 m:	0.36 ha/ plot
C^{UP} plots stocked:	28 (29.8%)
$C^{REGEN+D}$ plots stocked with C:	24 (25.5%)
$C^{REGEN+D}$ plots stocked with D:	15 (16.0%)
$C^{REGEN+D}$ plots stocked with C+D:	18 (19.1%)
Plot locations with stocked C^{UP} and $C^{REGEN+D}$ plots:	19 (20.2%)
C^{UP} plots not stocked:	66 (70.2%)
$C^{REGEN+D}$ plots not stocked:	37 (39.4%)

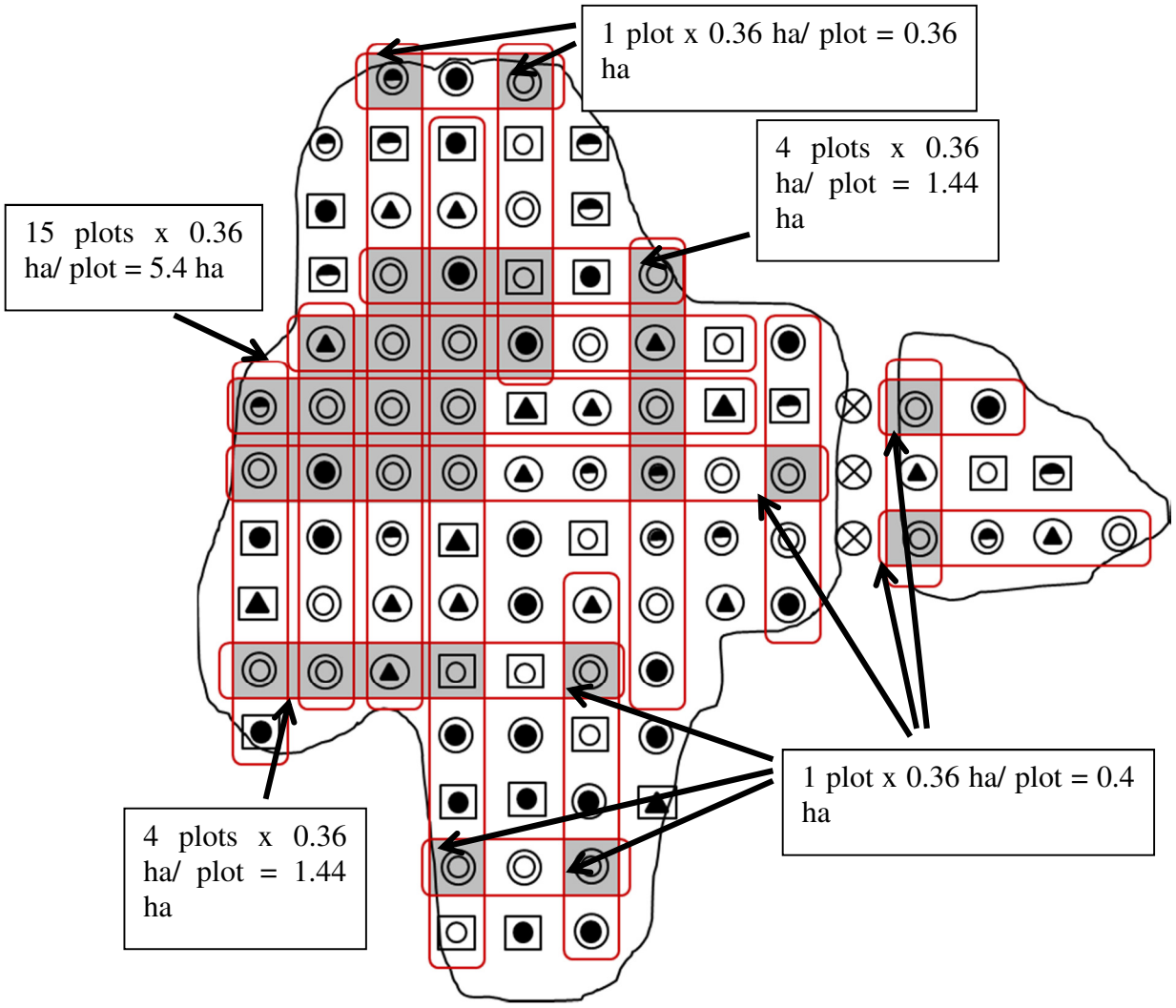
C^{UP} stocking:	28 plots/ 94 plots = 29.8%
Total opening-level stocking:	29.8 + 25.5 + 16.0 + 19.1 – 20.2 = 70.2%



Step 2: North to south delineation of suspected poorly stocked areas

Opening Area:	33.9 ha
Valid Plot Centre Locations:	94 plots
Grid 60 x 60 m:	0.36 ha/ plot
C^{UP} plots stocked:	28 (29.8%)
$C^{REGEN+D}$ plots stocked with C:	24 (25.5%)
$C^{REGEN+D}$ plots stocked with D:	15 (16.0%)
$C^{REGEN+D}$ plots stocked with C+D:	18 (19.1%)
Plot locations with stocked C^{UP} and $C^{REGEN+D}$ plots:	19 (20.2%)
C^{UP} plots not stocked:	66 (70.2%)
$C^{REGEN+D}$ plots not stocked:	37 (39.4%)

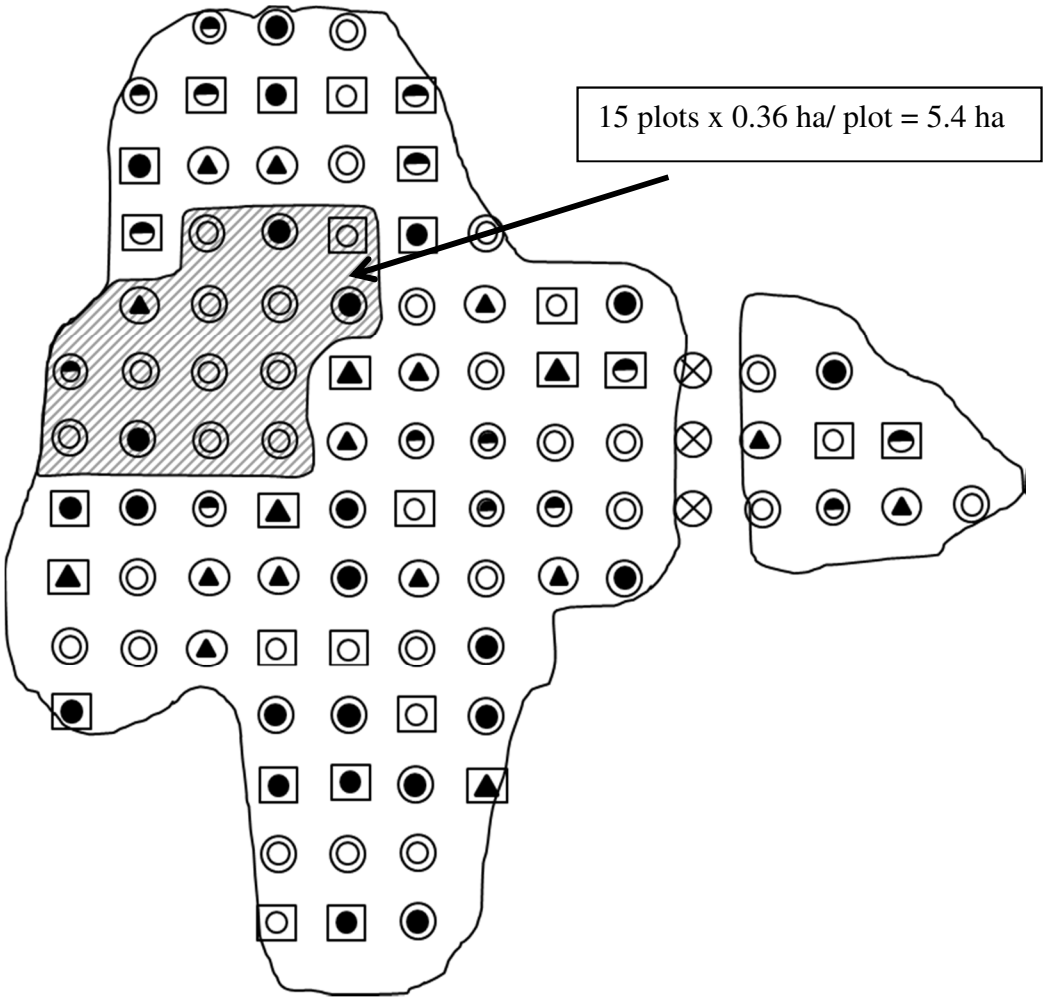
C^{UP} stocking:	28 plots/ 94 plots = 29.8%
Total opening-level stocking:	29.8 + 25.5 + 16.0 + 19.1 – 20.2 = 70.2%



Step 3: Overlapping area following east-west and north-south delineation of suspected poorly stocked areas (shaded areas).

Opening Area:	33.9 ha
Valid Plot Centre Locations:	94 plots
Grid 60 x 60 m:	0.36 ha/ plot
C^{UP} plots stocked:	28 (29.8%)
$C^{REGEN+D}$ plots stocked with C:	24 (25.5%)
$C^{REGEN+D}$ plots stocked with D:	15 (16.0%)
$C^{REGEN+D}$ plots stocked with C+D:	18 (19.1%)
Plot locations with stocked C^{UP} and $C^{REGEN+D}$ plots:	19 (20.2%)
C^{UP} plots not stocked:	66 (70.2%)
$C^{REGEN+D}$ plots not stocked:	37 (39.4%)

C^{UP} stocking:	28 plots/ 94 plots = 29.8%
Total opening-level stocking:	29.8 + 25.5 + 16.0 + 19.1 – 20.2 = 70.2%



Step 4: Poorly stocked area greater than 4.0 ha identified on the opening map (cross hatched area).

Opening Area:	33.9 ha
Valid Plot Centre Locations:	94 plots
Grid 60 x 60 m:	0.36 ha/ plot
C^{UP} plots stocked:	28 (29.8%)
$C^{REGEN+D}$ plots stocked with C:	44 (25.5%)
$C^{REGEN+D}$ plots stocked with D:	15 (16.0%)
$C^{REGEN+D}$ plots stocked with C+D:	18 (19.1%)
Plot locations with stocked C^{UP} and $C^{REGEN+D}$ plots:	19 (20.2%)
C^{UP} plots not stocked:	66 (70.2%)
$C^{REGEN+D}$ plots not stocked:	37 (39.4%)

C^{UP} stocking:	28 plots/ 94 plots = 29.8%
Total opening-level stocking:	29.8 + 25.5 + 16.0 + 19.1 – 20.2 = 70.2%

7.12 Damage and Site Conditions

The extent of damage to acceptable C^{UP} or $C^{REGEN+D}$ trees by wind throw, logging damage, insects, disease, and/ or animals may be recorded for the opening using the Understory Protection Establishment Survey Summary Sheet (Section 7.16). Space is also provided to record opening summary information specific to site conditions.

Recording damage and site condition information is optional but may be very important for determining why a particular opening may have failed the C^{UP} or total opening-level stocking standard.

7.13 Determining Opening Status

Based on the results from an Understory Protection establishment survey, each opening will be assigned a stocking status of Satisfactorily Restocked (SR), Not Satisfactorily Restocked (NSR), Satisfactorily Restocked to the reduced C^{UP} standard (SRR) or Not Satisfactorily Restocked to the reduced C^{UP} standard (NSRR) (Figure 7-3).

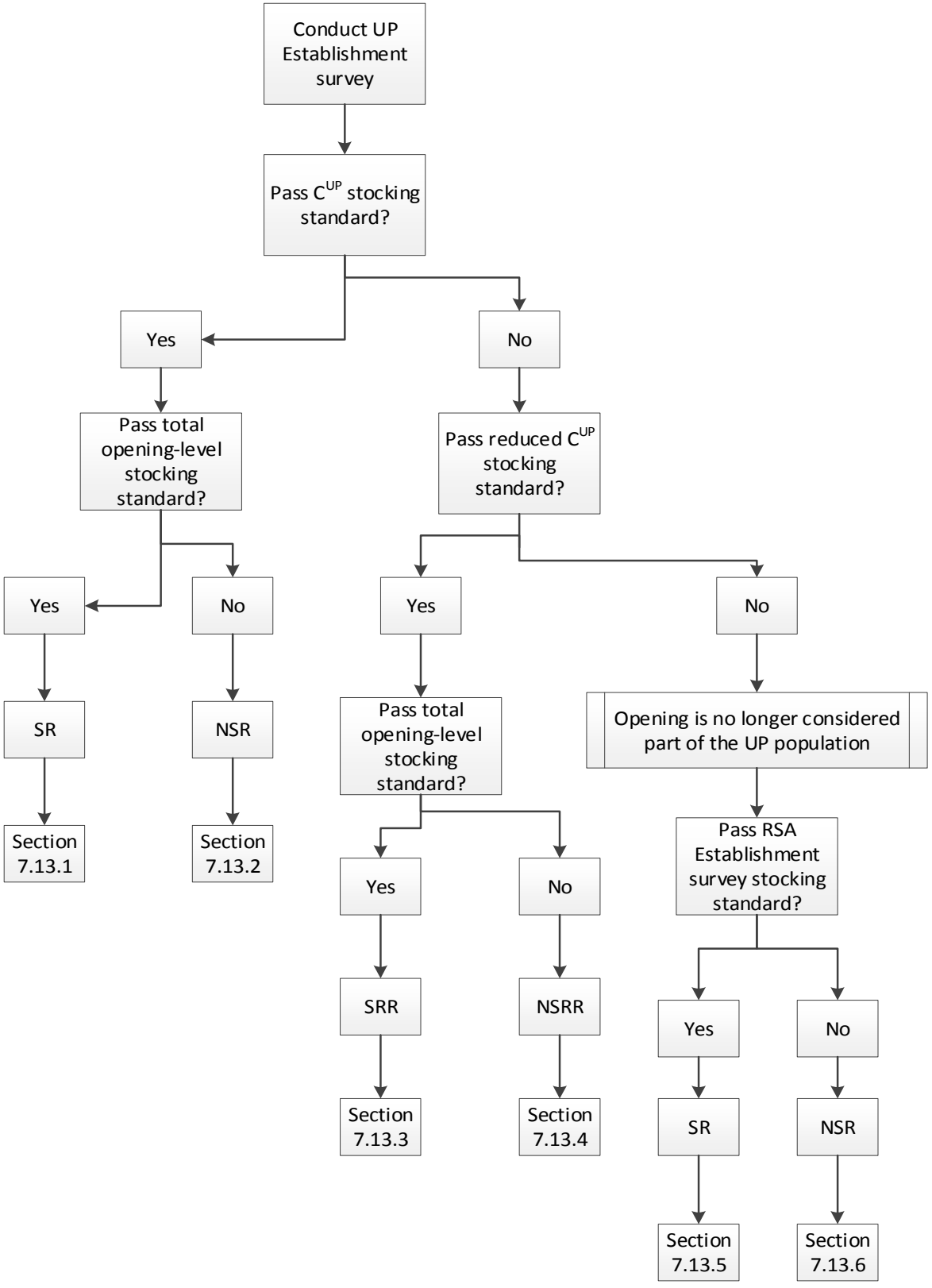


Figure 7-3. Process to determine the stocking status of an Understory Protection opening following an establishment survey

7.13.1 Satisfactorily Restocked to Understory Protection Standard (SR)

If an opening meets or exceeds both the C^{UP} stocking standard and the total opening-level stocking standard and the opening has no contiguous poorly stocked areas exceeding four hectares in size, the opening shall be declared Satisfactorily Restocked (SR) (see example in Table 7-9).

When the opening is SR to the declared Understory Protection stratum, stratum re-declarations are not permitted.

7.13.2 Not Satisfactorily Restocked to Understory Protection Standard (NSR)

If an opening meets or exceeds the C^{UP} stocking standard, but fails to achieve the total opening-level stocking standard, or the opening has one or more contiguous poorly stocked areas that are four hectares or greater, the opening shall be declared Not Satisfactorily Restocked (NSR) (see example in Table 7-9).

Openings declared NSR to a UP stratum cannot be re-declared to an alternate non-UP stratum. If timber disposition holders have more than one approved Understory Protection yield curve (and associated landbase designation code), re-declaration to an alternate UP stratum may be permitted. Timber disposition holders shall use the Understory Protection Establishment Survey Summary Sheet (Section 7.16) to briefly describe the rationale for any re-declaration requests. Any stratum re-declarations must be approved by Forest Management Branch prior to being implemented.

All UP openings declared NSR will require retreatment using methods and operations approved by the Director (TMR 141.6(2)).

7.13.3 Satisfactorily Restocked to Reduced Understory Protection Standard (SRR)

If an opening does not achieve the C^{UP} stocking standard, the actual C^{UP} stocking result that was recorded in a given opening must be examined to determine the magnitude by which the C^{UP} stocking result failed to meet the standard.

If the C^{UP} stocking result is 50% or greater of the C^{UP} stocking standard, the opening shall still considered to be an Understory Protection opening, but at a reduced C^{UP} stocking level[14].

If timber disposition holders have developed more than one C^{UP} stocking standard, the assessment of the 50% reduced C^{UP} stocking threshold shall apply to all C^{UP} stocking standards. However, the assessment of whether an opening achieves the reduced C^{UP} stocking standard should first be completed for the C^{UP} stocking standard associated with the current stratum declaration. If the opening does not achieve that reduced standard, the survey results should then be compared against the reduced C^{UP} stocking standard associated with any other approved UP yield curves.

[14] The threshold of 50% of the C^{UP} stocking standard for reduced C^{UP} stocking will be re-evaluated once this protocol has been in place for several years. This threshold is subject to change.

If an opening meets or exceeds a reduced C^{UP} stocking standard and the full total opening-level stocking standard and the opening has no contiguous poorly stocked areas exceeding four hectares in size, the opening shall be declared Satisfactorily Restocked to a reduced standard (SRR) (see example in Table 7-9).

Openings that meet or exceed a reduced C^{UP} stocking standard cannot be re-declared to an alternate non-UP stratum. If timber disposition holders have more than one approved Understory Protection yield curve (and associated landbase designation code), re-declaration to an alternate UP stratum may be permitted. Timber disposition holders shall use the Understory Protection Establishment Survey Summary Sheet (Section 7.16) to briefly describe the rationale for any re-declaration requests. Any stratum re-declarations of Understory Protection openings must be approved by Forest Management Branch prior to being implemented.

No re-treatment is required for SRR status openings.

7.13.4 Not Satisfactorily Restocked to Reduced Understory Protection Standard (NSRR)

If an opening meets or exceeds a reduced C^{UP} stocking standard, but fails to achieve the total opening-level stocking standard, or the opening has one or more contiguous poorly stocked areas exceeding four hectares in size, the opening shall be declared Not Satisfactorily Restocked to the reduced standard (NSRR) (see example in Table 7-9).

Openings that meet or exceed a reduced C^{UP} stocking standard cannot be re-declared to an alternate non-UP stratum. If timber disposition holders have more than one approved Understory Protection yield curve (and associated landbase designation code), re-declaration to an alternate UP stratum may be permitted. Timber disposition holders shall use the Understory Protection Establishment Survey Summary Sheet (Section 7.16) to briefly describe the rationale for any re-declaration requests. Any stratum re-declarations of Understory Protection openings must be approved by Forest Management Branch prior to being implemented.

All UP openings declared NSRR will require retreatment using methods and operations approved by the Director (TMR 141.6(2)).

7.13.5 Satisfactorily Restocked to RSA Establishment Survey Standard (SR)

If an opening does not achieve at least 50% of any approved C^{UP} stocking standard for the SYU, then the opening would no longer be considered an Understory Protection opening. This opening would then be required to be assessed using the RSA Establishment Survey standards (stocking calculations described in Section 7.10.7.3 and Section 6).

Any openings that are no longer considered to be Understory Protection following a UP establishment survey must remain out of the Understory Protection 'population' going forward. This means that any UP openings that fail to achieve a reduced C^{UP} stocking standard would be required to be assessed with the 'standard' non-photo RSA performance survey protocol and would not be eligible to use the Understory Protection performance survey protocol.

If the opening meets or exceeds all the Establishment survey requirements described in Section 6, it shall be declared Satisfactorily Restocked (SR) (see example in Table 7-9). Requirements for achieving SR status are:

- The total stocking for the opening must be:

- 84% or greater after a reconnaissance survey; or
- 80% or greater after an intensive survey; and

- Minimum stocking (%) requirements for Coniferous and Deciduous must be met (Table 6-2); and
- The opening has no contiguous poorly stocked areas exceeding four hectares.

Since openings in this category are no longer considered to be Understory Protection, they must be re-declared to a non-UP stratum. Timber disposition holders should re-declare the opening to the stratum that most closely aligns with the new reforestation objectives for the opening.

Timber disposition holders shall use the Understory Protection Establishment Survey Summary Sheet (Section 7.16) to calculate acceptable coniferous, deciduous and total tree stocking, and briefly describe the rationale for the specific stratum re-declaration. All stratum re-declarations must be approved by Forest Management Branch prior to being implemented.

No retreatment is required for openings declared SR to the non-UP establishment standard.

7.13.6 Not Satisfactorily Restocked to RSA Establishment Survey Standard (NSR)

If an opening does not achieve at least 50% of any approved C^{UP} stocking standard for the SYU, then the opening would no longer be considered an Understory Protection opening. This opening would then be required to be assessed using the RSA Establishment Survey standards (stocking calculations described in Section 7.10.7.3 and Section 6).

Any openings that are no longer considered to be Understory Protection following a UP establishment survey must remain out of the Understory Protection 'population' going forward. This means that any UP openings that fail to achieve a reduced C^{UP} stocking standard would be required to be assessed with the 'standard' RSA non-photo performance survey protocol and would not be eligible to use the Understory Protection performance survey protocol.

If the opening does not achieve all the Establishment Survey requirements described in Section 6, the opening shall be declared Not Satisfactorily Restocked (NSR) (see example in Table 7-9).

Since openings in this category are no longer considered to be Understory Protection, they must be re-declared to a non-UP stratum. Timber disposition holders should re-declare the opening to the stratum that most closely aligns with the new reforestation objectives for the opening.

Timber disposition holders shall use the Understory Protection Establishment Survey Summary Sheet (Section 7.16) to calculate acceptable coniferous, deciduous and total tree stocking, and briefly describe the rationale for the specific stratum re-declaration. All stratum re-declarations must be approved by Forest Management Branch prior to being implemented.

All openings declared NSR will require retreatment using methods and operations approved by the Director (TMR 141.6(2)).

Table 7-9 shows some example UP opening status and stratum declarations based on establishment survey results. For these examples, the C^{UP} stocking standard is 42% and the total opening-level stocking standard is 78%.

Openings that fail to attain the reduced C^{UP} stocking standard and are no longer considered a UP opening must achieve at least 80% stocking at the opening level.

Table 7-9. Example opening status declarations

C^{UP} stocking	Total opening level stocking	Opening status	Stratum
45%	85%	SR	UP
48%	70%	NSR	UP
31%	86%	SRR	UP
37%	69%	NSRR	UP
11%	87%	SR	Non-UP
18%	60%	NSR	Non-UP

7.14 Reporting

Understory Protection establishment surveys shall be reported to Alberta on or before May 15 following the Timber Year in which they are completed.

Reporting of Understory Protection establishment survey sheets shall be hardcopy (paper) or digital. A complete and validated Reforestation Survey Reporting Cover Page (Appendix 8) must accompany all reporting of Understory Protection establishment survey information to Alberta Agriculture and Forestry Regional offices. Understory Protection establishment surveys should be submitted separately from 'standard' RSA establishment surveys.

For those timber disposition holders who harvest more than 30,000 m^3 annually, the Reforestation Survey Reporting Cover Page must be validated by a Regulated Forestry Professional (RFP). Validated work is work that has been prepared by or reviewed and approved by an RFP. The RFP who validates work must have done the work, contracted the work, or supervised those who did the work. The validating RFP is accountable for ensuring the reporting of Understory Protection establishment survey information is complete, accurate, and on time.

For those timber disposition holders who harvest less than 30,000 m^3 annually, the Reforestation Survey Reporting Cover Page must be signed by the timber disposition holder. By signing the Reforestation Survey Reporting Cover Page, the timber disposition holder is stating that the establishment survey information is complete, accurate, and on time.

The Reforestation Survey Reporting Cover Page (with RFP validation or signature, where appropriate) may be submitted digitally, but shall be in a proprietary file format (e.g., Adobe Acrobat) for digital signature protection.

7.14.1 Aerial Reconnaissance Surveys

An acceptable Understory Protection aerial reconnaissance survey reporting package for each opening shall include, at a minimum, a completed Understory Protection Establishment Survey Summary Sheet and the results of the opening stratification.

Opening stratification results shall include:

- Copies of the aerial photos, maps or field data that were used to stratify each opening into protected and unprotected area;
- Opening-by-opening breakdown of all required stratification metrics (Section 7.4.2); and
- Opening-specific C^{UP} and total opening-level stocking standard calculations for each opening. Calculations need to clearly demonstrate how the opening-specific stocking standards were determined.

The stratification metrics and stocking standard calculations can be submitted in digital (i.e., spreadsheet) or hard copy format.

An Understory Protection Establishment Survey Field Map Sheet is required for aerial reconnaissance surveys when poorly stocked areas and/ or natural deletions and/ or land-use dispositions have been delineated.

7.14.2 Intensive Surveys

An acceptable Understory Protection intensive survey reporting package for each opening shall contain:

- A completed Understory Protection Establishment Survey Summary Sheet;
- A completed Understory Protection Establishment Survey Tally Sheet(s);
- A completed Understory Protection Establishment Survey Field Map Sheet or other acceptable format; and
- Opening stratification results.

Opening stratification results shall include:

- Copies of the aerial photos, maps or field data that were used to stratify each opening into protected and unprotected area;
- Opening-by-opening breakdown of all required stratification metrics (Section 7.4.2); and
- Opening-specific C^{UP} and total opening-level stocking standard calculations for each opening. Calculations need to clearly demonstrate how the opening-specific stocking standards were determined.

The stratification metrics and stocking standard calculations can be submitted in digital (i.e., spreadsheet) or hard copy format.

7.14.3 Stewardship Reporting

Timber disposition holders that complete Understory protection establishment surveys are required to roll up and report on UP establishment survey stocking status outcomes in the appropriate Stewardship Report.

This reporting shall include the total number of openings and opening area that has been declared:

- Satisfactorily Restocked (SR) to the UP stocking standards;
- Not Satisfactorily Restocked (NSR) to the UP stocking standards;
- Satisfactorily Restocked to a reduced C^{UP} stocking standard (SRR) ;
- Not Satisfactorily Restocked to a reduced C^{UP} stocking standard (NSRR); and
- To a non-UP stratum (regardless of any RSA establishment survey outcomes).

The Stewardship Report shall also include rationale around why openings may have failed to achieve SR status to the declared UP stratum, as well as any corrective actions taken, as appropriate.

7.14.4 ARIS submissions

For Understory Protection establishment surveys, results submitted to the Alberta Regeneration Information System (ARIS) for each opening shall include:

- Status;
- Stratum;
- Acceptable C^{UP} stocking (%)[15]; and
- Acceptable total opening-level stocking (%).

Where a reconnaissance survey and an intensive survey have been completed for the same opening, only the results of the intensive survey shall be reported to Alberta and submitted to ARIS.

If an opening is to be re-declared to a non-UP stratum, ARIS submissions must conform to the standards for 'standard' openings per Section 6.12.3.

7.15 Survey Quality

Alberta requires all establishment survey information be complete and accurate. Timber disposition holders shall ensure quality control systems are developed and being used (required since May 1, 2008). Quality control systems must include surveyor training, field auditing, and data validation.

Surveyors shall receive training specific to Understory Protection and the Sustained Yield Unit (SYU) to ensure appropriate measurements are made and recorded.

Audits of openings and/or surveyors shall be conducted using check surveys carried out by qualified surveyors.

Because regenerating Understory Protection stands are complex, a minimum of 50% of openings assessed with an aerial reconnaissance survey must also receive an intensive survey to confirm the survey observations. This requirement will be in place for at least the first three years that a

[15] Results from 3.99 m radius (50 m^2) plots only

timber disposition holder or forestry consultant carries out the UP establishment survey protocol. The 50% audit requirement will be reassessed on a case-by-case basis following the initial three year implementation period.

If the 50% audit requirement is deemed to no longer be required, the expectation will be that a minimum of 25% of openings assessed with an aerial reconnaissance survey must also receive an intensive survey to confirm the survey observations every year going forward.

For openings where both an aerial reconnaissance survey and an intensive survey were completed, the results of both surveys must be made available to Alberta upon request.

Audits shall focus on openings where the risk of error is highest.

7.16 Understory Protection Establishment Survey Summary, Tally Sheets and Field Map

UNDERSTORY PROTECTION ESTABLISHMENT SURVEY SUMMARY SHEET

OPENING HEADER			
Disposition holder		Survey Type (Aerial or Intensive)	
Disposition		Timber Year of Cut (YYYY-YYYY)	
Forest Area		Natural Subregion	
Opening number		Ecosite (optional)	
Field number		Drainage class (optional)	
Opening area (ha)		Pre-harvest stratum	
C^{UP} Stocking Standard (%)		Survey date (YYYY-MM-DD)	
Total Opening-Level Stocking Std (%)		Surveyor ID1	
Plot Centre Spacing (m)		Surveyor ID2	
Line Spacing (m)		Regenerated yield class stratum	

STOCKING CALCULATIONS		
Plot Data	**# plots**	**% plots**
C^{UP} (3.99m) plots stocked		
C^{UP} plots not stocked		
$C^{REGEN+D}$ (1.78m) plots stocked with C^{UP} tree		
$C^{REGEN+D}$ plots stocked with C tree		
$C^{REGEN+D}$ plots stocked with C^{UP} and C trees		
$C^{REGEN+D}$ plots stocked with D tree		
$C^{REGEN+D}$ plots stocked with C and D trees		
$C^{REGEN+D}$ plots stocked with C^{UP} and D trees		
$C^{REGEN+D}$ plots stocked with C^{UP}, C and D trees		
$C^{REGEN+D}$ plots not stocked		
Plot locations with stocked C^{UP} and $C^{REGEN+D}$ plots		
Plot locations not cut or deleted		
Total (excl not cut/ deleted plot locations)		

ACCEPTABLE STOCKING SUMMARY			
Acceptable C^{UP} stocking (%) - 1.78 m plot*			
Acceptable C^{UP} stocking (%) - 3.99 m plot			
Acceptable total opening-level stocking (%)			
Poorly stocked area (ha)			
Survey passes:	Full C^{UP} std?	Reduced C^{UP} std?	
Total opening level stocking std?			
UP stratum assignment			
Opening stocking status (circle one)	SR (UP)	NSR (UP)	SRR (UP)
	NSRR (UP)	SR (non-UP)	NSR (non-UP)

Explanation if timber disposition holder is requesting to re-declare the opening to an alternate stratum

ACCEPTABLE STOCKING SUMMARY FOR OPENINGS TO BE RE-DECLARED TO NON-UP STRATA **Only results from $C^{REGEN+D}$ plots to be used in this calculation				
Acceptable coniferous tree stocking				
Acceptable deciduous tree stocking				
Total stocking (%)				
Survey passes	C	CD	DC	D
Establishment stratum assignment	C	CD	DC	D
Opening status	SR		NSR	

Damage:	Windthrow	% Extent		Comments:	
	Logging damage	% Extent		Comments:	
	Insect	% Extent		Comments:	
	Disease	% Extent		Comments:	
	Hare/Rodent	% Extent		Comments:	
	Weeds:	% Extent		Comments:	
	Other (specify)	% Extent		Comments:	

Site Conditions:

Comments:

* Intensive surveys only

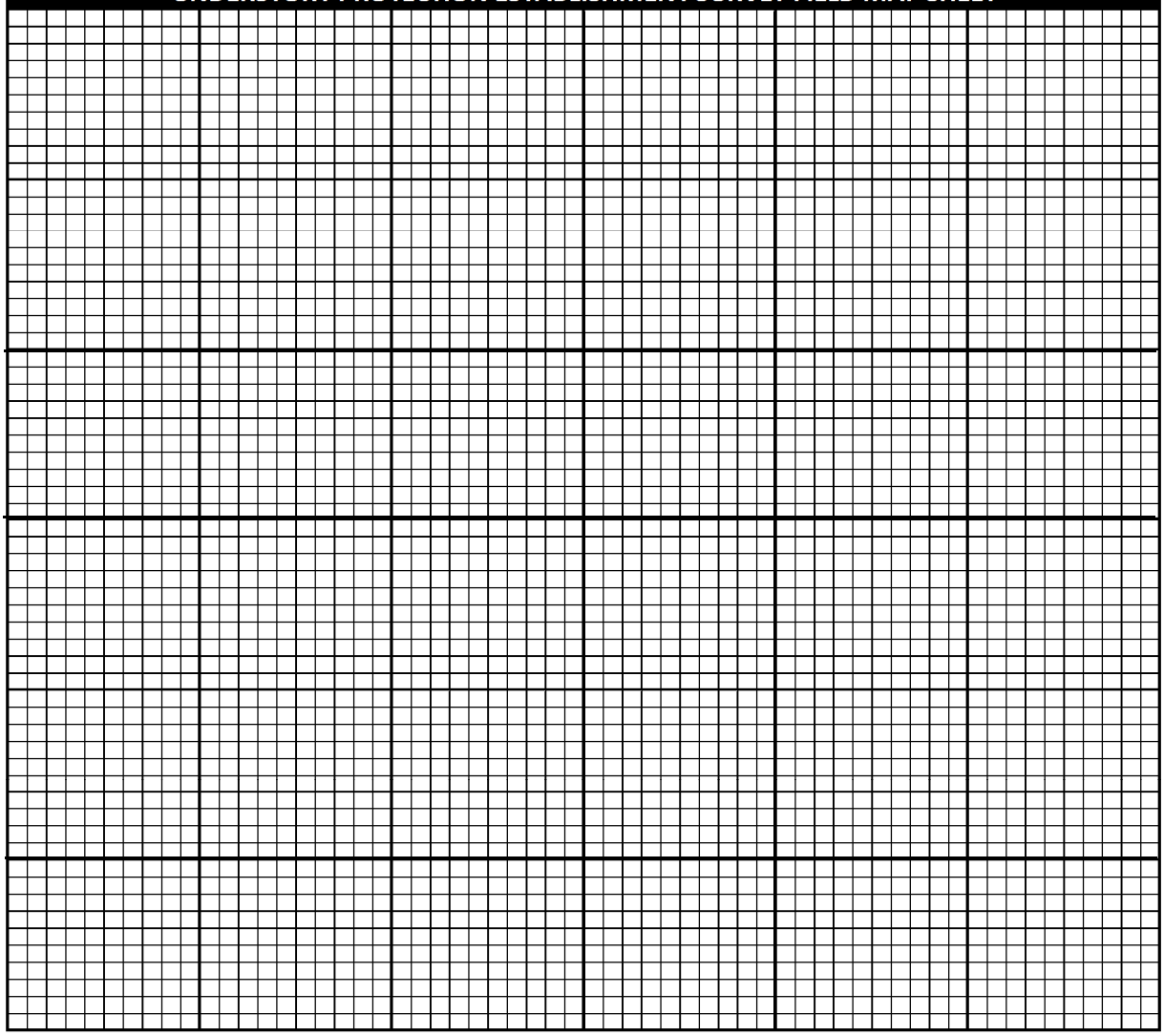
Table 7-10. **Understory Protection Establishment Survey Summary Sheet Opening Header data dictionary (all non-optional fields must be populated)**

Field name	Description	Note
Disposition Holder	The company responsible for reforestation.	E.g., River City Timber Ltd.
Disposition	The FMA, license or permit number under which the opening was harvested.	E.g., FMA0900088, CTQA130010, DTAA090001, etc.
Forest Area	The Provincial administrative unit (Appendix 8).	E.g., NE1, etc.
Opening Number	Unique AAF number based on legal location of the centroid of the harvest area.	E.g., 423075229A
Field Number	The number assigned by the timber disposition holder to the opening that appears on the AOP or harvest plan map.	E.g., 1234
Opening Area (ha)	Area (ha; 0.1 ha) of the opening as Update area (where available) or Net harvested hectares.	E.g., 20.1
C^{UP} Stocking Standard	Opening-specific, area-weighted C^{UP} stocking standard. Identifies the C^{UP} standard against which C^{UP} stocking is assessed.	E.g., 42%
Total Opening-Level Stocking Standard	Opening-specific, area-weighted total opening-level stocking standard. Identifies the standard against which total opening-level stocking is assessed. Total opening-level stocking incorporates both C^{UP} and $C^{REGEN+D}$ stocking.	E.g., 78%
Plot Centre Spacing	The distance (m) between plot centres on a survey line.	E.g., 35 m
Line Spacing	The distance (m) between survey lines.	E.g., 28 m

Field name	Description	Note
Survey Type (Aerial or Intensive)	Identifies the type of Understory Protection Establishment survey method as Aerial (visual evaluation from the air) or Intensive (on the ground plot-based survey).	E.g., Aerial
Timber Year of Cut (YYYY-YYYY)	Timber Year of Cut	E.g., 2010-2011
Natural Subregion	Alberta's forested areas are classified into geographical areas, which exhibit similar natural forest vegetation. Enter the code for the Natural Subregion. DM - Dry Mixedwood CM - Central Mixedwood NM - Northern Mixedwood LF - Lower Foothills UF - Upper Foothills LB - Lower Boreal Highlands UB - Upper Boreal Highlands SA – Subalpine MO - Montane	E.g., LB
Ecosite (optional)	Functional unit defined by the moisture and nutrient regime. The ecosite is determined during the pre-harvest survey. Ecosite is an optional field.	E.g., e1

Field name	Description	Note
Drainage class (optional)	Defined by water in excess of field capacity and the length of time water is in excess in the plant-root zone. Enter the code for drainage class: VR – Very rapidly drained R – Rapidly drained W – Well drained MW – Moderately well drained I – Imperfectly drained P – Poorly drained VP – Very poorly drained Drainage class is an optional field.	E.g., MW
Pre-harvest stratum	Base 10 ARS stratum as identified in the Planning Standard (2006)	E.g., Sw/Aw
Survey date (YYYY-MM-DD)	Year, month, day of Understory Protection establishment survey	E.g., 2010-05-23
Surveyor ID1	Name (first and surname) of primary qualified surveyor.	E.g., Elihu Steward
Surveyor ID2	Name (first and surname) of qualified surveyor	E.g., Reginald Loomis
Regenerated Yield Class Stratum	The up to 8 digit landbase designation code for the opening. Unless the timber disposition holder intends to apply for re-designation of the opening, the code must be for a UP stratum.	E.g., RCTL1413

UNDERSTORY PROTECTION ESTABLISHMENT SURVEY FIELD MAP SHEET



Disp. Holder: _____
Disposition: _____
Opening number: _____
Field number: _____
Scale: _____
Tie point: _____
Control line bearing: _____
Line/ plot spacing: _____
GPS make: _____
GPS model: _____
GPS coordinate sys: _____
Poor stk. Area (ha): _____

LEGEND	
C^{UP} not stocked; $C^{REGEN+D}$ not stocked	◎
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C	●
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C^{UP}	■
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C^{UP} and C	▬
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C^{UP}, C & D	✚
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C^{UP} and D	◆
C^{UP} not stocked; $C^{REGEN+D}$ stocked with D	◓
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C and D	▲
C^{UP} stocked; $C^{REGEN+D}$ not stocked	○
C^{UP} stocked; $C^{REGEN+D}$ stocked with C	●
C^{UP} stocked; $C^{REGEN+D}$ stocked with C^{UP}	■
C^{UP} stocked; $C^{REGEN+D}$ stocked with C^{UP} and C	▬
C^{UP} stocked; $C^{REGEN+D}$ stocked with C^{UP} and D	◆
C^{UP} stocked; $C^{REGEN+D}$ stocked with C^{UP}, C & and D	✚
C^{UP} stocked; $C^{REGEN+D}$ stocked with D	◓
C^{UP} stocked; $C^{REGEN+D}$ stocked with C and D	▲
Not cut or deleted	⊗

Comments: _____

Opening number: _____

UNDERSTORY PROTECTION ESTABLISHMENT SURVEY TALLY SHEET A

Line	Plot	C^{UP} Stocking		$C^{REGEN+D}$ Stocking (1.78m plot)		C^{UP} Plot status (3.99m plot)	$C^{REGEN+D}$ Plot status (1.78m plot)	$C^{REGEN+D}$ Plot under height trees* (1.78m plot)	
		Acceptable C^{UP} tree?		Acceptable C tree?	Acceptable D tree?	Stocked or Not Stocked	Not stocked or Stocked-C or Stocked-D or Stocked C+D	UH C Species ≥15 cm tall	UH D Species ≥30 cm tall
		1.78 m plot	3.99 m plot						

*Optional to collect this information. Not to be used in the calculation of C^{UP} or total opening-level stocking for UP openings.

Page _____ of _____

Opening number: ______________________

UNDERSTORY PROTECTION ESTABLISHMENT SURVEY TALLY SHEET B

GPS X Corrdinates	GPS Y Coordinates	Plot ID	C^{UP} Stocking		$C^{REGEN+D}$ Stocking (1.78m plot)		C^{UP} Plot status (3.99m plot)	$C^{REGEN+D}$ Plot status (1.78m plot)	$C^{REGEN+D}$ Plot under height trees* (1.78m plot)	
			Acceptable C^{UP} tree?		Acceptable C tree?	Acceptable D tree?	Stocked or Not Stocked	Not stocked or Stocked-C or Stocked-D or Stocked C+D	UH C Species ≥15 cm tall	UH D Species ≥30 cm tall
			1.78 m plot	3.99 m plot						

*Optional to collect this information. Not to be used in the calculation of C^{UP} or total opening-level stocking for UP openings.

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8 Performance survey standard

8.1 Purpose

The *Timber Management Regulation (122.1(1) a.1)* defines Performance surveys as a survey to determine if established stands have continued to grow and to ensure these stands are healthy, vigorous, and capable of generating yields similar to the post-harvest yields assumed in the timber supply analysis.

The Performance survey utilizes two (2) assessment systems to generate Mean Annual Increments (MAI):

1) Aerial Stratification System (Section 8.4); and,

2) Non-photo System (Section 8.5).

The Aerial Stratification System is the standard method for Performance surveys. The Non-photo System is only available to obligation holders with a total annual Performance survey program of 250 ha or less within a forest management unit (TSA generally coincident with a FMA or FMU) or as described in Section 8.3.1.

Aerial Stratification and Non-photo System Performance field surveys shall:

- Measure density, top height, and age by species; and,
- Locate poorly regenerated areas (areas greater than 2 ha in size with less than 200 stems per ha).

The standard also includes a survey protocol for openings whose current status in the Alberta Regeneration Information System (ARIS) is Conditionally Satisfactorily Restocked (CSR) or Not Satisfactorily Restocked (NSR) to the Deciduous (D) Standard (Section 9). This protocol uses the stocked plot method to determine the stocking status for the opening.

Applying a CSR stocking status to an opening as a result of an Establishment survey is no longer valid, effective May 1, 2010.

8.2 Objectives

The objectives of the Performance survey are:

- To assess every opening, as required under the *Timber Management Regulation*, at performance timing to document the status of the opening;
- To identify homogeneous units (polygons, Sampling Units) within openings to support model forecasts of Coniferous and Deciduous Mean Annual Increment (MAI) in a manner that is sensitive to the architecture and assumptions of the model used to generate the MAI;

- To support efficient data gathering that will result in accurate regeneration assessment metrics (tree and stand parameters, stand type, MAI);
- To estimate stand and tree parameters to known and acceptable levels of accuracy; and,
- To provide data to demonstrate maintenance of minimum forest structures (i.e., identification of poorly regenerated areas).

8.3 Timing

8.3.1 Aerial photography acquisition

For those timber disposition holders using the Aerial Stratification System, the following applies:

Aerial photography shall be acquired no sooner than 11 years and no later than 14 years after the end of the Timber Year of Cut or disturbance date, whichever is more recent. Table 8-1 summarizes the timing requirements for the acquisition of aerial photography.

Table 8-1. Aerial photography acquisition timing and opening eligibility by Timber Year of Cut or disturbance date, whichever is more recent.

Photo Program Year	Timber Year of Cut eligibility																
	1995 1996	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002	2002 2003	2003 2004	2004 2005	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012
2010	Y[a]	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
2011	N	Y[a]	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
2012	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N
2013	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N
2014	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N
2015	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N
2016	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N
2017	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N
2018	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
2019	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N
2020	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N
2021	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N
2022	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
2023	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y

[a] with approved deferral

Y = Openings with harvest dates within the specific Timber Year of Cut are eligible for acquisition of aerial photography for the specified program year.

N = Openings with harvest dates within the specific Timber Year of Cut are not eligible for acquisition of aerial photography for the specified program year.

For openings with stand tending activities (manual or chemical), aerial photography shall be acquired after all silviculture activities (i.e., stand tending) are completed. This is necessary to ensure Sampling Units within openings are interpreted accurately for species composition and density prior to field sampling. Prior written approval from the department is required each year

where this requirement cannot be met. Approval may be granted where operational constraints preclude this requirement from being met.

In the event that aerial photographs are not acquired due to circumstances beyond the control of the obligation holder and the openings are due for Performance surveys (year 14 in the Performance survey window; Table 8-2), obligation holders shall use the Non-Photo System for these openings.

8.3.2 Field survey

For openings currently declared to the C, CD, or DC Strata Standards, the following applies:

Performance field surveys shall be completed no sooner than 11 years and no later than 14 years after the end of the Timber Year of Cut or disturbance date, whichever is more recent (Table 8-2).

Table 8-2. Performance field survey timing and opening eligibility by Timber Year of Cut or disturbance date, whichever is more recent.

Timber Year	Timber Year of Cut eligibility																		
of field survey	1995 1996	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002	2002 2003	2003 2004	2004 2005	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012	Complete by	Report by
2010/2011	Y[a]	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	30 April, 2011	15 May, 2011
2011/2012	N	Y[a]	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	30 April, 2012	15 May, 2012
2012/2013	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	30 April, 2013	15 May, 2013
2013/2014	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	30 April, 2014	15 May, 2014
2014/2015	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	30 April, 2015	15 May, 2015
2015/2016	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	30 April, 2016	15 May, 2016
2016/2017	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	30 April, 2017	15 May, 2017
2017/2018	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	30 April, 2018	15 May, 2018
2018/2019	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	30 April, 2019	15 May, 2019
2019/2020	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	30 April, 2020	15 May, 2020
2020/2021	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	30 April, 2021	15 May, 2021
2021/2022	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	30 April, 2022	15 May, 2022
2022/2023	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	30 April, 2023	15 May, 2023
2023/2024	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	30 April, 2024	15 May, 2024

[a] with approved deferral

Y = Openings with harvest dates within the specific Timber Year of Cut are eligible for Performance field survey.

N = Openings with harvest dates within the specific Timber Year of Cut are not eligible for Performance field survey.

For openings currently declared to the D Stratum Standard, the following applies:

Where an Establishment survey has been completed for an opening prior to 1 May, 2010 and the opening is deemed Satisfactorily Restocked (SR), a Performance survey is not required.

Where an Establishment survey has been completed for an opening prior to 1 May, 2010 and the opening is deemed to be CSR or NSR, a Performance field **stocking** survey (Section 9) shall be completed no sooner than 8 years and no later than 14 years after the end of the Timber Year of Cut.

Where an Establishment survey has not been completed for an opening as of 1 May, 2010, a Performance survey is required to be completed no sooner than 11 years and no later than 14 years after the end of the Timber Year of Cut or clock re-set date or disturbance date.

For all openings declared to any Regenerated Yield Stratum, the following applies:

Performance field surveys shall be completed no sooner than 11 years and no later than 14 years after the end of the Timber Year of Cut or clock re-set date or disturbance date.

For openings with stand tending activities, the following applies:

Performance field surveys must not be completed within two (2) growing seasons after a manual tending treatment for openings located within the Lower Foothills and Mixedwood Natural Subregions.

Performance field surveys may be completed at any time after herbicide treatment provided that the efficacy of the treatment is evident at the time of the survey and the survey is completed within the required period of time (Table 8-2).

8.4 Aerial Stratification System

The Aerial Stratification System is the standard method for completing Performance surveys. The system is designed to support a high level of confidence in polygon-level MAI projections. Timber disposition holders shall sample annual populations of stratified polygons (Sampling Units) to achieve this high level of prediction confidence.

The Aerial Stratification System has six (6) distinct and sequential phases:

(1) Aerial photography acquisition;

(2) Softcopy development;

(3) Stratification;

(4) Field sample selection;

(5) Field survey; and,

(6) Compilation and calculation of MAI.

The annual population for which MAI projections will be determined shall be those openings submitted for field sample selection. The annual population may contain openings of the same age or different ages but must be from within the Performance survey timing window (Table 8-2) and from within the same TSA generally coincident with a FMA or FMU.

8.4.1 Aerial photography acquisition

8.4.1.1 Standards for submission of openings to Alberta

Timber disposition holders are responsible for organizing and managing their own aerial photography acquisition programs. The most current spatial layer (AVI or cutblock layer) for the opening shall be used for photo acquisition. For openings harvested on or after May 1, 2016, the requirements under ESRD, Land and Forestry Policy, 2015, No. 3 Final Cutblock Digital Data Submissions apply. These opening boundaries shall be used for photo acquisition subject to the timing requirements under Section 8.3.

However, in order to facilitate the audit of opening boundaries, original shape files used to identify openings for photo acquisition, in the format described below, must be submitted to the department (Forest Management Branch) as part of the submission package (Section 8.7.6).

The standard for submission of shape files to Alberta is geospatial data in the Environmental System Research Institute (ESRI) ARC compatible shape file format.

The shape files shall consist of four (4) mandatory files, all of which must be submitted as a cumulative shape file:

<filename>**.prj** The file that stores the coordinate system information. This file is the datum and projection coordinate system for the shape file.

(1) The Datum for all shape files shall be North American Datum 1983 (NAD83).

(2) The location coordinate system for all shape files shall be Universal Transverse Mercator (UTM Zone 11 or 12) projection (easting and northing) in meters.

<filename>**.shp** The main file that stores the geometry of the polygon;

<filename>**.shx** The file that stores the index of the polygon's geometry;

<filename>**.dbf** The dBASE table that stores the attribute information of the polygon.

There shall be a one-to-one relationship between geometry and attributes. Attribute records in the dBASE file must be in the same order as records in the main file.

The attribute file shall contain the field names and associated information described in Appendix 10, Table 11-6.

Original shape files shall accompany the Performance survey annual reporting package submitted to the Forest Management Branch by 15 May.

8.4.1.2 Standards for aerial photography

The Standards for the acquisition of aerial photography shall follow the *General Specifications for Acquiring Aerial Photography (March 2014)*[16].

For conventional aerial photography:

- The scale of aerial photography shall be 1:20,000 or larger;
- Aerial photography shall be acquired as stereo pairs; and,
- The preferred film is True Color.

For digital aerial photography:

[16] http://aep.alberta.ca/forms-maps-services/maps/resource-data-product-catalogue/documents/GeneralSpecsAcquiringAerialPhoto-2014.pdf

- Images must meet or exceed a 20 cm digital direct, 4 band (RGB) resolution captured with IMU/GPS.

The preferred season of photography is spring leaf-off.

Effective 1 May, 2014, aerial photography acquired for the purpose of Performance surveys must be digital and to the standard described in the RSA. Conventional aerial photography **acquired** on or after 1 May, 2014 and used for Performance surveys will not be acceptable.

8.4.1.3 Process for distributing negatives

Repealed 1 May, 2013.

8.4.2 Softcopy development

8.4.2.1 Scanning Standards

The Standard for scanning negatives shall be the *General Specifications for Acquiring Aerial Photography*.

The scanning resolution for 1:20,000 scale photography shall be 15 microns or higher.

If larger-scale photography is acquired, then the scanning resolution shall be modified accordingly.

Timber disposition holders who have returned negatives to Alberta for storage may request access at any time for a period of five (5) years. Alberta will permit access to the negatives providing the timber disposition holder making the request has openings on the roll of film. After the five year period, Alberta will contact timber disposition holders to determine whether to return or destroy the negatives.

8.4.2.2 Aerial triangulation standards

The Standard for aerial triangulation shall be the *General Specifications for Acquiring Aerial Photography.*

Softcopy development requires Digital Elevations Models (DEM). Timber disposition holders shall be responsible for obtaining appropriate DEM. DEM data (i.e., ArcInfo GRIS 25 meter) may be obtained from the Data Distribution Unit, Informatics Branch, Environment and Parks.

8.4.3 Stratification

Stratification of openings is a key first step for Performance surveys. The objectives of stratification are:

- To delineate homogeneous strata (Sampling Units) within openings to increase sampling precision; and,

- To identify Poorly Regenerated Areas.

The general stratification procedure shall be:

(1) Delineate the Net Assessment Area (NAA) by netting-out land use and/or natural deletions (Section 8.4.3.4);

(2) Stratify the NAA into Sampling Units (Section 8.4.3.5); and,

(3) Stratify the NAA into Poorly Regenerated Areas (Section 8.4.3.6).

Delineating Sampling Units and Poorly Regenerated Areas are separate exercises:

Exercise 1: **NAA** ⇨ **Delineate Sampling Units**

Exercise 2: **NAA** ⇨ **Delineate Poorly Regenerated Areas**

Two separate shape files are required, one for each exercise. Poorly Regenerated Areas may overlap with more than one Sampling Unit.

8.4.3.1.1 Opening boundaries

Stratification shall be completed within opening boundaries. Ensuring that opening boundaries are complete and accurate is a fundamental requirement of RSA.

For openings harvested on or after May 1, 2016 and to meet the requirements under ESRD, Land and Forestry Policy, 2015, No. 3 Final Cutblock Digital Data Submissions, opening boundaries shall not be re-drawn except where land use deletions have occurred.

There may be instances where the shape file boundaries do not line up with the softcopy image either because the opening boundary appears to have shifted or portions of the opening boundary appear to be incorrect (e.g., un-harvested areas within the opening boundaries, harvested areas that are clearly part of the opening but outside of the boundary). Interpreters shall use the following guidelines when re-drawing opening boundaries:

- Where the opening boundary appears to have shifted, the opening boundary shall be re-drawn.
- Where portions of the opening boundary appear to include areas of un-harvested trees from an adjacent mature stand, the opening boundary shall be re-drawn to exclude those portions.
- Where portions of the opening boundary appear to exclude harvested areas which are clearly part of the opening, the opening boundary shall be re-drawn to include those portions.
- Where portions of the opening boundary appear to either include or exclude harvested areas which may or may not be part of the opening, care must be taken to ensure the adjacent area is actually part of the original harvest. This situation may occur where two openings of similar age are adjacent to one another. Similarly, where the opening is adjacent to an area without trees, care must be taken to not be removing Poorly

Regenerated Areas that appear to not fit the remainder of the harvested area. Interpreters shall consult with timber disposition holders to obtain more information **before** any changes are made.

- Where land use dispositions straddle opening boundaries, the opening boundaries shall not be re-drawn. The portions of the land use within openings shall be netted out using the methods described in Section 8.4.3.4.

Other spatial layers (e.g., AVI layer, complete opening layer) shall be used to assist interpreters with re-drawing opening boundaries.

Overlap of opening boundaries within and among timber dispositions or land use dispositions is not permitted (Figure 8-1). Conversely, areas clearly harvested and associated with two or more openings but not part of any opening are not permitted.

These types of boundary issues found as a result of an audit completed by the department will result in the entire performance survey program being deemed unacceptable. Subdivision of openings due to these boundary issues will not be permitted.

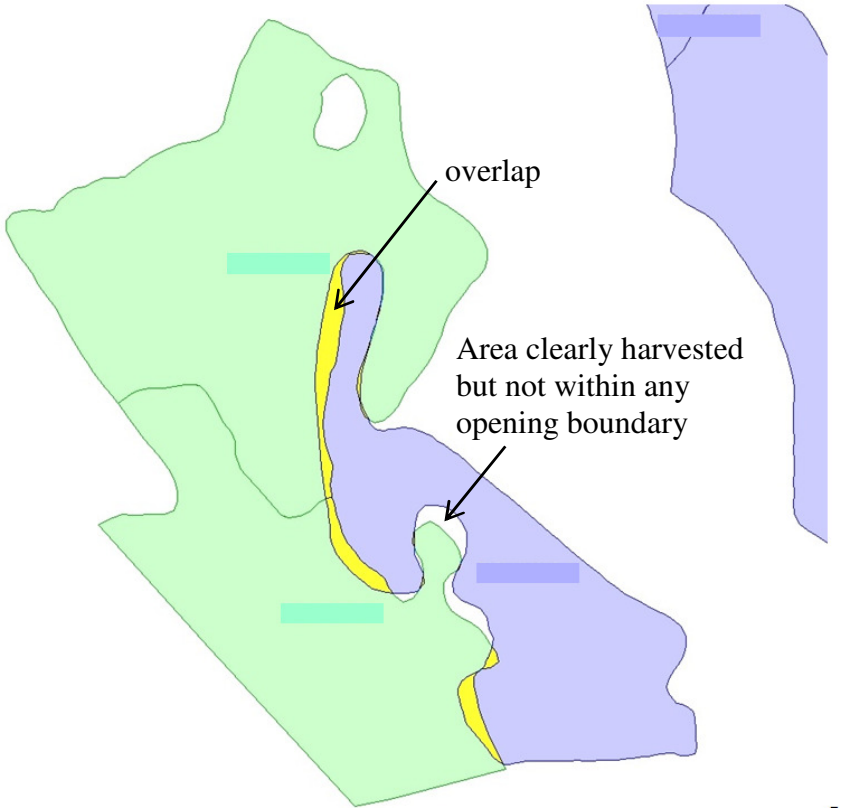


Figure 8-1. Example of opening boundary overlap (in yellow) and area clearly harvested but not within any opening boundary.

Opening boundaries that cross administrative units (FMA or FMU with different forest management plans) shall be re-drawn to correspond with the administrative unit boundary. This is necessary because there are specific forest management assumptions associated with each administrative unit.

Where boundaries have been re-drawn, interpreters shall document, on an opening by opening basis, their justification for the new opening boundaries together with the area difference between the boundary area supplied by the timber disposition holder and the re-drawn boundary area. Only include those openings where the boundary area changes are greater than 0.5 ha or 5%, whichever is smaller. The documentation and rationale are necessary for audit purposes and shall be included in the Performance Survey Summary Report (Section 8.7.6.1.9).

8.4.3.2 Recording administrative information

Interpreters shall record information on imagery, interpretation, and unique polygon identifiers for Sampling Units and poorly regenerated areas. A data dictionary is provided in Appendix 11, Table 11-7 (Interp1). References to applicable field names are provided in the following text.

8.4.3.2.1 Imagery

Interpreters shall record the date the image was captured, image emulsion, scale of photography, and the season (leaf-off or leaf-on) the image was acquired. When recording imagery information, the applicable fields are “PHOTO_Y”, “PHOTO_M”, “PHOTO_D”, “EMULSION”, “SCALE”, and “LEAF”.

8.4.3.2.2 Interpretation

Interpreters shall record the year and month of interpretation and their full name (first name first then surname). When recording interpretation information, the applicable fields are “INTRP_Y”, INTRP_M”, and “INTRP”.

8.4.3.2.3 Unique polygon identifier

The interpreter shall record the opening number, polygon number, unique identifier, and area in hectares for each polygon. Each netted out land use disposition and/or natural deletion, delineated Sampling Unit, and Poorly Regenerated Area shall be assigned a unique polygon number.

For example, if an opening has one netted out natural deletion, two Sampling Units, and one Poorly Regenerated Area, then there shall be four (4) unique polygon numbers. When recording unique polygon identifier information, the applicable fields are “OPENING”, “POLYGON”, “UNIQUE_ID”, and “AREA_HA”.

8.4.3.3 Higher-level stratification

In order to capture known or anticipated significant differences in stand characteristics and/or performance, a higher-level of stratification of openings for sampling may be necessary. Use of higher-level stratification is at the discretion of each timber disposition holder (i.e., optional).

There is one exception. Higher-level stratification is required for Enhance Forest Management (EFM) (see below). However, higher-level stratification should be utilized where timber disposition holders wish to enhance the accuracy of the MAI forecast.

Silviculture treatments (e.g. manual, chemical, non-tending activities) or geographic growing conditions (e.g. Lower Foothills Natural Subregion versus Upper Foothills Natural Subregion) are examples of higher-level stratification.

Best practice: A higher-level stratification should be considered for polygons stratified as 'accidental' Hw. 'Accidental' Hw occur in polygons or openings where the primary species of management is conifer (e.g., HwSx, SxHw, Sw). These polygons may have a significant conifer component however the density proportion of deciduous leads to a Hw call. These Hw are different than the true Hw where the primary species of management is broadleaf. Opting for a higher-level stratification (accidental Hw vs true Hw) will correctly account for the conifer component and not inflate the conifer component in Hw managed stands for the yield curves in the next FMP.

Where higher level of stratification is used, the information must be recorded and the appropriate code (timber disposition holder defined) assigned to each Sampling Unit in the population.

8.4.3.3.1 Enhanced Forest Management

Enhanced Forest Management (EFM) is defined as improvement to forest growth resulting from thinning, fertilization, tree improvement or drainage[17]. Area (ha) deemed EFM must be sampled as its own population and specific to each type of EFM.

Specifically for the EFM tree improvement type,

- Openings with either an AIC9 or AIC11 genetic classification code in ARIS shall contribute to the EFM tree improvement type population; and,
- Openings where ≥50% of the area was bare ground planted and ≥70% of seedlings planted are from seed lot(s) deemed improved seed shall contribute to the EFM tree improvement type population; and,
- Spatially known (shape file, map) portions of openings where ≥70% of seedlings bare ground planted are from seed lot(s) deemed improved shall contribute to the EFM tree improvement type population. Timing and submission of planting of genetically improved stock spatial information associated with ESRD, Land and Forestry Policy, 2015, No. 4 Silvicultural Activities Digital Data Submission shall also be used to fulfil this requirement.

Bare ground planting refers to planting activities that meet the two year treatment rule under Section 141.1(1) of the *Timber Management Regulation*.

All other requirements for defining populations (Section 8.4.5.2) and Sample Unit size (Section 8.4.5.3) apply.

8.4.3.4 Delineating the Net Assessment Area (Field "NAA")

In most cases, land use dispositions and natural deletions will have been netted out of the opening area by the timber disposition holder prior to the stratification process.

Where land use dispositions and natural deletions (Table 8-3) have not been netted out of the opening, interpreters shall remove these features using the following guidelines:

[17] Alberta Sustainable Resource Development, 2006. Alberta Forest Management Planning Standard. Version 4.1 – April 2006. For a digital copy of this document, visit the AAF website (forestry.alberta.ca) and use the following search term: "Alberta Forest Management Planning Standard".

- Land use dispositions that have resulted in landbase with-drawls shall be netted out, regardless of size, status of clearing or extent of re-vegetation.
- Natural deletions ≥0.5 ha in size, regardless of width, shall be netted out.
- Where the spatial layer containing land use dispositions or natural deletions has shifted, the boundaries shall be re-drawn.
- Interpreters shall use the most current information when netting out land use. For example, the spatial land use layer may be dated. Interpreters may use other more current sources of documentation to assist with netting out land use dispositions. For audit purposes, these other sources of information, when used, shall be retained and made available to Alberta upon request.

Each net down polygon shall be assigned a unique number (Field 'POLYGON'). A code shall be assigned to polygons delineated and removed from the opening (Table 8-3) (Field "NAA").

The area remaining within the opening after the net down process defines the NAA.

The NAA within an opening shall be stratified by interpreters. Unique numbers (Field 'POLYGON') shall be assigned to delineated polygons within the NAA.

Table 8-3. Net Assessment Area, anthropogenic and natural deletion codes.

Category	Code	Description
Net Assessment Area	0	Net Assessment Area
Anthropogenic	1	Any of: MLL – Miscellaneous Lease (campsite, sand and gravel, etc.) PLA – Pipeline Agreement LOC – Licence of Occupation Road Well site Archaeological and historic sites Permanent sample plots or other research areas (covered under a protective notation)
Natural	2	Riparian areas and uncut buffers (0.5 ha or larger) Uncut patches within the opening (0.5 ha or larger)

8.4.3.5 Stratifying the Net Assessment Area into Sampling Units

Interpreters shall stratify the NAA into homogeneous areas, called Sampling Units, by considering the regeneration layer only.

The regeneration layer is the primary layer of regenerating trees that contributes to reforestation performance. This layer includes seedlings, suckers, and advanced growth (e.g., conifer understory avoidance).

8.4.3.5.1 Silviculture records and field calibration

Timber disposition holders shall provide silviculture records to interpreters. The purpose of silviculture records is to assist interpreters with making informed decisions when delineating and assigning attributes to polygons. Silviculture records may include:

- Site preparation type and extent;
- Planting (species, stock type, density, extent or leave for natural);
- Establishment survey results; and,
- Stand tending activities.

Interpreters shall undertake field calibration. Field visitation by interpreters to a subset of openings is necessary in order to calibrate or confirm species identification, species composition, and/or density. Interpreters may establish plots and collect data or simply walk-through the opening. The amount of field verification may vary, but must be sufficient to enable interpreters to make reasonable and consistent interpretations.

8.4.3.5.2 Tree species composition and density classes

Delineation of Sampling Units within the regeneration layer shall be based on tree species composition and density classes.

Table 8-4 describes the ten (10) tree species composition classes. These tree species composition classes correspond with the standardized stratification for yield estimates, as described in the Alberta Forest Management Planning Standard (SRD 2006)[18].

Tree species proportions used to define tree species composition classes are based on interpreted tree species density (i.e., stems per ha).

[18] Alberta Sustainable Resource Development, 2006. Alberta Forest Management Planning Standard. Version 4.1 – April 2006. For a digital copy of this document, visit the AAF website (forestry.alberta.ca) and use the following search term: "Alberta Forest Management Planning Standard".

Table 8-4. Tree species composition class definitions.

Tree species composition class	Coniferous tree percent (density based)	Leading coniferous tree species (density based)
Hw	0-20	NA
HwPl	30-50	Pine
HwSx	30-50	Spruce
SwHw	50-70	White spruce
PlHw	50-70	Pine
SbHw	50-70	Black spruce
Sw	80-100	White spruce
Pl	80-100	Pine
Sb	80-100	Black spruce
Fd	80-100	Douglas-fir

Pine = Pl, Pj, Pw, Pf, Lt, La, Lw; Spruce = Sw, Sb, Se, Fb, Fa; White spruce = Sw, Se, Fb, Fa; Black spruce = Sb; Hardwood = Aw, Pb, Bw; Douglas-fir = Fd

If the species proportions are 50% coniferous trees and 50% deciduous trees, then use the order of tree species to determine which has the higher density to differentiate coniferous tree leading mixedwood or deciduous tree leading mixedwood.

Table 8-5 describes the four (4) density classes. These density classes represent the relative sensitivity in model forecast culmination MAI. For example, where MAI is more sensitive to change in density, the range within the density class is less. Density classes are defined as the total stems per hectare of trees in the regeneration layer.

Table 8-5. Density class definitions.

Density class	Code	Density range (stems per ha)
Low	L	1 – 1,000
Medium	M	1,001 – 2,000
High	H	2,001 – 5,000
Dense	D	>5,000

8.4.3.5.3 Stratification standard

Interpreters shall stratify the regeneration layer of the NAA into Sampling Units based on species composition and density classes to the following standards:

- Sampling Units shall not be delineated when smaller than two (2.0) hectares.
- Sampling Unit widths at any point shall not be less than 50 meters.
- Stratification shall be hierarchical.
    - **Step 1**: Stratify the regeneration layer within the NAA based on species composition:
        - Where tree species composition class (Table 8-4) differs; and
        - Where the tree species composition percentage of a single species within the cover type differ by more than 10%; and,
        - Where the Sampling Unit size (minimum 2 ha) and width (minimum 50 m) criteria are met.

Box 8. Stratifying the regeneration layer based on tree species composition.

Aw7Sw3/Aw8Sw2 (criterion 2 not met)	*Aw6Sw4/Aw8Sw2 (all criteria met)*
Aw6Sw4/Aw7Sw3 (criteria 1 and 2 not met)	*Pl5Aw4Sb1/Aw6Pl4 (all criteria met)*
Pj5Aw4Sb1/Aw5Pj5 (criterion 2 not met)	*Pl6Aw2Sw2/Pl6Aw4 (all criteria met)*
Pl6Aw2Sw2/Pl7Aw3 (criterion 2 not met)	*Sw8Pl2/Pl5Sw4Aw1 (all criteria met)*
Sw5Pl5/Pl6Sw4 (criterion 2 not met)	*Aw10/Sw10 (all criteria met)*

Step 2: Stratify the regeneration layer within the NAA based on density:

- Where total density class (Table 8-5) differs; and,
- Where total density differs by more than 25% (tolerances are defined in Table 8-6); and,
- Where the Sampling Unit size (minimum 2 ha) and width (minimum 50 m) criteria are met.

Table 8-6. Adjacent density class tolerances.

Adjacent density classes	Density class transition tolerance (stems per ha)
Low and Medium	250
Medium and High	500
High and Dense	1,250

Step 3: As described in Section 8.4.3.5.4, characterize each Sampling Unit for:

- Average height;
- Spatial distribution;
- Mixedwood pattern; and,
- Residual layer

Average height, spatial distribution, mixedwood pattern, and residual layer shall not contribute to Sampling Unit delineation, but rather are required attributes which characterize the Sampling Unit.

Interpreters shall only identify and attribute residual layers where crown closure exceeds 15% across the Sampling Unit. Crown closure is either inferred from stem counts in the leaf-off condition or directly where leaf-on aerial photography has been acquired.

Residual areas that have been netted out (i.e., excluded from the NAA) shall not be characterized.

Examples of netting down openings and hierarchical delineation of Sampling Units are provided in Appendix 12.

8.4.3.5.4 Recording Sampling Unit attribute information

For each Sampling Unit, interpreters shall record attribute information for regeneration layer species composition, density, average height, spatial distribution, mixedwood pattern, and residual layer species composition, density, and average height. A data dictionary for Sampling Units is provided in Appendix 11, Table 11-7 (Interp1). References to applicable field names are provided in the following text.

8.4.3.5.4.1 Regeneration layer species composition

Species composition is based on interpreted species density (i.e., stems per ha) and recorded to the nearest 10%. Eligible tree species codes are listed in Table 8-7.

Tree species present within a Sampling Unit shall be recorded in decreasing order of occurrence based on density. For example, if a regeneration layer density is composed of 54% Sw, 26% Aw, and 20% Pl, then the Sampling Unit would be labelled Sw5Aw3Pl2.

Where a Sampling Unit has two or more species of the same density class, the order shall be based on the species which is interpreted to have the greater absolute density.

When recording regeneration layer species composition information, the applicable fields are "SP1","SP1_PER", "SP2","SP2_PER", "SP3","SP3_PER", "SP4","SP4_PER", "SP5", "SP5_PER", "SP_CL".

Table 8-7. List of tree species names and associated codes.

Tree species		Interpretation and database codes	
Common name	**Scientific name**	**Specific code**	**Generalized code**
White spruce	*Picea glauca* (Moench) Voss[1]	Sw	Sw
Engelmann spruce	*Picea engelmannii* Parry ex Engel.	Se	Sw
Black spruce	*Picea mariana* (Mill.) BSP	Sb	Sb
Lodgepole pine	*Pinus contorta* Dougl. Ex Loud. var. *latifolia* Engelm.	Pl	P
Jack pine	*Pinus banksiana* Lamb.	Pj	P
Whitebark pine	*Pinus albicaulis* Engelm.	Pw	P
Limber pine	*Pinus flexilis* James	Pf	P
Balsam fir	*Abies balsamea* (L.)	Fb	Fb
Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.	Fa	Fb
Douglas-fir	*Pseudotsuga menziesii* (Mirb.)	Fd	Fd
Subalpine larch	*Larix lyallii* Parl.	La	Lt
Tamarack	*Larix laricina* (du Roi) K.Koch	Lt	Lt
Western larch	*Larix occidentalis* Nutt.	Lw	Lt
Trembling aspen	*Populus tremuloides* Michx.	Aw	A
Balsam poplar	*Populus balsamifera* L.	Pb	A
Paper birch	*Betula papyrifera* Marsh.	Bw	Bw

[1] Nomenclature follows Farrar, J.L. *Trees in Canada*. Fitzhenry & Whiteside Limited and the Canadian Forest Service, Markham, Ontario. 502 p.

8.4.3.5.4.2 Regeneration layer total density

Total density is the density of all tree species in the regeneration layer of the Sampling Unit. The units for total density are stems per ha. Total density shall be recorded as a numeric field to the nearest 50 stems per ha. Density class shall be recorded.

When recording regeneration layer total density information, the applicable fields are "DENSITY" and "DEN_CL".

8.4.3.5.4.3 Regeneration layer average height

Average height is the average height of the dominant and co-dominant trees of the regeneration layer.

The purpose of interpreting average height for the regeneration layer is to describe the sampling population. For example, average height may be used to determine if the Sampling Units selected for field survey appear to be outlier samples.

Average height for each Sampling Unit shall be recorded to the nearest 0.5 meters.

When recording regeneration layer average height information, the applicable field is "AVE_HT".

8.4.3.5.4.4 Regeneration layer spatial distribution

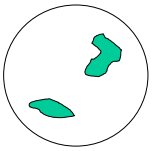
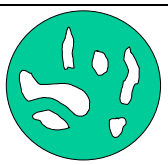
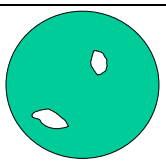
The spatial distribution of stems across the Sampling Unit is described using the tree distribution pattern code, as outlined in Table 8-8.

The spatial distribution only includes tree stems in the regeneration layer. A tree distribution pattern shall be assigned to each Sampling Unit.

Interpreting the spatial distribution of trees for the regeneration layer is analogous to assessing stocking.

The applicable field is "SPATIAL" when recording regeneration layer spatial distribution information.

Table 8-8. Spatial distribution codes and descriptions.

Description	Map label	Database code	Example
Single to very few (1 - 3) occurrences of trees covering <10% of the area of the Sampling Unit.	P1	1	
Several (≥ 4) sporadic occurrences of trees covering < 30% of the area of the Sampling Unit.	P2	2	
Intimately intermixed units, often with gradational transitions from one to another. The trees cover 30% to 50% of the area of the Sampling Unit.	P3	3	
Continuous occurrences with several gaps. 51% - 79% of the Sampling Unit area has trees.	P4	4	
Continuous occurrence (≥ 80%) throughout the Sampling Unit area with very few gaps.	P5	5	

8.4.3.5.4.5 Regeneration layer mixedwood pattern

A mixedwood pattern code is a qualitative measure describing the level of intermixing of coniferous and deciduous components within a Sampling Unit. It provides information on the relative spatial orientation of stand components to a scale more detailed than the minimum Sampling Unit dimensions. This metric indicates the types of mixedwoods in each Sampling Unit. A mixedwood pattern code must be assigned to each Sampling Unit.

The applicable field is “MIXED” when recording regeneration layer mixedwood pattern information.

The mixedwood pattern of the regeneration layer is a metric of the operational maintenance of the range of mixedwood types (e.g., intimate, aggregate, or segregate).

The mixedwood pattern code is defined from the perspective of the coniferous tree within the Sampling Unit. The more coniferous trees occur in the presence of deciduous trees, the more intimate the mixture. The more coniferous trees occur in the absence of deciduous trees, the more aggregate the mixture.

When both coniferous and deciduous tree species are listed in the detailed species composition, the mixedwood pattern code must be either intimate or aggregate. For example, if the label for the Sampling Unit is Aw9Sw1, then mixedwood pattern cannot be equal to "P" (pure).

One of the following mixedwood patterns codes must be assigned to each Sampling Unit:

Intimate

Intimate shall be recorded when the majority of area occupied by coniferous tree stems occur in patches[19] in the presence of significant numbers of deciduous tree stems. A significant number of deciduous tree stems is considered to be approximately 200 stems per ha. The eligible code is "I".

Aggregate

Aggregate shall be recorded when the majority of area occupied by coniferous tree stems occur in patches in the absence of significant numbers of deciduous tree stems. The eligible code is "A".

Pure

Pure shall be recorded when coniferous or deciduous tree species composition is 10 (100%) (e.g. Sw10, Sw7Pl3, and Aw7Pb3). The eligible code is "P".

The relative scale that interpreters should use when determining the mixedwood pattern code is 0.25 hectares. Figure 8-2 is a graphic that shows the various levels of intermixing and associated gradients that should be considered. The graphic also provides a general scale for interpreters to consider when making the mixedwood pattern call. The green dots represent coniferous trees while the orange dots represent deciduous trees.

This graphic is intended to be supporting rationale for how a mixedwood pattern call can be made. In general, interpreters should visually scan the Sampling Unit with these concepts in mind and assign a mixedwood pattern code based on the estimated level of intermixing. Additional description and interpretation on making a mixedwood pattern call is provided in Appendix 13.

[19] Patches considered as part of the mixedwood pattern call should be approximately a quarter hectare in size or larger.

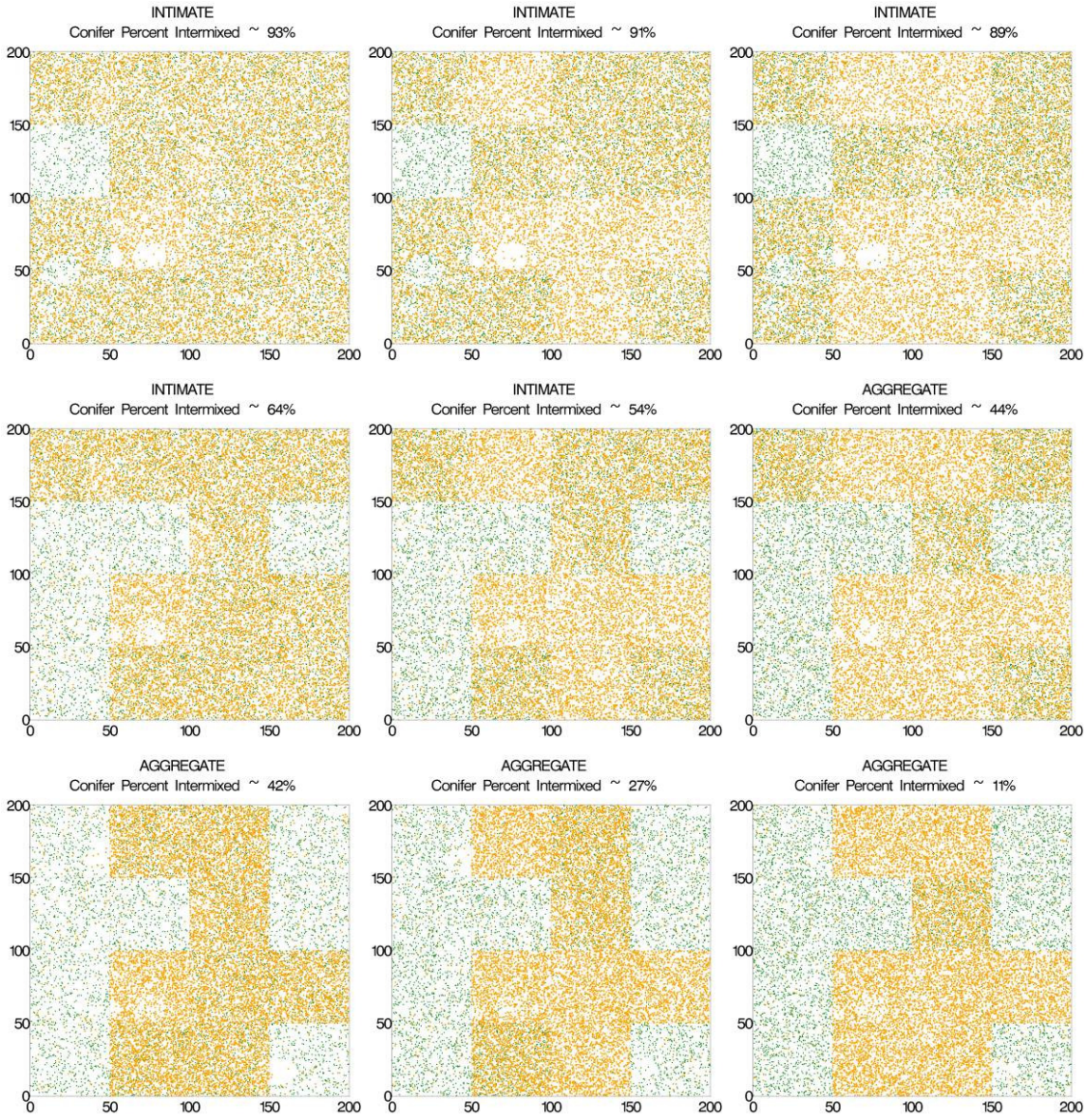


Figure 8-2. Mixedwood pattern.

8.4.3.5.4.6 Residual layer species composition

The purpose of interpreting the residual layer is to document the amount of residual trees in each Sampling Unit. This is necessary because the residual layer may impact the regeneration layer.

Interpreters shall only identify and attribute residual layers where crown closure exceeds 15% across the Sampling Unit. Crown closure is either inferred from stem counts in the leaf-off condition or directly where leaf-on aerial photography has been acquired.

Species composition is based on interpreted species density (i.e., stems per ha) and recorded to the nearest 10% class. Eligible tree species codes are listed in Table 8-7.

Tree species present within a Sampling Unit shall be recorded in decreasing order of occurrence based on density. For example, if a residual layer is composed of 54% Sw, 26% Aw, and 20% Pl, then the Sampling Unit is labelled Sw5Aw3Pl2.

Where a Sampling Unit has two or more species of the same density class, the order shall be based on the species which is interpreted to have the greater absolute density.

When recording residual layer species composition information, the applicable fields are "R_SP1","R_SP1_PER", "R_SP2","R_SP2_PER", "R_SP3", and "R_SP3_PER".

8.4.3.5.4.7 Residual layer total density

Total density is the density of all tree species in the residual layer of the Sampling Unit. The units for total density are stems per ha. Total density shall be recorded as a numeric field to the nearest 50 stems per ha.

When recording residual layer total density information, the applicable field is "R_DEN".

8.4.3.5.4.8 Residual layer crown closure

Residual layer crown closure refers to the ground area (expressed as a percentage of the total Sampling Unit area) covered by a vertical projection of tree crowns onto the ground. Crown closure is recorded as a numeric field to the nearest 10% specific to the residual layer.

The applicable field is "R_CC" when recording residual layer crown closure information.

8.4.3.5.4.9 Residual layer average height

Average height is the average height of the dominant and co-dominant trees of the residual layer. Average height for each Sampling Unit shall be recorded to the nearest 0.5 meters.

When recording residual layer average height information, the applicable field is "R_AVE_HT".

8.4.3.5.4.10 Residual layer spatial distribution

The spatial distribution of residual stems across the Sampling Unit is described using the tree distribution pattern code, as outlined in Table 8-8. Note that the spatial distribution includes all tree stems in the residual layer. A tree distribution pattern shall be assigned to each Sampling Unit.

The applicable field is "R_SPT" when recording residual layer spatial distribution information.

8.4.3.5.4.11 Assessment of stocking (optional)

The assessment of stocking is optional. Stocking information is being collected to aide in understanding the interpreted stratum call (in contrast to density) compared with the ground plot data at the stratum-level.

For each Sampling Unit, interpreters shall record attribute information for regeneration layer species composition and stocking. Stocking shall be assessed in a manner that replicates mil hectare plots in a systematic grid across the entire Sampling Unit. A data dictionary for Sampling

Units is provided in Appendix 11, Table 11-9 (Interp3). References to applicable field names are provided in the following text. The Interp3 dataset shall not imported into the RSA Compiler.

Species composition is based on interpreted tree species group stocking (i.e., in a manner that is equivalent to mil hectare plots systematically distributed across the Sample Unit; similar 'plot' intensity as the Establishment Intensive survey) and recorded to the nearest 10%. Eligible tree species group codes are 'AW', 'PL', 'SB', and 'SW".

Tree species groups present within a Sampling Unit shall be recorded in decreasing order of occurrence based on stocking. For example, if a regeneration layer stocking is composed of 84% SW, 36% AW, and 20% PL, then the Sampling Unit would be labelled SW8AW4PL2.

Where a Sampling Unit has two or more species groups of the same stocking, the order shall be based on the species group which is interpreted to have the greater absolute density.

When recording regeneration layer species composition information, the applicable fields are "PS_SG1","PS_SG1_PER", "PS_SG2","PS_SG2_PER", "PS_SG3","PS_SG3_PER", "PS_SG4","PS_SG4_PER", and "PS_SG_CL".

8.4.3.5.4.12 Regeneration layer coniferous, deciduous and total stocking

Coniferous stocking is the stocking of all coniferous tree species groups (PL, SB, and SW) in the regeneration layer of the Sampling Unit. The unit for coniferous stocking is percent. Coniferous stocking shall be recorded as a numeric field to the nearest 1%. Coniferous stocking shall not exceed 100%.

When recording regeneration layer coniferous stocking information, the applicable field is "PS_CON".

Total stocking is the stocking of all tree species groups (AW, PL, SB, and SW) in the regeneration layer of the Sampling Unit. The unit for total stocking is percent. Total stocking shall be recorded as a numeric field to the nearest 1%. Total stocking shall not exceed 100%.

When recording regeneration layer total stocking information, the applicable field is "PS_TOTAL".

8.4.3.6 Stratifying the Net Assessment Area for Poorly Regenerated Areas

A Poorly Regenerated Area is defined as an area within an opening that is greater than two (2) hectares in size with a total density of less than 200 stems per ha. All tree species present in the Poorly Regenerated Area (regeneration layer only) shall be considered when delineating and attributing the polygon.

Delineating Poorly Regenerated Areas shall be an independent exercise relative to the delineation of Sampling Units.

8.4.3.6.1 Stratification standards

Interpreters shall delineate Poorly Regenerated Areas within the NAA to the following standards:

- Poorly Regenerated Areas shall not be delineated when smaller than two (2.0) hectares.

- Widths of poorly regenerated areas at any point shall not be less than 50 meters.

Interpreters shall use the NAA within each opening to delineate and characterize Poorly Regenerated Areas.

Poorly Regenerated Areas shall be interpreted for:

- Species composition;
- Total density; and,
- Average height.

8.4.3.6.2 Recording Poorly Regenerated Area attribute information

For each Poorly Regenerated Area, interpreters shall record attribute information including species composition, total density, and average height. A data dictionary is provided in Appendix 11, Table 11-8 (Interp2).

8.4.3.6.2.1 Poorly Regenerated Area species composition

Where trees are present, species composition must be determined for the Poorly Regenerated Area polygon.

Species composition is based on interpreted species density (i.e., stems per ha) and recorded to the nearest 10% class. Eligible tree species codes are listed in Table 8-7.

Tree species present within a Poorly Regenerated Area polygon shall be recorded in decreasing order of occurrence based on density. For example, if a Poorly Regenerated Area density is composed of 54% Sw, 26% Aw, and 20% Pl, then the polygon would be labelled Sw5Aw3Pl2.

Where a Poorly Regenerated Area polygon has two or more species of the same density class, the order shall be based on the species which is interpreted to have the greater absolute density.

When recording poorly regenerated area species composition information, the applicable fields are “PR_SP1”,”PR_SP1_PER”, “PR_SP2”,”PR_SP2_PER”, “PR_SP3”,”PR_SP3_PER”, and “PR_SP_CL”.

8.4.3.6.2.2 Poorly Regenerated Area total density

Total density is the density of all tree species in the Poorly Regenerated Area polygon. The units for total density are stems per ha. Total density shall be recorded as a numeric field to the nearest 50 stems per ha.

When recording Poorly Regenerated Area total density information, the applicable field is “PR_DEN”.

8.4.3.6.2.3 Poorly Regenerated Area average height

Average height is the average height of the dominant and co-dominant trees of the Poorly Regenerated Area polygon. Average height for each Poorly Regenerated Area polygon shall be recorded to the nearest 0.5 meters.

When recording Poorly Regenerated Area average height information, the applicable field is "PR_AVE_HT".

8.4.3.7 Standardized attribute data dictionary

A standardized data format must be used to record polygon attributes. The field names, formats, descriptions and allowable codes are provided in Appendix 11, Table 11-7 (Sampling Units, Interp 1) and Table 11-8 (poorly regenerated areas; Interp2). Field names, formats, descriptions and allowable codes for optional Sample Unit stocking assessment are provided in Appendix 11, Table 11-9 (stocking, Interp 3). Attributes shall be recorded in a flat file format with one row per polygon.

8.4.3.8 Spatial data format standards

The format for the spatial data (stratification line-work) shall be in Environmental System Research Institute (ESRI®) Arc compatible format. The acceptable formats are:

- Shape file (*.shp, *.shx, *.dbf, *.prj);
- Geodatabase.

Spatial data shall be submitted in the North American Datum 1983 (NAD83) in the appropriate projection system: UTM Zone 11N or UTM Zone 12N in metres. Where opening data spans a UTM zone boundary, the data shall be referenced to the zone in which the majority of the feature occurs unless the feature extends more than 0.5 km into the other zone. Where this occurs, the data should be divided into distinct datasets within its own projection zone.

8.4.4 Stratification quality assessment and control procedures

See Section 11.

8.4.5 Sample design for field surveys

Following the net-down of openings (i.e., removal of land use dispositions and natural deletions), stratification of Net Assessment Areas (NAA) into Sampling Units, and delineation of Poorly Regenerated Areas, and audit, Sampling Units shall be selected for field sampling.

8.4.5.1 Guiding principles for development of the sample design

The guiding principles used to develop the sample design are:

- The sample design must provide an unbiased representation of each stratum population for which the sampling results are to be applied. All Sampling Units within a stratum population shall have equal probability of being selected for sampling (stratified random sampling).
- Minimum sample requirements.
    - The design shall adequately sample strata to meet or exceed minimum sample sizes (i.e., number of Sampling Units) based on the understanding of previously observed variations and desired allowable error targets.

- The sample design shall select openings until each stratum has reached its minimum sample size (i.e., number of Sampling Units) or all Sampling Units for a stratum have been selected.

8.4.5.2 Defining the population of openings for sampling

For the Aerial Stratification System, the population is defined as:

- Openings within a forest management unit (TSA generally coincident with a FMA or FMU); and,
- Openings eligible for Performance survey, as defined in Section 8.3; and,
- Openings for which aerial photography has been acquired; and,
- Openings that have been stratified, as described in Section 8.4.3; and,
- Openings submitted to the Sample Selection Tool (v20180331a).

Prior to submitting openings to the Sample Selection Tool, the population of openings shall be defined using the Master Opening List (Appendix 14, Table 11-9, Opening1).

8.4.5.3 Sample design input requirements

The sample design requires the delineation and interpretation of Sampling Units to the higher stratification (if applicable), tree species composition, and density class levels.

However, the sample design shall select Sampling Units from the higher-level strata (if applicable) and from as many of the tree species composition strata as were identified (as defined in Section 8.4.3.5). Therefore, the sampling strata are defined by both the high-level stratification (if applicable) and tree species composition. The Sampling Unit selection process uses the sampling strata as the basis for field sampling.

Input into the sample selection process must be standardized. The input is the Sampling Unit attributes generated from the stratification process (Section 8.4.3). Standardized formats for Sampling Unit attributes are described in Appendix 11, Table 11-7 (Interp1).

8.4.5.4 'Rare' strata standards

Repealed 1 May, 2014.

8.4.5.5 Sample design

Sample design: 2010 to 2016

The sample design originally developed for RSA was based on data collected from the 2008 ARS Pilot Projects. This design randomly selected a minimum number of Sampling Units (10 for Hw and Sw and 15 for HwPl, HwSx, SwHw, PlHw, SbHw, Pl, Sb, and Fd strata) from a defined population for field sampling. This sample design assumed an average program (i.e., population of openings) size of approximately 2,000 ha.

Sample design: effective May 1, 2016

A recently completed review of RSA performance survey programs found that 35% of programs completed since the new reforestation standard's inception on May 1, 2010 are larger than 2,000 ha. This is not a large proportion; however, the risk is that these larger programs represent 82% of the area (ha) assessed for performance surveys. Thus, the area being assessed in the field is relatively small and may not be representative of the area over which MAI estimates are applied. In addition, the RSA review determined that 66% of strata large enough to subsample have >10% error in MAI estimates. Since the fixed sample sizes by tree species composition stratum were strongly favouring large programs and resulting in >10% error in the MAI estimate over a large area, a new sample design is necessary to control the MAI error in a performance survey program.

The objective of the sample design for the Aerial Stratification System is a 5% allowable error in the MAI estimate for the primary tree species of management (coniferous or deciduous) by tree species composition stratum across a 5-year period or quadrant. This period was selected as it coincides with the population of openings assessed to determine the level of success in achieving the desired future forest condition (i.e., growth and stratum reconciliation). In order to achieve this 5% allowable error by tree species composition stratum across a quadrant, the allowable error by stratum is 12% within a performance survey program. In other words, if each performance survey program samples each stratum to achieve a 12% allowable error, then it is anticipated that a sufficient number of Sample Units will be field sampled over a 5-year period to achieve a 5% allowable error.

Stratified random sampling is used to select Sampling Units for field sampling. In stratified random sampling, the population of openings are stratified based on tree species composition and density (see Section 8.4.3.5) to create Sample Units. The Sample Units are selected for field sampling based on tree species composition by choosing random SUs within each stratum, independent of other strata.

The finite sample size equation is used to determine the sample size needed to achieve the 12% target error in stratum MAI.

$$n = \frac{t^2 CV^2 \, \mathrm{N}}{(\mathrm{N} * \%AE^2) + (t^2 * CV^2)}$$

where,
n = sample size
t = Student's t value with a probability of 0.05 and n – 1 degrees of freedom
CV = weighted coefficient of variation (%) by stratum (Table 8-10)
N = program population size
$\%AE$ = allowable error (12% for each stratum within a program).

The CV is the typical variation in MAI relative to its mean for each stratum, and standard CV values were set based on a review of previous RSA submissions. Past coniferous and deciduous MAIs were obtained from previous programs and then weighted by the number of SUs to account for the size of the program. Selection of CV was the 75th percentile of the observed CVs within each stratum (Table 8-9). The MAI of the primary species of management (coniferous MAI or deciduous MAI) was used for calculating CV, except in the mixedwood strata where the higher CV (the higher variation in coniferous MAI or deciduous MAI) was selected. Lastly,

since the strata CV values grouped into similar values for pure and for mixedwood strata, an aggregate CV was chosen for each group to form the standard to use in the sample size equation.

Table 8-9. The weighted coefficient of variation (CV) standard by coniferous (C) and deciduous (D) MAI selection priority.

Species composition strata	CV selection priority	Weighted CV %	CV (%) standard
Hw	D MAI	32	26
HwPl	D MAI	44	44
HwSx	D MAI	37	44
SwHw	D MAI	43	44
PlHw	D MAI	49	44
SbHw	D MAI	49	44
Sw	C MAI	26	26
Pl	C MAI	25	26
Sb	C MAI	27	26
Fd	C MAI		26

This sampling scheme and CV (%) standards have been incorporated into the Sample Selection Tool (v20180331a).

8.4.5.6 Field sample selection computer program

Alberta has developed a Sample Selection Tool (v20180331a) and an associated User's Manual to facilitate the field sample selection process. The Sample Selection Tool (v20180331a) is the standard for selecting Sampling Units for Performance field survey. The Sample Selection Tool (v20180331a) and associated User's Manual are available for viewing and/or downloading by visiting the AAF website (forestry.alberta.ca) and using the following search term: "Reforestation Standard of Alberta".

The Sample Selection Tool (v20180331a) requires standardized inputs (e.g., Interp1 Sampling Unit attribute data, Appendix 11, Table 11-7), conducts a validation on critical fields in the input dataset, generates population statistics, conducts the sample selection based on predetermined random seeds, and produces a standardized output.

8.4.5.7 Field sample inclusion probability

The sample design for selecting Sample Units for field sampling uses stratified random sampling. With stratified random sampling each Sample Unit has an equal probability of selection. Thus,

- The inclusion probability for each Sampling Unit and area are necessary for compiling MAI results;
- Clicking the 'Calculate Inclusion Probabilities' button under Sample Selection in the Sample Selection Tool is still required;
- The inclusion probabilities are set to one (1) in all cases; and,
- Running the Monte Carlo simulation is no longer required.

8.4.6 Allocating field plots to Sampling Units

8.4.6.1 Guiding principles

The guiding principles used to develop the field plot allocation rules are:

- The method for determining plot locations must be systematic, unbiased, and designed to simplify field layout within and across Sampling Units in openings.
- The sample intensity must obtain an estimate of model input variables.
- The method should have a mechanism to sub-sample large Sampling Units as the incremental value of additional plots diminishes as the sample size increases.

Combination of two sample intensities (Figure 8-3) shall be used to achieve the minimum and maximum number of plots to establish in each selected Sampling Unit (Table 8-10).

The two sample intensities are based on two grid sizes:

- 50 m × 50 m; and,
- 25 m × 25 m.

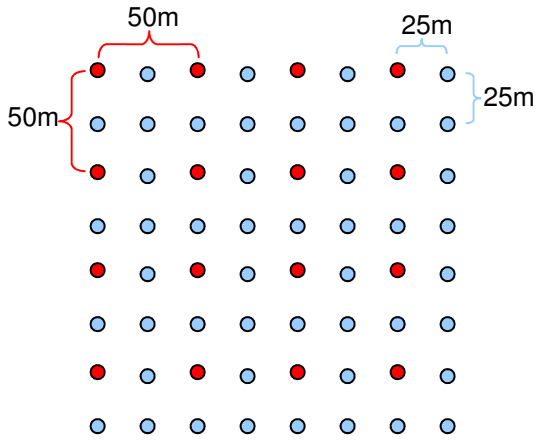


Figure 8-3. Sampling Unit Performance field survey sample intensities.

The grid shall be initiated using randomly selected x and y coordinates.

Table 8-10. Sample Unit minimum and maximum number of Basic and Detailed plots.

	Basic plots	Detailed plots
Minimum number of plots	32	8
Maximum number of plots	64	16

Where the Sampling Unit area is <2.0 ha, the number of basic plots may be less than 32 and the number of Detailed plots may be less than 8. This should only occur where the opening area is <2 ha.

8.4.6.2 Procedure

The preferred procedure for allocating plots within Sampling Units shall be pre-determined using a Geographic Information System (GIS). Manual methods for allocating plots may be used but must result in an equivalent outcome.

Step 1: Overlay a 50 m × 50 m grid across the selected Sampling Unit(s).

Where the number of plots falling within a Sampling Unit is greater than 64, then the following applies:

- The number of Basic plots to establish shall be capped at 64 plots;
- The number of Detailed plots to establish shall be capped at 16 plots (i.e., every 4th Basic plot shall have an associated Detailed plot);
- The line and plot spacing shall be 50 m × 50 m (i.e., 4 plots per ha);
- The first plot shall be selected randomly; and,
- The remaining plots shall be selected concentrically (i.e., the 63 Basic plots closest to the first randomly selected plot) within the boundary of the Sampling Unit).

Where the number of plots falling within a Sampling Unit is between 32 and 64, then the following applies:

- The entire Sampling Unit shall be sampled;
- The line and plot spacing shall be 50 m × 50 m (i.e., 4 plots per ha);
- The number of Basic plots to establish shall range between 32 and 64; and,
- The number of Detailed plots to establish shall range between 8 and 16 (i.e., every 4th Basic plot shall have an associated Detailed plot).

Where the number of plots falling within a Sampling Unit is less than 32, proceed to Step 2.

Step 2: Overlay a 25 m × 25 m grid across selected Sampling Units.

Where the number of plots falling within a Sampling Unit is 32 or greater, then the following applies:

- The entire Sampling Unit shall be sampled;
- The required number of plots shall be 32;
- All plots on the 50 m × 50 m grid shall be established;
- Plots on the 25 m × 25 m grid shall be selected randomly[20] until the required minimum number of plots (i.e., 32) is achieved;
- The number of Basic plots to establish shall be 32; and,
- The number of Detailed plots to establish shall be 8 (i.e., every 4th Basic plot shall have an associated Detailed plot).

Where the number of plots within a Sampling Unit is less than 32, then the following applies:

- The entire Sampling Unit shall be sampled;
- The line and plot spacing shall be 25 m × 25 m;
- All Basic plots shall be established; and,
- Every 4th Basic plot shall have an associated Detailed plot.

Where plot locations are pre-determined using GIS, neither the opening nor Sampling Unit boundary shall be buffered. The purpose of locating and measuring plots is to characterize the entire Sampling Unit. Selected X and Y coordinates shall be used as plot centres and loaded into a GPS receiver as waypoints. If the plot center falls within the Sampling Unit boundary in the GIS environment it is considered a valid planned plot location.

8.4.7 Field procedures

The Aerial Stratification System uses systematic field survey methods to collect specific data for trees present in 10 m^2 (1.78 m radius) and 100 m^2 (5.64 m radius) whole plots. The procedures for implementing Aerial Stratification System Performance field surveys are:

- Layout plots in the field; and,
- Determine tree species, density, top height, and age.

The use of contingency Sampling Units may be necessary where a disturbance, such as fire, has affected the opening area and precludes it from being included in the Performance survey population. Contingency Sampling Units shall be an output from the field sample selection

[20] Systematic with a random starting plot or starting location is acceptable. The goal with allocating plots within the Sampling Unit is to demonstrate coverage across the Sampling Unit in order to obtain an unbiased characterization of the Sampling Unit.

computer program. Contingency Sampling Units must be selected in the order listed by the Sample Selection Tool.

8.4.7.1 Field and plot layout

For each Sampling Unit to be surveyed, the method for locating plots in the field shall be either:

- GPS receiver to navigate to pre-determined plot locations created using GIS; or,
- GPS receiver to collect waypoints at plot locations determined using the manual method.

Two types of plots shall be established when conducting Performance field surveys:

Basic plot

- The Basic plot measurement protocol shall be completed at **every** plot location;
- The area of the plot shall be 10 m^2;
- The shape of the plot shall be circular and have a radius of 1.78 m;
- Plot centres shall be clearly located in the ground in such a way that they can be re-located for auditing purposes. Plots shall be marked,

  (1) In the ground at the exact location where plot centre is used to measure the plot radius. In all cases, plot centre shall be marked with all-weather flagging (e.g. winter weight, blue in colour preferably) attached to a wooden stick, nail, or pig-tail or in a shovel slit in the ground at plot centre. The plot number shall be written legibly on the flagging using a black, waterproof marker pen; and,

  (2) Where nails or shovel slit is used to mark plot centre, plots shall also be marked at eye-level using all-weather flagging marked with the plot number attached to a sturdy tree branch closest to plot centre to allow for easy identification of the location of the plot centre.

Detailed plot

- The Detailed plot measurement protocol shall be completed at the first Basic plot location and every 4th Basic plot location thereafter (regardless of plot numbering);
- The area of the plot shall be 100 m^2;
- The shape of the plot shall be circular and have a radius of 5.64 m; and,
- The centre of the plot shall share a common centre with the Basic plot (i.e., the Basic plot shall be nested within the Detailed plot).

Plots landing in uncut patches <0.5 ha in size must be established and measured. The rationale for this requirement is that plots are established and measured to characterize the NAA. Interpreters cannot net out uncut patches <0.5 ha. Thus, uncut patches <0.5 ha are part of the NAA and must be included as a valid plot location when characterizing the NAA.

The use of contingency plots may be necessary for each Sampling Unit where:

- Pre-determined plot locations are clearly within land use disposition and/or natural deletion boundaries that were netted out as part of the stratification process;
- New land use dispositions are encountered (i.e., post aerial photography acquisition);
- Pre-determined plot locations are clearly outside of the opening boundary; and,
- Pre-determine plot locations do not permit the establishment of whole plots (either Basic or Detailed plots).

New land use dispositions discovered during field layout (i.e., land use disposition established post aerial photography interpretation) must be mapped spatially (i.e., reflected on the map and final shape file) and the area (ha) determined.

If using GIS, contingency plots shall have pre-determined plot locations. If GIS is not used, GPS coordinates for contingency plot locations are required.

To ensure Performance survey results receive an unbiased plot-on-plot inspection by auditors,

- A final Microsoft Access database file, including all maps, shall be submitted to the Forest Management Branch by October 1; or,
- Plot centres must be clearly located (above) for a minimum period of 19 months, beginning May 1.

8.4.7.2 Plot measurements

8.4.7.2.1 Basic plot

8.4.7.2.1.1 Tree species

An acceptable tree is an individual seedling, sucker, coppice (collectively SDL), or advanced (ADV) regeneration that:

- Is alive; and,
- Is an acceptable tree species (TSA or FMA or FMU specific, see Appendix 23); and,
- Has been on-site for a minimum of two growing seasons; and,
- Originated from seed, suckering, coppice[21], but not from layering; and,
- Is 30 cm or taller if a coniferous tree; and,
- Is 130 cm or taller if a deciduous tree.

A growing season is defined as the period between June 20 and August 1 annually.

[21] Each stem originating from coppice growth may be considered a separate acceptable tree.

In addition,

- Coniferous tree species shall have:
    - A well-defined stem, and
    - Two or fewer stems originating at the base of the tree; and,
- White and Engelmann spruce and fir trees shall have a live-crown ratio[22] of 0.33 or greater.

Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

Where no acceptable trees are present in the Basic plot, record "No" in the appropriate space under the Species field.

8.4.7.2.1.2 Western gall rust

Western gall rust (WGR) is a main stem and lateral branch disease of Lodgepole pine. To record yes ("Y") in the available space, the gall must encircle ≥50% of the main stem. Where the gall does not encircle ≥50% of the main stem or there is no main stem gall, the available space shall be left blank. Trees with a main stem gall that encircles ≥50% of the main stem must be tallied separately.

8.4.7.2.1.3 Tally by species

SDL and ADV shall be tallied separately by tree species.

Tally the number of acceptable coniferous SDL ≥30 cm and deciduous SDL ≥130 cm in each Basic plot by tree species. SDL are planted or naturally regenerated trees, including deciduous suckering, that originated post-harvest or post-disturbance date, whichever is more recent. SDL with WGR that encircles ≥50% of the main stem must be tallied separately.

Tally the number of acceptable coniferous ADV ≥30 cm and deciduous ADV ≥130 cm in each Basic plot by tree species. ADV are trees that originated prior to the date of harvest and will likely be alive at time of next harvest. For openings with disturbance dates in ARIS, seedlings established naturally or artificially between the original skid clearance date and disturbance date shall also be considered and recorded as ADV. ADV with Western Gall Rust that encircles ≥50% of the main stem must be tallied separately.

To determine if a tree stem (SDL and/or ADV) is inside the plot, measure from the point where the plot centre marker enters the ground to the point of germination. If the point of germination is within 1.78 m (Basic plots; horizontal distance) or 5.64 m (Detailed plots; horizontal distance) of the plot centre, then the tree stem shall be considered in the plot.

The germination point is the point at which the coniferous or deciduous tree takes root and becomes established. For trembling aspen and balsam poplar stem sprouts, the point of

[22] Live crown ratio is the proportion of total stem length that is covered by living branches. It is expressed as a percentage or decimal of the total tree height. Live crown ratio is a useful indicator of the status of the tree in relation to vigor, photosynthetic leaf area, and is inversely related to stocking density. It is assumed that live crown ratio must be greater than 0.3 (30%) in order for the tree to release well.

germination is the point at which the sprout has originated on the original stump. If estimation is required, then assume the geometric centre of the main stem. Count a tree as within the plot when its point of germination is inside the plot even if the tree is leaning outside. Conversely, do not count a tree leaning into the plot but with its point of germination outside the plot.

8.4.7.2.1.4 Shrub cover

Repealed May 1, 2017. Field evaluation of shrub cover is no longer required; however, a place holder is still required in the RSA Compiler. Enter 0 (zero) for shrub cover (see Table 11-12. Ground 2: Plot header data dictionary).

8.4.7.2.2 Detailed plot

8.4.7.2.2.1 Tree species

An acceptable tree for measurement in Detailed plots is an individual seedling, sucker, or coppice that:

- Is a SDL (only); and,
- Is alive; and,
- Is an acceptable tree species (TSA or FMA or FMU specific; white birch is not an acceptable top height tree species), see Appendix 3); and,
- Has been on-site for a minimum of two growing seasons; and,
- Originated from seed, suckering, coppice[23], but not from layering; and,
- Is 30 cm or taller if a coniferous tree; and,
- Is 130 cm or taller if a deciduous tree.

A growing season is defined as the period between June 20 and August 1 annually.

In addition,

- Coniferous tree species shall have:
    - A well-defined stem, and
    - Two or fewer stems originating at the base of the tree; and,
- White and Engelmann spruce and fir trees shall have a live-crown ratio of 0.33 or greater.

Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

[23] Each stem originating from coppice growth may be considered a separate acceptable tree.

Where no acceptable trees are present in the Detailed plot, record “No” in the appropriate space under the ‘Species’ field.

8.4.7.2.2.2 Top height

A top height tree is the largest diameter at breast height (DBH; diameter outside bark at 130 cm) tree by species group present with in the 5.64 m radius Detailed plot.

DBH shall be measured to the nearest millimeter (mm) using calipers or diameter tape on the main stem that is the terminal leader.

For trees with irregularities at DBH (e.g., swellings, bumps, depressions, branches, missing wood or bark), measure DBH immediately above the irregularity at the place where it ceases to affect normal stem form.

For trees on a slope, measure DBH from the ground along the bole on the uphill side of the tree.

For leaning trees, measure DBH from the ground along the main stem. The 130 cm distance is measured along the underside face of the main stem.

The species groups are:

Aw = Aw + Pb;

Pl = Pl + Pj + Lt;

Sw = Sw + Se + Fb + Fa; and,

Sb = Sb.

Top height trees shall be selected based on the rules outlined in Table 8-11.

Table 8-11. Top height tree species selection rules.

All Strata	
Primary tree species to select	**Secondary tree species to select (if primary tree species is absent from the 5.64m radius plot)**
Aspen	Balsam poplar
Pine	Larch species
White spruce	Engelmann spruce, then fir species
Black spruce	None

If the largest DBH tree has a dead, lost or broken top that has not yet been replaced by a new leader, then the next largest DBH tree of that tree species group shall be selected based on the selection priorities in Table 8-11.

All ADV trees and SDL trees classified as having WGR (≥50% of the main stem encircled by WGR) are not eligible as top height trees.

If there are no coniferous trees taller than breast height (130 cm) within the Pine, White spruce, and Black spruce species groups, then select and measure the height of the tallest tree below breast height to a minimum height of 30 cm.

The minimum height for deciduous trees is 130 cm. Thus, if there are no deciduous trees taller than breast height (130 cm) within the Aspen species group, then no deciduous top height trees shall be selected.

Top height trees shall be measured for total height to the nearest centimeter (cm) using a calibrated measuring device incremented in centimeters and capable of measuring the entire length of the tree. Audits of height measurements completed by the department shall use measuring tapes or height poles (whichever provides the more accurate measurement for trees heights ≤300 cm and a height pole tree heights > 300 cm). Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

All measured top height trees must be clearly marked with flagging to facilitate field checking.

8.4.7.2.2.3 Total age

Total age is the number of years since germination.

To field-age a tree:

- Count the number of branch whorls on coniferous trees or bud scars on deciduous trees from the current season's growth (i.e., terminal leader) down to the root collar node;
- Add one year (germination to cotyledon); and,
- Record age.

For surveys conducted during the active height growth period (May, June, and July), the age of the tree shall not incorporate the current year's growth. Height measurements during this period must correspond with the appropriate aging point on the stem, which is at the terminal bud set the previous year.

For surveys conducted after 1 August, include the current year's growth in determining tree age.

For any seedlings planted prior to 20 June, the growing season in the year the seedling was planted may be counted as one year.

All surveyors shall be trained to recognize and distinguish Lammas growth, false whorls, and hidden whorls in coniferous trees.

As a check, total age of top height trees, as determined in the field, may be compared to the opening age or silviculture treatment activities.

Total age of top height trees shall not exceed the number of growing seasons since harvest (plus age at out-planting for planted stock).

Whenever possible, surveyors should be provided with the following information in order to reliably determine the total age of top height trees:

- Timber Year of Cut or skid clearance date;
- Site preparation date and type;
- Planting date;
- Planted species;
- Stock type (as relevant to tree age assessment; e.g., 1+0);
- Tending date and type (if applicable); and.
- Understory protection (yes or no).

8.4.7.2.2.4 Obtaining stand level estimates of basal area (optional)

The purpose of obtaining stand level estimates of basal area is to 'localize' the Growth and Yield Projection System (GYPSY) so that changes in Sample Unit basal area are considered in projections. A history of treatments which has resulted in an increase in performance age stand basal area may increase productivity. Therefore, timber disposition holders may elect to obtain stand level estimates of basal area[24].

When collecting information to inform stand level estimates of basal area, the minimum requirements are:

- Diameter at breast height (DBH) measurements; and,
- Tallies of coniferous trees ≥130 cm in height.

Trees with Western gall rust (WGR) encircling ≥50% of the main stem are not eligible for DBH measurements or tallies of coniferous trees ≥130 cm in height.

DBH measurements shall be as follows:

- Diameter of coniferous and deciduous trees shall be measured within the 1.78 m radius Basic plot at each Detailed plot location only; and,
- Diameter measurements shall be taken at breast height (130 cm) (if there is an abnormality in tree form at 130 cm, then measure diameter at the point on the tree stem above 130 cm where the tree form is normal); and,
- For individual coniferous and deciduous SDL tree diameter measurements, select the first three (maximum) trees ≥130 cm in height by tree species group (Aw = Aw + Pb; Pl =Pl + Pj + Lt; Sw = Sw + Se + Fb + Fa + Fd; Sb = Sb); and,

[24] Diameter and height sampling of ADV is optional. Sampling ADV is recommended for all strata in which understory protection strategies are assumed in the Forest Management Plan. If sampling of ADV is required, an additional three (3) trees shall be selected by species group in the Detailed plots.

- Always commence sampling at North (360°) and work in a clockwise manner around the plot until the maximum number (3) of sample trees is achieved for each tree species group; and,

- Record DBH of selected trees to the nearest millimeter (mm).

Although not required, total height of coniferous and deciduous trees may also be taken. Where total height measurements are taken:

- Total height measurements shall be paired with the DBH measurements (i.e., height and diameter measurements taken on the same tree); and,

- Total height shall be recorded to the nearest centimeter (cm).

Tallying of coniferous trees ≥130 cm in height shall be as follows:

- Within the Basic plots at each Detailed plot location; and,

- In addition to coniferous tree tallies ≥30 cm in height, coniferous SDL trees ≥130 cm in height shall be tallied separately by coniferous tree species.

Tallying coniferous trees ≥130 cm allows for appropriate scaling of the DBH measurements to stand basal area.

8.4.7.3 Performance Survey Sheets

Performance field survey information reported to Alberta (other than ARIS submissions) shall be:

- Digital; and,

- In a format as described in the data dictionaries in Appendix 14 and 17 and include a field map.

Thus, timber disposition holders may develop and use their own datasheets for recording survey data in the field. However, Performance survey Information and Tally Sheets are provided (Appendix 16) to assist timber disposition holders with field data collection. The Performance Survey Information and Tally Sheets are designed for use for both the Aerial Stratification and Non-photo Systems. These sheets approximate the format required in the Performance survey Opening Master List (Appendix 14, Table 11-10) and field data dictionaries (Appendix 17).

Timber disposition holders may choose to add columns to the Performance Survey Tally Sheet to record additional information that they feel relevant to collect while conducting the survey. In addition, timber disposition holders may choose to add specific data sets to a 'tailored' version of the Tally Sheet. Any data recorded in added columns do not form any part of the requirements of the Performance survey and are not considered mandatory by Alberta.

Timber disposition holders shall submit a field map. Timber disposition holders may use the Performance Survey Field Map Sheet (Appendix 16) or produce a digital field map.

The required elements of all field maps are:

- Opening number;

- Name of timber disposition holder;
- Disposition;
- Opening boundaries;
- Sampling Unit boundaries
- Location of new (since photography) land use dispositions;
- Location of points of commencement and tie points (if applicable);
- Locations of established and measured plots and associated plot identification numbers (Note: the location of Contingency plots may be included on maps but must be identified differently from the established and measured plots);
- North arrow; and,
- Scale.

8.5 Non-photo system

The Non-photo System is an acceptable methodology for timber disposition holders who:

- Have a total annual area due for a mandated Performance Survey of 250 ha or less within a forest management unit (TSA generally coincident with a FMA or FMU); or,
- Have adopted the Aerial Stratification System, but circumstances beyond the control of the timber disposition holder have prevented the acquisition of aerial photography and the opening(s) are due for Performance survey(s). The timber disposition holder shall provide a written request to Alberta to use the Non-photo system, no later than 30 November. The request shall include the following:
    - Opening numbers for all openings;
    - Disposition (e.g. FMA, CTL, CTP, DTA) of each opening;
    - Net harvested hectares of each opening;
    - Skid clearance date.
- Have openings past due for Performance surveys.

The guiding principles of the Non-photo system are:

- The system should provide the key features of the standard Performance survey Aerial Stratification System;
- The system should be capable of generating forecast MAI based on model forecasts;
- The system should support Quadrant Allowable Cut and strata reconciliation reporting;

- The system should be able to use Performance survey results to inform future managed stand yield assumptions; and,
- The system should be able to identify poorly regenerated areas in a manner defined in the Aerial Stratification System (i.e., areas 2 ha or larger that have 200 stems per hectare or less).

The Non-photo System has three (3) components:

(1) Stratification of each opening;

(2) Field survey of each opening; and,

(3) Data compilation.

8.5.1 Defining the population of openings to be surveyed

For the Non-photo System, the population is defined as openings eligible for Performance survey, as defined in Section 8.3.

In order to compile Non-photo System survey data, the population shall be defined using the Master Opening List (Appendix 14, Table 11-10).

8.5.2 Stratifying each opening

Stratification of openings is an important step for Performance surveys. The objectives of stratification are:

- To delineate strata (Sampling Units) within openings to increase sampling precision and accuracy of MAI forecasts;
- To collect sufficient plot level data to make projections at the sub-opening level (i.e., the stratified unit within an opening); and,
- Identify poorly regenerated areas (i.e., $\geq$ 2 ha in size and < 200 stems per ha).

The general stratification procedure for each opening shall be:

- Determine the Net Assessment Area (NAA) by netting out land use dispositions and natural deletions (Section 8.5.2.2);
- Stratify the NAA into strata (Sampling Units) (Section 8.5.2.3); and,
- Delineate poorly regenerated areas within the NAA (Section 8.5.2.4).

8.5.2.1 Unique polygon identifier

Timber disposition holders shall record the opening number, polygon number, unique identifier, and area in hectares for each Sampling Unit (polygon).

Each netted out land use disposition and/or natural deletion, delineated Sampling Unit, and poorly regenerated area shall be assigned a unique polygon number.

For example, if an opening has one netted out natural deletion, two homogeneous units, and one poorly regenerated area, then there shall be four (4) unique polygon numbers.

When recording unique polygon identifier information, the applicable fields are: “OPENING”, “POLYGON”, “UNIQUE_ID”, and “AREA_HA”.

8.5.2.2 Delineating the Net Assessment Area (Field “N_NAA”)

In most cases, land use dispositions and natural deletions have been netted out of the opening area prior to field surveying. Where land use dispositions and natural deletions have not been netted out of the opening, the timber disposition holder shall remove these features from the opening area.

There are no minimum area or width requirements for land use dispositions. Natural deletions must be 0.5 ha or larger; however, there is no minimum width requirement.

Land use dispositions and natural deletions must be delineated spatially (i.e., GPS, digitizing, or hand-drawn map to scale).

Each net down polygon shall be assigned a unique number (Field “POLYGON”). A code shall be assigned to polygons delineated and removed from the NAA (Table 8-12) (Field “N_NAA”).

The area within the opening remaining after the net down process defines the NAA.

Table 8-12. Net Assessment Area, anthropogenic, and natural deletion codes for the Non-photo system.

Category	Code	Description
Net Assessment Area	0	Net Assessment Area
Anthropogenic	1	Any of: MLL – Miscellaneous Lease (campsite, sand and gravel, etc.) PLA – Pipeline Agreement LOC – Licence of Occupation Road Well site Archaeological and historic sites Permanent sample plots or other research areas (covered under a protective notation)
Natural	2	Riparian areas and uncut buffers (0.5 ha or larger) Uncut patches within the opening (0.5 ha or larger)

8.5.2.3 Stratifying the Net Assessment Area into strata (Sampling Units)

In order to make the best possible forecasts with growth models, the NAA must be stratified into strata (Sampling Units).

Delineation of Sampling Units within the NAA shall be based on species composition and density classes.

Table 8-13 describes the six (6) species composition classes.

If the species proportions are 50% coniferous trees and 50% deciduous trees, then use the order of tree species to determine which has the higher density to differentiate coniferous tree leading mixedwood or deciduous tree leading mixedwood.

Species proportions used to define species composition classes are based on species density (i.e., stems per ha).

Table 8-14 describes the three density classes. Density classes are defined as the total number of stems per ha of regenerating trees (SDL - seedlings and ADV - advanced regeneration).

Table 8-13. Species composition class definitions, Non-photo System.

Tree species composition class	Coniferous percent (density based)	Leading coniferous tree species (density based)
Hw	0-20	NA
MxPl	30-70	Pine
MxSx	30-70	Spruce
Sw	80-100	White spruce
Pl	80-100	Pine
Sb	80-100	Black spruce

Pine = Pl, Pj, Pw, Pf, Lt, La, Lw; Spruce = Sw, Sb, Se, Fb, Fa; White spruce = Sw, Se, Fb, Fa; Black spruce = Sb; Hardwood = Aw, Pb, Bw; Douglas-fir = Fd

Table 8-14. Density class definitions for the Non-photo system.

Density class	Code	Density range (stems per ha)
Low	L	<1,000
Medium	M	1,000 – 5,000
High	H	>5,000

8.5.2.3.1 Stratification standard

Timber disposition holders shall stratify the NAA into Sampling Units based on species composition and density classes to the following standards:

- Sampling Units shall not be delineated when smaller than two (2.0) hectares.

- Sampling Unit widths at any point shall not be less than 50 meters.
- Only acceptable coniferous and deciduous trees shall be considered.
- Stratification shall be hierarchical.

Step 1: Stratify the NAA based on species composition:

- Where tree species composition class (Table 8-13) differs; and
- Where the homogeneous unit size (minimum 2 ha) and width (minimum 50 m) criteria are met.

Step 2: Stratify the NAA based on density:

- Where total density class (Table 8-14) differs; and,
- Where the Sampling Unit size (minimum 2 ha) and width (minimum 50 m) criteria are met.

A preliminary stratification of NAA into Sampling Units may be based on:

- Silviculture records such as site preparation type and extent, planting (species, density, extent or leave for natural), Establishment survey results, and stand tending activities;
- A walk through or fly over.

Surveyors may also make adjustments to the preliminary stratification while traversing the opening and establishing plots. However, plot level data shall not be used to delineate homogeneous units (i.e., post-stratification of the opening using the plot data is not permitted).

Sampling Units must be delineated spatially (i.e., GPS, digitizing, or hand-drawn map to scale). Each Sampling Unit shall be assigned a unique number (Field "POLYGON").

8.5.2.3.2 Recording strata (Sampling Units) attribute information

For each Sampling Unit, timber disposition holders shall record information for species composition and density classes according to the data dictionary format described in Table 8-15. The field for species composition class is "N_SP_CL" and density class "N_DEN_CL".

8.5.2.4 Stratifying the Net Assessment Area for Poorly Regenerated Areas

A Poorly Regenerated Area is defined as an area within an opening that is greater than two (2) hectares in size with a total density of less than 200 stems per ha. All acceptable coniferous and deciduous trees present in the Poorly Regenerated Area shall be considered when delineating and attributing the polygon.

Delineating Poorly Regenerated Areas shall be an independent exercise relative to the delineation of Sampling Units.

8.5.2.4.1 Stratification standard

Timber disposition holders shall delineate Poorly Regenerate Areas within the NAA to the following standards:

- Poorly Regenerated Areas shall not be delineated when smaller than two (2.0) hectares.
- Widths of Poorly Regenerated Areas at any point shall not be less than 50 meters.

Timber disposition holders shall use the NAA within each opening to delineate and characterize Poorly Regenerated Areas.

Poorly Regenerated Areas shall be assigned:

- A species composition class; and,
- Total density.

8.5.2.4.2 Recording Poorly Regenerated Area attribute information

For each Poorly Regenerated Area, timber disposition holders shall record attribute information for species composition class and total density. A data dictionary is provided (Table 8-16).

The Field for species composition class is “N_PR_SP_CL”.

The Field for total density is “N_PR_DEN”.

8.5.2.5 Standardized attribute data dictionary

A standardized data format must be used to record polygon attributes. The field names, formats, descriptions and allowable codes are provided in Table 8-15 and Table 8-16. Attributes shall be recorded in a flat file format with one row per polygon.

8.5.2.6 Spatial data format standards

The format for the spatial data (stratification line-work) shall be in Environmental System Research Institute (ESRI®) Arc compatible format. The acceptable formats are:

- Shape file (*.shp, *.shx, *.dbf, *.prj);
- Geodatabase.

Spatial data shall be submitted in the North American Datum 1983 (NAD83) in the appropriate projection system: UTM Zone 11N or UTM Zone 12N) in metres. Where opening data spans a UTM zone boundary, the data shall be referenced to the zone in which the majority of the feature occurs unless the feature extends more than 0.5 km into the other zone. Where this occurs, the data should be divided into distinct datasets within its own projections zone.

Table 8-15. Data dictionary for Sampling Unit attribute data, Non-photo System.

Field Name	Format	Description	Note
OPENING	$12.0	Opening number consistent with ARIS	For example: "423075229A", etc. (no blanks allowed)
POLYGON	$3.0	Polygon number within an opening	For example: “001”, “002”, “003”, etc. (no blanks allowed)
UNIQUE_ID	$16.0	Unique identifier is made up of opening number and polygon	For example: "423075229A_001", "423075229A_002", etc. (no blanks allowed)
AREA_HA	7.2	Area (hectares) of polygon	Eligible codes: 0.1 to 9999.9
N_NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, or 2
N_SP_CL	$4.0	Species composition class	Eligible codes: blank, “Hw”, “MxPl”, “MxSx”, “Sw”, “Pl”, “Sb”
N_DEN_CL	$2.0	Density class	Eligible codes: blank, “L”, “M”, “H”

Table 8-16. Data dictionary for Poorly Regenerated Areas attribute data, Non-photo System.

Field Name	Format	Description	Note
OPENING	$12.0	Opening number consistent with ARIS	For example: "423075229A", etc. (no blanks allowed)
POLYGON	$3.0	Polygon number within an opening	For example: "PR1", "PR2", "PR3" etc. (no blanks allowed)
UNIQUE_ID	$17.0	Unique identifier is made up of opening number and polygon	For example: "423075229A_PR1", "423075229A_PR2", etc. (no blanks allowed)
AREA_HA	7.2	Area (hectares) of polygon	Eligible codes: 0.1 to 9999.9
N_NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, or 2
N_PR_SP_CL	$4.0	Species composition class)	Eligible codes: blank, “Hw”, “MxPl”, “MxSx”, “Sw”, “Pl”, “Sb”
N_PR_DEN	6.0	Total density (stems per ha)	Eligible codes: 0 to 199

8.5.3 Stratification quality assessment and control procedures

8.5.3.1 Timber Disposition Holders

See Section 11.

8.5.4 Field procedures

The Non-photo System uses systematic field survey methods to collect specific data for trees present in 10 m^2 (1.78 m radius) and 100 m^2 (5.64 m radius) plots. The procedures for implementing Non-photo System Performance field surveys are:

- Determine the sample intensity (i.e., number of plots) for the NAA;
- Calculate the survey grid line and plot spacing for the NAA;
- Layout transects and plots in the field;
- Determine tree species, density, top height, and age; and,
- Add plots where necessary to meet minimum stratum (Sampling Unit) requirements.

8.5.4.1 Sample intensity

Sample intensity requirements are described in Table 8-17. The line and plot spacing applies to the area (ha) of the Net Assessment Area (NAA).

Where the entire NAA is between 0.1 and 1.9 ha in size, the minimum number of plots to establish in the Sampling Unit is 13 Basic plots and four (4) Detailed plots.

Table 8-17. NAA sample intensity requirements, Non-photo System.

NAA (ha)	Number of sample plots required
0.1 – 1.9	Establish a minimum of 13 plots per NAA
2.0 – 4.0	Establish a minimum of 41 plots per NAA.
4.1 – 24.0	Establish a minimum of 64 plots per NAA.
> 24.0*	Establish 2.77 plots per ha per NAA.

*To determine the number of sample plots needed for NAA larger than 24 ha, multiply the gross NAA area by 2.77 and round the product up to the nearest whole number.

Sampling Unit sample intensity requirements are described in Table 8-18.

Table 8-18. Sample Unit sample intensity requirements, Non-photo System.

Sample Unit area (ha)	Number of sample plots required
0.1 – 1.9	Establish a minimum of 13 Basic plots and four (4) Detailed plots per Sampling Unit
≥ 2.0	Establish a minimum of 21 Basic plots and six (6) Detailed plots per Sampling Unit.

Box 9. Opening stratification and determining the number of plots, Non-photo System.

NAA area: 47.0 ha

Before beginning the field survey, the timber disposition holder stratifies the NAA and determines that there are three strata based on stand tending records and a walk-through:

Sw - 30.0 ha
Hw - 14.0 ha
MxSx 3.0 ha.

The NAA is 47.0 ha, therefore the required number of plots per hectare (from Table 8-17) is 2.77

The minimum number of plots to establish for the NAA: 47.0 ha × 2.77 = 130.2 (rounded up = 131 plots)

The line and plot spacing for the NAA is 60 m × 60 m.

Sw stratum: the 60 m × 60 m line and plot spacing establishes 84 plots. The minimum number of plots to establish in this 30.0 ha Sw stratum is 21. Thus, the minimum number of plots requirement is satisfied (i.e., 84 is greater than 21). All 84 plots are established in the Sw stratum.

Hw stratum: the 60 m × 60 m line and plot spacing establishes 39 plots. The minimum of plots to establish in this 14.0 ha Hw stratum is 21. Thus, the minimum number of plots requirement is satisfied (i.e., 39 is greater than 21). All 39 plots are established in the Hw stratum.

MxSx stratum: the 60 m × 60 m line and plot spacing establishes 9 plots. The minimum number of plots to establish in this 3.0 ha stratum is 21. The minimum number of plots requirement is not satisfied (i.e., 9 is not greater than 21). Thus, the Timber Disposition Holder must establish an additional 12 plots in the MxSx stratum. All 21 plots are established in the MxSx stratum.

8.5.4.2 Calculating the survey grid line and plot spacing

When calculating line and plot spacing, two methods may be used:

- Square spacing; or,
- Rectangular spacing.

Square spacing

The survey standard is a square grid pattern where the distance between lines equals the distance between plots. When the total number of plots is determined and the area of the NAA is known, the survey grid (plot and line spacing) can be calculated using the following formula:

$$\text{Plot spacing} = \sqrt{(NAA\,(\text{ha}) \times 10{,}000\,\text{m}^2/\text{ha})/\text{required \# of plots}}$$

Box 10. Calculating square spacing, Non-photo System.

For surveys on a 12.1 ha NAA, calculate a square survey grid.
A 12.1 ha NAA requires 64 plots be established initially (Table 8-17)
Calculate the plot spacing:

$$\text{Plot Spacing} = \sqrt{(12.1 x 10{,}000 / 64} = \sqrt{1890.625} = 43.48$$

Round off to the nearest 0.1 m: line spacing = 43.5 m & plot spacing = 43.5 m

Appendix 7 (Table 11-4) lists the calculated square spacing for openings or NAA of various sizes.

For NAA 24 ha or larger, a 60 m × 60 m square grid shall be used.

Rectangular spacing

Rectangular spacing occurs when the line spacing differs from plot spacing. The line spacing shall not be greater than twice the plot spacing.

To calculate rectangular spacing, the desired line spacing is selected then the plot spacing needed to achieve the correct number of plots is calculated.

Box 11. Calculating rectangular spacing, Non-photo System.

For surveys on a 3.9 ha NAA; calculate a rectangular survey grid, assuming a line spacing of 35 m.

A 3.9 ha NAA requires that a minimum of 41 plots be established.

$$\text{Plot spacing x line spacing} = \frac{\text{NAA Area (ha) x 10,000 } (m^2/ha)}{\text{Required \# plots}}$$

$$\text{Plot spacing x 35 m} = \frac{3.9 \text{ ha x 10,000 } m^2/ha}{41 \text{ plots}}$$

$$\text{Plot spacing} = 951.22 \; m^2 / 35 \; m$$

$$\text{Plot spacing} = 27.1777 \; m$$

Round off to the nearest 0.1 m: line spacing = 35.0 m & plot spacing = 27.2 m

8.5.4.3 Field layout

For each NAA to be surveyed, the method for locating plots in the field shall be either:

- Compass and horizontal distance measuring device with GPS x and y coordinates for each plot location; or,
- GPS to navigate to pre-determined plots locations generated using a GIS.

When locating plots in the field using methods ‘1’ (above), control line(s) shall be established as follows:

- Establish one control line parallel to the long axis of the NAA (Figure 8-4). Additional parallel control lines shall be established at 400 m intervals where NAA widths exceed 400 m.
- The control line is best placed to coincide with the grid to enable points along the control line to be used as plot centres. Reference the control line in relation to the opening boundary to enable accurate mapping of the sample plot locations.
- Starting from the NAA boundary, the first survey line shall be located at one-half the interline distance. Each additional survey line is marked at the exact interline distance.
- Survey line intervals on the control line shall be double flagged using two different colours. The line and plot number shall be clearly written on the flagging.
- Beginning at the control line, the remaining individual plots shall be located at the required line and plot spacing.

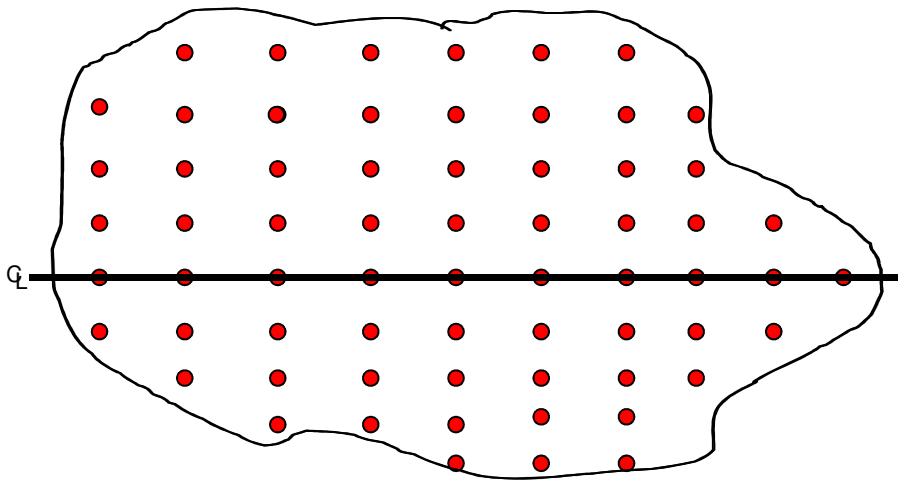


Figure 8-4. Sample plot distribution diagram.

When locating plots in the field using method ‘3’ (above), a control line is not required.

8.5.4.3.1 Adding plots

Where the minimum number of plot locations within each NAA (Table 8-17) or Sampling Unit (Table 8-18) can be established from the normal grid positions but the minimum number of

Detailed plots is not achieved (by counting every fourth plot beginning with the first), then Detailed plot locations shall be randomly assigned to other available locations on the normal grid.

Where the minimum number of plots within each NAA (Table 8-17) or Sampling Unit (Table 8-18) cannot be established from the normal grid positions, additional plots are required. Additional plots shall be located as follows:

- Halfway between every second survey line (i.e., halfway between and parallel to the second and third survey lines, fourth and fifth lines, etc.).
- Plot spacing shall be the same on additional lines as for the original lines.
- Where every second line does not add sufficient number of plots to meet the required number of plots, proceed to add lines between other survey lines until the required number of plots is reached. Lines shall be marked on the control line and numbered sequentially (no letters).
- Where plot spacing does not add the required number of plots, proceed to reduce the plot spacing by half.
- Every fourth plot added shall be a Detailed plot.
- Lines added using the compass and distance measuring device method (this also applies to GPS when used as a compass and distance measuring device) shall be given the next number in the sequence. Use only whole positive numbers.
- Plots added using GPS as waypoints shall be given unique, whole positive numbers.

8.5.4.4 Plot layout

Two types of plots shall be established when conducting Performance field surveys:

Basic plot

- The Basic plot measurement protocol shall be completed at every plot location;
- The area of the plot shall be 10 m^2;
- The shape of the plot shall be circular and have a radius of 1.78 m;
- Plot centres shall be clearly located in the ground in such a way that they can be re-located for auditing purposes. Plots shall be marked,

  (1) In the ground at the exact location where plot centre is used to measure the plot radius. In all cases, plot centre shall be marked with all-weather flagging (e.g. winter weight, blue in colour preferably) attached to a wooden stick, nail, or pig-tail or in a shovel slit in the ground at plot centre. The plot number shall be written legibly on the flagging using a black, waterproof marker pen; and,

  (2) Where nails or shovel slit is used to mark plot centre, plots shall also be marked at eye-level using all-weather flagging marked with the plot number

attached to a sturdy tree branch closest to plot centre to allow for easy identification of the location of the plot centre.

Detailed plot

- The Detailed plot measurement protocol shall be completed at the first Basic plot location and every 4th Basic plot location thereafter (regardless of plot numbering);
- The area of the plot shall be 100 m^2;
- The shape of the plot shall be circular and have a radius of 5.64 m; and,
- The centre of the plot shall share a common centre with the Basic plot (i.e., the Basic plot shall be nested within the Detailed plot).

New land use dispositions discovered during field layout must be mapped spatially and the area (ha) determined.

Plots landing in uncut patches <0.5 ha in size must be established and measured. The rationale for this requirement is that plots are established and measured to characterize the NAA. Interpreters cannot net out uncut patches <0.5 ha. Thus, uncut patches <0.5 ha are part of the NAA and must be included as a valid plot location when characterizing the NAA.

Plots landing within land use disposition and/or natural deletion boundaries, outside the NAA boundary, or where plot locations do not permit the establishment of whole plots (either Basic or Detailed plots) shall not be established or measured.

To ensure Performance survey results receive an unbiased plot-on-plot inspection by the department,

- A final Microsoft Access database file, including all maps, shall be submitted to the Forest Management Branch by October 1; or,
- Plot centres must be clearly located (1d above) for a minimum period of 19 months, beginning May 1.

8.5.4.5 Plot measurements

8.5.4.5.1 Basic plot

8.5.4.5.1.1 Tree species

An acceptable tree is an individual seedling, sucker, coppice (collectively SDL), or advanced (ADV) regeneration that:

- Is alive; and,
- Is an acceptable tree species (TSA or FMA or FMU specific), see Appendix 3); and,
- Has been on-site for a minimum of two growing seasons; and,

- Originated from seed, suckering, coppice[25], but not from layering; and,
- Is 30 cm or taller if a coniferous tree; and,
- Is 130 cm or taller if a deciduous tree.

A growing season is defined as the period between June 20 and August 1 annually.

In addition,

- Coniferous tree species shall have:
    - A well-defined stem, and
    - Two or fewer stems originating at the base of the tree; and,
- White and Engelmann spruce and fir trees shall have a live-crown ratio[26] of 0.33 or greater.

Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

Where no acceptable trees are present in the Basic plot, record "No" in the appropriate space under the Species field.

8.5.4.5.1.2 Western gall rust

Western gall rust (WGR) is a main stem and lateral branch disease of Lodgepole pine. To record yes ("Y") in the available space, the gall must encircle ≥50% of the main stem. Where the gall does not encircle ≥50% of the main stem or there is no main stem gall, the available space shall be left blank. Trees with a main stem gall that encircles ≥50% of the main stem must be tallied separately.

8.5.4.5.1.3 Tally by species

SDL and ADV shall be tallied separately by tree species.

Tally the number of acceptable coniferous SDL ≥30 cm and deciduous SDL ≥130 cm in each Basic plot by tree species. SDL are planted or naturally regenerated trees, including deciduous suckering, that originated post-harvest or post-disturbance date, whichever is more recent. SDL with WGR that encircles ≥50% of the main stem must be tallied separately.

Tally the number of acceptable coniferous ADV ≥30 cm and deciduous ADV ≥130 cm in each Basic plot by tree species. ADV are trees that originated prior to the date of harvest and will likely be alive at time of next harvest. For openings with disturbance dates in ARIS, seedlings established naturally or artificially between the original skid clearance date and the disturbance

[25] Each stem originating from coppice growth may be considered a separate acceptable tree.

[26] Live crown ratio is the proportion of total stem length that is covered by living branches. It is expressed as a percentage or decimal of the total tree height. Live crown ratio is a useful indicator of the status of the tree in relation to vigor, photosynthetic leaf area, and is inversely related to stocking density. It is assumed that live crown ratio must be greater than 0.3 (30%) in order for the tree to release well.

date shall also be considered and recorded as ADV. ADV with WGR that encircles ≥50% of the main stem must be tallied separately.

To determine if a tree stem (SDL and/or ADV) is inside the plot, measure from the point where the plot centre marker enters the ground to the point of germination. If the point of germination is within 1.78 m (Basic plots; horizontal distance) or 5.64 m (Detailed plots; horizontal distance) of the plot centre, then the tree stem shall be considered in the plot.

The germination point is the point at which the coniferous or deciduous tree takes root and becomes established. For trembling aspen and balsam poplar stem sprouts, the point of germination is the point at which the sprout has originated on the original stump. If estimation is required, then assume the geometric centre of the main stem. Count a tree as within the plot when its point of germination is inside the plot even if the tree is leaning outside. Conversely, do not count a tree leaning into the plot but with its point of germination outside the plot.

8.5.4.5.1.4 Shrub cover

Repealed May 1, 2017. Field evaluation of shrub cover is no longer required; however, a place holder is still required in the RSA Compiler. Enter 0 (zero) for shrub cover (see Table 11-12. Ground 2: Plot header data dictionary).

8.5.4.5.2 Detailed plot

8.5.4.5.2.1 Tree species

An acceptable tree for measurement in Detailed plots is an individual seedling, sucker, or coppice that:

- Is a SDL (only); and,
- Is alive; and,
- Is an acceptable tree species (TSA or FMA or FMU specific; white birch white birch is not an acceptable top height tree species), see Appendix 3); and,
- Has been on-site for a minimum of two growing seasons; and,
- Originated from seed, suckering, coppice[27], but not from layering; and,
- Is 30 cm or taller if a coniferous tree; and,
- Is 130 cm or taller if a deciduous tree.

A growing season is defined as the period between June 20 and August 1 annually.

In addition,

- Coniferous tree species shall have:

[27] Each stem originating from coppice growth may be considered a separate acceptable tree.

- A well-defined stem, and,
- Two or fewer stems originating at the base of the tree; and,

- White and Engelmann spruce and fir trees shall have a live-crown ratio of 0.33 or greater.

Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

Where no acceptable trees are present in the Detailed plot, record "No" in the appropriate space under the Species field.

8.5.4.5.2.2 Top height

A top height tree is the largest diameter at breast height (DBH; diameter outside bark at 130 cm) tree by species group present with in the 5.64 m radius Detailed plot.

DBH shall be measured to the nearest millimeter (mm) using calipers or diameter tape on the main stem that is the terminal leader.

For trees with irregularities at DBH (e.g., swellings, bumps, depressions, branches, missing wood or bark), measure DBH immediately above the irregularity at the place where it ceases to affect normal stem form.

For trees on a slope, measure DBH from the ground along the bole on the uphill side of the tree.

For leaning trees, measure DBH from the ground along the main stem. The 130 cm distance is measured along the underside face of the main stem.

The species groups are:

Aw = Aw + Pb;

Pl = Pl + Pj + Lt;

Sw = Sw + Se + Fb + Fa; and,

Sb = Sb.

Top height trees shall be selected based on the rules outlined in Table 8-19.

Table 8-19. Top height tree species selection rules.

All Strata	
Primary tree species to select	**Secondary tree species to select (if primary tree species is absent from the 5.64m radius plot)**
Aspen	Balsam poplar
Pine	Larch species
White spruce	Engelmann spruce, then fir species
Black spruce	None

If the largest DBH tree has a dead, lost or broken top that has not yet been replaced by a new leader, then the next largest DBH tree of that tree species group shall be selected based on the selection priorities in Table 8-19.

All ADV trees and SDL trees classified as having WGR (≥50% of the main stem encircled by WGR) are not eligible as top height trees.

If there are no coniferous trees taller than breast height (130 cm) within the Pine, White spruce, and Black spruce species groups, then select and measure the height of the tallest tree below breast height to a minimum height of 30 cm.

The minimum height for deciduous trees is 130 cm. Thus, if there are no deciduous trees taller than breast height (130 cm) within the Aspen species group, then no deciduous top height trees shall be selected.

Top height trees shall be measured for total height to the nearest centimeter (cm) using a calibrated measuring device incremented in centimeters and capable of measuring the entire length of the tree. Audits of height measurements completed by the department shall use measuring tapes or height poles (whichever provides the more accurate measurement for trees heights ≤300 cm and a height pole tree heights > 300 cm). Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

All measured top height trees must be clearly marked with flagging to facilitate field checking.

8.5.4.5.2.3 Total age

Total age is the number of years since germination.

To field-age a tree:

- Count the number of branch whorls on coniferous trees or bud scars on deciduous trees from the current season's growth (i.e., terminal leader) down to the root collar node;
- Add one year (germination to cotyledon); and,
- Record age.

For surveys conducted during the active height growth period (May, June, and July), the age of the tree shall not incorporate the current year's growth. Height measurements during this period must correspond with the appropriate aging point on the stem, which is at the terminal bud set the previous year.

For surveys conducted after 1 August, include the current year's growth in determining tree age.

For any seedlings planted prior to June 20, the growing season in the year the seedling was planted may be counted as one year.

All surveyors shall be trained to recognize and distinguish Lammas growth, false whorls, and hidden whorls in coniferous trees.

As a check, total age of top height trees, as determined in the field, may be compared to the opening age or silviculture treatment activities.

Total age of top height trees shall not exceed the number of growing seasons since harvest (plus age at out-planting for planted stock).

Whenever possible, surveyors should be provided with the following information in order to reliably determine the total age of top height trees:

- Timber Year of Cut or skid clearance date;
- Site preparation date and type;
- Planting date;
- Planted species;
- Stock type (as relevant to tree age assessment; e.g., 1+0);
- Tending date and type (if applicable); and.
- Understory protection (yes or no).

8.5.4.5.2.4 Obtaining stand level estimates of basal area (optional)

The purpose of obtaining stand level estimates of basal area is to 'localize' the Growth and Yield Projection System (GYPSY) so that changes in Sample Unit basal area are considered in projections. A history of treatments which has resulted in an increase in performance age stand basal area may increase productivity. Therefore, timber disposition holders may elect to obtain stand level estimates of basal area[28].

When collecting information to inform stand level estimates of basal area, the minimum requirements are:

- Diameter at breast height (DBH) measurements; and,

[28] Diameter and height sampling of ADV is optional. Sampling ADV is recommended for all strata in which understory protection strategies are assumed in the Forest Management Plan. If sampling of ADV is required, an additional three (3) trees shall be selected by species group in the Detailed plots.

- Tallies of coniferous trees ≥130 cm in height.

Trees with Western gall rust (WGR) encircling ≥50% of the main stem are not eligible for DBH measurements or tallies of coniferous trees ≥130 cm in height.

DBH measurements shall be as follows:

- Diameter of coniferous and deciduous trees shall be measured within the 1.78 m radius Basic plot at each Detailed plot location only; and,
- Diameter measurements shall be taken at breast height (130 cm) (if there is an abnormality in tree form at 130 cm, then measure diameter at the point on the tree stem above 130 cm where the tree form is normal); and,
- For individual coniferous and deciduous SDL tree diameter measurements, select the first three (maximum) trees ≥130 cm in height by tree species group (Aw = Aw + Pb; Pl =Pl + Pj + Lt; Sw = Sw + Se + Fb + Fa + Fd; Sb = Sb); and,
- Always commence sampling at North (360°) and work in a clockwise manner around the plot until the maximum number (3) of sample trees is achieved for each tree species group; and,
- Record DBH of selected trees to the nearest millimeter (mm).

Although not required, total height of coniferous and deciduous trees may also be taken. Where total height measurements are taken:

- Total height measurements shall be paired with the DBH measurements (i.e., height and diameter measurements taken on the same tree); and,
- Total height shall be recorded to the nearest centimeter (cm).

Tallying of coniferous trees ≥130 cm in height shall be as follows:

- Within the Basic plots at each Detailed plot location; and,
- In addition to coniferous tree tallies ≥30 cm in height, coniferous SDL trees ≥130 cm in height shall be tallied separately by coniferous tree species.

Tallying coniferous trees ≥130 cm allows for appropriate scaling of the DBH measurements to stand basal area.

8.5.4.6 Performance Survey Sheets

Performance field survey information reported to Alberta (other than ARIS submissions) shall be:

- Digital; and,
- In a format as described in the data dictionaries in Appendix 14 and 17 and include a field map.

Thus, timber disposition holders may develop and use their own datasheets for recording survey data in the field. However, Performance survey Information and Tally Sheets are provided (Appendix 16) to assist timber disposition holders with field data collection. The Performance Survey Information and Tally Sheets are designed for use for both the Aerial Stratification and Non-photo Systems. These sheets approximate the format required in the Performance survey Opening Master List (Appendix 14, Table 11-10) and field data dictionaries (Appendix 17).

Timber disposition holders may choose to add columns to the Performance Survey Tally Sheet to record additional information that they feel relevant to collect while conducting the survey. In addition, timber disposition holders may choose to add specific data sets to a 'tailored' version of the Tally Sheet. Any data recorded in added columns do not form any part of the requirements of the Performance survey and are not considered mandatory by Alberta.

Timber disposition holders shall submit a field map. Timber disposition holders may use the Performance Survey Field Map Sheet (Appendix 16) or produce a digital field map.

The required elements of field maps are:

- Opening number;
- Name of timber disposition holder;
- Disposition;
- Opening boundaries;
- Sampling Unit boundaries
- Location of all land use dispositions;
- Location of points of commencement and tie points (if applicable)
- Locations of established and measured plots and associated plot identification numbers (Note: the location of Contingency plots may be included on maps but must be identified differently from established and measured plots);
- North arrow; and,
- Scale.

8.6 Compilation procedures

The purpose of this section is to describe the procedures for compiling field survey data to obtain opening level estimates of Mean Annual Increment (MAI). The next series of steps in the Performance survey process involves using the information from field surveys to determine opening-level MAI. There are two stages in the process: field data compilation and opening MAI and composition label compilation. These procedures apply to timber disposition holders using the Aerial Stratification and/or Non-Photo Systems.

Performance survey data compilation procedures and submission requirements for Deciduous Standard CSR and NSR openings are described in Section 9 of this Standard.

8.6.1 Field data compilation procedures

The primary objective of these procedures is the standardization of field survey data formats in order to meet the input requirements for automated compilation using the RSA Compiler (v20180331).

The following datasets are required:

- Opening1: Master opening list;
- Ground1: Unit header;
- Ground2: Plot header;
- Ground3: Basic plot data; and,
- Ground4: Detailed plot data.

Where timber disposition holders have collected optional diameter measurements to obtain stand level estimates of basal area, two additional datasets are required:

- Ground5: Optional diameter data; and
- Ground6: Optional 130 cm coniferous tree tally.

8.6.1.1 Opening1: Master opening list

Opening1: Master opening list is the opening level information which defines the openings in the population being assessed for performance. The required master opening list fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 14, Table 11-10.

8.6.1.2 Ground1: Unit header

Ground1: Unit header shall contain Sampling Unit level administrative information. The required Unit header fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 17, Table 11-11.

8.6.1.3 Ground2: Plot header

Ground2: Plot header shall contain plot level administrative information. The required Plot header fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 17, Table 11-12.

8.6.1.4 Ground3: Basic plot

Ground3: Basic plot data shall contain the field collected data from each Basic plot. The required Basic plot data fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 17, Table 11-13.

8.6.1.5 Ground4: Detailed plot

Ground4: Detailed plot data shall contain the field collected data from each Detailed plot. The required plot data fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 17, Table 11-14.

8.6.1.6 Ground5: Optional diameter measurements

Where applicable, Ground5: Optional diameter measurements shall contain the field collected diameter measurements taken in the Basic plot at each Detailed plot location. The required diameter measurement fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 17, Table 11-15.

8.6.1.7 Ground6: Optional ≥130 cm coniferous tree tally

Where applicable, Ground6: Optional ≥130 cm coniferous tree tally shall contain tallies of coniferous trees ≥130 cm in height taken at each in the Basic plot at each Detailed plot location. The required ≥130 cm coniferous tree tally fields for the Aerial Stratification and Non-photo Systems are described in the data dictionary in Appendix 17, Table 11-16.

8.6.2 Opening MAI and composition label compilation procedures

8.6.2.1 The RSA Compiler

The RSA Compiler is a data compilation tool designed to assist timber disposition holders with data management, compilation, and reporting of Aerial Stratification and Non-photo Performance survey Systems results to the Alberta Regeneration Information System (ARIS) and to the Forest Management Branch (FMB). The RSA Compiler does not compile data collected using the D Standard CSR/NSR Performance survey methodology.

The RSA Compiler (v20180331) is to be used for all Performance surveys completed using the Aerial Stratification and Non-photo Systems. The RSA Compiler User's Manual is the standard for installing and using the RSA Compiler.

The RSA Compiler completes a number of steps including:

- The compilation of input variables;
- The computation of Sampling Unit MAI forecasts;
- The compilation of MAI and composition labels to the opening-level.

8.6.2.1.1 Compilation of input variables

Models have been developed to estimate the future growth and yield of forest stands. Growth refers to the total increase in size of trees within a forest stand over a specified period of time. Yield is the final accumulation of growth within a forest stand at the end of the specified period of time.

Alberta requires that a number of criteria be met before a model can be used to make estimates of growth and yield. The *Alberta Forest Management Planning Standard, Annex 1 (version 4.1 – April 2006)* describes these criteria and the procedures for growth and yield model approval.

The Growth and Yield Projection System (GYPSY) model has been approved by Alberta for making estimates of growth and yield. There are two versions of the GYPSY model: non-spatial and spatial. The non-spatial version of GYPSY should be used for fire-origin stands while the spatial version of GYPSY should be used for post-harvest stands.

The GYPSY model is composed of a number of sub-models or functions (Huang et. al, 2009)[29] including.

- Top height models;
- Percent stocking models;
- Spatial density models;
- Spatial basal area increment models;
- Gross total volume models; and,
- Merchantable volume models.

The GYPSY model was developed for four main tree species groups native to Alberta grown in pure and mixed-species stands. The tree species groups are trembling aspen (Aw), lodgepole pine (Pl), white spruce (Sw), and black spruce (Sb). All GYPSY sub-models are tree species group specific. In cases where other tree species are present, they can be grouped with the four main (leading) tree species.

The data compilation format described in following sections is specific to GYPSY. Other growth and yield models may be used; however, prior approval by Alberta is required.

The RSA Compiler uses the spatial version of the GYPSY model. In order to run the spatial version of the GYPSY model for post-harvest stands, input variables must include:

- Opening Age (stand age);
- Density (den13 for deciduous den03 for conifer) by species group;
- Total age (tage) by species group;
- Site Index (SI_bh) by species group; and,
- Percent Stocking (ps) by species group.

Where optional tree diameter measurements for basal area compilation have been collected, basal area shall be included as an input variable:

[29] Huang, S., Meng, S.X., and Yang, Y. 2009. *A Growth and Yield Projection System (GYPSY©) for Natural and Post-harvest Stands in Alberta.* Alberta Sustainable Resource Development, Forestry Division, Forest Management Branch. Edmonton, Alberta. 22 p.

- Basal Area (ba) by species group.

The compiled GYPSY input variables description and data dictionary for the Aerial Stratification and Non-photo Systems are described in Appendix 18.

8.6.2.1.2 Computation of Sampling Unit MAI forecasts

Once the input variables have been compiled, a forecast of Sampling Unit attributes shall be made using GYPSY within the RSA Compiler.

Coniferous and deciduous MAI shall be computed for each Sampling Unit field sampled based on the point of culmination for the primary tree species (i.e., declared coniferous or deciduous culmination). Merchantable volume shall be computed using the 15/10/30/TL (stump height diameter outside bark/top diameter inside bark/stump height) coniferous and deciduous utilization standards. Merchantable MAI is calculated using decadal merchantable volume and the opening age.

Compiled GYPSY output variables and data dictionary for the Aerial Stratification and Non-photo Systems are described in Appendix 19, Table 11-19.

8.6.2.1.3 Compilation of MAI and composition label to the opening-level

A general overview of the Opening MAI and composition label compilation procedures for the Aerial Stratification and Non-photo Systems are shown in Figures 8-5 and 8-6, respectively. Each of these steps is automated within the RSA Compiler. A detailed description of the procedures for each step is provided in Appendix 20.

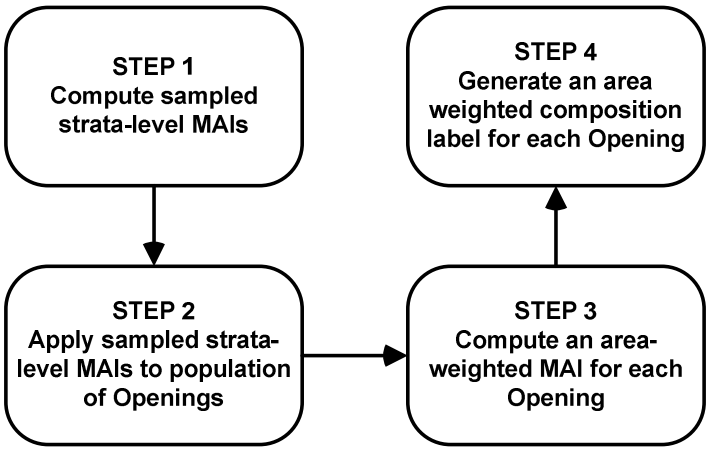


Figure 8-5. General overview of the Opening MAI and composition label compilation procedures, Aerial Stratification System.

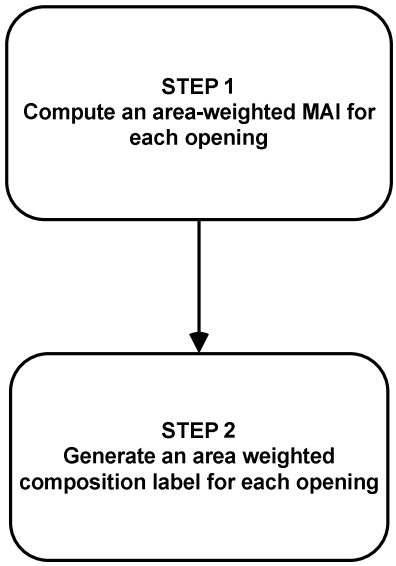


Figure 8-6. General overview of the opening MAI and composition label compilation procedures, Non-photo System.

8.7 Performance survey final reporting procedures

8.7.1 Purpose

These reporting procedures describe the mandatory elements (content), format, and manner of digital reporting of Performance surveys for:

- The Aerial Stratification System; and,
- The Non-photo System.

These procedures do not apply to openings assessed using the D Standard CSR and NSR Performance survey protocol. Performance survey compilation and reporting requirements for this survey protocol are described in Section 9.

8.7.2 Submission versus reporting

With respect to the Performance surveys, Alberta defines **submissions** as regeneration survey results submitted to the Alberta Regeneration Information System (ARIS).

Alberta defines **reporting** as any regeneration survey information reported to the Forest Management Branch.

Table 8-20 summarizes the ARIS submission requirements for Performance survey results.

Table 8-20. Performance survey results submission requirements to the Alberta Regeneration Information System (ARIS; see ARIS manual for reporting requirements).

ARS Performance survey type	ARIS submission (survey results for each opening)
Aerial Stratification System	1) Coniferous MAI; and, 2) Deciduous MAI; and, 3) Composition label; and, 4) Survey date; and, 5) Survey area; and, 6) Status
Non-photo System	1) Coniferous MAI; and, 2) Deciduous MAI; and, 3) Composition label; and, 4) Survey date; and, 5) Survey area; and, 6) Status.
Deciduous Standard - Conditional Satisfactorily Restocked (CSR) and Not Satisfactorily Restocked (NSR)	1) Coniferous stocking (%); and, 2) Deciduous stocking (%); and, 3) Total stocking (%); and, 4) Survey date; and, 5) Status; and, 6) Stratum.

For those timber disposition holders who have elected to work together (i.e., share a common population for field sampling), each timber disposition holder is responsible for submitting MAI and composition labels to ARIS for each opening for which they have reforestation obligation.

8.7.3 Applicability

These reporting procedures apply to timber disposition holders (including FRIAA) with reforestation obligation as defined in the *Timber Management Regulation* (Alberta Regulation 60/1973 with amendments up to and including Alberta Regulation 76/2013) who are working singly or cooperatively (i.e., share a common population[30] of openings).

8.7.4 Accountability

Timber disposition holders are accountable for reporting complete and accurate reforestation information for openings for which they have reforestation obligation (TMR 143.2(2)).

Thus, it is the responsibility of timber disposition holders to report all required elements as described in these Performance survey reporting procedure.

[30] Population is defined in Sections 8.4.5.2. (Aerial Stratification System) and 8.5.1 (Non-photo System).

For those timber disposition holders who have elected to work together as a collective within a FMA or FMU (TSA), it is the responsibility of the collective to ensure all required elements, as described in these procedures, are reported. Reporting of Performance survey information shall be as a collective with all mandatory elements requiring signature/validation by all participating timber disposition holders.

8.7.5 Digital folder and file nomenclature

This section describes the required naming convention for digital folders and files. When naming folders and files for reporting, nomenclature shall be (Figures 8-7, 8-8, and 8-9):

- An order number (e.g., from 1 up to 8 for the Aerial Stratification System and from 1 to 5 for the Non-photo System);
- The four letter ARIS stakeholder code (e.g., WBLL; include all ARIS stakeholder codes for joint programs);
- The FMA or FMU that defines the population of openings (e.g., W6);
- The reporting timber year the program was completed (e.g., 2016-17);
- The type of system used to complete the surveys (e.g., as = Aerial Stratification System or np = Non-photo System); and,
- Specific information to determine the content of the folders and files.

Examples of folder nomenclature are show in Figures 8-7, 8-8, and 8-9.

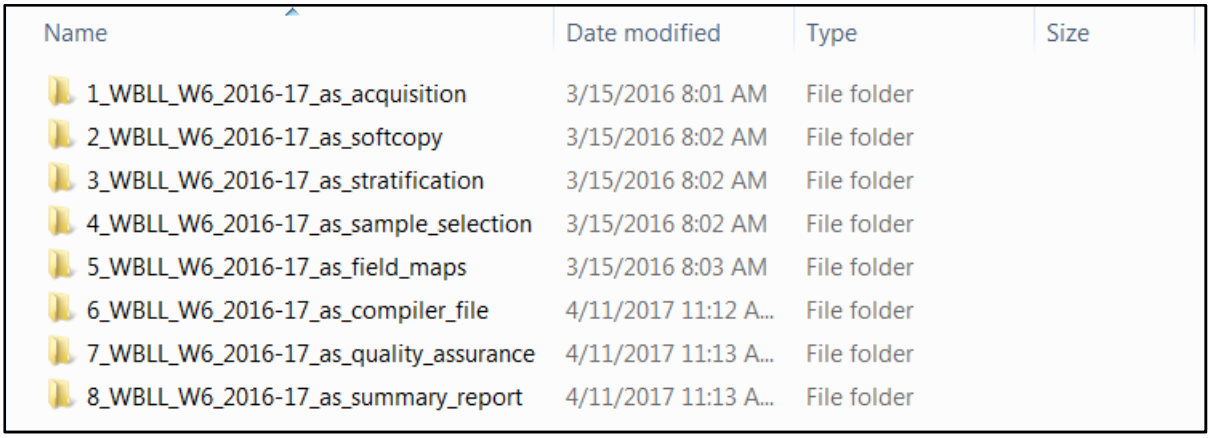


Figure 8-7. Example of folder nomenclature for an Aerial Stratification System program.

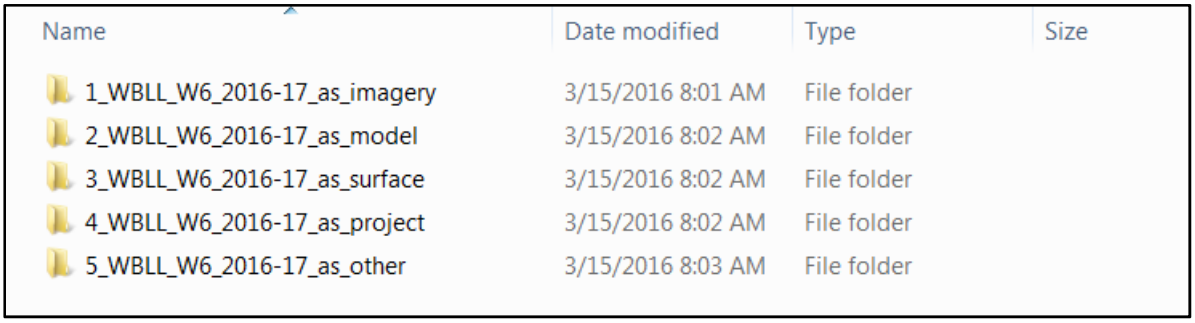


Figure 8-8. Example of folder nomenclature for the as_softcopy folder (Figure 8-7) for an Aerial Stratification System program.

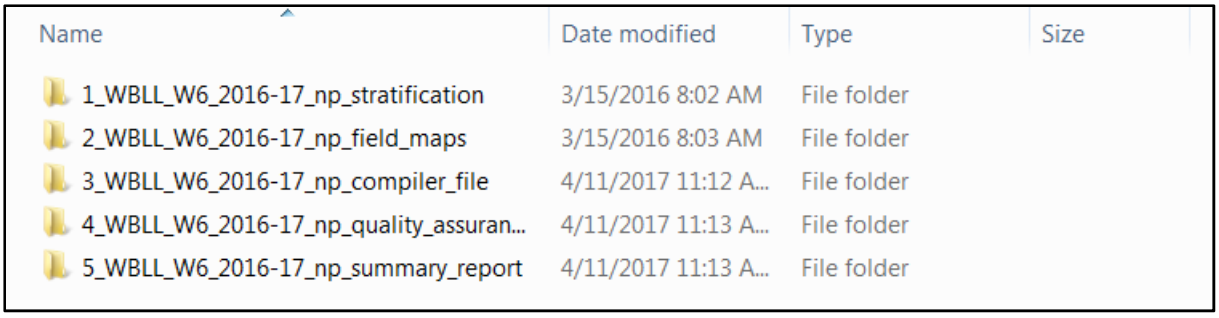


Figure 8-9. Example of folder nomenclature for a Non-photo System program.

Examples of file nomenclature include:

WBLL_W6_2016-17_as_compiler_file.mdb

WBLL_W6_2016-17_as_checklist.pdf

WBLL_W6_2016-17_as_summary_report.pdf

For timber disposition holders reporting Performance survey information for both the Aerial Stratification and Non-photo Systems, files associated with the Aerial Stratification System shall be put into a digital folder labelled ‘AERIAL’ while files associated with the Non-photo System shall be put into a digital folder labelled ‘NON_PHOTO’.

8.7.6 Aerial Stratification System

8.7.6.1 Annual reporting

For each population, timber disposition holders will ensure the provision of Performance survey information, as described in Sections 8.7.6.1.1 to 8.7.6.1.9 and summarized in Figure 8-10. Each program must be reported as one complete package (i.e., containing all the required elements, as described in Figure 8-10). If more than one program is being reported on a medium, then each program must be clearly identified and in separate folders.

Required elements for the Aerial Stratification System (Figure 8-10) shall be reported using a zip file sent to the following email address:

AF.RSA@gov.ab.ca

The subject line for the email shall include the following information:

- The four letter ARIS stakeholder code (e.g., WBLL; include all ARIS stakeholder codes for joint programs);
- The FMA or FMU that defines the population of openings (e.g., W6);
- The reporting timber year the program was completed (e.g., 2016-17); and,
- The type of system used to complete the surveys (e.g., as = Aerial Stratification System).

The zip file nomenclature shall include the following information:

- The four letter ARIS stakeholder code (e.g., WBLL; include all ARIS stakeholder codes for joint programs);
- The FMA or FMU that defines the population of openings (e.g., W6);
- The reporting timber year the program was completed (e.g., 2016-17); and,
- The type of system used to complete the surveys (e.g., as = Aerial Stratification System).

Prior to attaching the zip file to the email, change the file extension form *.zip to *.zipfile or *.zzz.

For ARIS submissions:

- ***Survey date*** for the Aerial Stratifications System is defined as the compilation date (Assessment date, Appendix 20, Table 11-22). For the population of opening whose Performance survey results are submitted to ARIS annually, the compilation date must be on or before 30 April.
- ***Survey area*** is defined as NAA_FINAL (as described in Appendix 20, Table 11-22).

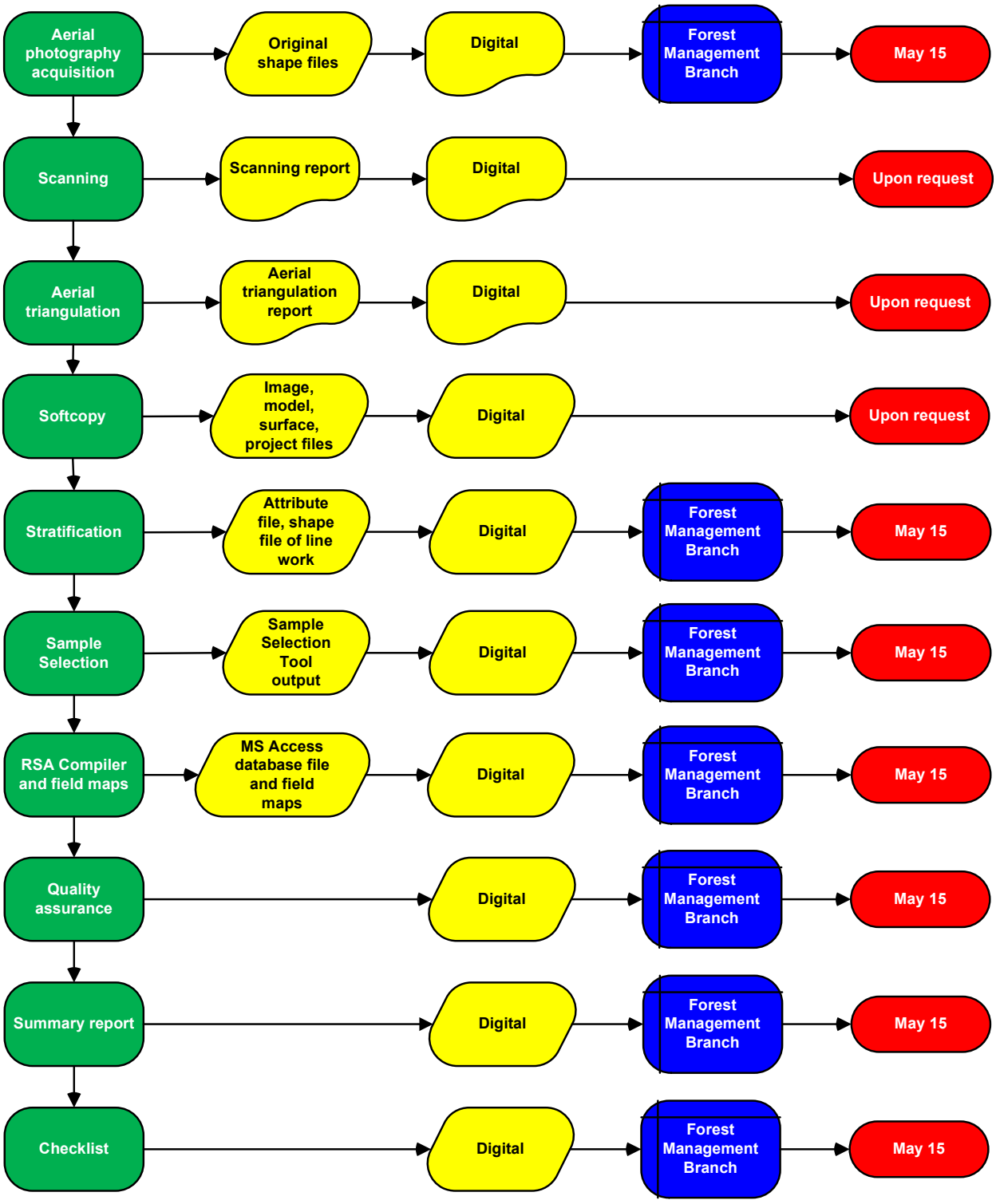


Figure 8-10. Summary of the reporting elements, Aerial Stratification System.

8.7.6.1.1 Aerial photography

Timber disposition holders completing Performance surveys using the Aerial Stratification System must provide the original shape files used in to acquire aerial photography for the population of openings being reported. The shape files are necessary in order to facilitate the auditing of openings where the opening boundary has been re-drawn.

8.7.6.1.2 Scanning

The reporting requirement for the scanning component of the Performance survey is:

- A report, from the agent contracted to perform the scanning, describing the scanning process and resolution.

This report must be made available to the department upon request.

8.7.6.1.3 Aerial Triangulation

The reporting requirement for the Aerial Triangulation component of the Performance survey is:

- A report, from the agent contracted to perform the aerial triangulation, describing the aerial triangulation process.

This report must be made available to the department upon request.

8.7.6.1.4 Softcopy

Three of the most common Softcopy systems used for Performance surveys are DiAP Viewer, PurView, and Summit Evolution (DAT/EM). The digital format will be specific to the Softcopy system used.

Thus, the reporting requirements for the Softcopy component of Performance survey are:

- Image file(s); and,
- Camera file(s);
- Surface file(s) if used; and,
- Project files.

These files must be made available to the department upon request

8.7.6.1.5 Stratification

The reporting requirements for the Interpretation using Softcopy component of the Performance survey are:

- Stratification line-work spatial data; and,
- Attribute data:

- Interp1: Interpreted Sampling Unit attribute data (as described in Appendix 11, Table 11-7); and,
- Interp2: Interpreted poorly regenerated areas attribute data (as described in Appendix 11, Table 11-8).
- Interp3: Interpreted Sample Unit stocking data (optional as described in Appendix 11, Table 11-9).

Acceptable file formats for the stratification line-work spatial data are described in Section 8.4.3.8.

In order to perform a comprehensive audit of the interpretation component of Performance surveys, the following information must be made available to the department upon request:

- Silviculture records used by the interpreters (as described in Section 8.4.3.5.1);
- Field calibration data (as described in Section 8.4.3.5.1);

8.7.6.1.6 Sample selection

The reporting requirement for the sample selection component of the Performance survey is:

- The standardized output file from the Sample Selection Tool (as described in the Sample Selection Tool User's Manual).

8.7.6.1.7 RSA Compiler *.mdb file and field maps

The reporting requirement is the RSA Compiler *.mdb file, which contains a number of tables including the Master Opening List, field data (Ground 1-4, Ground 5-6 if applicable), GYPSY input, MAI Output, Strata-level MAI, Sampling Unit-level MAI, and Opening-level MAI.

Field maps for each opening field sampled (as described in Section 8.4.7.3) shall also be reported.

8.7.6.1.8 Quality assurance

The reporting requirement is completed, original, and signed:

1) Stratification audit forms as described in Section 11. Corrective actions as a result of the audit are described on Form 1.
2) Field check survey sheets, audit compiler file, and evaluation of the quality of the survey as described in Section 11. Outcomes and corrective actions as a result of the audit are described in the Summary report (section 8.7.6.1.9.)

8.7.6.1.9 Summary report

Timber disposition holders shall prepare and submit a summary report in Microsoft Word format or Portable Document Format (PDF). The information provided in the summary report will help facilitate the audit process and identify areas where more clarity may be needed in the RSA.

Specifically, the summary report shall include the following information:

1. Opening boundaries or land use/natural deletions that have been re-drawn

Where boundaries have been re-drawn, timber disposition holders shall document, on an opening by opening basis, their justification for the new opening boundaries together with the area difference between the boundary area supplied by the timber disposition holder and the re-drawn boundary area. Only include those openings where the boundary area change results in differences 0.5 ha or greater or 5% or greater. This applies to the re-drawing of land use and natural deletions. The documentation and rationale are necessary for audit purposes.

2. Planned versus actual field sampled Sampling Units

In this section of the summary report, timber disposition holders shall describe and rationalize all deviations from the planned sample selection (i.e., the field sampling program as determined by the Sample Selection Tool).

Timber disposition holders shall:

- List planned Sampling Units that were dropped from the field sampling program;
- Describe why these Sampling Units were dropped from the field sampling program;
- List replacement CONTINGENCY Sampling Units that were added to the field sampling program; and,
- Describe the order in which CONTINGENCY Sampling Units were selected for inclusion in the field sampling program.

3. Allocation of plots

Repealed May 1, 2017.

4. Contingency plots

Timber disposition holders shall describe:

- Situations where assigned plots were dropped (i.e., assigned plots that were not established nor measured in the field); and,
- How contingency plots were selected (i.e., closest contingency plot to the dropped assigned plot; the contingency plot assumed the plot type of the assigned plot that was dropped).

5. Audited opening outcomes and corrective actions

Timber disposition holders shall describe the outcomes of the field check audit and their corrective actions to ensure continuous improvement.

8.7.7 Non-photo System

8.7.7.1 Annual reporting

For each program, timber disposition holders will ensure the provision of Performance survey information, as described in Sections 8.7.7.1.1 to 8.7.7.1.3 and summarized in Figure 8-11. Each program must be reported as one complete package (i.e., containing all the required elements, as described in Figure 8-11). If more than one program is being reported on a medium, then each program must be clearly identified and in separate folders.

Required elements for the Non-photo System (Figure 8-11) shall be reported using a zip file sent to the following email address:

AF.RSA@gov.ab.ca

The subject line for the email shall include the following information:

- The four letter ARIS stakeholder code (e.g., WBLL; include all ARIS stakeholder codes for joint programs);
- The FMA or FMU that defines the population of openings (e.g., W6);
- The reporting timber year the program was completed (e.g., 2016-17); and,
- The type of system used to complete the surveys (e.g., np = Non-photo System).

The zip file nomenclature shall include the following information:

- The four letter ARIS stakeholder code (e.g., WBLL; include all ARIS stakeholder codes for joint programs);
- The FMA or FMU that defines the population of openings (e.g., W6);
- The reporting timber year the program was completed (e.g., 2016-17); and,
- The type of system used to complete the surveys (e.g., np = Non-photo System).

Prior to attaching the zip file to the email, change the file extension form *.zip to *.zipfile or *.zzz.

For ARIS submissions:

- ***Survey date*** for the Non-photo System is defined as the date of actual field survey (Assessment date, Appendix 20, Table 11-22).
- ***Survey area*** is defined as NAA_FINAL (as described in Appendix 20, Table 11-22).

8.7.7.1.1 Stratification

The reporting requirements for the stratification component of the Performance survey are:

- Stratification line-work spatial data; and,

- Attribute data:
    - Sampling Unit attribute data (as described in Table 8-15); and,
    - Poorly regenerated areas attribute data (as described in Table 8-16).

Acceptable methods for obtaining the stratification line-work spatial data are described in Section 8.5.2.4.1. Where Sampling Units were delineated spatially using GPS or digitizing, shape file, geodatabase, or coverage file are acceptable formats (as described in Section 8.5.2.6). If neither GPS nor digitizing were used to delineate Sampling Units within openings, then a hand-drawn map to scale is acceptable.

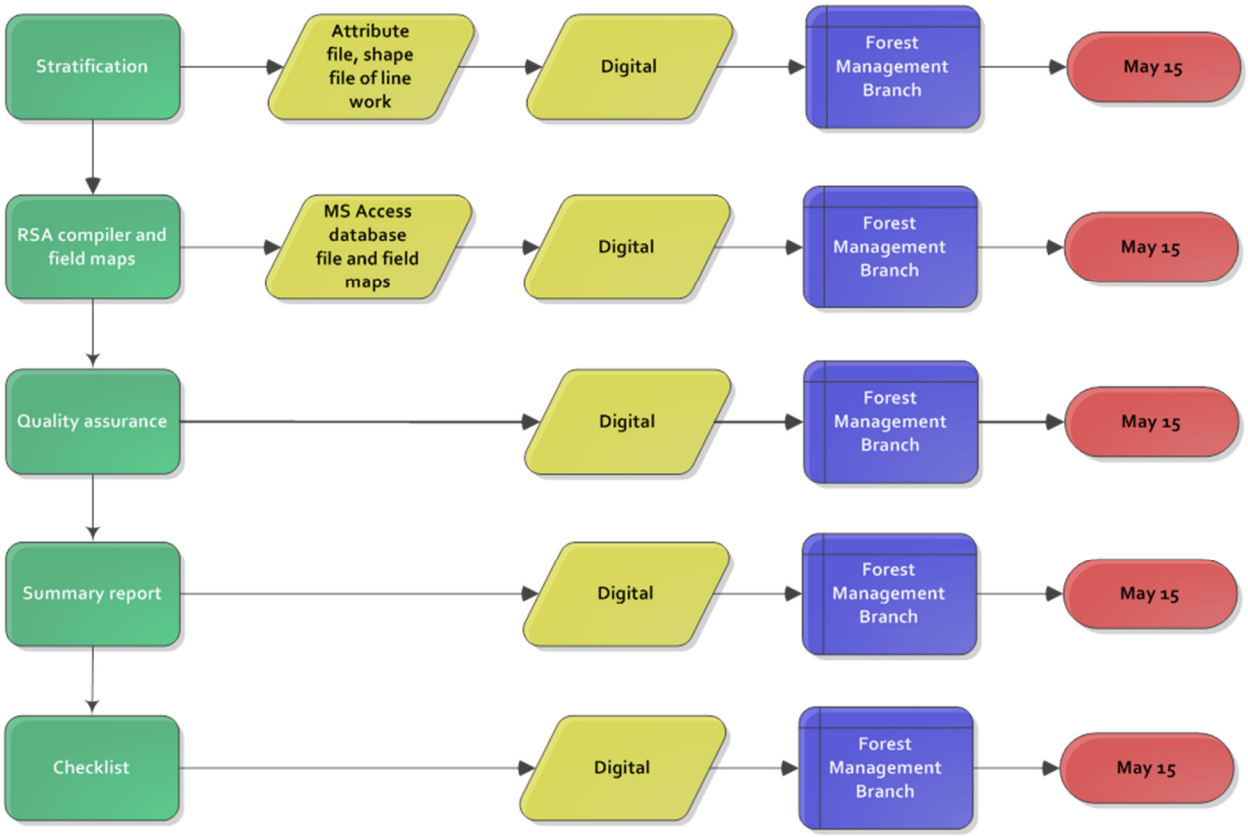


Figure 8-11. Summary of the reporting requirements, Non-photo System.

8.7.7.1.2RSA Compiler *.mdb file and maps

The reporting requirement is the RSA Compiler *.mdb file, which contains a number of tables including the Master Opening List, field data (Ground 1-4, Ground 5-6 if applicable), GYPSY input, MAI Output, Strata-level MAI, Sampling Unit-level MAI, and Opening-level MAI.

Field maps for each opening field sampled (as described in Section 8.5.4.6) shall also be reported.

8.7.7.1.3 Quality assurance

The reporting requirement is completed, original, and signed:

1) Field check survey sheets, audit compiler file, and evaluation of the quality of the survey, as described in Section 11. Outcomes and corrective actions as a result of the audit are described in the Summary report (Section 8.7.7.1.4)

8.7.7.1.4 Summary report

Timber disposition holders shall prepare and submit a summary report in Microsoft Word format or Portable Document Format (PDF). The information provided in the summary report will help facilitate the audit process and identify areas where more clarity may be needed in the Standard.

Specifically, the summary report shall include the following information:

1. Opening area (ha) changes

Where opening areas have changed, timber disposition holders shall document, on an opening by opening basis, the area change between the net harvested hectares or update area (ha) and the NAA_FINAL. Only include those opening where the opening area changes are larger than 0.5 ha or 5%, whichever is smaller.

2. Audited opening outcomes and corrective actions

Timber disposition holders shall describe the outcomes of the field check audit and their corrective actions to ensure continuous improvement.

8.7.8 Reporting medium

Timber disposition holders shall submit:

1) Required reporting elements in a zip file sent via email to AF_RSA@gov.ab.ca as described in Sections 8.7.6 (Figure 8-10) and 8.7.7 (Figure 8-11).

2) Elements made available to the department upon request (see Section 8.7.6 and 8.7.7 and Figures 8-10 and 8-11) on a stable, portable, and easily accessible medium such as an external hard/flash drive or CD/DVD (maximum of 2 discs) to the Forest Management Branch. External hard/flash drives or CD/DVD will not be returned to timber disposition holders.

8.7.9 Reporting Checklist and Validation

A Reporting Checklist is provided to ensure all mandatory reporting elements are accounted for (Appendix 21). Timber disposition holders shall ensure that each appropriate element is reported by initialling beside each element and by signing and dating the Reporting Checklist. By initialling, signing and dating the Reporting Checklist, timber disposition holders are stating that the report is complete, accurate, and on time.

Completed checklists must accompany all reporting of Performance survey information to FMB. Completed checklist may be digital (scan) or hardcopy.

For those timber disposition holders who harvest more than 30,000 m^3 annually, the Reporting Checklist must be validated by a Regulated Forestry Professional (RFP). Validated work is work that has been prepared by or reviewed and approved by an RFP. The RFP who validates work must have done the work, contracted the work, or supervised those who did the work. The validating RFP is accountable for ensuring the reporting of Performance survey information is complete and accurate.

For those timber disposition holders who harvest less than 30,000 m^3 annually, the Reporting Checklist must be validated by a RFP or signed by the timber disposition holder with reforestation responsibility.

For those timber disposition holders who have agreed to work together, one Reporting Checklist is required; however, each participating timber disposition holder must initial and sign/validate the checklist.

Alberta will acknowledge receipt of the Performance survey reporting package via a letter within 5 business days.

8.7.10 Acceptance audit by the Forest Management Branch

All Aerial Stratification and Non-photo Systems reporting packages received by the Forest Management Branch undergo an Acceptance Audit. The Acceptance Audit is a high-level check that verifies all required elements are present in the reporting package. The Acceptance Audit also includes a recompilation (RSA Compiler Audit Tool Shadow Compilation) to ensure that the field data, GYPSY inputs, and Sample Unit, Strata, and Opening-level output align. All RSA Performance survey packages must pass the Acceptance Audit before they undergo specific inspections including:

- Spatial data verification;
- Photo interpretation verification;
- ARIS Data verification; and,
- Field Data verification.

Detailed descriptions of the required RSA reporting elements for the Aerial Stratification and Non-photo System reporting packages are contained in Sections 8.7.6 and 8.7.7. A summary of the required elements is a follows:

- A completed and RFP validated Checklist;
- Stratification line-work spatial data;
- Sampling Unit and Poorly Regenerated attribute data;
- RSA Compiler MS Access database file;
- Quality assurance report;
- Digital field maps;
- Summary Report;

- Photo acquisition shape files (Aerial Stratification System only); and,
- Sample Selection Tool output file (Aerial Stratification System only).

For Performance surveys packages completed using the Aerial Stratification and Non-photo Systems and reported to the Forest Management Branch on or after 1 May, 2014, the following applies:

- The Forest Management Branch shall acknowledge receipt of the package by notifying the timber disposition holder(s) within five (5) business days;
- The Forest Management Branch shall complete an audit of the Performance survey package after May 15 to verify that the reported package is complete (all required reporting elements are present and the MS Access database file passes the Shadow Compilation);
- The Forest Management Branch shall notify timber disposition holder(s) in writing of the outcome of the audit.
- Incomplete Performance survey packages shall be subject to non-compliance investigation.

9 Deciduous Standard for Conditional Satisfactorily Restocked (CSR) and Not Satisfactorily Restocked (NSR) openings

Openings, whose current status in the Alberta Regeneration Information System (ARIS) is Conditionally Satisfactorily Restocked (CSR) or Not Satisfactorily Restocked (NSR) to the Deciduous (D) Standard, require Performance surveys. The methodology for completing D Standard CSR and NSR Performance surveys is described herein.

Applying a CSR condition to an opening as a result of an Establishment survey is no longer valid, effective May 1, 2010.

9.1 Timing

For openings currently declared to the D Standard, the following applies:

Where an Establishment survey has been completed for an opening prior to 1 May, 2010, and the opening was deemed to be CSR or NSR to the D Standard, a Performance field stocking survey shall be completed no sooner than 8 years and no later than 14 years after the end of the Timber Year of Cut or disturbance date, whichever is more recent.

9.2 Stocking

Stocking status of each opening shall be determined by assessing the spatial distribution of acceptable trees.

The basic sampling unit is a 10 m^2 circular plot, 1.78 m in radius. This sample plot is considered stocked if it contains at least one acceptable tree that meets the species, height, and other characteristics listed below.

9.2.1 Acceptable trees

An acceptable tree is an individual seedling, sucker, coppice (collectively SDL), or advanced (ADV) regeneration that:

- Is alive; and,
- Is an acceptable tree species (TSA or FMA or FMU specific), see Appendix 3; and,
- Has been on-site for a minimum of two growing seasons; and,
- Originated from seed, suckering, coppice[31], or layering (Sb); and,

[31] Each stem originating from coppice growth may be considered a separate acceptable tree.

- Achieved the minimum coniferous or deciduous tree height requirement at time of survey (Table 9-1).

A growing season is defined as the period between June 20 and August 1 annually.

Additional acceptable tree criteria specific to coniferous tree species include:

- A well-defined stem with not more than two stems originating at the base; and,
- A live-crown ratio of 1/3 or greater (applies to white spruce, Engelmann spruce, and fir trees only).

Height shall be measured as the tree lies plumb from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

Advance regeneration is a specific tree that meets *all* of the above criteria and, in addition, was established in advance of the harvest and will probably be alive when the rest of the stand is harvested. For openings with disturbance dates in ARIS, seedlings established naturally or artificially between the original skid clearance date and disturbance date shall be considered and recorded as ADV.

Table 9-1. Performance survey minimum tree height and average height of acceptable deciduous tree requirements by Natural Subregion, Species, drainage class, and ecosite (D Standard).

Natural Subregion	Species	Drainage Class	Ecosite[1]	Minimum tree height (cm)	Minimum average height of acceptable deciduous trees[2]
Central Mixedwood, Dry Mixedwood, Northern Mixedwood	Pl, Pj, Lt	All	A – H	160	n/a
	Sw, Sb, Fb, Fa	All	A – H	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – E	200	400
		P to VP	F – H	200	300
Lower Boreal Highlands, Lower Foothills	Pl, Lt	All	A – J (A – H)	160	n/a
	Sw, Sb, Fa, Fb	All	A – J (A – H)	80	n/a
	Aw, Pb, Bw	All	A – J (A – H)	150	250
Upper Boreal Highlands3, Upper Foothills	Pl, Lt	All	A – J (A – H)	160	n/a
	Sw, Sb, Fa	All	A – J (A – H)	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – F (A – E)	150	250
		P to VP	G – J (F – H)	150	190
Montane	Pl, Pf, Lt	All	A – G (A – G)	160	n/a
	Sw, Sb, Fa, Fd	All	A – G (A – G)	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – E (A – F)	150	250
		P to VP	F – G (G)	150	190

[1] Ecosites in brackets are from the Field guide to Ecosites of South Western Alberta, whereas the other ecosites are from the Field Guide to Ecosites of West Central Alberta and the Field Guide to Ecosites of Northern Alberta for the appropriate Natural Subregions. THESE ARE DETERMINED BEFORE HARVEST ONLY.

[2] The average height of acceptable deciduous trees is the arithmetic mean of the tallest deciduous tree from each plot in the opening stocked to deciduous species, excluding advance growth and those plots contributing to the declared conifer stocking percentage.

[3] For this subregion, ecosite types have not yet been defined. Drainage class shall be used for classifying an opening's condition for purposes of selecting minimum tree height and density.

9.2.2 Stocking standard

For D Standard CSR and NSR status openings, the stocking standard is:

- 80% or more of the sample plots must be stocked with at least one acceptable tree; and,
- A minimum of 60% of the sample plots must be stocked with an acceptable deciduous tree; and,
- The average height of acceptable deciduous trees shall be greater than or equal to the average height by natural subregion, drainage class, and ecosite, as listed in Table 9-1.

Where an opening is found to be NSR as a result of a D Standard CSR/NSR Performance survey based on the D stocking standard described above, an opening will be considered SR to a C, CD, or DC stratum standard when the total stocking equals 80% or more and the stocked plots meet the minimum proportions specified in Table 9-2. A plot is considered stocked if a tree in the plot meets the requirements described in Section 9.8.1.

Table 9-2. Minimum stocking requirements for D Standard CSR/NSR Performance survey.

	Harvest date	Minimum coniferous tree stocking (%)	Minimum deciduous tree stocking (%)	Minimum total tree stocking (%)
C Standard	Openings harvested between 1 March, 1991 and 30 April, 2000 Openings harvested after 1 May, 2000 in Central Mixedwood, Dry Mixedwood, Northern Mixedwood, Lower Boreal Highlands, and Lower Foothills	70	0	80
	Openings harvested after 1 May, 2000 in Subalpine, Montane, Upper Boreal Highlands, and Upper Foothills	80	0	80
CD Standard	Openings harvested after 1 March, 2000	50	30	80
DC Standard	Areas harvested after 1 March, 1991	30	50	80

9.3 Performance survey Sheets (D Standard CSR/NSR)

Performance survey information and data shall be recorded on the following datasheets:

- Performance Survey Information Sheet – D Standard CSR/NSR;
- Performance Survey Tally Sheet – D Standard CSR/NSR;
- Performance Survey Field Map Sheet – D Standard CSR/NSR; and,
- Performance Survey Summary Sheet – D Standard CSR/NSR.

Unless otherwise indicated, all fields contained on the tally sheets are mandatory to complete.

9.3.1 Performance Survey Information Sheet – D Standard CSR/NSR

The Performance Survey Information Sheet – D Standard CSR/NSR is the first page of the Performance survey Sheet package (Figure 9-1).

PERFORMANCE SURVEY INFORMATION SHEET - D Standard CSR/NSR		
Reference	Opening number	1
	Disposition	2
	Disposition holder	3
	Field number	4
	Forest Area	5
	Opening area (nearest 0.1 ha)	6
	Skid clearance date (YYYY-MM-DD)	7
	Survey date (YYYY-MM-DD)	8
	Surveyor ID #1	9
	Surveyor ID #2	10
Ecology	Natural subregion (e.g. CM)	11
	Ecosite (e.g. E1) **record only one**	12
	Drainage class (e.g. VR) **record only one**	13
Specifications	Survey grid (nearest 0.1 m: e.g. 35.4 m × 35.4m)	14
	Survey grid X (nearest 0.1 m: e.g. 35.4 m)	15
	Survey grid Y (nearest 0.1 m: e.g. 35.4 m)	16
	Notes / special instructions	17

Figure 9-1. Performance Survey Information Sheet – D Standard CSR/NSR.

The fields of the Performance Survey Information Sheet – D Standard CSR/NSR are:

Reference

1) **Opening number**: Record the Opening number. The Opening number is a unique AAF number based on the legal location of the centroid of the harvest area (e.g. 4230755229A; no blanks allowed).

2) **Disposition**: Record the Disposition. The Disposition is the number that refers to the legal document that grants the right to harvest timber to the holder of the disposition. Reforestation liability is attached to the disposition.

3) **Disposition Holder**: Record the timber disposition holder. The timber disposition holder is the legal name of the forest company or organization with reforestation liability for the opening.

4) **Field number**: Record the field number. The Field number is the number assigned by the timber disposition holder to an opening that normally appears on the Annual Operating Plan (AOP) or harvest plan map.

5) **Forest Area**: Record the Forest Area. The Forest Area is an Alberta administrative unit (region/area) where the opening is located (Appendix 9).

6) **Opening area**: Record the Opening area. Opening area is the area in hectares (0.1 ha) of the opening.

7) **Skid clearance date**: Record the Skid clearance date as YYYY-MM-DD.

8) **Survey date**: Record the date the survey was completed as YYYY-MM-DD.

9) **Surveyor ID #1**: Record the first and last name of the primary qualified surveyor.

10) **Surveyor ID #2**: Record the first and last name of the qualified surveyor.

Ecology

11) **Natural subregion**: Record Natural subregion. Alberta's forested areas are classified into geographical areas, which exhibit similar natural forest vegetation. Enter the short version of the Natural Subregion:

DM	Dry Mixedwood
CM	Central Mixedwood
NM	Northern Mixedwood
LF	Lower Foothills
UF	Upper Foothills
LBH	Lower Boreal Highlands
UBH	Upper Boreal Highlands
SA	Subalpine
MO	Montane

12) **Ecosite**: Record ecosite (as described in Section 9.6). Within each subregion, openings or portions of openings can be classified into plant community types. This ecosite categorization will have been determined in the pre-harvest survey. Enter the ecosite code as in "E1".

13) **Drainage class**: Record Drainage class (as described in Section 9.6). Drainage assessments provide a standard method for assessing soil moisture conditions. Enter the code of the drainage class for the opening or the portion of the opening. Drainage class will have been determined based on pre-harvest condition**.**

VR	Very rapid
R	Rapid

W	Well
MW	Moderately well
I	Imperfectly
P	Poorly
VP	Very Poorly

Specifications

14) **Survey grid**: Record the line and plot spacing to the nearest 0.1 m.

15) **Survey grid X**: Record the line spacing to the nearest 0.1 m.

16) **Survey grid Y**: Record the plot spacing to the nearest 0.1 m.

17) **Notes / special instructions**: Record any notes or special instructions.

9.4 Determining the sample intensity

The required sample intensity is described in Table 9-3. The layout of the 10 m^2 plots is described in Section 9-7. The sampling scheme is expected to provide allowable sampling errors of between 10 and 15 percent 19 times out of 20 for stocking (%).

Table 9-3. Sampling requirements for D Standard CSR/NSR Performance surveys.

Opening Size (Ha)	Number of Sample Plots Required
0.1 – 1.9	Minimum of 12.4 plots per hectare
2.0 – 4.0	Establish minimum of 41 plots per opening or as many as needed to cover opening.
4.1 – 24.0	Establish minimum of 64 plots per opening or as many as needed to cover opening.
> 24.0*	2.77 plots per hectare

*To determine the number of sample plots needed for openings which are greater than 24 ha, multiply the gross opening area by 2.77 and round the product up to the nearest whole number.

9.5 Calculating the survey grid line and plot spacing

When calculating line and plot spacing, two methods may be used:

- Square spacing; and,
- Rectangular spacing.

Square spacing

The survey standard is a square grid pattern where the distance between lines equals the distance between plots. Once the total number of plots and the area of the opening are known, the survey grid (plot and line spacing) can be calculated.

Plot spacing = $\sqrt{(Opening\ Area\ (ha)\ x 10{,}000\ m^2\ /\ ha) / required\ \#\ of\ Plots}$

Example:

For surveys on a 12.1 ha opening, calculate a square survey grid.

A 12.1 ha opening requires that 64 plots be established initially (Table 9-3)

1) Calculate the plot spacing:

Plot Spacing = $\sqrt{(12.1 x 10{,}000 / 64}$ = $\sqrt{1890.625}$ = 43.48

2) Round off to the nearest 0.1 m: line spacing = 43.5 m & plot spacing = 43.5 m

NOTE: Appendix 7 contains calculated square spacing distances for various opening sizes.

Rectangular spacing

Line spacing may differ from plot spacing provided the line spacing does not exceed twice the plot spacing. For openings 24 ha and larger, a 60 m by 60 m square grid must be used. In order to calculate rectangular spacing, one usually selects the desired line spacing, and then calculates the plot spacing needed to achieve the correct number of plots.

Example:

For surveys on a 3.9 ha opening; calculate a rectangular survey grid, assuming a line spacing of 35 m.

1) A 3.9 ha opening requires that 41 plots be established initially.

2) Plot spacing x line spacing = $\frac{\text{Opening Area (ha) x 10,000 (m}^2\text{/ha)}}{\text{Required \# plots}}$

Plot spacing x 35 m = $\frac{\text{3.9 ha x 10,000 m}^2\text{/ha}}{\text{41 plots}}$

Plot spacing = 951.22 m^2 / 35 m

Plot spacing = 27.1777 m

3) Round off to the nearest 0.1 m : line spacing = 35.0 m & plot spacing = 27.2 m

9.6 Defining ecosite and site drainage classifications

All assessments of drainage class or ecosite classification will be conducted using site evaluation methods acceptable to Alberta. The classification will be conducted on an opening by opening basis by personnel suitably trained and experienced. If the timber disposition holder wishes to indicate discrete and mappable areas of the opening where drainage class differences occur, the site evaluation information must be submitted along with the regeneration surveys.

Proper ecosite classification requires evaluation of the undisturbed plant community types and therefore must be conducted prior to harvest. In the case of ecosite classification where the equivalent to P-VP drainage class is expected, Alberta reserves the right to refuse the classification where a soil drainage assessment does not confirm the assumed moisture limitations for the ecosite.

9.6.1 Applicability

For D stratum standard openings cut after May 1, 1998, drainage and ecosite assessments conducted after harvest will not be accepted as just cause for modification to the classification (as defined by the VR to I drainage class by Natural Subregion).

9.6.2 Stratification by ecosite or drainage class

Where opening areas are to be separated into discrete areas of differing drainage classes or ecosite classes, it is expected that these areas will be delineated and treated as separate openings.

For openings with areas of differing drainage classes, where it is not desirable to treat these as separate openings, the percentage of area for each drainage or ecosite class may be estimated.

For D openings containing small, scattered areas of differing drainage or ecosite, the new opening minimum average height and minimum trees/plot requirements are calculated based on the respective percentages for each ecosite or drainage class.

9.7 Laying out transects and plots in the field

For each opening to be surveyed, the methods for locating plots in the field shall be either:

- Compass and horizontal distance measuring device and using GPS to record x and y coordinates for each plot location; or,
- Global Positioning System (GPS) used to navigate to pre-determined plots locations (e.g. waypoints).

The standard of accuracy is <10 m horizontal distance with 95% confidence when using GPS for D Standard CSR/NSR Performance surveys. The GPS receiver shall be configured to NAD83.

When using a compass and horizontal distance measuring device (includes GPS), control line(s) shall be established as follows:

- Establish one control line parallel to the long axis of the opening (Figure 9-2). Additional parallel control lines shall be established every 400 metres where opening width exceeds 400 m.

- The control line is best placed to coincide with the grid to enable points along the control line to be used as plot centres. Reference the control line in relation to the opening boundary to enable accurate mapping of the sample plot locations.
- Starting from the opening edge, the first survey line is located at one-half the interline distance. Each additional survey line is marked at the exact interline distance.
- Survey line intervals on the control line shall be double flagged using two different colours. The line and plot number shall be clearly written on the flagging.
- Beginning at the control line, the remaining individual plots shall be located at the required spacing.

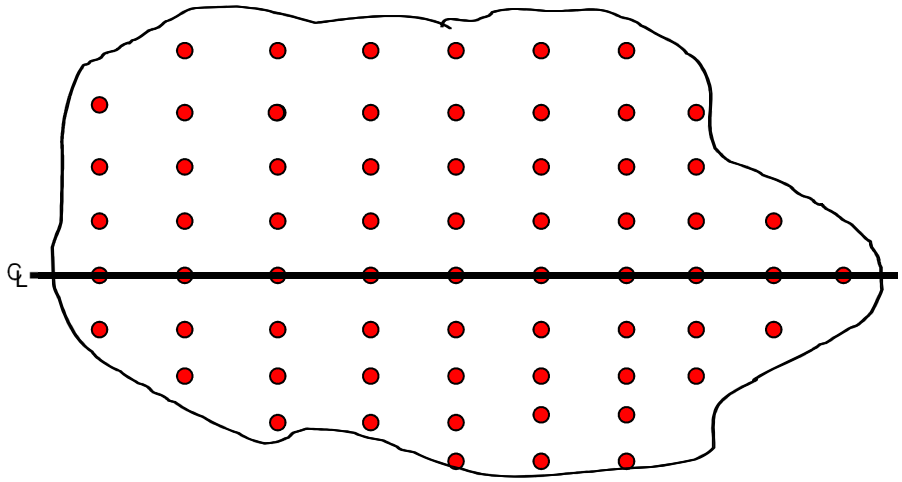


Figure 9-2. Sample plot distribution diagram (D Standard CSR/NSR Performance surveys).

A control line is not required when GPS is used to navigate to pre-determined plot locations.

9.7.1 Plots to delete

Areas within openings where plots are unnecessary shall include those under a land-use disposition or those classified as landbase deletions in the FMP.

Where, prior to beginning the survey, an area is known to be within a land-use disposition or a FMP landbase deletion, the area shall be deleted from the opening and the grid shall be calculated using the reduced opening area.

As plots are being located in an opening, any plot landing in a deletion area may be established for grid reference purposes but shall not be measured. If the area of the deletion is correct, the proper number of plots to fill the opening should be obtained without moving any plots.

Examples of land use deletions from the opening area include:

- Miscellaneous lease (MLL) (e.g. campsite, sand and gravel);
- Pipeline Agreement (PLA);
- Licence of Occupation Road (LOC);
- Well site;
- Archaeological and historic sites; and,
- Permanent sample plots (PSP) or other research areas (in most cases).

'Natural' deletions from the opening area include:

- Riparian areas and treed buffers (no stumps encountered; 0.05 ha or larger); and,
- Treed patches within the opening (no stumps encountered; 0.5 ha or larger).

Plots landing on seismic lines shall not be moved or deleted unless the area of the seismic line has been removed from the opening.

Plots shall not be deleted in areas of understory protection. Surveyors identify understory protection areas by the presence of advanced white spruce trees (understory) where some or all of the overstory deciduous trees were left intact to protect them.

9.7.2 Moving plots

Where surveyors encounter new dispositions or natural deletions whose areas were not deleted from the opening area at the time the grid was calculated, the line and plot spacing may be set to at a wider spacing to avoid the deletion. This will achieve the required number of plots. In these cases, the plot shall be moved half the plot distance toward the next plot to achieve the required number of plots.

Should the plot still land on the disposition or natural deletion, the surveyor shall continue to move at one half the plot distance intervals until a plot can be established. The plot following a moved plot remains at the calculated line and plot spacing for the opening.

9.7.3 Adding plots

A minimum number of plots shall be established within each opening to achieve the desired sampling precision (Table 9-3). If additional plots are required to make up this minimum number, they should be located as follows:

- Halfway between every third survey line (i.e., halfway between and parallel to the third and fourth survey lines, sixth and seventh lines).
- Plot spacing shall be the same on additional lines as for the original lines to facilitate delineation of stocked or poorly stocked areas.
- Where every third line does not add the required number of plots, proceed to add lines between other survey lines until the required number of plots is reached. Lines shall be marked on the control line and numbered sequentially (no letters).

- Lines added using the compass and distance measuring device method (this also applies to GPS when used as a compass and distance measuring device) shall be given the next number in the sequence. Use only whole positive numbers.

- Plots added using GPS as waypoints shall be given unique, whole positive numbers.

9.7.4 Plot layout

- The size of the sample plot shall be 10 m^2;

- The shape of the sample plot shall be circular and have a radius of 1.78 m;

- Plot centres shall be clearly marked in the field (e.g. wooden stick);

- Flagging shall be attached to the centre marker with plot and line numbers written legibly on the flagging using a black, waterproof marker pen; and,

- To facilitate field checking, acceptable trees (coniferous and/or deciduous) that stocked the plot shall be marked with flagging.

9.8 Plot assessment

9.8.1 Performance Survey Tally Sheet – D Standard CSR/NSR

Regeneration survey data shall be recorded for each plot on the Performance Survey Tally Sheet – D Standard CSR/NSR (Figure 9-3).

The fields of the Performance Survey Tally Sheet – D Standard CSR/NSR are:

1) **Opening number**: Record the Opening number. The Opening number is a unique number based on the legal location of the centroid of the harvest area (e.g. 4230755229A; no blanks allowed).

2) **Line**: Record the line number. Record GPS X coordinate on next line below.

3) **Plot**: Record the plot number. Record GPS Y coordinate on next line below.

4) **Species**: Record tree species. Acceptable tree species vary by approved Forest Management Plan (FMP) and, therefore, are FMA/FMU specific (Appendix 2) (Eligible codes: Sw, Sb, Se, Pl, Pj, Pw, Pf, Lt, Lw, Ls, Fb, Fd, Fa, Aw, Pb, Bw).

5) **Tree type**: Record tree type as SDL (trees planted or naturally regenerated post-harvest) or ADV (trees established in advance of the harvest and will probably be alive when the rest of the stand is harvested).

6) **Height**: Record the height (cm) of the tallest tree meeting the minimum height requirements, as described in Table 9-1. Height shall be measured as the tree lies perpendicular (plumb) from upper most live bud to ground (or vice versa) for all trees regardless of lean from vertical.

7) **Plot status**: Record SR (Satisfactorily Restocked) if the plot is stocked with an acceptable tree. Record NSR (Not Satisfactorily) if the plot is not stocked with an acceptable tree.

PERFORMANCE SURVEY TALLY SHEET - D Standard CSR/NSR

Opening number:_____1_____

Plot information		All plots (1.78 m radius)				Plot information		All plots (1.78 m radius)			
Line	Plot	Species	Tree type (SDL or ADV)	Height (cm)	Plot status (SR or NSR)	Line	Plot	Species	Tree type (SDL or ADV)	Height (cm)	Plot status (SR or NSR)
2	3	4	5	6	7						

Figure 9-3. Performance Survey Tally Sheet – D Standard CSR/NSR.

9.9 Performance Survey Field Map Sheet – D Standard CSR/NSR

Field maps should be drawn on the standard Performance Survey Field Map Sheet – D Standard CSR/NSR (Figure 9-4) as the surveyor progresses through the opening. This will help the surveyor map certain features of the opening and the status of the plots surveyed. All maps submitted are to show the following information for each opening surveyed:

1) **Opening Number**: Record the Opening number. The Opening number is a unique number based on the legal location of the centroid of the harvest area (e.g. 4230755229A; no blanks allowed).

2) **Disp. Holder**: Record the timber disposition holder. The timber disposition holder is the legal name of the forest company or organization with that carries the reforestation liability for the opening.

3) **Field Number**: Record the field number. The Field number is the number assigned by the timber disposition holder to an opening that normally appears on the Annual Operating Plan (AOP) or harvest plan map.

4) **Scale**: Record the scale for the map. The scale is a measure of map distance and the equivalent measure of distance on the ground expressed as a representative fraction. Survey maps shall be provided to a scale of 1:5,000 or larger.

5) **Control Line Bearing**: Record the bearing for the control line. A bearing is a measurement of direction between two points. Bearings shall be given as an azimuth (e.g. 202°).

6) **Tie Point**: Record the location of the tie point. A tie point is a location on or close to the opening boundary that is easily found on a map or air photo and on the ground. Tie points are necessary to indicate where surveyors entered openings to access Sampling Units for audit purposes. Tie points shall be clearly marked in the field with flagging. Surveyors shall write the following information using waterproof ink on the flagging at each tie point:

    - The surveyor(s) first and last initial and date of the survey;
    - The distance in meters and compass bearing in degrees to the first plot. If using GPS, a track log is acceptable.

7) **Poor Stk Area (ha)**: Record area of opening that is poorly stocked (to the nearest 0.1 ha). Poorly stocked is equivalent to Not Satisfactorily Restocked (NSR).

8) **Stk Area (ha)**: Record area of opening that is stocked (to the nearest 0.1 ha).

9) **GPS receiver make**: Record the make of the GPS receiver (e.g. Garmin, Trimble), if applicable.

10) **GPS receiver model**: Record the model of the GPS receiver (e.g. Map 76CSx), if applicable.

11) **Damage**: Record extent (%) of insect, disease, hare/rodent, weed, other damage. Damage is an optional field.

12) **Site conditions**: Record site conditions, where applicable. Site conditions are an optional field. Site conditions to record may include:

    - Fire kill;
    - Flooded areas;
    - Wind-throw; and,
    - Heavy duff.

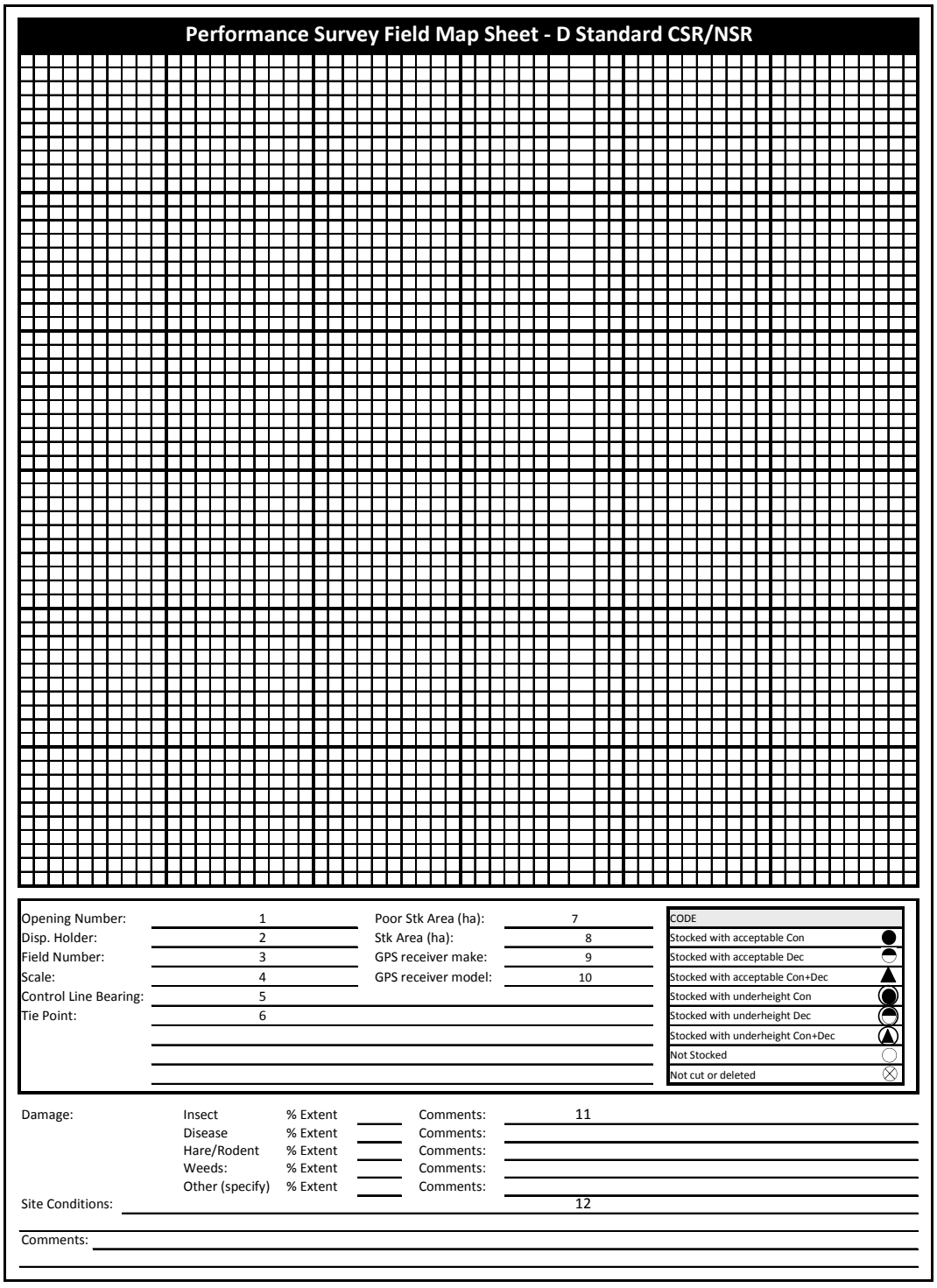


Figure 9-4. Performance Survey Field Map Sheet – D Standard CSR/NSR.

In addition to the above, all maps submitted shall have the following information recorded for each opening:

- Opening boundaries;
- Total opening area;
- North arrow;
- Plot numbers; and,
- Location and size of permanent deletions.

Symbols to illustrate the stocking status for each plot are shown in Table 9-4. Stocking must be assessed using minimum heights, as defined in Table 9-1. This means, for example, a plot is stocked to deciduous if one of the measured tallest deciduous trees is greater than the minimum height.

Table 9-4. Regeneration survey map symbols.

Symbol	Definition	Symbol	Definition
	not cut or deleted plot		stocked with an acceptable deciduous species
	non-stocked		stocked with **both** acceptable coniferous and deciduous species
	stocked with an acceptable coniferous species		

9.10 Identifying poorly stocked (NSR) areas

In addition to plot locations and symbols, the map for Performance surveys (D Standard CSR/NSR) shall identify poorly stocked (NSR) areas that are 4 ha or larger. Stocking is determined by the presence of an acceptable tree within each 10 m^2 plot.

Delineating poorly stocked areas 4 ha in size or larger is based on a moving average-of-plot status where areas not meeting the stocking requirement are assessed using perpendicular rows across the opening.

The following procedure shall be used for Performance surveys (D Standard CSR/NSR) to delineate poorly stocked (NSR) areas within generally stocked openings by:

- Starting at one corner of the opening, proceed along the survey lines and examine five plots at a time. After the first five plots have been examined, drop the first plot in the line and add one plot on the end (running average of five plots). Continue progressing to the end of the line until the last five plots have been assessed.
- A survey line section of five plots shall be considered stocked if four of the plots are stocked. All stocked plots should be considered regardless of coniferous or deciduous status.

- A survey line section of five plots shall be considered poorly stocked if it contains zero to three stocked plots.

- If there are fewer than five plots in a line, all plots shall be stocked in order to call the section stocked.

- If there are more than five plots in a line, the beginning of the first poorly stocked five-plot section and the end of the last poorly stocked five-plot section should be marked to select the poorly stocked portion of the survey line.

After each line is assessed and marked, draw a boundary around the marked areas to identify the locations of the suspected poorly stocked areas. The same procedure must be repeated by running the five-plot, moving average perpendicular to the first direction. An area shown to be poorly stocked in both directions shall be considered the poorly stocked area.

When the above procedure has been completed, calculate the area (ha) of each poorly stocked area to determine if any are greater than 4 ha.

Poorly stocked areas over 4 ha in size shall be mapped in a manner acceptable to Alberta.

The area of a poorly stocked patch shall be recorded in the "Poorly Stocked Area (ha)" line on the Performance Survey Summary Sheet – D Standard CSR/NSR.

9.11 Performance Survey Summary Sheet – D Standard CSR/NSR

The data recorded on the Performance Survey Tally Sheets – D Standard CSR/NSR are rolled-up into summary categories on the Performance Survey Summary Sheet – D Standard CSR/NSR (Figure 9-5).

The following information (fields) shall be compiled at the opening level:

Opening information

1) **Opening number**: Record the Opening number. The Opening number is a unique number based on the legal location of the centroid of the harvest area (e.g. 4230755229A; no blanks allowed).

2) **Disposition**: Record the Disposition. The Disposition is the number that refers to the legal document that grants the right to harvest timber to the holder of the disposition. Reforestation liability is attached to the disposition.

3) **Disposition holder**: Record the timber disposition holder. The timber disposition holder is the legal name of the forest company or organization with that carries the reforestation liability for the opening.

4) **Field number**: Record the field number. The Field number is the number assigned by the timber disposition holder to an opening that normally appears on the Annual Operating Plan (AOP) or harvest plan map.

5) **Strata standard**: Record D.

6) **Field protocol**: Record CSR.

7) **Skid clearance date**: Record the Skid clearance date as YYYY-MM-DD.

PERFORMANCE SURVEY SUMMARY SHEET - D Standard CSR/NSR

OPENING INFORMATION

Opening number	1	Natural subregion (e.g. CM)	8
Disposition	2	Ecosite (e.g. E1) **record only one**	9
Disposition holder	3	Drainage class (e.g. VR) **record only one**	10
Field number	4	Opening area (nearest 0.1 ha)	11
Strata standard (D/DC/CD/D)	5	Survey date (YYYY-MM-DD)	12
Field protocol (CSR)	6	Survey grid (e.g. 35.4m×35.4m)	13
Skid clearance date (YYYY-MM-DD)	7	GPS receiver (make and model)	14

STOCKING CALCULATIONS

Type of Plot	# Plots	% Plots
Stocked with an acceptable conifer	15a	15b
Stocked with an acceptable deciduous	16a	16b
Stocked with both acceptable C and D	17a	17b
Not stocked	18a	18b
Not cut or deleted	19	
Total (excl cut/deleted) - use to calc % plots	20	

Average height of tallest deciduous (cm)	21

Percent Acceptable Coniferous	22
Percent Acceptable Deciduous	23
Total Percent Stocking	24

Poorly stocked area (ha)					25
Stocked area (ha)					26
Survey Passes	27	C	CD	DC	D

Opening Status	**SR**	**NSR** 28

Damage:

Insect	% Extent		Comments: 29
Disease	% Extent		Comments:
Hare/Rodent	% Extent		Comments:
Weeds:	% Extent		Comments:
Other (specify)	% Extent		Comments:

Site Conditions: 30

Comments:

Figure 9-5. Performance Survey Summary Sheet – D Standard CSR/NSR.

8) **Natural subregion**: Record Natural subregion. Alberta's forested areas are classified into geographical areas, which exhibit similar natural forest vegetation. Enter the short version of the Natural Subregion:

DM	Dry Mixedwood
CM	Central Mixedwood
NM	Northern Mixedwood
LF	Lower Foothills
UF	Upper Foothills
LBH	Lower Boreal Highlands
UBH	Upper Boreal Highlands
SA	Subalpine
MO	Montane

9) **Ecosite**: Record ecosite. Within each subregion, openings or portions of openings can be classified into plant community types. This ecosite categorization will have been determined in the **pre-harvest survey**. Enter the ecosite code as in "E1"**.**

10) **Drainage class**: Record Drainage class. Drainage assessments provide a standard method for assessing soil moisture conditions. Enter the code of the drainage class for the opening or the portion of the opening. Drainage class will have been determined based on pre-harvest condition**.**

VR	Very rapid
R	Rapid
W	Well
MW	Moderately well
I	Imperfectly
P	Poorly
VP	Very Poorly

11) **Opening area**: Record the Opening area. Opening area is the area in hectares (0.1 ha) of the opening.

12) **Survey date**: Record the date the survey was completed as YYYY-MM-DD.

13) **Survey grid**: Record the line and plot spacing to the nearest 0.1 m.

14) **GPS receiver**: Record make and model of GPS receiver, if applicable.

Stocking calculations

15) **Stocked with an acceptable conifer**: 15a: Record the number of plots with an acceptable coniferous tree. 15b: Calculate the percent of plots with an acceptable coniferous tree (i.e., Field 15a ÷ Field 20 × 100).

16) **Stocked with an acceptable deciduous**: 16a: Record the number of plots with an acceptable deciduous tree. 16b: Calculate the percent of plots with an acceptable deciduous tree (i.e., Field 16a ÷ Field 20 × 100).

17) **Stocked with both acceptable C and D**: 17a: Record the number of plots with both acceptable C and D. 17b: Calculate the percent of plots with both acceptable C and D (i.e., Field 17a ÷ Field 20 × 100).

18) **Not stocked**: Record the number of plots that are not stocked with an acceptable tree. Record the percent of plot not stocked with an acceptable tree (i.e., Field 18 ÷ Field 20 ×100).

19) **Not cut or deleted**: Record the number of plots in areas not cut or deleted.

20) **Total**: Record the total number of plots. Do not include plots in area not cut or deleted.

21) **Average height of tallest deciduous (cm)**: Record the average height of tallest deciduous trees from all stocked plots.

22) **Percent acceptable coniferous**: Record the percent of plots with an acceptable coniferous tree (Field 15b + Field 17b).

23) **Percent acceptable deciduous**: Record the percent of plots with an acceptable deciduous tree (Field 16b + Field 17b).

24) **Total percent stocking**: Record the total percent stocking (Field 15b + Field 16b + Field 17b).

25) **Poorly stocked area**: Record the area that is poorly stocked (to the nearest 0.1 ha).

26) **Stocked area**: Record the area that is sufficiently restocked (to the nearest 0.1 ha).

27) **Survey passes**: Record the Standard the Performance survey passes.

28) **Opening status**: Record the opening status as SR (Satisfactorily Restocked) or NSR (Not Satisfactorily Restocked). This is the final assignment for the opening based on the minimum standards described in Section 9.2.2.

29) **Damage**: Record extent (%) of insect, disease, hare/rodent, weeds, other damage. Recording this data is optional, but may be very important for determining why a particular opening failed the survey. Damage is an optional field.

30) **Site conditions**: Record site conditions, where applicable. Site conditions are an optional field. Site conditions to record may include:

    - Fire kill;
    - Flooded areas;
    - Wind-throw; and,
    - Heavy duff.

9.12 Performance survey (D Standard CSR/NSR) reporting requirements

Regeneration surveys completed by timber disposition holders shall be reported to AAF regional offices on or before **15 May** of the Timber Year in which they are completed.

Submissions of Performance Survey Sheets D Standard CSR/NSR shall be hardcopy (paper) and/or digital.

Regeneration surveys reported to Alberta shall be RFP validated. An example of a recommended format for a regeneration survey report cover page is shown in Appendix 8. The regeneration

survey report cover page (bearing the signature of the RFP) may be submitted digitally, but shall be in a proprietary file format (e.g., Adobe Acrobat) for digital signature protection.

9.12.1 Paper reports

An acceptable Performance survey D Standard CSR/NSR submission package for each opening contains a completed:

- Performance Survey Information Sheet – D Standard CSR/NSR;
- Performance Survey Field Map Sheet - D Standard CSR/NSR;
- Performance Survey Tally Sheet - D Standard CSR/NSR; and,
- Performance Survey Summary Sheet - D Standard CSR/NSR.

Each submission package shall be RFP validated as being complete and accurate.

9.12.2 Digital reports

An acceptable Performance survey D Standard CSR/NSR digital submission must contain the information defined in Section 9.12.1 in a format acceptable to Alberta.

Each submission package shall be RFP validated as being complete and accurate.

9.13 ARIS reporting

For Performance surveys D Standard CSR/NSR, results reported to ARIS for each opening shall include:

- Status;
- Stratum;
- Coniferous stocking (%);
- Deciduous stocking (%); and,
- Total Stocking (%).

For ARIS reporting requirement, please refer to the applicable ARIS Manual.

10 Understory Protection Performance Survey Standard

10.1 Population/ Applicability

This survey protocol shall be used on all Understory Protection (UP) openings that are eligible for a performance survey. Understory Protection openings must have been harvested with planned strip cuts (or other approved method) designed to protect sub-merchantable coniferous understory trees. The understory trees protected during UP harvesting are assumed to be merchantable and available for harvest at the next stand entry.

This survey protocol shall not be used to assess openings harvested with Understory Avoidance techniques. Openings harvested via Understory Avoidance shall be assessed with the 'standard' RSA performance survey standard.

This survey protocol shall also not be used to assess any opening that fails to achieve the reduced C^{UP} stocking standard following an Understory Protection establishment survey (Sections 7.13.5 and 7.13.6). Instead, any openings that fail to achieve the reduced UP standard at establishment must be assessed with a 'standard' RSA non-photo performance survey.

Understory Protection openings harvested on or after May 1, 2013 must have been approved as 'Understory Protection' in an Annual Operating Plan (AOP) and have been designated as UP in the Alberta Regeneration Information System (ARIS) with the correct codes[32] and an approved UP landbase designation code (see Section 5).

All UP openings harvested on or after May 1, 2015 must have been appropriately subdivided so as to not contain any contiguous clearcut areas ≥ 2 ha in size (see Section 5 for further explanation/ requirements).

This performance survey protocol shall be used on all partially harvested openings with ≥ 2 ha of Understory Protection (planned strip cuts). This requirement applies even if openings have been declared to a non-UP harvest system in ARIS (e.g., shelterwood (SW)), provided at least 2 ha of the opening was harvested with planned strip cuts. Openings with < 2 ha of strip cuts shall use the 'standard' RSA performance survey protocols (Section 8). Subdivision of openings may be required for some pre-2015 openings prior to implementing this survey protocol. Affected timber disposition holders are encouraged to contact Forest Management Branch for opening-specific direction.

10.2 Objectives

The objectives of Understory Protection performance surveys are:

- Assess every opening, as required under the *Timber Management Regulation*, at performance survey timing;
- Document the reforestation status of each opening; and

[32] Opening Type = PC and Harvest System = UP

- Document tree and stand metrics for both retained coniferous trees and regenerating seedlings and suckers across the entire opening.

10.3 Terminology

This Understory Protection performance survey protocol contains some terms that are not common in 'standard' forestry operations. Terms used in this protocol are defined in Table 10-1 and an example Understory Protection opening is shown in Figure 10-1.

Table 10-1. Understory Protection terms and definitions.

Term	Definition
Backline	Clearcut trail that surrounds an Understory Protection area. The harvesting equipment travels in this corridor in order to navigate between extraction trails.
Buffer	Corridor where no timber harvesting takes place.
C^{UP}	Acceptable coniferous trees that were protected during Understory Protection harvesting. These trees are greater than or equal to an SYU-specific minimum height threshold (see Section 10.6.3).
$C^{REGEN+D}$	Acceptable coniferous trees below the SYU-specific minimum height threshold, plus all acceptable deciduous trees throughout the opening.
Extraction trail	Clearcut trail where all trees have been removed. The corridor in which the harvesting equipment travels, adjacent to the protected areas.
Protected area	Reach areas and buffers.
Reach area	Corridor where the harvesting equipment reaches in to remove merchantable trees. The harvesting equipment does not travel in this corridor.
Understory Protection (UP) area	Area where understory trees were protected through the use of planned strip cuts or other approved harvesting methods. The UP area contains all components of Understory Protection harvesting, including extraction trails, reach areas, buffers, embedded or adjacent roads, landings and backlines and any embedded or adjacent clearcut areas less than two hectares in size. The UP area includes both protected and unprotected areas.
Unprotected area	Extraction trails, backline, roads, landings and embedded or adjacent clearcut areas less than 2 ha in size.

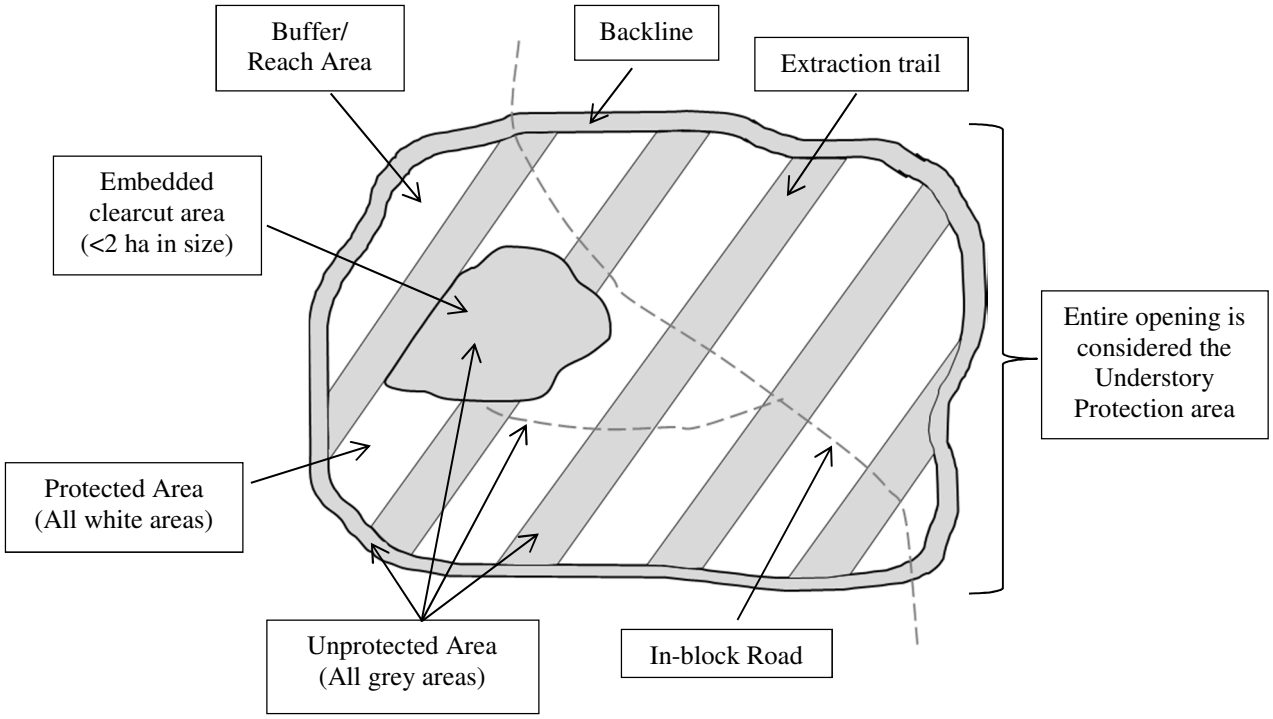


Figure 10-1. Example Understory Protection opening

10.4 Timing

10.4.1 Aerial Photography Acquisition

All timber disposition holders conducting an Understory Protection performance survey are required to capture aerial photography prior to undertaking any field-based assessments.

In the event that aerial photographs cannot be acquired due to circumstances beyond the control of the timber disposition holder and the openings are due for a performance survey (year 14 in the survey window), the timber disposition holder shall notify Forest Management Brach as soon as possible.

Aerial photographs are a mandatory component of UP performance surveys; as such, there is no non-photo option and the requirement to capture photos cannot be waived.

The following applies to all timber disposition holders:

Aerial photography shall be acquired no sooner than 11 years and no later than 14 years after the end of the Timber Year of Cut. Table 10-2 summarizes the timing requirements for the acquisition of aerial photography and submission of shape files to the department.

For openings with stand tending activities (manual or chemical), aerial photography shall be acquired after all silviculture activities (i.e., stand tending) are completed. This is necessary to ensure openings are interpreted accurately for species composition prior to field sampling. Prior written approval from the department is required each year where this requirement cannot be

met. Approval may be granted where operational constraints preclude this requirement from being met.

Table 10-2. Aerial photography acquisition timing and opening eligibility by timber year of cut

Photo Program Year	Timber Year of Cut Eligibility																
	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002	2002 2003	2003 2004	2004 2005	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012	2012 2013
2011	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
2012	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
2013	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N
2014	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N
2015	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N
2016	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N
2017	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N
2018	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N
2019	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N
2020	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N
2021	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N
2022	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N
2023	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
2024	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y

10.4.2 Field Surveys

Performance field surveys of Understory Protection openings shall be completed no sooner than 11 years and no later than 14 years after the end of the Timber Year of Cut (Table 10-3).

UP performance field surveys must not be completed within two growing seasons after a manual tending treatment for openings located within the Lower Foothills and Mixedwood Natural Subregions.

UP performance field surveys may be completed at any time after herbicide treatment provided that the efficacy of the treatment is evident at the time of the survey and the survey is completed within the required period of time (Table 10-3).

Table 10-3. Performance field survey timing and opening eligibility by timber year of cut

Timber Year of Survey	Timber Year of Cut Eligibility																	Complete by	Report by
	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002	2002 2003	2003 2004	2004 2005	2005 2006	2006 2007	2007 2008	2008 2009	2009 2010	2010 2011	2011 2012	2012 2013		
2011/2012	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	Apr 30, 2012	May 15, 2012
2012/2013	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	Apr 30, 2013	May 15, 2013
2013/2014	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	Apr 30, 2014	May 15, 2014
2014/2015	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	Apr 30, 2015	May 15, 2015
2015/2016	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	Apr 30, 2016	May 15, 2016
2016/2017	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	Apr 30, 2017	May 15, 2017
2017/2018	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	Apr 30, 2018	May 15, 2018
2018/2019	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	Apr 30, 2019	May 15, 2019
2019/2020	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	Apr 30, 2020	May 15, 2020
2020/2021	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	Apr 30, 2021	May 15, 2021
2021/2022	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	Apr 30, 2022	May 15, 2022
2022/2023	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	Apr 30, 2023	May 15, 2023
2023/2024	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	Apr 30, 2024	May 15, 2024
2024/2025	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Apr 30, 2025	May 15, 2025

Y = Openings with harvest dates within the specific Timber Year of Cut are eligible for UP performance field survey.
N = Openings with harvest dates within the specific Timber Year of Cut are not eligible for UP performance field survey.

10.5 Understory Protection Opening Aerial Photography Standards

Acquiring, interpreting and stratifying aerial photography is a mandatory component of UP performance surveys and must be completed before any field-based data is collected.

The UP aerial photography stratification system has two distinct sequential phases:

(1) Aerial photography acquisition; and

(2) Stratification.

The annual population of UP openings assessed with a performance survey may contain openings of the same age or different ages, but must be from within the performance survey timing window (Table 10-3) and from within the same Sustained Yield Unit (SYU), which is generally coincident with a Forest Management Agreement (FMA) area or Forest Management Unit (FMU).

10.5.1 Aerial Photography Acquisition

10.5.1.1 Standards for Submissions of Openings

Timber disposition holders are responsible for organizing and managing their own aerial photography acquisition programs. The most current spatial layer (AVI or cutblock layer) for the opening shall be used for photo acquisition. For openings harvested on or after May 1, 2016, the requirements under ESRD, Land and Forestry Policy, 2015, No. 3 Final Cutblock Digital Data Submissions apply. These opening boundaries shall be used for photo acquisition subject to the timing requirements under Section 10.4.

However, in order to facilitate the audit of opening boundaries, original shape files used to identify openings for photo acquisition, in the format described below, must be submitted to the department (Forest Management Branch) as part of the submission package (Section 10.12).

The standard for submission of shape files to Alberta is geospatial data in the Environmental System Research Institute (ESRI) ARC compatible shape file format.

The shape files shall consist of four mandatory files, all of which must be submitted as a cumulative shape file:

<filename>**.prj** The file that stores the coordinate system information. This file is the datum and projection coordinate system for the shape file.

1. The Datum for all shape files shall be North American Datum 1983 (NAD83).
2. The location coordinate system for all shape files shall be Universal Transverse Mercator (UTM Zone 11 or 12) projection (easting and northing) in meters.

<filename>**.shp** The main file that stores the geometry of the polygon;

<filename>**.shx** The file that stores the index of the polygon's geometry;

<filename>**.dbf** The dBASE table that stores the attribute information of the polygon.

There shall be a one-to-one relationship between geometry and attributes. Attribute records in the dBASE file must be in the same order as records in the main file.

The attribute file shall contain the field names and associated information described in the data dictionary (Table 10-7; Section 10.5.3.7).

Original shape files shall accompany the UP performance survey annual reporting package submitted to Forest Management Branch by May 15.

10.5.1.2 Standards for Aerial Photography

The Standards for the acquisition of aerial photography shall follow the *General Specifications for Acquiring Aerial Photography (March 2014)*[33].

Aerial photography acquired for the purpose of UP performance surveys must be digital and must meet or exceed a 20 cm digital direct, 4 band (RGB) resolution captured with IMU/GPS.

10.5.2 Stratification

Stratification of Understory Protection openings is a simplified process relative to 'standard' RSA performance surveys. For UP performance surveys, interpreters are required to delineate the Net Assessment Area (NAA) by netting out any land use dispositions or natural deletions.

[33] http://aep.alberta.ca/forms-maps-services/maps/resource-data-product-catalogue/documents/GeneralSpecsAcquiringAerialPhoto-2014.pdf

The identification and stratification of Sampling Units and/or Poorly Regenerated Areas is not required as part of this survey system.

10.5.2.1 Opening Boundaries

Stratification shall be completed within opening boundaries. Ensuring that opening boundaries are complete and accurate is a fundamental requirement of all reforestation surveys.

There may be instances where the shape file boundaries do not line up with the Softcopy image either because the opening boundary appears to have shifted or portions of the opening boundary appear to be incorrect (e.g., un-harvested areas within the opening boundaries, harvested areas that are clearly part of the opening but outside of the boundary). Interpreters shall use the following guidelines when re-drawing opening boundaries:

- Where the opening boundary appears to have shifted, the opening boundary shall be re-drawn.
- Where portions of the opening boundary appear to include areas of un-harvested trees from an adjacent mature stand, the opening boundary shall be re-drawn to exclude those portions. Note that any uncut buffer strips that form part of the Understory Protection area (see Table 10-1 and Figure 10-1) shall be considered part of the opening.
- Where portions of the opening boundary appear to exclude harvested areas which are clearly part of the opening, the opening boundary shall be re-drawn to include those portions.
- Where portions of the opening boundary appear to either include or exclude harvested areas which may or may not be part of the opening, care must be taken to ensure the adjacent area is actually part of the original harvest area. This situation may occur where two openings of similar age are adjacent to one another. Interpreters shall consult with timber disposition holders to obtain more information **before** any changes are made.
- Where land use dispositions straddle opening boundaries, the opening boundaries shall not be re-drawn. The portions of the land use within openings shall be netted out using the methods described in Section 10.5.2.3.

Other spatial layers (e.g., AVI layer, complete opening layer) shall be used to assist interpreters with re-drawing opening boundaries.

Overlap of opening boundaries within and among timber dispositions or land use dispositions is not permitted. Conversely, areas clearly harvested and associated with two or more openings but not part of any opening are not permitted.

These types of boundary issues found as a result of an audit completed by the department will result in the UP performance survey being deemed unacceptable. Subdivision of openings due to these boundary issues is not permitted.

Opening boundaries that cross administrative units (FMA or FMU with different Forest Management Plans) shall be re-drawn to correspond with the administrative unit boundary. This is necessary because there are specific forest management assumptions associated with each administrative unit.

Where boundaries have been re-drawn, interpreters shall document, on an opening by opening basis, their justification for the new opening boundaries together with the area difference

between the boundary area supplied by the timber disposition holder and the re-drawn boundary area. Only include those openings where the boundary area changes are greater than 0.5 ha or 5%, whichever is smaller. The documentation and rationale are necessary for audit purposes and shall be included in the Summary Report (Section 10.12.2).

10.5.2.2 Recording Administrative Information

Interpreters shall record information on imagery, interpretation and polygons for all UP openings. A data dictionary is provided in Section 10.5.2.7, Table 10-7. References to applicable field names are provided in the following text.

10.5.2.2.1 Imagery

Interpreters shall record the date the image was captured and the season (leaf-off or leaf-on) the image was acquired. When recording imagery information, the applicable fields are "PHOTO_Y", "PHOTO_M", "PHOTO_D", and "LEAF".

10.5.2.2.2 Interpretation

Interpreters shall record the year and month of interpretation and their full name (first name first then surname). When recording interpretation information, the applicable fields are "INTRP_Y", INTRP_M", and "INTRP".

10.5.2.2.3 Unique Polygon Identifier

The interpreter shall record the opening number, polygon number, unique identifier and area for each polygon. Each netted out land use disposition and natural deletion shall be assigned a unique polygon number.

For example, if an Understory Protection opening has one netted out natural deletion, one land use disposition, as well as the Understory Protection area, there would be three unique polygon numbers reported for the opening.

When recording unique polygon identifier information, the applicable fields are "OPENING", "POLYGON", "UNIQUE_ID" and "AREA_HA".

10.5.2.3 Delineating the Net Assessment Area (NAA)

In most cases, land use dispositions and natural deletions will have been netted out of the opening area by the timber disposition holder prior to the opening stratification process.

Where land use dispositions and natural deletions (Table 10-4) have not been netted out of the opening, interpreters shall remove these features using the following guidelines:

- Land use dispositions that have resulted in landbase withdrawals shall be netted out, regardless of size, status of clearing or extent of re-vegetation.
- Natural deletions ≥0.5 ha in size, regardless of width, shall be netted out. Uncut buffers within the Understory Protection area (Table 10-1) are not considered natural deletions.
- Where the spatial layer containing land use dispositions or natural deletions has shifted, the boundaries shall be re-drawn.

- Interpreters shall use the most current information when netting out land use. For example, the spatial land use layer may be dated. Interpreters may use other more current sources of documentation to assist with netting out land use dispositions. For audit purposes, these other sources of information, when used, shall be retained and made available to Alberta upon request.

Each net down polygon shall be assigned a unique number (Field "POLYGON"). A code shall be assigned to polygons delineated and removed from the opening (Table 10-4) (Field "NAA").

The area remaining within the opening after the net down process defines the NAA.

Table 10-4. Net Assessment Area, Anthropogenic and Natural Deletion Codes

Category	Code	Description
Net Assessment Area	0	Net Assessment Area
Anthropogenic	1	Any of: MLL – Miscellaneous Lease (campsite, sand and gravel, etc.) PLA – Pipeline Agreement LOC – Licence of Occupation Road Well site Archaeological and historic sites Permanent sample plots or other research areas (covered under a protective notation)
Natural	2	Riparian areas and uncut buffers (0.5 ha or larger) Uncut patches within the opening (0.5 ha or larger) Note: Any uncut buffers that form part of the Understory Protection area (Table 10-1) are not considered natural deletions.

10.5.2.4 Determining Area and Proportion of Protected and Unprotected Areas within NAA

Interpreters shall determine the area (hectares) and proportion (%) of the NAA that is comprised of protected and unprotected areas (Table 10-1). For the UP performance survey, protected and unprotected areas are each referred to as "treatment units".

The protected area treatment unit includes all reach areas and buffers (Table 10-1). The unprotected area treatment unit includes all extraction trails, embedded or adjacent roads, landings and backlines and any embedded or adjacent clearcut areas less than two hectares in size (Table 10-1).

The determination of the area and proportion of protected/unprotected treatment units shall be made for every UP opening and shall be completed by considering where C^{UP} trees (Table 10-1; Figure 10-1) were retained or removed during UP harvesting operations.

There is no requirement to delineate each protected/unprotected area within UP openings. Instead, interpreters should measure several transects in each UP opening to determine the proportion and area of the opening made up of protected vs. unprotected treatment units. It is important that interpreters ensure all transects are located in areas that are representative of the entire opening.

There is no requirement to delineate or report on the area or proportion of the NAA within each individual disturbance type (reach area, extraction trail, roads, etc.).

The applicable fields are “OPENING”, “POLYGON”, “UNIQUE_ID”, “TRT_UNIT”, “AREA_HA” and “PROPORTION”.

10.5.2.5 Silviculture Records and Field Calibration

Timber disposition holders shall provide harvest and silviculture records to interpreters to assist interpreters with making informed decisions.

Interpreters shall undertake field calibration. Since Understory Protection openings are often more challenging to interpret than openings harvested via clearcut harvesting, interpreters carrying out UP interpretation are strongly encouraged to calibrate themselves on a subset of openings harvested with Understory Protection techniques.

Interpreters may establish plots and collect data or simply walk through the opening. The amount of field verification can vary, but must be sufficient to enable interpreters to make reasonable and consistent interpretations. The specific requirements for interpreter field verification are left to the discretion of the interpreter and the timber disposition holder.

10.5.2.6 Recording Attribute Information

Interpreters shall record attribute information for the tree species composition and tree species composition class of each UP opening for strata balancing purposes. A data dictionary is provided in Section 10.5.2.7, Table 10-7. References to applicable field names are provided in the following text.

10.5.2.6.1 Tree Species Composition and Tree Species Composition Class

Timber disposition holders are required to report on the species composition and the species composition class of all Understory Protection openings being assessed with a performance survey. These assessments shall be done at the opening level and should include trees in both the protected and unprotected area treatment units (C^{UP} and $C^{REGEN+D}$ trees). However, this assessment shall only include trees that are expected to be alive and merchantable at the time of final harvest, which means that deciduous trees older than the reforestation clock start date for the opening are not to be included in the opening-level assessment of species composition.

Species composition shall be based on the interpreted stocking for the opening and shall be recorded to the nearest 10%. Eligible tree species codes are listed in Table 10-5.

Tree species present within each opening shall be recorded in decreasing order of occurrence based on the stocking of acceptable trees. For example, if an opening is composed of 54% Sw, 26% Aw, and 20% Pl, then the species composition would be labeled as Sw5Aw3Pl2.

Where an opening has two or more species of the same stocking, the order shall be based on the species that is interpreted to have the greater absolute density.

Table 10-5. Tree species names and associated codes

Tree Species Names		
Common	**Scientific**	**Codes**
White spruce	*Picea glauca* (Moench) Voss[1]	Sw
Engelmann spruce	*Picea engelmannii* Parry ex Engel.	Se
Black spruce	*Picea mariana* (Mill.) BSP	Sb
Lodgepole pine	*Pinus contorta* Dougl. Ex Loud. var. *latifolia* Engelm.	Pl
Jack pine	*Pinus banksiana* Lamb.	Pj
Whitebark pine	*Pinus albicaulis* Engelm.	Pw
Limber pine	*Pinus flexilis* James	Pf
Balsam fir	*Abies balsamea* (L.)	Fb
Subalpine fir	*Abies lasiocarpa* (Hook.) Nutt.	Fa
Douglas-fir	*Pseudotsuga menziesii* (Mirb.)	Fd
Subalpine larch	*Larix lyallii* Parl.	La
Tamarack	*Larix laricina* (du Roi) K.Koch	Lt
Western larch	*Larix occidentalis* Nutt.	Lw
Trembling aspen	*Populus tremuloides* Michx.	Aw
Balsam poplar	*Populus balsamifera* L.	Pb
Paper birch	*Betula papyrifera* Marsh.	Bw

Species composition class shall also be assessed at the opening level and shall be based on the ten tree species composition classes described in Table 10-6. These tree species composition classes correspond with the standardized base 10 strata described in the Alberta Forest Management Planning Standard.

Tree species proportions used to define tree species composition classes should be based on interpreted stocking of acceptable trees.

Note that species composition class should only include trees that are expected to be alive and merchantable at the time of final harvest, which means that deciduous trees that are older than the reforestation clock start date for the opening are not to be included in the opening-level assessment of species composition class.

When recording species composition information, the applicable fields are “SP1”, “SP1_PER”, “SP2”, “SP2_PER”, “SP3”, “SP3_PER”, “SP4”, “SP4_PER”, “SP5”, “SP5_PER” and “SP_CL”.

Table 10-6. Tree species composition class definitions

Tree species composition class	Coniferous tree percent (stocking based)	Leading coniferous tree species (stocking based)
Hw	0-20	N/A
HwPl	30-50	Pine
HwSx	30-50	Spruce
SwHw	50-70	White spruce
PlHw	50-70	Pine
SbHw	50-70	Black spruce
Sw	80-100	White spruce
Pl	80-100	Pine
Sb	80-100	Black spruce
Fd	80-100	Douglas-fir

Pine = Pl, Pj, Pw, Pf, Lt, La, Lw; Spruce = Sw, Sb, Se, Fb, Fa; White spruce = Sw, Se, Fb, Fa; Black spruce = Sb; Hardwood = Aw, Pb, Bw; Douglas-fir = Fd

10.5.2.7 Standardized Attribute Data Dictionary

A standardized data format must be used to record UP opening attributes. The field names, formats, descriptions and allowable codes are provided below in Table 10-7.

Attributes shall be recorded in a flat file format with one row per polygon.

10.5.2.8 Spatial Data Format Standards

The format for the spatial data (stratification line-work) shall be in Environmental System Research Institute (ESRI) Arc compatible format. Acceptable formats are:

- Shape file (*.shp, *.shx., *.dbf, *.prj); or
- Geodatabase.

Spatial data shall be submitted in the North American Datum 1983 (NAD83) in the appropriate projection system: UTM Zone 11N or UTM Zone 12N in meters. Where opening data spans a UTM boundary, the data shall be referenced to the zone in which the majority of the opening occurs unless the feature extends more than 0.5 km into the other zone. Where this occurs, the data should be divided into distinct datasets within its own projection zone.

Table 10-7. Aerial photo interpretation data dictionary

Field Name	Format	Description	Note
PHOTO_Y	4.0	Year of photography	Example: 2008, 2009, etc. (no blanks allowed)
PHOTO_M	2.0	Month of photography	Eligible codes: 1 to 12
PHOTO_D	2.0	Day of photography	Eligible codes: 1 to 31
LEAF	$8.0	Season of photography	Eligible codes: leaf-on, leaf-off
INTRP_Y	4.0	Year of interpretation	Example: 2008, 2009, etc. (no blanks allowed)
INTRP_M	2.0	Month of interpretation	Eligible codes: 1 to 31
INTRP	$20.0	Name of interpreter	Example: Reginald Loomis (no blanks allowed)
OPENING	$11.0	Opening number consistent with ARIS	Example: 423075229A (no blanks allowed)
POLYGON	$3.0	Unique polygon number within an opening	Example: 001, 002, 003 (no blanks allowed)
UNIQUE_ID	$16.0	Unique identifier made up of opening number and polygon	Example: 423075229A_001 (no blanks allowed)
AREA_HA	7.2	Area (ha) of polygon or treatment unit	Eligible codes: 0.01 to 9999.99
NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, 2
TRT_UNIT	$5.0	Treatment Unit PRO=protected area; UNPRO=unprotected area	Eligible codes: PRO or UNPRO (no blanks allowed)
PROPORTION	2.1	Proportion of NAA in each treatment unit	Eligible codes: 0.1 to 99.9
SP1	$2.0	Species code of most dominant species	Eligible codes: blank, Sw, Se, Sb, Pl, Pj, Pw, Pf, Fb, Fa, Fd, La, Lt, Lw, Aw, Pb, Bw, P, A
SP1_PER	2.0	SP1's contribution to species composition; to nearest 10%	Eligible codes: 0, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP2	$2.0	Species code of second most dominant species	Eligible codes: blank, Sw, Se, Sb, Pl, Pj, Pw, Pf, Fb, Fa, Fd, La, Lt, Lw, Aw, Pb, Bw, P, A
SP2_PER	2.0	SP2's contribution to species composition; to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP3	$2.0	Species code of third most dominant species	Eligible codes: blank, Sw, Se, Sb, Pl, Pj, Pw, Pf, Fb, Fa, Fd, La, Lt, Lw, Aw, Pb, Bw, P, A
SP3_PER	2.0	SP3's contribution to species composition; to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP4	$2.0	Species code of fourth most dominant species	Eligible codes: blank, Sw, Se, Sb, Pl, Pj, Pw, Pf, Fb, Fa, Fd, La, Lt, Lw, Aw, Pb, Bw, P, A
SP4_PER	2.0	SP4's contribution to species composition; to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP5	$2.0	Species code of fifth most dominant species	Eligible codes: blank, Sw, Se, Sb, Pl, Pj, Pw, Pf, Fb, Fa, Fd, La, Lt, Lw, Aw, Pb, Bw, P, A
SP5_PER	2.0	SP5's contribution to species composition; to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP_CL	$4.0	Species composition class	Eligible codes: Hw, HwPl, HwSx, SwHw, PlHw, SbHw, Sw, Pl, Sb, Fd

10.6 Understory Protection Performance Survey Stocking Standards

Understory Protection openings each have two separate stocking standards: C^{UP} stocking and total opening-level stocking (C^{UP} + $C^{REGEN+D}$ stocking; see Table 10-1). For an Understory Protection opening to be considered Satisfactorily Restocked (SR), the opening must achieve both the C^{UP} and total opening-level stocking standards.

10.6.1 C^{UP} Stocking Standards

C^{UP} stocking standards must be developed by each timber disposition holder undertaking Understory Protection harvesting. The C^{UP} stocking standard shall be Sustained Yield Unit (SYU)-specific and is expected to be directly linked to the assumptions made during the development of UP yield curves. If timber disposition holders elect to develop multiple UP yield curves, each yield curve shall have an associated C^{UP} stocking standard.

Trees that contribute to the determination of C^{UP} stocking shall be acceptable coniferous trees that meet or exceed the SYU-specific minimum height threshold (Section 10.6.3).

The C^{UP} stocking standard will apply to the entire UP opening, but will be area-weighted to the proportion of the opening where understory was protected (protected area comprised of reach areas and buffers, see Section 10.5.2.4). As such, C^{UP} stocking standards will vary among openings due to differing proportions of observed protected and unprotected areas.

The calculation of opening-specific C^{UP} stocking standards shall be included in the aerial photography results that are required as part of the annual May 15 reporting package submitted to Forest Management Branch (Section 10.12).

All stocking standards shall be rounded up to the nearest whole number.

All SYU-specific C^{UP} stocking standards must be approved in writing by Forest Management Branch prior to use.

Box 10-1: How to calculate the C^{UP} stocking standard

Opening A		*Opening B*	
C^{UP} stocking standard for SYU:	*75%*	*C^{UP} stocking standard for SYU:*	*75%*
% of opening in protected area:	*55%*	*% of opening in protected area:*	*40%*
C^{UP} stocking standard for opening A:	*42%*	*C^{UP} stocking standard for opening B:*	*30%*
(0.75 x 0.55 = 0.4125 = 42%)		*(0.75 x 0.40 = 0.30 = 30%)*	

10.6.2 Total Opening-Level Stocking Standards

The total opening-level stocking standard is the minimum total tree stocking required across an entire UP opening.

This stocking metric includes acceptable coniferous trees above the minimum height threshold (C^{UP}, Section 10.6.3), as well as acceptable coniferous trees below the minimum height threshold

(and above the minimum acceptable coniferous tree height specified in Table 10-8) and acceptable deciduous trees across the entire opening ($C^{REGEN+D}$). To calculate total opening-level stocking, both the C^{UP} and $C^{REGEN+D}$ metrics shall be area-weighted to the proportion of the opening that was protected or unprotected, respectively, and the values shall be added together.

There is no minimum stocking standard associated with $C^{REGEN+D}$ trees. However, unless otherwise approved, the $C^{REGEN+D}$ stocking expectation to be used in the calculation of total opening-level stocking standards shall be 80% in the unprotected area.

The calculation of opening-specific total opening-level stocking standards shall be included in the aerial photography results that are required as part of the annual May 15 reporting package submitted to Forest Management Branch (Section 10.12).

All stocking standards shall be rounded up to the nearest whole number.

See example calculations below.

Table 10-8. Minimum acceptable coniferous and deciduous tree height requirements

Tree Species Group	Minimum Acceptable Height (cm)
Coniferous	30
Deciduous	130

Box 10-2: How to calculate the total opening-level stocking standard

Opening A

C^{UP} stocking standard for SYU: 75%
% of opening in protected area: 55%

C^{UP} stocking standard opening A: 42%
(0.75 x 0.55 = 0.4125 = 42%)

$C^{REGEN+D}$ stocking expectation: 80%
% of opening in unprotected area: 45%

$C^{REGEN+D}$ stocking expectation opening A:36%
(0.80 x 0.45 = 0.36 = 36%)

Total opening-level stocking standard: 78%
(42% + 36% = 78%)

Opening B

C^{UP} stocking standard for SYU: 75%
% of opening in protected area: 40%

C^{UP} stocking standard opening B: 30%
(0.75 x 0.40 = 0.30 = 30%)

$C^{REGEN+D}$ stocking expectation: 80%
% of opening in unprotected area: 60%

$C^{REGEN+D}$ stocking expectation opening B: 48%
(0.80 x 0.60 = 0.48 = 48%)

Total opening-level stocking standard: 78%
(30% + 48% = 78%)

10.6.3 Minimum Height Thresholds

In order to differentiate between trees that will contribute to C^{UP} stocking from those that will contribute to $C^{REGEN+D}$ stocking, all timber disposition holders must develop one or more minimum height thresholds. All acceptable coniferous trees that meet or exceed the minimum

height threshold will contribute to C^{UP} stocking, whereas acceptable coniferous trees below the minimum threshold and above the minimum acceptable coniferous tree height (Table 10-8) will contribute to $C^{REGEN+D}$ stocking. All acceptable deciduous trees that achieve at least the minimum acceptable deciduous tree height (Table 10-8) will contribute to $C^{REGEN+D}$ stocking.

Minimum height thresholds must be directly linked to the assumptions made during the development of UP yield curves. Depending on the UP yield assumptions, each C^{UP} stocking standard may require an individual minimum height threshold.

The minimum height threshold(s) used in the Understory Protection performance survey must incorporate the expected growth rates that inform the UP yield assumptions (yield curves). As such, the minimum height threshold identified for use in the Understory Protection performance survey must be greater than the thresholds identified for use in the Understory Protection establishment survey.

All minimum height thresholds must be approved in writing by Forest Management Branch prior to use.

10.6.4 Acceptable Trees

The C^{UP} and total opening-level stocking status of each UP opening shall be determined by assessing the spatial distribution of acceptable trees.

An acceptable tree is an individual seedling, sucker, coppice or advanced regeneration that:

- Is alive; and
- Is an acceptable tree species (SYU- and yield curve-specific, Appendix 3); and
- Has been on site for a minimum of two growing seasons[34]; and
- Originated from seed, suckering, coppice or layering (Sb); and
- Achieved the minimum coniferous or deciduous tree height requirement at the time of survey (Table 10-8); and
- Is expected to survive until the final stand harvest, i.e., deciduous trees older than the reforestation clock start date for the opening shall not be considered acceptable trees.

In addition to the criteria above,

- Acceptable coniferous trees shall have:
  - A well-defined stem; and
  - Two or fewer stems originating at the base of the tree; and
  - White and Engelmann spruce and fir trees shall have a live-crown ratio[35] of 0.33 or greater.
- Acceptable C^{UP} trees must also achieve the following:

[34] A growing season is defined as the period between June 21 and August 1 annually

[35] Live crown ratio is the proportion of total stem length that is covered by living branches. It is expressed as a percentage or decimal of the total tree height. Live crown ratio is a useful indicator of the status of the tree in relation to vigour and photosynthetic leaf area, and is inversely related to stocking density. It is assumed that live crown ratio must be greater than 0.33 (33%) in order for the tree to release well following partial harvesting.

- Meet or exceed the minimum height threshold (Section 10.6.3); and
- Have less than 25% of the live crown lost due to top breakage; and
- Have no bole scars (bark removed to cambium) greater than 10 cm in length (vertical) or greater than 20% of the bole circumference.

10.6.5 Choice of Performance Survey Method

Understory Protection openings due for a performance survey shall be assessed once, at minimum, using the following survey methods:

- Aerial reconnaissance survey; and/ or
- Intensive survey.

Both survey methods determine the adequacy of the Understory Protection treatment and the post-harvest regeneration and subsequent tree growth and survival. Results from aerial reconnaissance surveys shall be used to determine if subsequent intensive surveys are necessary.

Intensive survey protocols shall be used as the quality assessment and quality control (QA/QC) procedure for timber disposition holders to 'field check' the results of aerial reconnaissance surveys.

Because regenerating Understory Protection stands are complex, a minimum of 50% of openings assessed with an aerial reconnaissance performance survey must also receive an intensive performance survey to confirm the survey observations. This requirement will be in place for at least the first three years that a timber disposition holder or forestry consultant carries out the UP performance survey protocol. The 50% audit requirement will be reassessed on a case-by-case basis following the initial three year implementation period (see also Section 10.12.6).

10.7 Aerial Reconnaissance Performance Surveys

10.7.1 Procedures

Aerial reconnaissance surveys are visual evaluations of openings by qualified surveyors to determine C^{UP} and total opening-level stocking. This survey is conducted by flying over the opening.

The entire opening shall be evaluated to adequately assess the spatial distribution of acceptable coniferous and deciduous trees. Aerial reconnaissance surveys shall have opening level information recorded in the Acceptable Stocking Summary component of the Understory Protection Performance Survey Summary Sheet (Section 10.13) including:

- Acceptable C^{UP} stocking (%); and
- Acceptable total opening-level stocking (%).

While conducting aerial reconnaissance surveys, surveyors shall delineate areas:

- Classified as land use dispositions (Section 10.5.2.3); and
- Classified as natural deletions (Section 10.5.2.3).

In most cases, the land use and natural deletions will have been removed at the photo interpretation phase of the UP performance survey; surveyors are only required to delineate any new natural deletions or land-use dispositions that were not identified during photo interpretation. Both land use and natural deletions shall be withdrawn from the area of the opening.

Where there are natural deletions or land-use dispositions, these shall be reported using the Understory Protection Performance Survey Field Map Sheet (Section 10.13) or produced using GIS (i.e., a block map).

Where there are no natural deletions or land-use dispositions to report for an opening, the submission of an Understory Protection Performance Survey Field Map Sheet is not required.

10.7.2 Outcome and Next Course of Action

Subject to the outcome of an aerial reconnaissance performance survey, Understory Protection openings shall be assigned to one of the following categories:

a. C^{UP} stocking and total opening-level stocking are both significantly below their respective stocking standards (at least 10 percentage points below the standard); or

b. C^{UP} stocking and/ or total opening-level stocking are slightly above or slightly below their respective stocking standards (less than 10 percentage points below the standard, and less than 4 percentage points above the standard); or

c. C^{UP} stocking and total opening-level stocking are both significantly greater than their respective stocking standards (at least 4 percentage points above the standard).

See examples below.

Box 10-3: C^{UP} and total opening-level stocking standard outcomes

Example 1 – C^{UP} stocking standard is 42%

Survey results are:

- *Clearly below C^{UP} stocking standard (scenario a above): 32% stocking or lower*
- *Slightly above/ below C^{UP} stocking standard (scenario b above): greater than 32% stocking but less than 46% stocking*
- *Significantly above C^{UP} stocking standard (scenario c above): 46% stocking or greater*

Example 2 – Total opening-level stocking standard is 78%

Survey results are:

- *Clearly below total opening-level stocking standard (scenario a above): 68% stocking or lower*
- *Slightly above/ below total opening-level stocking standard (scenario b above): greater than 68% stocking but less than 82% stocking*
- *Significantly above total opening-level stocking standard (scenario c above): 82% stocking or greater*

Where C^{UP} stocking and total opening-level stocking for an opening is scenario 'a' or 'c' above, an intensive survey is not required.

Where C^{UP} stocking or total opening-level stocking for an opening is scenario 'b' above, an intensive survey is required (Section 10.8). The results from the intensive survey shall be used to report the opening stocking and reforestation status to Alberta.

10.8 Intensive Performance Surveys

Intensive performance surveys shall be conducted:

- In lieu of aerial reconnaissance performance surveys; or
- When the C^{UP} and/ or total opening-level stocking assessed by an aerial reconnaissance performance survey is in the 'grey' area between Satisfactorily Restocked (SR) and Not Satisfactorily Restocked (NSR) (less than 10 percentage points below, and less than 4 percentage points above the stocking standard); and/ or
- As the QA/QC procedure for timber disposition holders to 'field check' the results of aerial reconnaissance performance surveys[36].

Intensive surveys use systematic survey methods to collect data in 10 m^2 (1.78 m radius) and 50 m^2 (3.99 m radius) nested circular plots. The 10 m^2 and 50 m^2 plots shall share a common plot centre. The procedures for completing intensive surveys are:

- Determine the sampling intensity (i.e., number of plot centres required);
- Calculate the survey grid line and plot centre spacing;
- Layout transects and plot centre locations in the field;
- Assess the 10 m^2 and 50 m^2 plots; and
- Calculate C^{UP} and total opening-level stocking.

10.8.1 Determining Sampling Intensity

Sample intensity requirements are specified in Table 10-9. The statistical accuracy of total opening-level acceptable tree stocking, based on these sample intensities, varies by opening size but is generally within 10 to 15% with a 95% confidence (Appendix 5 and 6).

[36]During at least the first three years that a timber disposition holder or forestry consultant implements this survey protocol, a minimum of 50% of openings assessed with aerial reconnaissance surveys must also receive an intensive survey to verify the survey observations (see also Section 10.12.6).

Table 10-9. Number of sample plot centres required by opening area (ha)

Opening Area (ha)	Number of plot centres required
0.1 – 1.9	Minimum of 12.4 plot centres per hectare
2.0 – 4.0	Minimum of 41 plot centres per opening Optional: If stocking is 7 percentage points or less below the standard, increase the number of plot locations to 54
4.1 – 24.0	Minimum of 64 plot centres per opening Optional: If stocking is 7 percentage points or less below the standard, increase the number of plot locations to 84
>24.0*	2.77 plot centres per hectare

*To determine the number of sample plot centres needed for openings > 24 ha in size, multiply the net area by 2.77 and round the product up to the nearest whole number.

Note that because this survey protocol utilizes nested plots, the number of plot centres required refers to the number of plot locations. Both a C^{UP} and a $C^{REGEN+D}$ plot must be completed at every plot centre location.

Box 10-4: Calculation of the minimum number of plot centre locations

Opening area: 26.4 ha

Required number of plot centre locations (from Table 10-9): 2.77 per hectare

Number of sample plot centre locations: 26.4 ha x 2.77 = 73.13

Round up to nearest whole number: 74

Minimum number of plot centre locations required: 74

10.8.2 Calculating Survey Grid Line and Plot Centre Spacing

When calculating line and plot centre spacing, two methods may be used:

- Square spacing; or
- Rectangular spacing.

Square spacing

Square spacing is a grid pattern where the distance between lines equals the distance between plot centres. When the total number of plot centres is determined and the area of the opening is known, the survey grid (plot and line spacing) can be calculated using the following formula:

$$\text{Plot center spacing} = \sqrt{(\text{Opening Area (ha)} \times 10{,}000\ m^2/\text{ha})/\text{requi red \# of Plots}}$$

Box 10-5: Calculation of square spacing

Opening area: 12.1 ha, calculate a square survey grid.

From Table 10-9, a 12.1 ha opening requires a minimum of 64 plot centre locations.

Calculate the plot spacing:

Plot spacing = $\sqrt{(\text{Opening Area (ha)} \times 10{,}000\ \text{m}^2/\text{ha}) / \text{required \# of plot centre locations}}$

Plot spacing = $\sqrt{(12.1 \times 10{,}000/64} = \sqrt{1890.625} = 43.48$

Round off to nearest 0.1m; line spacing = 43.5 m and plot centre spacing = 43.5 m

Appendix 7 lists calculated square line and plot centre spacing for openings of various sizes. For openings 24 ha or larger, a 60 m × 60 m square grid shall be used.

Rectangular spacing

Rectangular spacing occurs when the line spacing differs from plot centre spacing. The line spacing shall not be greater than twice the plot centre spacing. To calculate rectangular spacing, the desired line spacing is selected then the plot centre spacing needed to achieve the correct number of plots is calculated using the following formula:

$$\text{Plot centre spacing} \times \text{line spacing} = \frac{\text{Opening area (ha)} \times 10{,}000\ \text{m}^2/\text{ha}}{\text{Required \# of plot centre locations}}$$

For openings 24 ha and larger, a 60 m × 60 m square grid must be used.

Line and plot centre spacing shall be recorded on the Understory Protection Performance Survey Summary Sheet (Section 10.13).

Box 10-6: Calculation of rectangular spacing

Opening area: 3.9 ha, calculate a rectangular survey grid assuming a line spacing of 35 m.

From Table 10-9, a 3.9 ha opening requires a minimum of 41 plot centre locations.

Calculate the plot spacing:

$$\text{Plot centre spacing} \times \text{line spacing} = \frac{\text{Opening area (ha)} \times 10{,}000\ (m^2/ha)}{\text{Required \# plot centre locations}}$$

$$\text{Plot centre spacing} \times 35\ m = \frac{3.9\ ha \times 10{,}000 m^2/ha}{41\ plots}$$

$$\text{Plot centre spacing} = \frac{951.22}{35} = 27.1777\ m$$

Round off to nearest 0.1m; line spacing = 35.0 m and plot centre spacing = 27.2 m

10.8.3 Laying Out Transects and Plot Centre Locations in the Field

For each UP opening to be surveyed, one of two methods may be used to establish plot centre locations in the field:

1. Compass and horizontal distance measuring device; or
2. GPS to navigate to pre-determined plot locations generated using GIS.

When locating plot centres in the field using methods '1' (above), control line(s) must be used and shall be established as follows:

- Establish one control line that is offset approximately 20-30° from the orientation of the UP extraction trails (Figure 10-2). Additional parallel control lines shall be established every 400 m where opening widths exceed 400 m.
- The control line should be as close as possible to parallel to the long axis of the opening, wherever possible.
- The control line is best placed to coincide with the grid to enable points along the control line to be used as plot centres. Reference the control line in relation to the opening boundary to enable accurate mapping of the sample plot locations.
- Starting from the opening edge, the first survey line shall be located at one-half the interline distance. Each additional survey line is marked at the exact interline distance.
- Survey line intervals on the control line shall be double flagged using two different colours. The line and plot number shall be clearly written on the flagging.
- Beginning at the control line, the remaining individual plot centres shall be located at the required line and plot centre spacing. All measured distances must be based on horizontal or surface projections.

Note that the actual orientation angles of the control line(s)/ survey lines are not critical, provided neither the control line(s) nor the survey lines follow the UP extraction trails.

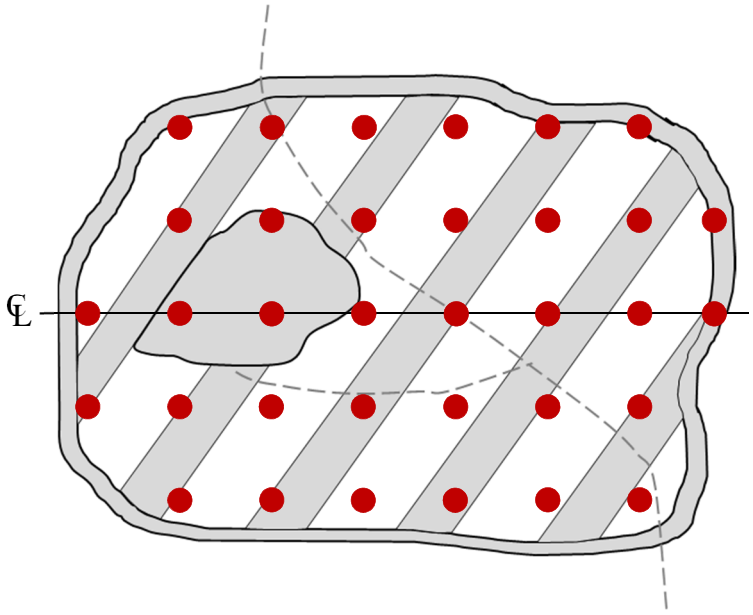


Figure 10-2. Sample plot centre distribution diagram

When locating plot centres in the field using method '2' (above), a control line is not required.

10.8.4 Deleting Plot Centre Locations

Areas within openings where plots are unnecessary include those areas under a land use disposition or classified as a natural deletion, as defined in the applicable Forest Management Plan.

Examples of land-use deletions include:

- Miscellaneous Lease (MLL) (e.g., campsite, sand and gravel);
- Pipeline Agreement (PLA);
- Licence of Occupation (LOC) road;
- Well Site (MSL);
- Archaeological and historic sites; and
- Permanent Sample Plots (PSP) or other research areas (ISP, DNR, PNT).

Examples of natural deletions include:

- Riparian areas (no stumps encountered; ≥0.05 ha); and
- Treed retention patches within openings (no stumps encountered; ≥0.5 ha).

Any uncut buffers that form part of an Understory Protection harvest are not considered natural deletions.

Where, prior to beginning the survey, an area is known to be within a land use disposition or natural deletion, the area shall be deleted from the opening and the plot centre spacing shall be calculated using the reduced area.

As plot centres are being located in an opening, any plot location landing in a deletion area may be established for grid reference purposes but shall not be measured. If the area of the deletion is correct, the proper number of plot centres to fill the opening should be obtained without moving any plots.

Plot centres landing on seismic lines shall not be moved or deleted unless the area of the seismic line has been removed from the opening (i.e., FMP landbase deletion).

10.8.5 Moving Plot Centre Locations

Where surveyors encounter new land use dispositions or natural deletions whose areas were not deleted from the opening area at the time the grid was calculated, the line and plot centre spacing may be set to a wider spacing to avoid the deletion and still achieve the required number of plot locations. In these cases, the plot centre shall be moved half the plot spacing distance toward the next plot centre location.

Should the plot location continue to land on the disposition or natural deletion, surveyors shall continue to move at one half the plot centre distance intervals until a plot can be established. The plot following a moved plot is to remain at the calculated line and plot centre spacing for the opening.

10.8.6 Adding Plot Centre Locations

A minimum number of plot centres shall be established within each opening to achieve the desired sampling precision (Table 10-9). If additional plot centres are required to make up this minimum number or if additional plot centres are added to confirm stocking that is just below the stocking standard (optional), they should be located as follows:

- Halfway between every third survey line (i.e., halfway between and parallel to the third and fourth survey lines, sixth and seventh lines, etc.).
- Plot centre spacing shall be the same on additional lines as for the original lines to facilitate delineation of stocked or poorly stocked areas.
- Where every third line does not add the required number of plot centres, proceed to add lines between other survey lines until the required number of plot centres is reached. Lines shall be marked on the control line and numbered sequentially (no letters).
- Lines added using the compass and distance measuring device method (this also applies to GPS when used as a compass and distance measuring device) shall be given the next number in the sequence. Use only whole positive numbers.
- Plot centres added using GPS as waypoints shall be given unique, whole positive numbers.

10.8.7 Plot Layout

Both a C^{UP} and a $C^{REGEN+D}$ plot shall be established at every plot centre location when conducting intensive Understory Protection performance surveys.

C^{UP} plots shall be 50 m^2 in size, with a plot radius of 3.99 m.

$C^{REGEN+D}$ plots shall be 10 m^2 in size, with a plot radius of 1.78 m.

In addition, the following is required for all plot locations:

- All plots shall be circular;
- The centre of the circle and the centres of both the C^{UP} and $C^{REGEN+D}$ plots shall be a common point;
- Plot centres shall be clearly marked in the field (e.g., wooden stick anchored in the ground) and must be sufficiently robust to last up to 18 months in the field;
- Flagging shall be attached to the centre marker with the plot identification number written legibly on the flagging using a black, waterproof marker pen; and
- To facilitate field checking, acceptable coniferous and deciduous trees that contributed to C^{UP} or $C^{REGEN+D}$ stocking shall be marked with flagging.

10.8.8 Assessing Plots

Assessments of C^{UP} and $C^{REGEN+D}$ plots shall be completed to determine the presence of acceptable coniferous and/ or deciduous trees (Table 10-10). Each plot type shall be assessed separately and the results of each plot shall be recorded on the Understory Protection Performance Survey Tally Sheet (Section 10.13).

The type of tally sheet will depend on the method that was used for laying out plots in the field, as described in Section 10.8.3. Methods '1' and '2' shall use Understory Protection Performance Survey Tally Sheet A, while method '3' shall use Understory Protection Performance Survey Tally Sheet B.

Table 10-10. Summary of intensive performance survey plot assessments

Required – C^{UP} plots (3.99 m radius)
Plot stocked with an acceptable coniferous tree that meets or exceeds the minimum height threshold
Required – $C^{REGEN+D}$ plots (1.78 m radius)
Plot stocked with an acceptable coniferous trees that meets or exceeds the minimum height threshold
Plot stocked with an acceptable coniferous tree below the minimum height threshold, but greater than or equal to the minimum acceptable coniferous tree height (Table 10-8)
Plot stocked with an acceptable deciduous tree greater than or equal to the minimum acceptable deciduous tree height (Table 10-8). Note that deciduous trees that are older than the reforestation clock start date for the opening shall not be considered acceptable trees because they are not expected to be alive and merchantable at the final stand harvest.

To determine if a tree main stem is inside a plot, surveyors are to measure from the point where the plot centre marker enters the ground to the tree in question. Depending on the type of plot being assessed, the specific rules to determine whether a tree is inside the plot are:

- C^{UP} plot: if any part of the tree is within the plot radius (3.99m), then the tree is in the plot.
- $C^{REGEN+D}$ plot: if the point of germination is within the plot radius (1.78m), then the tree is in the plot.

The point of germination is the point at which the coniferous or deciduous tree takes root and becomes established. For trembling aspen and balsam poplar stem sprouts, the point of germination is the point at which the sprout has originated on the original stump. If estimation is required, then assume the geometric centre of the main stem is the point of germination. For $C^{REGEN+D}$ plots, count the tree as within the plot when its point of germination is inside the plot, even if the tree is leaning outside. Conversely, do not count a tree leaning into the plot but with its point of germination outside the plot.

10.8.9 Adding Columns to the Survey Tally Sheet

Timber disposition holders may choose to add columns to the Understory Protection Performance Survey tally sheet to record other relevant information. Any data recorded in added columns do not form part of the requirements of the Understory Protection performance survey and are not required to be submitted to Alberta.

10.8.10 On-Site Stocking Confirmation (Optional)

After completing an intensive performance survey and while still at the opening, surveyors may choose to calculate C^{UP} and total opening-level stocking (Section 10.8.11). If C^{UP} or total opening-level stocking is slightly below the stocking standard (7 percentage points or less), surveyors have the option to increase the number of plots to confirm the stocking assessment. The required number of plots to confirm stocking is described in Table 10-9. The method for adding plots is described in Section 10.8.6.

10.8.11 Calculating Acceptable Tree Stocking

Understory Protection openings must each have two separate stocking results calculated and reported: C^{UP} stocking and total opening-level stocking. For an opening to be considered SR, the opening must achieve both the C^{UP} and total opening-level stocking standards.

Information about acceptable C^{UP} and total opening-level stocking shall be compiled for each opening on the Understory Protection Performance Survey Summary Sheet (Section 10.13) including:

- Number of C^{UP} plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold;
- Number of C^{UP} plots not stocked;
- Number of $C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree that meets or exceeds the minimum height threshold;
- Number of $C^{REGEN+D}$ plots stocked with an acceptable coniferous tree that is below the minimum height threshold;
- Number of $C^{REGEN+D}$ plots stocked with an acceptable deciduous tree;

- Number of $C^{REGEN+D}$ plots stocked with both an acceptable coniferous tree that is below the minimum height threshold and an acceptable deciduous tree;
- Number of $C^{REGEN+D}$ plots not stocked;
- Number of plot centre locations where both the C^{UP} and $C^{REGEN+D}$ plots are stocked with acceptable trees;
- Number of plot centre locations landing in areas not cut, within deletions or land-use dispositions; and
- Total number of eligible plot centre locations.

Based on these values, C^{UP} stocking and total opening-level stocking shall be calculated as follows, regardless of the opening-specific stocking standard.

10.8.11.1 Calculating C^{UP} Stocking

A C^{UP} plot (3.99 m radius) containing an acceptable coniferous tree that meets or exceeds the minimum height threshold shall count once towards the calculation of C^{UP} stocking. Therefore, C^{UP} stocking shall be calculated by dividing the total number of C^{UP} plots stocked with an acceptable C^{UP} tree by the total number of eligible plot locations and then multiplying by 100.

C^{UP} stocking is also required to be calculated in the $C^{REGEN+D}$ plots (1.78 m radius) and shall be calculated the same manner as described above.

Both calculations of C^{UP} stocking shall be reported on the Understory Protection Performance Survey Summary Sheet (Section 10.13); however, only the C^{UP} stocking recorded in the 50 m^2 C^{UP} plots should be reported to ARIS as the official C^{UP} stocking result. The C^{UP} stocking recorded in the $C^{REGEN+D}$ plots will be used for information only and may contribute to future refinements of this survey protocol.

10.8.11.2 Calculating Total Opening-Level Stocking

A $C^{REGEN+D}$ plot (1.78 m radius) containing an acceptable coniferous tree that is below the minimum height threshold, an acceptable deciduous tree or both shall count once towards the calculation of total opening-level stocking.

A C^{UP} plot (3.99 m radius) containing an acceptable coniferous tree that meets or exceeds the minimum height threshold shall count once towards the total opening-level stocking.

Each plot centre location may only count once toward total opening-level stocking. Therefore, the number of plot locations where both the C^{UP} and $C^{REGEN+D}$ plots are stocked with acceptable trees must be subtracted from the calculation of total opening-level stocking (this will eliminate double counting of stocked plot centre locations).

Therefore, total opening-level stocking shall be calculated by adding the number of stocked $C^{REGEN+D}$ plots to the number of stocked C^{UP} plots, subtracting the number of plot centre locations where both the $C^{REGEN+D}$ and C^{UP} plots were stocked, dividing by the total number of eligible plot centre locations and then multiplying by 100.

See example stocking calculation in Table 10-11.

Table 10-11. Example C^{UP} and total opening-level stocking calculation

Survey Metric	# Plots	% Plots
C^{UP} plots stocked with acceptable C^{UP} tree	58	41.1
C^{UP} plots not stocked	83	58.9
$C^{REGEN+D}$ plots stocked with an acceptable C^{UP} tree	17	12.1
$C^{REGEN+D}$ plots stocked with an acceptable C tree	49	34.8
$C^{REGEN+D}$ plots stocked with an acceptable D tree	30	21.3
$C^{REGEN+D}$ plots stocked an acceptable C and D tree	19	13.5
$C^{REGEN+D}$ plots not stocked with an acceptable C or D tree	43	30.5
Plot centre locations with stocked C^{UP} and $C^{REGEN+D}$ plots	42	29.8
Plot centre locations in areas that were not cut or deleted	1	-
Total eligible plot centre locations	141	-
Acceptable Stocking:		
C^{UP} stocking (in C^{UP} plots) = **41.1%***		
C^{UP} stocking (in $^{CREGEN+D}$ plots) = 12.1%		
Total opening-level stocking =41.1 + 34.8 + 21.3 + 13.5 - 29.8 = **80.9% ***		

*Results reported to ARIS

10.9 Understory Protection Performance Survey Map Sheet

Field maps shall be drawn on the Understory Protection Performance Survey Field Map Sheet (Section 10.13) or produced in an acceptable digital format (i.e., GIS block maps) and submitted to Alberta. For intensive surveys, plots shall be drawn on the map as surveyors progress through the opening. This will assist surveyors with mapping certain features of the opening and the status of the plots surveyed.

All maps submitted to Alberta shall contain all required information for each surveyed opening per Table 10-12.

If an intensive survey is completed, the map symbols shown in Table 10-13 shall be used. The larger exterior symbols indicate the status of the C^{UP} plot and the smaller interior symbols show the status of the $C^{REGEN+D}$ plots. A large and small symbol must be displayed at every plot location.

Table 10-12. Map sheet information requirements by survey type

Item	Survey Type	
	Aerial	Intensive
Opening boundary	✓	✓
Disposition holder	✓	✓
Disposition	✓	✓
Opening number	✓	✓
Field number	✓	✓
Map scale	✓	✓
Location of tie points		✓
Location and bearing of control lines		✓
Location of survey lines and plots		✓
Line and plot numbers		✓
Line and plot centre spacing		✓
Plot stocking status symbols		✓
GPS make, model and coordinate system (if used)	✓	✓
Location and size of land-use and natural deletions	✓	✓
North arrow	✓	✓

Table 10-13. Intensive survey map symbols and definitions

Symbol	Definition
	Plot centre location not cut or deleted
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot not stocked
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable C tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with an acceptable D tree
	C^{UP} plot not stocked and $C^{REGEN+D}$ plot stocked with both an acceptable C tree and an acceptable D tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot not stocked
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable C tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with an acceptable D tree
	C^{UP} plot stocked with an acceptable C^{UP} tree and $C^{REGEN+D}$ plot stocked with both an acceptable C tree and an acceptable D tree

10.10 Damage and Site Conditions

The extent of damage to acceptable C^{UP} or $C^{REGEN+D}$ trees by wind throw, logging damage, insects, disease, and/ or animals may be recorded for the opening using the Understory Protection Performance Survey Summary Sheet (Section 10.13). Space is also provided to record opening summary information specific to site conditions.

Recording damage and site condition information is optional but may be very important for determining why a particular opening may have failed to achieve the C^{UP} or total opening-level stocking standard.

10.11 Determining Opening Status

Based on the results from an Understory Protection performance survey, each opening will be assigned a stocking status of Satisfactorily Restocked (SR), Not Satisfactorily Restocked (NSR), Satisfactorily Restocked to the reduced C^{UP} standard (SRR) or Not Satisfactorily Restocked to the reduced C^{UP} standard (NSRR) (Figure 10-3).

If it becomes apparent that an opening will not achieve the full or reduced C^{UP} stocking standards during an intensive survey, the surveyors can elect to stop the UP performance survey before the entire opening is assessed. Under these circumstances, and per the direction of the timber disposition holder, the surveyors could instead complete a ‘standard’ non-photo RSA performance survey for the opening while they are still on site.

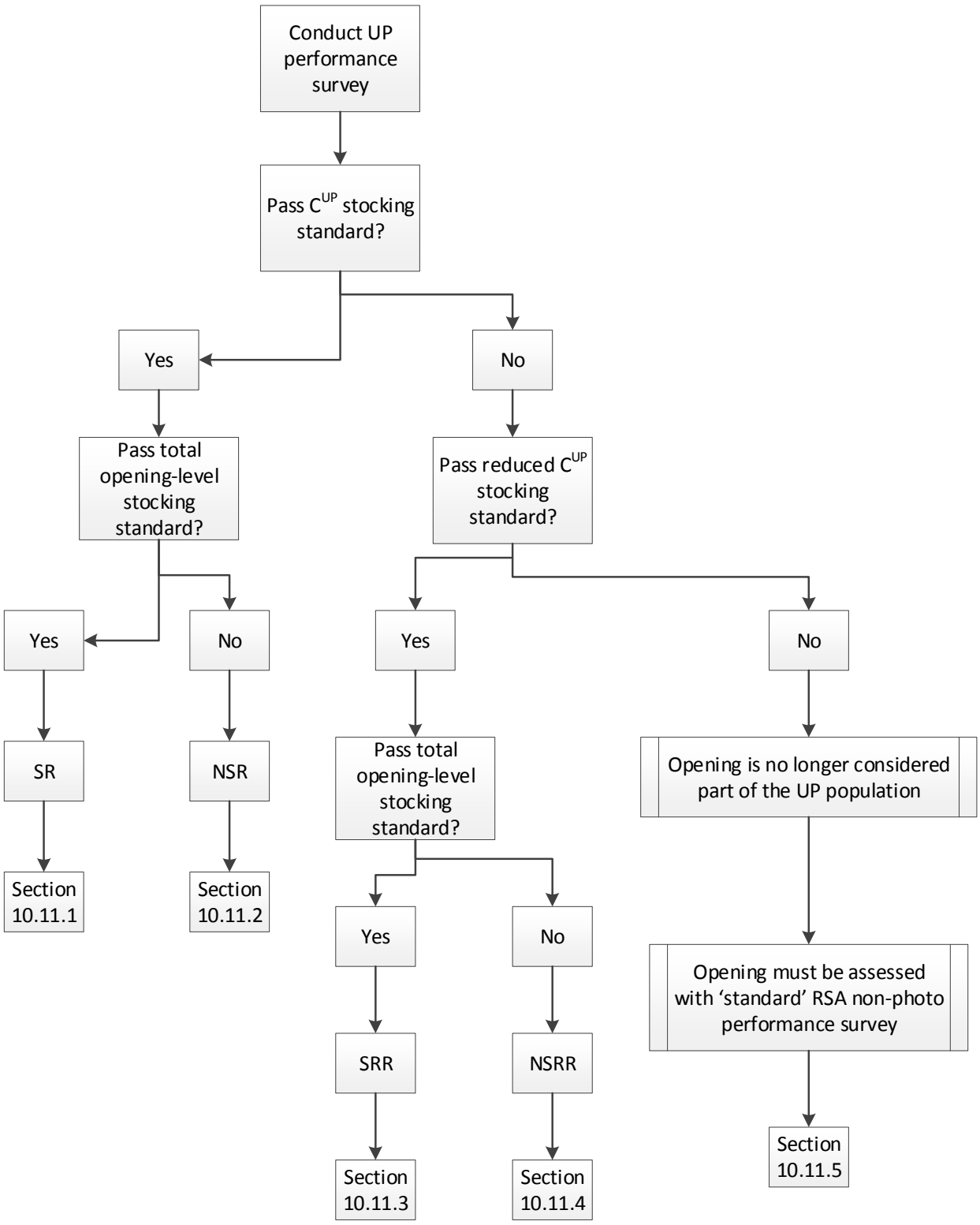


Figure 10-3. Process to determine the stocking status of an Understory Protection opening following a performance survey

10.11.1 Satisfactorily Restocked to Understory Protection Standard (SR)

If an opening meets or exceeds both the C^{UP} stocking standard and the total opening-level stocking standard, the opening shall be declared Satisfactorily Restocked (SR) (see example in Table 10-14).

When the opening is SR to the declared Understory Protection stratum, stratum re-declarations are not permitted.

10.11.2 Not Satisfactorily Restocked to Understory Protection Standard (NSR)

If an opening meets or exceeds the C^{UP} stocking standard, but fails to achieve the total opening-level stocking standard, the opening shall be declared Not Satisfactorily Restocked (NSR) (see example in Table 10-14).

Openings declared NSR to a UP stratum cannot be re-declared to an alternate non-UP stratum. If timber disposition holders have more than one approved Understory Protection yield curve (and associated landbase designation code), re-declaration to an alternate UP stratum may be permitted. Timber disposition holders shall use the Understory Protection Performance Survey Summary Sheet (Section 10.13) to briefly describe the rationale for any re-declaration requests. Any stratum re-declarations must be approved by Forest Management Branch prior to being implemented.

UP openings declared NSR following a performance survey do not require retreatment.

10.11.3 Satisfactorily Restocked to Reduced Understory Protection Standard (SRR)

If an opening does not achieve the C^{UP} stocking standard, the actual C^{UP} stocking result that was recorded in a given opening must be examined to determine the magnitude by which the C^{UP} stocking result failed to meet the standard.

If the C^{UP} stocking result is 50% or greater of the C^{UP} stocking standard, the opening shall still considered to be an Understory Protection opening, but at a reduced C^{UP} stocking level[37].

If timber disposition holders have developed more than one C^{UP} stocking standard, the assessment of the 50% reduced C^{UP} stocking threshold shall apply to all C^{UP} stocking standards. However, the assessment of whether an opening achieves the reduced C^{UP} stocking standard should first be completed for the C^{UP} stocking standard associated with the current stratum declaration. If the opening does not achieve that reduced standard, the survey results should then be compared against the reduced C^{UP} stocking standard associated with any other approved UP yield curves.

If an opening meets or exceeds a reduced C^{UP} stocking standard and the full total opening-level stocking standard, the opening shall be declared Satisfactorily Restocked to a reduced standard (SRR) (see example in Table 10-14).

[37] The threshold of 50% of the C^{UP} stocking standard for reduced C^{UP} stocking will be re-evaluated once this protocol has been in place for several years. This threshold is subject to change.

Openings that meet or exceed a reduced C^{UP} stocking standard cannot be re-declared to an alternate non-UP stratum. If timber disposition holders have more than one approved Understory Protection yield curve (and associated landbase designation code), re-declaration to an alternate UP stratum may be permitted. Timber disposition holders shall use the Understory Protection Performance Survey Summary Sheet (Section 10.13) to briefly describe the rationale for any re-declaration requests. Any stratum re-declarations of Understory Protection openings must be approved by Forest Management Branch prior to being implemented.

UP openings declared SRR following a performance survey do not require re-treatment.

10.11.4 Not Satisfactorily Restocked to Reduced Understory Protection Standard (NSRR)

If an opening meets or exceeds a reduced C^{UP} stocking standard, but fails to achieve the total opening-level stocking standard, the opening shall be declared Not Satisfactorily Restocked to the reduced standard (NSRR) (see example in Table 10-14).

Openings that meet or exceed a reduced C^{UP} stocking standard cannot be re-declared to an alternate non-UP stratum. If timber disposition holders have more than one approved Understory Protection yield curve (and associated landbase designation code), re-declaration to an alternate UP stratum may be permitted. Timber disposition holders shall use the Understory Protection Performance Survey Summary Sheet (Section 10.13) to briefly describe the rationale for any re-declaration requests. Any stratum re-declarations of Understory Protection openings must be approved by Forest Management Branch prior to being implemented.

UP openings declared NSRR following a performance survey do not require retreatment.

10.11.5 Openings that Fail to Achieve Reduced C^{UP} Stocking Standard

If an opening does not achieve at least 50% of any approved C^{UP} stocking standards for the SYU, then the opening would no longer be considered an Understory Protection opening.

Under this scenario, the timber disposition holder would be required to re-declare the opening to a non-UP stratum and complete a non-photo RSA performance survey. The timber disposition holder would be required to adhere to all requirements specified in Section 8 of the RSA for non-photo surveys. The results from the RSA performance survey are the results that are to be submitted to ARIS.

Table 10-14 shows some example UP opening stocking status and stratum declarations based on hypothetical performance survey results.

For these examples, the C^{UP} stocking standard is 42% and the total opening-level stocking standard is 78%.

Table 10-14. Example opening status declarations

C^{UP} stocking	Total opening level stocking	Opening status	Stratum
45%	85%	SR	UP
48%	70%	NSR	UP
31%	86%	SRR	UP
37%	69%	NSRR	UP
11%	87%	N/A*	Non-UP*
18%	60%	N/A*	Non-UP*

* Must complete a non-photo RSA performance survey and those results would be submitted to ARIS

10.12 Reporting

Understory Protection performance surveys shall be reported to Alberta on or before May 15 following the Timber Year in which they are completed.

Understory Protection performance survey information reported to Alberta (other than ARIS submissions) shall be:

- Digital; and
- Contain all the required components as described in Sections 10.12.1 to 10.12.3; and
- In a format as described below.

A complete and validated Reporting Checklist (Section 10.14) must accompany each Understory Protection performance survey submission to Forest Management Branch.

Understory Protection performance survey results must be submitted separately from 'standard' RSA performance surveys.

10.12.1 Aerial Photography

The acquisition and interpretation of aerial photography is a required component of all UP performance surveys. Therefore, information from the aerial photography program must be submitted for all openings that receive a UP performance survey.

The following components are required:

10.12.1.1 Photo Acquisition of Openings

The reporting requirements for the submission of openings is:

- Original shape files used to identify openings for photo acquisition according to the format described in Section 10.5.1.1; and
- Copies of all aerial photos used to determine the breakdown of protected and unprotected area treatment units and to calculate C^{UP} and $C^{REGEN+D}$ stocking standards in Portable Document Format (pdf).

10.12.1.2 Softcopy

The most common Softcopy systems used for performance surveys is Summit Evolution (DAT/EM), but other systems may also be acceptable. The digital format will be specific to the Softcopy system used.

The reporting requirements for the Softcopy component of the performance survey are:

- Image file(s); and
- Camera file(s); and
- Surface file(s) if used; and
- Project file(s).

These files must be made available to the department upon request.

10.12.1.3 Stratification and Interpretation

The reporting requirements for the stratification of the NAA component of UP performance surveys are:

- Stratification line-work spatial data for any openings with natural/land use deletions; and
- Attribute data (Section 10.5.2.7, Table 10-7)

Acceptable file formats for the stratification line-work spatial data are described in Section 10.5.2.8.

In order to perform a comprehensive audit of the interpretation component of UP performance surveys, the following information must be made available to the department upon request:

- Harvest and silviculture records used by the interpreters (as described in Section 10.5.2.5); and
- Field calibration data (as described in Section 10.5.2.5).

10.12.1.4 Protected and Unprotected Treatment Unit Breakdowns

The reporting requirements for the determination of area and proportion of protected and unprotected treatment units within each UP opening are opening-by-opening breakdowns of:

- Area (hectares) and proportion (%) of NAA comprised of protected area treatment units; and
- Area (hectares) and proportion (%) of NAA comprised of unprotected area treatment units.

This information can be presented on the pdf versions of the aerial photos submitted per Section 10.12.1.1 or in a Microsoft Excel spreadsheet.

10.12.1.5 C^{UP} and Total Opening-Level Stocking Standard Calculations

The reporting requirements for the calculation of C^{UP} and total opening-level stocking standards are:

- Opening-specific C^{UP} and total opening level stocking standard calculations that clearly demonstrate how the opening-specific stocking standards were calculated.

This information can be presented on the pdf versions of the aerial photos submitted per Section 10.12.1.1 or in a Microsoft Excel spreadsheet.

10.12.2 Summary Report

Timber disposition holders shall prepare and submit a Summary Report in Microsoft Word format or Portable Document Format (pdf). The Summary Report must include the following information:

1. **Opening boundaries or land use/ natural deletions that have been re-drawn**

   Where opening boundaries have been re-drawn, timber disposition holders shall document, on an opening-by-opening basis, their justification for the new opening boundaries, as well as the area difference between the boundary area supplied by the timber disposition holder and the re-drawn boundary area.

   Only include those openings where the opening area changes result in differences that are larger than 0.5 ha or 5%, whichever is smaller.

2. **Audited openings and corrective actions**

   Timber disposition holders shall list the openings where the results of the aerial reconnaissance survey were checked with an intensive survey. Note that at least 50% of aerially surveyed openings must be checked with an intensive survey for at least the first three years that the UP performance survey is being carried out (Section 10.12.6).

   Timber disposition holders shall also provide the results from each survey that was carried out, as well as a description of any corrective actions that were undertaken, if any. Timber disposition holders are expected to demonstrate continuous improvement.

3. **Summary of UP performance survey results**

   Timber disposition holders shall summarize the opening area that was assigned to each UP stocking status declaration outcome (SR, NSR, SRR or NSRR). This summary must include a brief rationale of why any openings did not achieve SR status to the declared UP stratum standards at the time of the UP performance survey.

4. **List of openings that are no longer considered part of the Understory Protection population**

   Timber disposition holders shall identify any openings that are being removed from the Understory Protection population. A brief rationale as to why these openings did not achieve the full or reduced C^{UP} standard must also be included.

10.12.3 Performance Survey Results

Results of UP performance surveys shall also be reported as described in Section 10.12.3.1 (Aerial Reconnaissance surveys) and Section 10.12.3.2 (Intensive surveys).

All required components of UP performance surveys shall be reported using a zip file sent to the following email address:

AF.RSA@gov.ab.ca

As the reporting requirements are different from RSA performance surveys, each UP performance survey submission must be sent separately from any RSA performance survey submissions being submitted for the same timber year.

The subject line for each email submission shall include the following information:

- Four letter ARIS stakeholder code (e.g., WBLL);
- FMA or FMU that defines the location of the openings (e.g., F11);
- Reporting timber year the program was completed (e.g., 2017-18); and
- Notation that the program was completed on Understory Protection openings (UP)

Prior to attaching the zip file to an email, it is important to change the file extension from *.zip to *.zipfile or *.zzz.

10.12.3.1 Aerial Reconnaissance Survey Results

An acceptable Understory Protection aerial reconnaissance survey reporting package for each opening shall include, at a minimum, a completed Understory Protection Performance Survey Summary Sheet, the results of the aerial photography interpretation process as described in Section 10.12.1, and a validated RFP reporting checklist (Section 10.14).

An Understory Protection Performance Survey Field Map Sheet is required for aerial reconnaissance surveys when natural deletions and/ or land-use dispositions have been delineated.

10.12.3.2 Intensive Survey Results

An acceptable Understory Protection intensive survey reporting package for each opening shall contain:

- A completed Understory Protection Performance Survey Summary Sheet;
- A completed Understory Protection Performance Survey Tally Sheet(s);
- A completed Understory Protection Performance Survey Field Map Sheet or other acceptable format;
- Aerial photography interpretation results as described in Section 10.12.1; and
- Validated RFP reporting checklist (Section 10.14).

10.12.4 Stewardship Reporting

Timber disposition holders that complete Understory Protection performance surveys are required to roll up and report on UP performance survey stocking status outcomes in the appropriate Stewardship Report.

This reporting shall include the total number of openings and opening area that has been declared:

- Satisfactorily Restocked (SR) to the UP stocking standards;
- Not Satisfactorily Restocked (NSR) to the UP stocking standards;

- Satisfactorily Restocked to a reduced C^{UP} stocking standard (SRR) ;
- Not Satisfactorily Restocked to a reduced C^{UP} stocking standard (NSRR); and
- To a non-UP stratum (regardless of any RSA performance survey outcomes).

The Stewardship Report shall also include rationale around why openings may have failed to achieve SR status to the declared UP stratum, as well as any corrective actions taken, as appropriate.

10.12.5 ARIS Submissions

For Understory Protection performance surveys, results submitted to the Alberta Regeneration Information System (ARIS) for each opening shall include:

- Status;
- Stratum;
- Acceptable C^{UP} stocking (%)[38];
- Acceptable total opening-level stocking (%); and
- Species composition label.

Where a reconnaissance survey and an intensive survey have been completed for the same opening, only the results of the intensive survey shall be reported to Alberta and submitted to ARIS.

If an opening is to be re-declared to a non-UP stratum, ARIS submissions must conform to the standards for the submission of performance survey results per Section 6.12.3 of the RSA.

10.12.6 Survey Quality

Alberta requires all performance survey information to be complete and accurate. Timber disposition holders shall ensure quality control systems are developed and being used (required since May 1, 2008). Quality control systems must include surveyor training, field auditing, and data validation.

Surveyors shall receive training specific to Understory Protection and the Sustained Yield Unit to ensure appropriate measurements are made and recorded.

Audits of openings and/or surveyors shall be conducted using check surveys carried out by qualified surveyors.

Because regenerating Understory Protection stands are complex, a minimum of 50% of openings assessed with an aerial reconnaissance survey must also receive an intensive survey to confirm the survey observations. This requirement will be in place for at least the first three years that a timber disposition holder or forestry consultant carries out the UP performance survey protocol. The 50% audit requirement will be reassessed on a case-by-case basis following the initial three year implementation period.

[38] Results from 3.99 m radius (50 m^2) plots only

Openings that were surveyed via an aerial reconnaissance survey and then field checked with an intensive survey shall be listed in the Summary Report (Section 12.2).

Audits shall focus on openings where the risk of error is highest.

10.13 Understory Protection Performance Survey Summary, Tally Sheets and Field Map

UNDERSTORY PROTECTION PERFORMANCE SURVEY SUMMARY SHEET

OPENING HEADER			
Disposition holder		Survey Type (Aerial or Intensive)	
Disposition		Timber Year of Cut (YYYY-YYYY)	
Forest Area		Natural Subregion	
Opening number		Ecosite (optional)	
Field number		Drainage class (optional)	
Opening area (ha)		Pre-harvest stratum	
Minimum height threshold (m)		Survey date (YYYY-MM-DD)	
Opening C^{UP} Stocking Standard (%)		Surveyor ID1	
Total Opening-Level Stocking Std (%)		Surveyor ID2	
Plot Centre Spacing (m)		Regenerated yield class stratum	
Line Spacing (m)			

STOCKING CALCULATIONS		
Plot Data	**# plots**	**% plots**
C^{UP} (3.99m) plots stocked		
C^{UP} plots not stocked		
$C^{REGEN+D}$ (1.78m) plots stocked with C^{UP} tree		
$C^{REGEN+D}$ plots stocked with C		
$C^{REGEN+D}$ plots stocked with D		
$C^{REGEN+D}$ plots stocked with C and D		
$C^{REGEN+D}$ plots not stocked		
Plot locations with stocked C^{UP} and $C^{REGEN+D}$ plots		
Plot locations not cut or deleted		
Total (excl not cut/ deleted plot locations)		

ACCEPTABLE STOCKING SUMMARY		
Acceptable C^{UP} stocking (%) - 1.78 m plot*		
Acceptable C^{UP} stocking (%) - 3.99 m plot		
Acceptable total opening-level stocking (%)		
Poorly stocked area (ha)		
Survey passes: Full C^{UP} std? Reduced C^{UP} std? Total opening level stocking std?		
UP stratum assignment		
Opening stocking status (circle one)	SR (UP)	SRR (UP)
	NSR (UP)	NSRR (UP)

Explanation if timber disposition holder is requesting to re-declare the opening to an alternate stratum

Damage:	Windthrow	% Extent	_____	Comments:	
	Logging damage	% Extent	_____	Comments:	
	Insect	% Extent	_____	Comments:	
	Disease	% Extent	_____	Comments:	
	Hare/Rodent	% Extent	_____	Comments:	
	Weeds:	% Extent	_____	Comments:	
	Other (specify)	% Extent	_____	Comments:	

Site Conditions: _____

Comments: _____

* Intensive surveys only

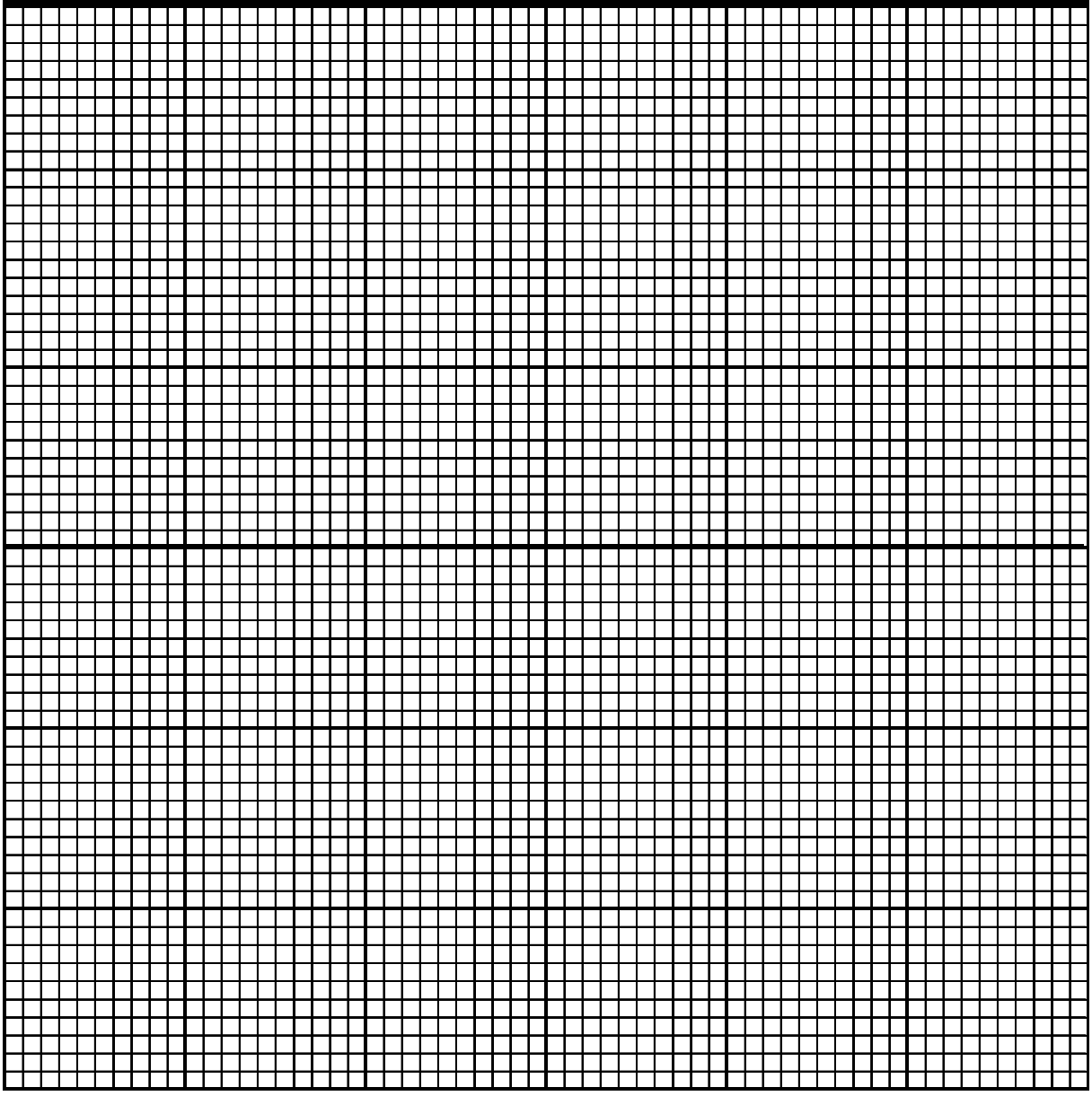
Table 10-15. Understory Protection Performance Survey Summary Sheet Opening Header data dictionary (all non-optional fields must be populated)

Field name	Description	Note
Disposition Holder	The company responsible for reforestation.	E.g., River City Timber Ltd.
Disposition	The FMA, license or permit number under which the opening was harvested.	E.g., FMA0900088, CTQA130010, DTAA090001, etc.
Forest Area	The Provincial administrative unit (Appendix 8).	E.g., NE1, etc.
Opening Number	Unique AAF number based on legal location of the centroid of the harvest area.	E.g., 423075229A
Field Number	The number assigned by the timber disposition holder to the opening that appears on the AOP or harvest plan map.	E.g., 1234
Opening Area (ha)	Area (ha; 0.1 ha) of the opening as Update area (where available) or Net harvested hectares.	E.g., 20.1
Minimum Height Threshold (m)	SYU- and yield curve-specific height threshold that differentiates coniferous trees that will contribute to C^{UP} stocking vs. $C^{REGEN+D}$ stocking.	E.g., 3.5 m
C^{UP} Stocking Standard	Opening-specific, area-weighted C^{UP} stocking standard. Identifies the C^{UP} standard against which C^{UP} stocking is assessed.	E.g., 42%
Total Opening-Level Stocking Standard	Opening-specific, area-weighted total opening-level stocking standard. Identifies the standard against which total opening-level stocking is assessed. Total opening-level stocking incorporates both C^{UP} and $C^{REGEN+D}$ stocking.	E.g., 78%
Plot Centre Spacing	The distance (m) between plot centres on a survey line.	E.g., 35 m
Line Spacing	The distance (m) between survey lines.	E.g., 28 m
Survey Type (Aerial or Intensive)	Identifies the type of Understory Protection performance survey method as Aerial (visual evaluation from the air) or Intensive (on the ground plot-based survey).	E.g., Aerial

Field name	Description	Note
Timber Year of Cut (YYYY-YYYY)	Timber Year of Cut	E.g., 2010-2011
Natural Subregion	Alberta's forested areas are classified into geographical areas, which exhibit similar natural forest vegetation. Enter the code for the Natural Subregion. DM - Dry Mixedwood CM - Central Mixedwood NM - Northern Mixedwood LF - Lower Foothills UF - Upper Foothills LB - Lower Boreal Highlands UB - Upper Boreal Highlands SA – Subalpine MO - Montane	E.g., LB
Ecosite (optional)	Functional unit defined by the moisture and nutrient regime. The ecosite is determined during the pre-harvest survey. Ecosite is an optional field.	E.g., e1
Drainage class (optional)	Defined by water in excess of field capacity and the length of time water is in excess in the plant-root zone. Enter the code for drainage class: VR – Very rapidly drained R – Rapidly drained W – Well drained MW – Moderately well drained I – Imperfectly drained P – Poorly drained VP – Very poorly drained Drainage class is an optional field.	E.g., MW
Pre-harvest stratum	Base 10 ARS stratum as identified in the Planning Standard (2006)	E.g., Sw/Aw
Survey date (YYYY-MM-DD)	Year, month, day of Understory Protection performance survey	E.g., 2010-05-23
Surveyor ID1	Name (first and surname) of primary qualified surveyor.	E.g., Elihu Steward
Surveyor ID2	Name (first and surname) of qualified surveyor	E.g., Reginald Loomis

Field name	Description	Note
Regenerated Yield Class Stratum	The up to 8 digit landbase designation code for the opening. Unless the timber disposition holder intends to apply for re-designation of the opening, the code must be for a UP stratum.	E.g., RCTL1413

UNDERSTORY PROTECTION PERFORMANCE SURVEY FIELD MAP SHEET



Disp. Holder: _____

Disposition: _____

Opening number: _____

Field number: _____

Scale: _____

Tie point: _____

Control line bearing: _____

Line/ plot spacing: _____

GPS make: _____

GPS model: _____

GPS coordinate sys: _____

LEGEND	
C^{UP} not stocked; $C^{REGEN+D}$ not stocked	◎
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C	◉
C^{UP} not stocked; $C^{REGEN+D}$ stocked with D	◓
C^{UP} not stocked; $C^{REGEN+D}$ stocked with C and D	▲
C^{UP} stocked; $C^{REGEN+D}$ not stocked	○
C^{UP} stocked; $C^{REGEN+D}$ stocked with C	●
C^{UP} stocked; $C^{REGEN+D}$ stocked with D	◓
C^{UP} stocked; $C^{REGEN+D}$ stocked with C and D	▲
Not cut or deleted	⊗

Comments: _____

Opening number: _____

UNDERSTORY PROTECTION PERFORMANCE SURVEY TALLY SHEET A

Line	Plot	C^{UP} Stocking		$C^{REGEN+D}$ Stocking (1.78m plot)		C^{UP} Plot status (3.99m plot)	$C^{REGEN+D}$ Plot status (1.78m plot)
		Acceptable C^{UP} tree?		Acceptable C tree?	Acceptable D tree?	Stocked or Not Stocked	Not stocked or Stocked-C or Stocked-D or Stocked C+D
		1.78 m plot	3.99 m plot				

Page _____ of _____

Opening number: ______________________

UNDERSTORY PROTECTION PERFORMANCE SURVEY TALLY SHEET B

GPS X Corrdinates	GPS Y Coordinates	Plot ID	C^{UP} Stocking		$C^{REGEN+D}$ Stocking (1.78m plot)		C^{UP} Plot status (3.99m plot)	$C^{REGEN+D}$ Plot status (1.78m plot)
			Acceptable C^{UP} tree?		Acceptable C tree?	Acceptable D tree?	Stocked or Not Stocked	Not stocked or Stocked-C or Stocked-D or Stocked C+D
			1.78 m plot	3.99 m plot				

Page ________ of ________

10.14 Reporting Checklist

A Reporting Checklist is provided to ensure all mandatory reporting elements are accounted for. Timber disposition holders shall ensure that each appropriate element is reported by initialing beside each element and by signing and dating the Reporting Checklist. By initialling, signing and dating the Reporting Checklist, timber disposition holders are stating that the report is complete, accurate and on time.

Completed checklists must accompany all reporting of Understory Protection performance survey information to FMB. Completed checklists may be digital (scan) or hard copy.

For those timber disposition holders that harvest more than 30,000 m^3 annually, the Reporting Checklist must be validated by a Regulated Forestry Professional (RFP). Validated work is work that has been prepared by or reviewed and approved by an RFP. The RFP who validates the work must have done the work, contracted the work or supervised those who did the work. The validating RFP is accountable for ensuring the reporting of performance survey information is complete and accurate.

For those timber disposition holders that harvest less than 30,000 m^3 annually, the Reporting Checklist must be validated by an RFP or signed by the timber disposition holder with reforestation liability.

For those timber disposition holders that have agreed to work together to complete a UP performance survey program, one Reporting Checklist is required; however, each participating timber disposition holder must initial and sign/validate the checklist.

Alberta will acknowledge receipt of the Understory Protection performance survey reporting package via a letter within 5 business days.

UNDERSTORY PROTECTION PERFORMANCE SURVEY CHECKLIST & VALIDATION (pg. 1)

Timber disposition holder(s)		**Initial(s) of company rep:**		**Reporting date**	
				FMB Use Only	
				Received by:	
				Date:	

NAMES OF QUALIFIED INTERPRETERS AND SURVEYORS or as attached (first and last name)			
Interpreters:		**Surveyors:**	

INSTRUCTIONS

All required elements listed below must be reported to Forest Management Branch in order for the submission to be deemed complete. All reforestation obligation holders with openings included in this program shall initial beside each element if the element has been enclosed at the time of reporting. The following is required for each surveyed opening:

PHOTO ACQUISITION OF OPENINGS									**FMB Initials**
Shape Files									

SOFTCOPY													
File type	**DiAP Viewer**				**PurView**				**Summit Evolution (DAT/EM)**				
Image													
Camera													
Surface													
Project													

STRATIFICATION SPATIAL AND ATTRIBUTE DATA					
Element					
Stratification line-work spatial data					
Stratification attribute data					

PROTECTED AND UNPROTECTED AREA TREATMENT UNITS					
Element					
Area and proportion in protected area					
Area and proportion in unprotected area					
C^{UP} & opening-level stocking std calculations					

PERFORMANCE SURVEY RESULTS - AERIAL RECONNAISSANCE AND INTENSIVE SURVEYS					
Element					
UP performance survey summary sheets					
UP performance survey tally sheets					
UP field map sheet or digital field map					

SUMMARY REPORT					
Element					
Opening boundary changes					
Audited openings					
Summary of UP performance survey results					
List of openings no longer considered UP					

UNDERSTORY PROTECTION PERFORMANCE SURVEY CHECKLIST & VALIDATION (pg. 2)

DECLARATION

I (We) do hereby declare that this report:

Adheres to all components of the required Quality Assessment/Quality Control program;

Includes only surveys that have been conducted according to the methods detailed in the UP Performance Survey Standard;

Complies with the requirements for report timing and format; and,

Is complete, accurate, and on time as required by the Timber Management Regulation s. 143.2(2).

Printed name	Title	RFP number or Seal
Signature	Date	

Printed name	Title	RFP number or Seal
Signature	Date	

Printed name	Title	RFP number or Seal
Signature	Date	

Printed name	Title	RFP number or Seal
Signature	Date	

FMB reviewer's printed name	FMB reviewer's title	RFP number or Seal
FMB reviewer's signature	Date	

11 Quality assurance standard

Timber disposition holders are accountable for ensuring all reforestation information submitted to the director under the requirements of the *Timber Management Regulation* and the Reforestation Standard of Alberta (RSA) is complete and accurate[39].

The department is committed to achieving a high level of consistency through well planned Quality Assurance/Quality Control (QA/QC) activities at all stages of the RSA. The QA/QC program is designed to assure the quality of RSA data. This includes planning (development and maintenance of a QA/QC management system), documentation of methods, training for field surveyors, interpreters, and users at all levels, checks of data quality, and continuous feedback to ensure that data collection and understanding of procedures and importance of the data improves over time.

This quality assurance standard applies to Establishment stocking surveys (Sections 11.2 and 11.3) and Performance surveys completed using the Aerial Stratification and Non-photo Systems (Sections 11.2 and 11.4).

The quality assurance standard shall be reviewed annually to ensure that RSA data is credible, achieves the required level of 'fitness for purpose' for silviculturists, forest managers, and decision makers, and maintains the public's trust and confidence in RSA and reforestation.

11.1 Guiding principles

Quality assurance plays an important role in RSA data collection and reporting. The goal of this quality assurance standard is to ensure RSA data are scientifically defensible and of known quality. This will be achieved using:

1) Quality control activities (prevention) - training, standardized procedures, and data quality standards; and,

2) Quality assessment activities (appraisal and remedial work) – determine the level of compliance with the data quality standards, provide feedback, remedial action, and ensure continuous improvement by collecting data to inform the data quality standards and identify quality control needs.

The quality assurance standard reflects the core principles and components required of all reforestation programs, including the department's reforestation monitoring program, since May 1, 2008 (see the Alberta Regeneration Survey Manual 2008, Alternative Regeneration Standards, 2009, and the Reforestation Standard of Alberta 2010 - 2015). The guiding principles are based on training, aerial photography interpretation, field, and submission data quality assessments.

[39] Complete and accurate records are those records whose contents can be trusted as reliable representations of the business transactions, activities, or fact to which they attest and can be depended upon in the course of subsequent transactions.

11.1.1 Training

All persons involved with forest regeneration surveys must be trained to enable them to accurately carry out the necessary tasks, including interpretation of aerial photography using Softcopy, field data gathering, and compilation and reporting of results.

The QA/QC program will:

- Identify necessary interpreter and surveyor competencies.
- Identify training requirements for acquiring and maintaining competencies through initial classroom and/or field training, specifying the number of assessments and field surveys each interpreter and surveyor must conduct annually; and describing the process for remaining competent through re-training and incorporating periodic RSA updates (i.e., due to changes to survey methods or standards).
- Identify specific outcomes and remedial actions where reforestation assessments are found to have been carried out by personnel lacking the necessary training and/or competencies.

11.1.2 Aerial photography interpretation quality assessments

The QA/QC program will:

- Employ quality assessments which utilize sampling intensities and methods that account for variability in interpreters; and,
- Publish clear accuracy and completeness standards for stratification and interpretation.
- Identify specific outcomes and remedial actions where inaccurate methods and/or data are found.

11.1.3 Field quality assessments

The QA/QC program will:

- Employ field-level quality assessments which utilize sampling intensities and methods that account for variability in surveyors, survey method, and strata; and,
- Publish clear accuracy and completeness standards for survey layout and data collection.
- Identify specific outcomes and remedial actions where inaccurate methods and/or data are found.

11.1.4 Data quality assessments ('paper" check')

The QA/QC program will:

- Employ submission-level data quality assessments which utilize sampling intensities and methods that evaluate accuracy and integrity of submissions, ensuring a reasonable opportunity to identify and resolve issues prior to submission to the department; and,
- Publish clear accuracy and completeness standards for all survey "paperwork", including survey card information, plot data, mapping and compilation of results.

- Identify specific outcomes and remedial actions for errors and/or issues affecting the accuracy or integrity of submissions.

11.2 Training

Training is fundamental to the RSA quality assurance program. A RSA training program including certification/accreditation is currently under development. Therefore, RSA training remains the responsibility of the obligation holder for the 2018/2019 timber year.

Evidence of successful completion of necessary training for all persons involved with reforestation assessments must be maintained and made available to the department upon request.

11.3 Establishment surveys

A documented quality assurance quality control program must be implemented by each reforestation obligation holder responsible for submitting Establishment surveys to the department. The QA/QC program must adhere to the principles and components described in Section 11.1. See Section 6.3 for additional requirements.

The documented QA/QC program must be made available to the department upon request.

A provincial QA/QC program will accompany new Establishment assessment standards.

11.4 Performance surveys

11.4.1 Aerial photography stratification

11.4.1.1 Purpose

The purpose of the stratification audit is to ensure that RSA stratification standards are being met. The audit will determine the consistency and accuracy of the information derived from the interpretation of openings of performance age from aerial photography. A scoring system is used to evaluate randomly selected openings, Sampling Units (SU), and Poorly Regenerated Areas (PRA).

A digital data (attribute data) integrity inspection is not part of this audit because stratification data verification procedures are built into both the RSA Sample Selection Tool and Compiler. Final polygon attribute verification, topology integrity, and polygon adjacency checks are performed following the RSA stratification verification and any required re-work is completed.

The purpose of this section is to describe the procedures for completing audits of aerial photography stratification/interpretation for performance assessments completed using the Aerial Stratification System.

The stratification audit shall be completed prior to selecting Sample Units for field sampling (e.g., prior to the import of the Interp 1 dataset into the Sample Selection Tool).

11.4.1.2 Qualified auditors

Aerial photography stratification audits shall be completed by qualified personnel, defined as:

1) Department certified Alberta Vegetation Inventory (AVI) Level 2 interpreters; and,

2) Interpreters who have not completed the original RSA stratification work or audits of this work for the population of openings under consideration for the audit.

11.4.1.3 Procedures

The procedures for the audit evaluate:

1) The completeness of the spatial data (original opening shape files used for aerial photography acquisition and image, photogrammetric stereo model, surface, final shape and project files).

2) The delineation of the re-drawn opening boundary, where applicable, as described in RSA Section 8.4.3;

3) The delineation of the Net Assessment Area (NAA), as described in RSA Section 8.4.3.4;

4) The stratification of the NAA into Sampling Units (SU), as described in RSA Section 8.4.3.5; and,

5) The stratification of the NAA into Poorly Regenerated Areas (PRA), as described in RSA Section 8.4.3.6.

The audit will be completed using a softcopy viewing scale ranging from 1:300 for tree species identification and stem counts to 1:2,000 for polygon line assessment and attribute assignment.

An audit record must be maintained by the auditor to facilitate efficient monitoring and to create a record of the audit of the stratification. The audit record is composed of four forms and two evaluation criteria:

1) The RSA Stratification Audit Summary Form 1 (Figure 11-1) contains the header information, findings, comments, suggestions for improvement, a summary of results, and audit validation.

2) The RSA Delineation Standards Audit Criteria 1 (Figure 11-2) describes the audit scoring for opening line work and polygon line work, size, width, adjacency, and presence.

3) The RSA Delineation Standards Audit Form 2 (Figure 11-3) shall be used for assessments of opening boundary, Net Assessment Area (NAA), Sampling Unit (SU) and Poorly Regenerated Areas (PRA) line work.

4) The RSA Attribute Standards Audit Criteria 2 (Figure 11-4) shall be used to determine attribute audit deductions and scoring based on tolerances.

5) The RSA Sampling Unit (SU) Attribute Audit Form 3 (Figure 11-5) shall be used for evaluations of Sampling Unit (SU) attributes.

6) The RSA Poorly Regenerated Area (PRA) Attribute Audit Form 4 (Figure 11-6) shall be used for evaluations of Poorly Regenerated Area (PRA) attributes.

A digital version (RSA_Performance_Strat_Audit_Forms_v2.xls) of each form and criteria is available and shall be used to record the results of the stratification audit. The RSA_Strat_Audit_Forms_v2.xls file is available for viewing and/or downloading by visiting the AAF website (forestry.alberta.ca) and using the following search term: "Reforestation Standard of Alberta".

Stratification audits shall be completed by program.

STEP 1: Preparation and set-up

The RSA Aerial Stratification System requires the use of digital imagery and softcopy technology in order to complete the stratification audit of programs. Thus, the stratification audit must be completed using softcopy systems that are able to accept image and supporting file formats used to do the original interpretation.

The following materials are required for completing stratification audits in the softcopy environment:

- Digital image, camera, project, and surface files used for the interpretation;
- Digital reference files of base map and original opening boundary;
- Completed interpretation for openings with SU and openings with PRA (shape files or geodatabase and attribute databases);
- Applicable RSA document(s); and,
- Stratification audit forms.

Programs with all the required spatial data and softcopy files that allow for the rest of the audit to proceed shall be deemed Complete and recorded on Form 1: RSA Stratification Audit Summary Form (Figure 11-1).

The following materials should be provided to the auditor, if used in the interpretation (materials may need to be requested):

- Field, air and ground calibration data;
- Field photographs of opening strata visited;
- Silviculture (site prep) records or records from the Alberta Regeneration Information System (ARIS); and,
- Land use.

Image file formats, surface file formats, and photogrammetric stereo model formats (project files) will depend on the softcopy system being used.

STEP 2: Selecting openings for audit

A minimum sample of the total number of openings interpreted by program will be audited. The unit for audit is the opening. A program may contain one or more reforestation obligation holders.

The audit intensity shall be minimum 10% audits with a minimum sample size of three (3) openings.

The audit

Stratification audits of randomly selected openings shall be without the original interpreter(s) present but with the interpreter data available. The purpose of the audit is to evaluate the quality and accuracy of the interpretation data. Audits evaluate adherence to the stratification standard. Differences shall be corrected both in the audited opening and any previously interpreted openings since the last audit. Corrective action taken shall be summarized on Form 1.

There shall be a one to one relationship between the population of openings audited and the population of openings in a program reported to the department.

STEP 3: Evaluating opening boundary, Net Assessment Area (NAA), Sample Unit (SU) and Poorly Regenerated Area (PRA) delineation

Opening boundary

Each opening boundary should be assessed to ensure that it represents the true shape of the opening. Auditors are to evaluate each opening for the accuracy of opening boundary line placement using the standards and scoring described in Criteria 1: RSA Delineation Standards Audit Criteria (Figure 11-2). The evaluation of the opening boundary delineation should be recorded on the Form 2: RSA Delineation Standards Audit Form (Figure 11-3).

NAA, SU, and PRA

The purpose of the Net Assessment Area (NAA), Sampling Unit (SU), and Poorly Regenerated Area (PRA) delineation evaluation is to determine whether RSA photo interpreters are following the RSA stratification standard for identifying polygons. The RSA stratification standard produces two separate coverages and associated attributes:

1) NAA and SU; and,

2) The NAA and PRA, if present.

Each selected opening will be evaluated for the accuracy of NAA, SU and PRA line placement according to the audit standards and scoring described in Criteria 1 (Figure 11-2).

The NAA should show the netting out of all land use under disposition and all natural deletions ≥0.5 ha in size.

SU should not be less than the minimum size (≥2 ha) except for those:

- Created from land use or natural deletions; or,
- Where the original openings size was <2 ha.

Isolated polygons <2 ha in size caused from delineating the NAA must be merged with other similarly interpreted polygons and assigned the same polygon ID.

Separation between polygons and adherence to adjacency rules must follow the RSA.

Openings are to be evaluated for missing polygons.

Form 2: RSA Delineation Standards Audit Form (Figure 11-3) shall be used to record the delineation audit. The form shows the rating obtained and the pass/fail status for openings and programs based on the audit standards. A minimum score of 85% is required for acceptable completion of work.

STEP 4: Evaluating SU and PRA attribute assignments

The audit of attribute assignments will be undertaken following the completion of the delineation audit. It is performed on the same set of randomly selected openings as were selected for the opening boundary and polygon delineation audits.

Attributes for polygons (i.e., all SU or PRA's) in each selected opening should be evaluated using the tolerances and scoring described in Criteria 2: RSA Attribute Standards Audit Criteria (Figure 11-4). To ensure an effective attribute evaluation, each attribute is assigned to one of three categories, as shown in Table 11-2.

Table 11-1. Attribute evaluation categories.

Critical attributes	Regeneration layer attributes	Residual layer attributes
1. NAA type 2. Species composition class 3. Density class 4. PRA total density	1. Species composition 2. Total density 3. Average height 4. Spatial pattern 5. Mixedwood pattern	1. Species composition 2. Total density 3. Crown closure 4. Average height 5. Spatial distribution

Critical attributes are attributes deemed critical because they are used in delineating the SU and PRA polygon boundaries. Each attribute must achieve an overall minimum score of 90% in order for the interpretation to be acceptable.

Regeneration layer attributes are attributes that characterize the regeneration layer in each SU and PRA. Each attribute must achieve an overall minimum score of 80% in order for the interpretation to be acceptable.

Residual layer attributes are attributes that characterize the residual layer. A residual layer is considered present if either the interpreter or auditor identifies a residual layer meeting minimum requirements. Inspectors are to report observed trends by residual layer attribute.

For each sampled opening and associated polygons, the preferred method to complete the evaluation is an independent evaluation of all attributes. Due the subjective nature of photo interpretation, auditor must take into consideration what is "reasonable".

SU attribute assignment

The SU attribute assignment evaluation should be recorded on the Form 3: RSA Sampling Unit (SU) Attribute Standard Audit Form (Figure 11-5).

Score deductions for each attribute shall be imposed if the interpretation does not meet the audit standard tolerances. There are two ways in which overall SU photo interpretation success is determined:

1) By SU; and,

2) By attribute.

A SU will fail either because of incorrect deletion area type, or an overall score of < 80%. An attribute will fail either because of an overall score of <90% for critical attributes or <80% for regeneration layer attributes.

Overall scores are automatically calculated by opening; however, in order for the scoring system to work correctly on the Microsoft Excel form and where appropriate:

- Set to 1 if NAA=0; and,
- Set to 1 if Resid layer present.

PRA attribute assignment

The PRA attribute assignment evaluation should be recorded on Form 4: RSA Poorly Regenerated Area (PRA) Attribute Standard Audit Form (Figure 11-6).

Score deductions for each attribute shall be imposed if the interpretation does not meet the inspection standard tolerances (Figure 11-4).

A PRA will fail either because of:

1) An incorrect assignment of density <200 sph (e.g., a PRA is identified with <200 sph but it actually has more or a PRA with <200 sph was missed); or,

2) An PRA density attribute overall score of <90%; or,

3) An overall minimum score of 80% is not achieved.

Audit outcomes

Auditors shall provide results of audits to the supervisors and interpreters as soon as possible. Interpreters who fail to meet and maintain the data quality standard should be identified and a determination of the appropriate action to be taken (e.g., additional training, competency development, supervision). In addition, all identified differences found as a result of the audit must be corrected in audited openings as well as all non-audited openings.

11.4.1.4 Reporting of audit results to the department

Original stratification audit reports for the 10% audit shall be submitted by program to the Forest Management Branch as part of the submission package (see Section 8.7). Audit reports shall include the following:

1) A completed and signed RSA Stratification Audit Summary Form (Figure 11-1); and,

2) An audit record of tabulated scoring results composed of the following forms:

   a) RSA Delineation Standards Audit Form (Figure 11-3); and,

   b) RSA Sampling Unit (SU) Attribute Standards Audit Form (Figure 11-5); and,

   c) RSA Poorly Regenerated Area (PRA) Attribute Standards Audit Form (Figure 11-6), where applicable.

11.4.1.5 Audits completed by the department

The department, using qualified interpreters, may conduct annual third-party audits using the procedures for audits describe above. The audit intensity will be 10%. The audit shall include opening boundaries and stratification of openings and associated attributes.

Differences found as a result of the department's audit must be addressed by the timber disposition holder and will result in the performance survey program being deemed unacceptable to the director under Section 143.2(2) of the *Timber Management Regulation*. The differences must be corrected to the satisfaction of the department. As stratification is a fundamental first step in the sub-sampling approach to Performance surveys, implications of the corrections to the field sample design will be evaluated by the department which may result in no further action or a re-running of the Sample Selection Tool and a field sample and compilation based on the revised sample selection. The date of the submission of corrected performance surveys to FMB shall be deemed the date of the acceptable performance survey results as prescribed by Section 141.6(1) of the *Timber Management Regulation*.

RSA Stratification Audit Summary Form

Program:	
Original interpreter(s):	**Inspector:**
Organization:	**Organization:**
Survey year:	**Number of openings audited:**
Submission date:	**Audit date:**

Findings:

Comments:

Suggestions for improvement:

Audit summary

Spatial data files

Complete Incomplete

Delineation and attribute data

Category	# Openings Evaluated	# Opening failures	# Program-level failures
Boundary Delineation			
SU/PRA Delineation			
SU Attributes			
PRA Attributes			

Signature of Inspector:

Date:

Form 1

Figure 11-1. Form 1: RSA Stratification Audit Summary Form

RSA Delineation Standards Audit Criteria			
Parameter	**Scoring**	**Scoring criteria**	**Standard**
Accuracy of opening boundary line placement	7	>90% of line placement correct	Subjective: within ±10 meters on the ground for distinct type and opening boundary breaks and ±20 meters for types that are indistinct.
	5	≥85 - 90% of line placement correct	
	0	<85% of line placement correct	
Accuracy of polygon line placement	7	>90% of line placement correct	Subjective: within ±10 meters on the ground for distinct type and opening boundary breaks and ±20 meters for types that are indistinct. Do not double count for common boundaries between polygons.
	5	≥85 - 90% of line placement correct	
	0	<85% of line placement correct	
Polygon size	7	100% correct	Minimum polygon size: no limit on land-use; ≥0.5 ha for natural deletions; ≥2.0 ha for Sampling Units (SU).
	0	<100% correct	
Polygon width	7	>95% correct	Minimum polygon width: ≥50 meters.
	0	≤95% correct	
Type separation	5	>95% correct	Homogeneous polygons are correctly identified as per RSA. Polygons across land-use with identical attributes must share the same polygon ID.
	0	≤95% correct	
Missing polygons	5	>95% correct	NAA is correctly identified. Sampling Units are correctly separated by tree species composition and density classes. Poorly Regenerated Areas are correctly identified.
	0	≤95% correct	
			Criteria 1

Figure 11-2. Criteria 1: RSA Delineation Standards Audit Criteria

RSA Delineation Standards Audit Form

Opening number	Number of polygons (SU + PRA)	Standard						Total Score by Opening / SU	Potential score by opening / SU	Percent of potential by opening / SU	Delineation evaluation *
		Boundary line placement	Polygon line placement	Polygon size	Polygon width	Type separation	Missing polygon				
		7	*7*	*7*	*7*	*5*	*5*				
Total points by parameter		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**#DIV/0!**	
Potential points by parameter		**0**	**0**	**0**	**0**	**0**	**0**				
Percent of potential by parameter		**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**				
Program parameter evaluation **		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				**Form 2**

* An opening will fail because of a percent score less than 85%.
** A program will fail if program level parameter score is less than 85%

Rules: Opening Assessments
- for each opening, the audit must achieve a minimum score of 85%

Rules: Program-level Assessments
- for each program, the audit must achieve a score 85% or greater by parameter

Figure 11-3. Form 2: RSA Delineation Standards Audit Form

RSA Attribute Standards Audit Criteria				
	Opening/SU	Potential score	Standard	Score deduction
Critical	Net Assessment Area (NAA) type	10	Correct Always	Minus 10 if incorrect NAA assignment
	Species composition class	20	±1 Class	Minus 10 if out by 1 species class; Minus 20 if out by >1 species class
	Density class	20	±1 Class	Minus 10 if out by 1 density class; Minus 20 if out by >1 density class
Regen Layer	Species composition percent	20	±10%	Minus 10 for incorrect lead conifer; Minus 2 for each 10%, Minus 4 for each other incorrect species
	Total density	20	±10% (min 100 sph)	Minus 4 for each 10% outage
	Average height	12	±20% (min 1 m)	Minus 4 for each 10% outage
	Spatial distribution	8	1 Class	Minus 4 for each distribution class outage
	Mixedwood pattern	8	Correct Always	Minus 4 for each pattern class outage
Resid Layer	Species composition percent	5	±20%	Minus 3 for incorrect lead conifer; Minus 1 for each 20%, Minus 1 for each other incorrect species
	Total density	5	±20%	Minus 1 for each 20% outage
	Average height	3	±20%	Minus 1 for each 20% outage
	Spatial distribution	2	1 Class	Minus 1 for each distribution class outage
	Crown closure	2	±15% (above 15% min)	Minus 2 for each 15% outage
PRA Layer	Density < 200 sph	10	<200 st/ha	-10 if PRA density is actually 200 sph or greater
	Species composition percent	10	±20%	Minus 6 for incorrect leading conifer; Minus 2 for each 20%, Minus 2 for each other incorrect tree species
	Total density	12	±50 stems (when <200 sph)	Minus 6 for each 50 sph outage
	Average height	6	±20%	Minus 2 for each 20% outage
				Criteria 2

Figure 11-4. Criteria 2: RSA Attribute Standards Audit Criteria

RSA Sampling Unit (SU) Attribute Standards Audit Form																					
				Critical			Regeneration layer standard					Residual layer standard									
Opening number	SU	Set to 1 if NAA = 0 *	Set to 1 if Resid layer present **	NAA type	Tree species composition class	Density class	Tree species composition %	Total density	Average height	Spatial distribution	Mixedwood pattern	Tree species composition %	Total density	Average height	Spatial distribution	Crown closure	Total score by opening / SU	Potential score by opening / SU	Percent of potential by opening / SU	SU evaluation - Correct NAA ***	SU evaluation - interpreted attributes ***
				10	*20*	*20*	*20*	*20*	*12*	*8*	*8*	*5*	*5*	*3*	*2*	*2*					
Total Points by Attribute				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**					
Potential Points by Attribute				**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**					
% of Potential by Attribute				**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**					
Program Attribute Evaluation ****				#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!										**Form 3**

* Set to 1 if NAA = 0 (part of Net Assessment Area) to enable calculations on attributes.
** A residual layer is considered present if either the interpreter or the auditor identifies a residual layer meeting the minimum requirements.
*** An SU will fail either because of incorrect Net Assessment Area type, or percent score less than 80%.
**** An attribute will fail either because of an overall score < 90% for critical attributes, or < 80% for regeneration layer attributes.

Rules: Opening / SU assessments
- for each opening / SU, the audit must achieve a minimum score of 85%
- incorrect Net Assessment Area type will result in an automatic fail for the SU

Rules: Program-level attribute assessments
- for critial attributes, must achieve overall minimum score of 90% for each attribute
- for regen layer attributes, must achieve overall minimum score of 80% for each attribute
- for resid layer attributes, report on observed trends by attribute

Figure 11-5. Form 3: RSA Sampling Unit (SU) Attribute Audit Form

RSA Poorly Regenerated Area (PRA) Attribute Standards Audit Form											
Opening number	SU	Standard				Total Score by Opening / PRA	Potential Score by Opening / PRA	Percent of Potential by Opening / PRA	PRA Evaluation - Density < 200 sph *	PRA Evaluation - Interpreted Attributes *
		PRA Density < 200 sph	Species Composition Percent	Total Density	Average Height					
		10	*10*	*12*	*6*					
Total Points by Attribute		0	**0**	**0**	**0**					
Potential Points by Attribute		0	**0**	**0**	**0**					
% of Potential by Attribute		#DIV/0!	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**					
Evaluation **		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!					**Form 4**

* A PRA will fail either because of incorrect assignment of density (must be < 200 sph), or score less than 80%.

** An attribute will fail because of an overall score < 90% for assessing PRA density as < 200 sph.

Rules: Attribute Assessments

- for PRA density < 200 st/ha, must achieve overall minimum score of 90% for each attribute
- for PRA layer attributes, report on observed trends by attribute

Rules: Opening / SU Assessments

- for each opening / PRA, the audit must achieve a minimum score of 80%
- incorrect density where density is actually >= 200 st/ha will result in an automatic fail for the SU

Figure 11-6. Form 4: RSA Poorly Regenerated Area (PRA) Attribute Audit Form

11.4.2 Field check surveys and ARIS reporting verification

To ensure all Performance surveys reported to the department are complete and accurate, audits of Sample Units and openings shall be conducted by means of field check surveys and verification of Performance survey results reported to ARIS.

Field check surveys shall be completed by independent qualified surveyors.

11.4.2.1 Audits of field surveys

Audits of field surveys are required in order to have confidence that the survey data adequately reflects the true conditions in managed stands of survey age. The intent of this audit process is to ensure that the field survey data and resulting Mean Annual Increment (MAI) estimates are 'fit for purpose' (e.g., reforestation results are acceptable to the director as required by the Timber Management Regulation, to publicly report reforestation and forest sustainability performance metrics, and to support analysis, along with PSP and TSP data, for managed stand yield projections in FMPs). This is best accomplished using independent plot-on-plot measurements of established plots from randomly selected Sample Units (SUs; Aerial Stratification System) and openings (Non-photo System).

The objectives of this audit process are:

1. To evaluate the accuracy of surveys relative to an outcome-based data quality standard;

2. To evaluate quality of surveys to determine how well plots were located and trees measured relative to the standard; and,

3. To provide timely feedback to surveyors during active surveys to ensure quality surveys and to promote continuous improvement at the program level[40].

Timing

Meaningful audits of performance surveys are best completed during active surveying while the surveyors are in the area. This will allow for the opportunity:

- To provide timely and continuous feedback to surveyors; and,

- To take the necessary remedial steps to ensure the accuracy of the surveys before the field data is imported into the RSA Compiler.

Because audits are independent, the surveyors must not be present during the audit; however, the auditor shall use the data collected by surveyors in order to complete the audit.

Selection of Sample Units or Openings

A minimum of 10 % of Sample Units (SU; Aerial Stratification) or openings (Non-photo) shall be selected for audit.

[40] The department only audits official field data submitted under professional sign-off; therefore, the department will meet this objective where field data is provided in a timely manner and field conditions are conducive to a quality audit.

- For surveys completed using the Aerial Stratification System, a minimum 10% audit of SU can be selected from the RSA Sample Selection Tool using the SU_SAMPLE_LIST worksheet.

- For surveys completed using the Non-photo System, a minimum 10% audit of openings can be selected from the Master Opening List (O1 dataset). The sample intensity shall be rounded up to the nearest whole number.

A minimum of 5% of SUs or openings shall be selected randomly for field audit. The remaining proportion could be targeted towards specific strata, specific surveyors or MAI estimate extremes (both high and low).

Selection of plots

Plot-on-plot checks of a minimum of 40% of established plots[41] shall be completed for each SU or opening selected for audit. All Detailed plot locations (where Basic plots are nested within Detailed plots) shall be audited. The remainder of the established plots for audit shall be composed of Basic plots.

For example, SU 123456789_A has 48 established plots (48 Basic plots and 12 Detailed plots).

48 plots × 40% = 19.2 or 20 plots (rounded up)

Total number of established plots to audit is 20.

All 12 Basic and Detailed plots at the Detailed plot locations are audited as well as eight (8) additional Basic plots. The additional Basic plots may be selected randomly or be higher risk plots (e.g., white spruce versus black spruce or null tally plots). Selecting Basic plots based on proximity to access is not acceptable.

Field procedure

Auditors shall obtain plot locations (GPS X and Y coordinates), skid clearance date or disturbance date (to understand stand age and maximum tree age) and silviculture records (planting records, etc.) prior to the audit.

The audit shall repeat the survey for a subsample of selected plots in selected SU or openings.

A field audit must contain a complete set of plot-on-plot evaluations including:

- Administration (program, opening number, and date of field audit);

- Stratum information (polygon number and stratum);

- Plot information (GPS accuracy, plot center location and marking, plot identification, plot type);

[41] The 40% of established plots requirement is similar to the survey quality requirement under the Alberta Regeneration Survey Manual where a minimum of 25 plots in an opening (assuming 64 plots per opening) were required to be carefully checked.

- Basic plot tree-level data (acceptable tree tallies by species, SDL, ADV, and WGR within 1.78 m radius plots); and,

- Detailed plot tree-level data (tree marking, top height tree selection by acceptable tree species group, total height and total age within 5.64 m radius plots).

The results of the audit shall be recorded on the audit tally sheet (Figure 11-7) or a reasonable facsimile that achieves the same outcome. The original audit shall be included with the survey package submitted to the department.

PERFORMANCE SURVEY TALLY SHEET - Field audit

Program:__________ Opening number:__________ Date:__________ PSATS2018

Stratum information		Plot information				Basic Plot - 1.78 m radius				Detailed Plot - 5.64 m radius			
										Top height trees - SDL ONLY			
Polygon	Stratum[1] (Aerial Stratification or Non-photo Systems)	Plot ID (from Plot Header)	Plot ID[1]	Plot type[2]	GPS accuracy (m)	Tree species	WGR[3]	SDL[4] tally by tree species	ADV[4] tally by tree species	Correct selection[5] (Y or N)	Tree species	Total height (cm)	Total age (years)

1 Record Plot ID from ribbon; comment if not legible
2 B = Basic plot; D = Detailed plot
3 Tally by WGR; Y or leave blank
4 Min height: coniferous trees ≥30 cm; deciduous trees ≥130 cm
5 Was the correct top height tree selected (Y or N)? If yes, then record Y and measure height and age for the selected TH tree. If no, then record N and measure the height and age of the correct TH tree.

Field auditor(s):__________ __________ Page ____ of ____

Figure 11-7. Plot-on-plot audit tally sheet.

Plot centers that are not to standard or not locatable (e.g., plot center not verifiable or locatable, no wooden stake, nail, shovel slit with flagging in the ground or plot center marked with flagging attached to blades of grass or shrub or tree branch) shall be recorded as ‘NL’ on the Audit Tally Form under GPS (Figure 11-7). Plot centers that are located outside of SUs or opening boundaries shall be recorded as ‘NV’ (not valid).

Auditors shall evaluate whether surveyors selected the correct top tree by recording 'Y' for yes or 'N' for no (e.g., missed tree species group or selected top height tree does not meet the definition for top height trees).

- If 'Y', then auditors shall evaluate the height and age of the top height tree selected by the surveyor. This comparison of surveyor versus auditor shall be used to evaluate quality of survey for top height tree total height and age.

- If 'N', then auditors shall measure the height and determine the age of the tree they selected as the top height tree. This extra measurement step is necessary in order to determine the impact of incorrect top height tree selection on the MAI estimate. The top height tree height and age measurements completed by the auditor shall not contribute to the evaluation of quality of survey for top height tree height and age.

Once the independent plot-level assessment is complete and to ensure an unbiased audit, auditors shall compare the audit measurement results with the original survey measurement data. Differences shall be verified before going to the next plot to ensure the audit data is 100% correct.

Evaluation of audit results

Plot-on-plot measurements shall be rolled up to the SU- or opening-level to determine the plot location, C and D MAI, and quality of survey outcomes, as described in Table 11-2.

The audit re-measurement value shall be used as the value of comparison. Differences are calculated by subtracting the survey value from the audit value. The precision of the survey measurement shall be compared against the tolerance and the undesirable condition (Table 11-2) to determine the level of adherence. The undesirable condition calculation is the percent of measurement data by parameter that is outside of tolerance at the SU- or opening-level.

Accuracy of survey based on plot center location and MAI estimate outcomes

The Non-photo System, in a separate RSA Compiler session, should be used to compile survey and audit C and D MAI estimates for comparison. The import datasets will need to reflect the requirements of the Non-photo System, as described in:

- Appendix 14 Master opening list data dictionary

- Appendix 17 Performance field survey data dictionaries, Aerial Stratification and Non-photo Systems

    - Table 12-11. Ground1: Unit header data dictionary

    - Table 12-12. Ground2: Plot header data dictionary

    - Table 12-13. Ground3: Basic plot data dictionary

    - Table 12-14. Ground4: Detailed plot data dictionary.

Only those plots with both survey and audit data shall be used to compile MAI estimates. Survey plot data shall not be used to compile MAI estimates where audit plot data is deemed NL or NV.

Where the level of adherence to tolerances for plot center location, Coniferous MAI, and Deciduous MAI is greater than the undesirable conditions, remedial actions in the field shall be required. Remedial actions include:

- Where there are plot center location issues, correctly locating plot centers to meet the standard and re-measuring Basic and Detailed plots based on the newly re-established plot centers (this may necessitate a re-compilation depending on the stage in the performance survey process).

- Where there are MAI estimate issues, re-measuring Basic and Detailed plots in the field based on MAI estimate results relative to audit outcomes.

- As the audit represents a sample and there are two levels of auditing (industry and the department), additional plots, SUs or openings shall be checked to ensure plot locations and MAI estimates are to standard.

Quality of survey

Where the level of adherence to tolerances for parameters used to determine quality of survey (Table 11-2) is greater than the undesirable conditions, remedial actions shall be required.

After ensuring that the survey equipment used for establishing plots and measuring trees meet the standard, remedial actions include:

- A discussion of the procedural/measurement discrepancy as determined by the audit;

- A review of appropriate procedures (targeted training);

- Additional supervision, observation and feedback; and,

- Additional independent audits of plots.

Table 11-2. Performance survey field data quality standards (DQS) and measurement quality objectives (MQO; tolerances). The data quality standard is applied at the Sample Unit-level for the Aerial Stratification System and the opening-level for the Non-photo System.

Parameter	Tolerance	Undesirable condition
Accuracy of survey based on plot centre location and MAI estimate outcomes		
Plot center location	No tolerance	>10% NL and/or NV
Coniferous MAI	No tolerance	>10% or 0.20 m^3/ha/year, whichever is greater
Deciduous MAI	No tolerance	>10% or 0.20 m^3/ha/year, whichever is greater
Quality of survey		
GPS	±10 m	>5% of differences > tolerance
Coniferous tree tally (presence or absence)	>0 or ≤ 1 no tolerance	>5% of differences > tolerance
Deciduous tree tally (presence or absence)	>0 or ≤ 1 no tolerance	>5% of differences > tolerance
Aw, Pb, Bw SDL tally	Tally ≥2 20%	>15% of differences > tolerance
Pl, Pj, Pw, Pa, Lt SDL tally	Tally ≥2 20%	>15% of differences > tolerance
Sw, Fb, Fa, Fd SDL tally	Tally ≥2 20%	>15% of differences > tolerance
Sb SDL tally	Tally ≥2 20%	>15% of differences > tolerance
Aw, Pb, Bw ADV tally	Tally ≥2 20%	>15% of differences > tolerance
Pl, Pj, Pw, Pa, Lt ADV tally	Tally ≥2 20%	>15% of differences > tolerance
Sw, Fb, Fa, Fd ADV tally	Tally ≥2 20%	>15% of differences > tolerance
Sb ADV tally	Tally ≥2 20%	>15% of differences > tolerance
Correct TH tree selection across tree species groups	No tolerance	>15% of differences > tolerance
TH tree height across tree species groups	±5%	>15% of differences > tolerance
TH tree age across tree species groups	±1 year	>15% of differences > tolerance

11.4.2.2 Verification of Performance survey information reported to ARIS

Obligation holders shall ensure that Performance survey results are correct and accurately reported to ARIS. A minimum 10% sample of openings shall be randomly selected for audit. Each selected opening shall have the results verified by comparing the data in the Opening_Level table (RSA Compiler database file) with the data in the obligation holder's submission file. This comparison shall be completed prior to the submission to ARIS. The comparison shall include the fields listed in Table 11-3.

Table 11-3. Parameters compared in the verification of Performance survey information reported to ARIS.

RSA Compiler database file	ARIS
SKID_YEAR SKID_MONTH SKID_DAY	Skid clearance date or disturbance date (as reported in ARIS), whichever is more recent.
ASSESSMENT_Y ASSESSMENT_M ASSESSMENT_D	Survey date
NAA_FINAL	Final survey area
CON_MAI_WT	Acc CON
DEC_MAI_WT	Acc DEC
ARIS_LABEL	MAI label in the operator comments

There are no tolerances (e.g., no differences are permitted). Differences must be corrected.

Where differences are found as part of the minimum 10% sample, all Performance survey results reported in a program must be verified. All differences must be corrected.

11.4.2.3 Reporting of audit results to the department

Obligation holders shall report to the department all **original** outcomes of audits (including the audit compiler file) and verification of Performance survey results reported to ARIS. Where there are differences, obligation holders shall summarize the corrective actions taken and how the audit outcomes will be used to ensure complete and accurate Performance survey information is reported to the department in subsequent timber years (continuous improvement).

Audits shall be submitted to the department as part of the Performance survey package (Forest Management Branch). Corrective actions shall be reported in the Summary Report.

Verification of Performance survey results reported to ARIS and a summary of corrective actions shall be reported to the department with the ARIS RFP Validation Form (Forest Management Branch).

11.4.2.4 Audits completed by the department

The department, using qualified auditors, may conduct field audits using the procedures for field audits described above. The field audit intensity shall be a minimum 10% of Sample Units openings in a program. Sample Units or openings will be selected randomly unless otherwise stated in the Data Package – Field Data Verification Report. The department's audit may include both Basic plot locations (i.e., Basic plots only) and/or Detailed plot locations (i.e., Basic and Detailed plots at the same location).

The audit shall include locating plots, plot layout, and plot measurements. The evaluation shall be plot-on-plot. The department shall use GPS units, 1.78 m and 5.64 m plot cords or tapes, calipers, and calibrated measuring tapes and height poles to complete the audit.

The department may complete twice annually (May 15 and September 15 for programs reported after May 15) an ARIS Data Verification audit. This is an opening level comparison between parameters in the RSA Compiler database file and the same parameters reported to ARIS, as described in Table 10-3.

The audit is 100% with no differences permitted except for NAA_FINAL, which has a tolerance of 0.1 ha to reflect the change in accuracy in reporting survey area from 0.01 ha to 0.1 ha.

Differences as a result of the department's audits and ARIS data verification must be addressed by the timber disposition holder and will result in the performance survey program being deemed unacceptable to the director under Section 143.2(2) of the *Timber Management Regulation*. The differences must be corrected to the satisfaction of the department. The date of the re-submission of corrected performance surveys to FMB shall be deemed the date of the acceptable performance survey results as prescribed by Section 141.6(1) of the *Timber Management Regulation*.

The department will from time to time undertake quality assessments of re-measurement data for uncertainty analysis.

11.5 Implementation

These quality assurance standards apply to all survey work completed on or after May 1, 2016. Specifically,

- Aerial Stratification System Performance surveys with interpretation dates (INTRP_Y and INTRP_M) on or after May 2016.
- All field data collection associated with Aerial Stratification and Non-photo Systems Performance surveys with survey dates (SURVEY_YEAR, SURVEY_MONTH, and SURVEY_DAY in the Ground1 file) on or after May 1, 2018.

12 Appendices

Appendix 1. FMA and FMU specific Landbase Designation Code and Mean Annual Increment (MAI) standards

The Landbase Designation Code and Mean Annual Increment Standard are a separate document from the RSA as it requires regular updates as new forest management plans are approved by the department.

Therefore, all timber disposition holders are responsible for checking the AAF website on a regular basis for updates to the Landbase Designation Code and Mean Annual Increment Standard to ensure proper landbase designation codes assignment to harvested areas.

The Landbase Designation Code and Mean Annual Increment Standard will be available on the AAF website (forestry.alberta.ca; using the following search term: “Landbase Designation Code and Mean Annual Increment Standard”).

Appendix 2. Forest Management Agreements

FMA number	FMA holder(s)
9100029	Alpac Forest Products Inc.
8900026	ANC Timber Ltd.
7500020	Blue Ridge Lumber Inc.
9900037	Canadian Forest Products Ltd.
0900044	Daishowa-Marubeni International Ltd. (East)
0900045	Daishowa-Marubeni International Ltd. (West)
0200039	Gordon Buchanan Enterprises Ltd. and Tolko Industries Ltd.
0200041	Manning Diversified Forest Products Ltd.
9700034	Millar Western Forest Products Ltd.
0100038	Spray Lake Sawmills (1980) Ltd.
9200030	Sundre Forest Products Inc.
9700033	Tolko Industries Ltd. (High Prairie)
0200040	Tolko Industries Ltd., Footner Forest Products Ltd., and La Crete Sawmills Ltd.
0600043	Tolko Industries Ltd., Vanderwell Contractors (1971) Ltd., and West Fraser Mills Ltd. (Slave Lake)
9700036	Vanderwell Contractors (1971) Ltd.
9700032	West Fraser Mills Ltd. (Edson)
8800025	West Fraser Mills Ltd. (Hinton)
9000028	West Fraser Mills Ltd. (Slave Lake)
0900046	Weyerhaeuser Company Ltd., Pembina
6900016	Weyerhaeuser Company Ltd., Grand Prairie

Appendix 3. Acceptable tree species by Forest Management Agreement (FMA) and Forest Management Unit (FMU)

Acceptable tree species by Forest Management Agreement (FMA)																		
FMA	**Sw**	**Sb**	**Se**	**Pl**	**Pj**	**Pw**	**Pf**	**Lt**	**La**	**Lw**	**Ls**	**Fd**	**Fb**	**Fa**	**Aw**	**Pb**	**Bw**	**Ax**
9100029	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y	Y	Y	N
8900026	Y	Y	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
7500020	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
9900037	Y	Y	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
0900044	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
0900045	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
0200039	Y	Y	N	Y	N	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	N
8800025	Y	Y	Y	Y	N	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
0200041	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
9700034	Y	Y	Y	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
9000028	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
0100038	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N
9700032	Y	Y	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
9200030	Y	Y	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
0200040	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	N
9700033	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
0600043	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	N
9700036	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
0900046	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
6900016	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N

Acceptable tree species by Forest Management Unit (FMU)																		
FMU	**Sw**	**Sb**	**Se**	**Pl**	**Pj**	**Pw**	**Pf**	**Lt**	**La**	**Lw**	**Ls**	**Fd**	**Fb**	**Fa**	**Aw**	**Pb**	**Bw**	**Ax**
A6, A9, A10, A11, A12, A13	Y	Y	N	Y	Y	N	N	N	N	N	N	N	Y	N	Y	Y	Y	N
B11, B52	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N
C4, C5, C51, C52	Y	N	Y	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N
E8, E10	Y	Y	Y	Y	N	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
E9, H1	Y	Y	Y	Y	N	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
F10, F20, F51,	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	N
F11	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
F14	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
F23	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
G9, G10, G11, W51	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N
G12	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N
G13	Y	Y	N	Y	N	N	N	Y	N	N	N	N	N	N	Y	Y	Y	N
G14, G53, G54, L9, L51, P51, P52, P53, S14, S52	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
P8	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N
P14	Y	Y	N	Y	N	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	N
R11	Y	Y	Y	Y	N	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N

R14	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
S10	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N
S16	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	Y	Y	Y	N

Appendix 4. Establishment Survey Summary Sheet and data dictionary, Field Map Sheet and Tally Sheet

ESTABLISHMENT SURVEY SUMMARY SHEET

OPENING HEADER			
Disposition holder		Natural subregion	
Disposition		Ecosite (optional)	
Forest Area		Drainage class (optional)	
Opening number		Pre-harvest stratum (1-10)	
Field number		Survey date (YYYY-MM-DD)	
Opening area (ha)		Surveyor ID1	
Strata Standard (C, CD, DC, D)		Surveyor ID2	
Survey type (Air, Walk, or Intensive)		Regenerated yield class stratum	
Timber Year of Cut (YYYY-YYYY)			

STOCKING CALCULATIONS		
Type of Plot	# of plots	% of plots
Stocked with acceptable coniferous tree (C)		
Stocked with acceptable deciduous tree (D)		
Stocked with both acceptable C and D		
Stocked with under height (UH) C		
Stocked with UH D		
Stocked with both UH C and UH D		
Not stocked		
Not cut or deleted		
Total (excl not cut/deleted plots) - used to calc %		

ACCEPTABLE STOCKING SUMMARY*				
Acceptable coniferous tree stocking (%)				
Acceptable deciduous tree stocking (%)				
Total stocking (%)				
Poorly stocked area (ha)				
Survey passes	C	CD	DC	D
Establishment stratum assignment	C	CD	DC	D
Opening status	SR		NSR	
If NSR, stocking summary (acceptable and under height trees)				
Total stocking (%)				

* Only acceptable tree stocking information is reported to ARIS

Explanation if opening is SR and the Stratum Declaration ≠ Stratum assignment (check all applicable)
□ Expected development of the opening is consistent with stratum declaration
□ With additional treatment, the opening is expected to achieve the declared stratum
□ Stratum assignment of other openings is expected to compensate for this change
□ Area of changed stratum is insignificant given the expected/observed results of other surveys in this 5-year period
□ Other:

Regenerated yield class stratum leading coniferous tree species group (check one box only)		
□ **Pine**	□ **White spruce**	□ **Black spruce**
Pine = Pl + Pj + Lt	**White spruce = Sw + Se + Fb + Fa + Fd**	**Black spruce = Sb**

Damage:	Insect	% Extent	_____	Comments:	_____
	Disease	% Extent	_____	Comments:	_____
	Hare/Rodent	% Extent	_____	Comments:	_____
	Weeds:	% Extent	_____	Comments:	_____
	Other (specify)	% Extent	_____	Comments:	_____

Site Conditions: _____

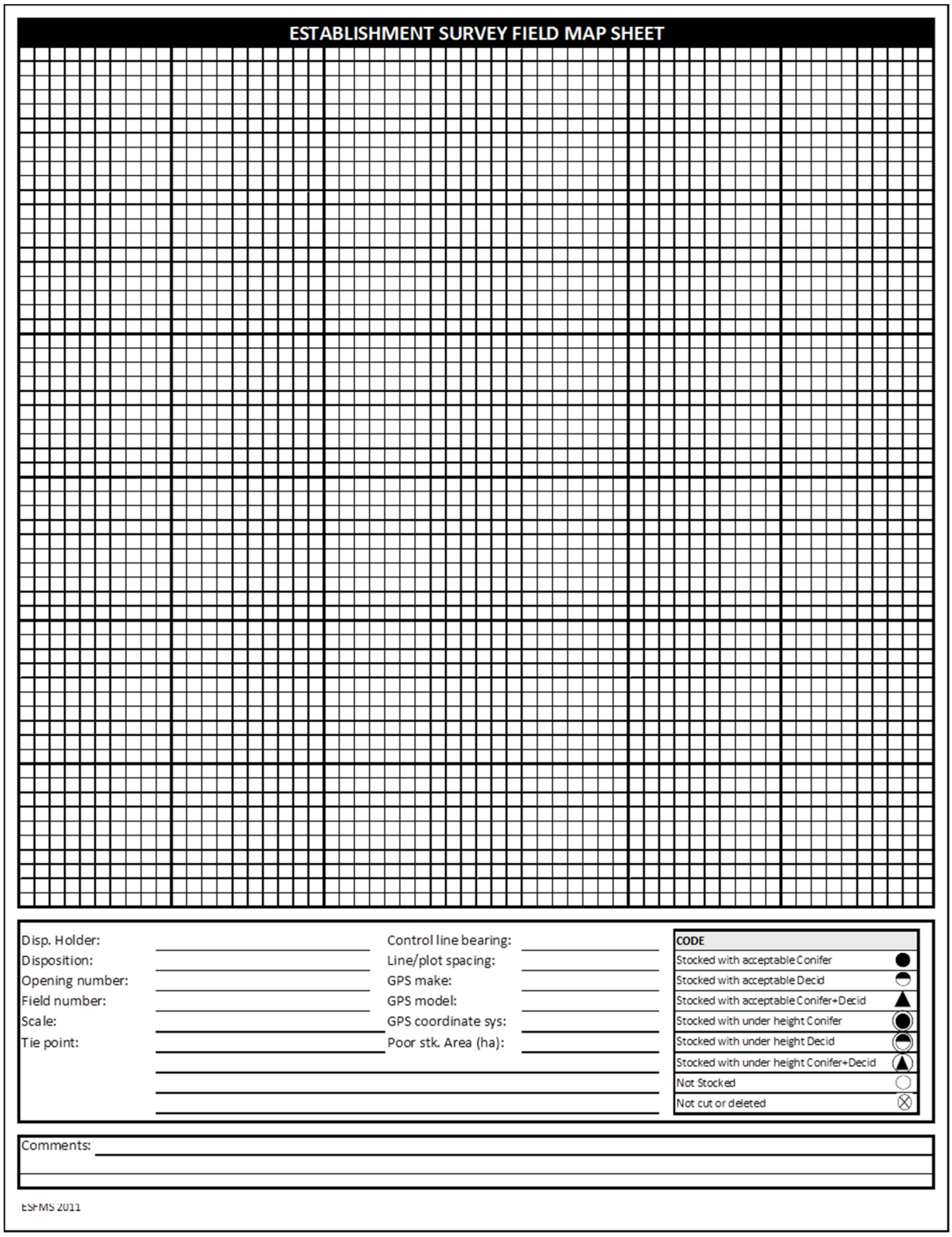
Comments: _____

ESSS 2013

Table 12-1. Establishment Survey Summary Sheet Opening Header data dictionary (all non-optional fields must be populated).

Field name	Description	Note
Disposition holder	The company responsible for reforestation.	E.g., River City Timber Ltd.
Disposition	The FMA, license or permit number under which the opening was harvested.	E.g., FMA0900088, CTQA130010, DTAA090001, etc.
Forest Area	The Provincial administrative unit (Appendix 6-8).	E.g., NE1, etc.
Opening Number	Unique AAF number based on legal location of the centroid of the harvest area.	E.g., 423075229A
Field number	The number assigned by the timber disposition holder to the opening that appears on the AOP or harvest plan map.	E.g., 1234
Opening area (ha)	Area (ha; 0.1 ha) of the opening as Update area (where available) or Net harvested hectares.	E.g. 20.1
Strata Standard (C, CD, DC, C)	Identifies the standard against which stocking is measured and the status of the opening determined.	E.g., C
Survey type (Air, Walk, Intensive)	Identifies the type of Establishment survey method as Air (Aerial Reconnaissance survey), Walk (Walk-through Reconnaissance survey) or Intensive (Intensive grid survey).	E.g., Air, Walk, Intensive
Timber Year of Cut (YYYY-YYYY)	Timber Year of Cut	E.g., 2010-2011
Natural subregion	Alberta's forested areas are classified into geographical areas, which exhibit similar natural forest vegetation. Enter the code for the Natural subregion. DM - Dry Mixedwood CM - Central Mixedwood NM - Northern Mixedwood LF - Lower Foothills UF - Upper Foothills LB - Lower Boreal Highlands UB - Upper Boreal Highlands SA – Subalpine MO - Montane	E.g., LB

Field name	Description	Note
Ecosite (optional)	Functional unit defined by the moisture and nutrient regime. The ecosite is determined during the pre-harvest survey. Ecosite is an optional field.	E.g., E1
Drainage class (optional)	Defined by water in excess of field capacity and the length of time water is in excess in the plant-root zone. Enter the code for drainage class: VR – Very rapidly drained R – Rapidly drained W – Well drained MW – Moderately well drained I – Imperfectly drained P – Poorly drained VP – Very poorly drained Drainage class is an optional field.	E.g., I
Pre-harvest stratum	Base 10 ARS stratum as identified in the Planning Standard (2006)	E.g., Sw, Sw/Hwd, etc.
Survey date (YYYY-MM-DD)	Year, month, day of Establishment survey	E.g., 2010-05-23
Surveyor ID1	Name (first and surname) of primary qualified surveyor.	E.g., Elihu Steward
Surveyor ID2	Name (first and surname) of qualified surveyor	E.g., Reginald Loomis
Regenerated yield class stratum	The up to 8-digit landbase designation code for the opening.	E.g., RCTL0702



Opening number: _____

ESTABLISHMENT SURVEY TALLY SHEET A

Line	Plot	Coniferous tree stocking				Deciduous tree stocking				Plot status
		Acceptable trees		Under height trees (to confirm LIG)		Acceptable trees		Under height trees (to confirm LIG)		One of: SR-C, SR-D, SR-CD, UH-C, UH-D, UH-CD, NSR
		Species	Above min. height?	Species	Above min. height?	Species	Above min. height?	Species	Above min. height?	

ESTSA 2011

Page _____ of _____

Opening number: _____

ESTABLISHMENT SURVEY TALLY SHEET B

GPS X coordinate	GPS Y coordinate	Plot ID	Coniferous tree stocking				Deciduous tree stocking				Plot status
			Acceptable trees		Under height trees (to confirm LIG)		Acceptable trees		Under height trees (to confirm LIG)		One of: SR-C, SR-D, SR-CD, UH-C, UH-D, UH-CD, NSR
			Species	Above min. height?	Species	Above min. height?	Species	Above min. height?	Species	Above min. height?	

ESTSB 2011

Page _____ of _____

Appendix 5. Statistical accuracy for stocking surveys

The Establishment (Intensive survey) and Performance (D Standard CSR/NSR) methods have been designed to satisfy the statistical accuracy standards outlined below (Table 11-2). The error levels are inherent in the survey design and do not include unintended surveyor error. Accuracy will be further reduced if surveyor error, either by omission or commission, is introduced into the sampling.

The approximate sampling error for stocking of an individual opening can be calculated using the formula:

$$E = \pm 200 \sqrt{\frac{p \times q}{n}}$$

where,

E = sampling error in percent;

p = proportion of stocked plots expressed as a decimal (e.g., 70% = 0.70);

q = 1-p; proportion of plots poorly stocked as a decimal (e.g., 1.00-0.70 = 0.30); and,

n = number of plots established.

The following table presents the statistical accuracy of stocking for Establishment and Performance (D Standard CSR/NSR) surveys:

Table 12-2. Statistical accuracy requirements by opening size.

Opening area (ha)	Statistical Accuracy
0 – 1.9	Variable
2.0 – 4.0	± 12.5% with 95% confidence
> 4.0	± 10.0% with 95% confidence when stocking is 80% or greater

The approximate sampling error for top height and diameter will be calculated as:

$$E = 2 \times SE$$

where,

E = sampling error in percent; and,

SE = standard error of the mean

Appendix 6. Number of sample plots for stocking surveys

The number of sample plots required is based on the allowable error of the stocking estimate (Table 11-3).

The total number of plots required to sample any given area can be calculated using the formula:

$$n = \frac{40{,}000 \times p \times q}{E^2}$$

where,

n = number of sample plots to be established

p = proportion of plots stocked expressed as a decimal

q = 1 - p; proportion of plots poorly stocked expressed as a decimal

E = maximum allowable sampling error

Table 12-3. Required number of sample plots by opening size.

Opening area (ha)	Required Sample Plots
0.1 – 1.9 ha	Minimum of 12.4 plots/ ha
2.0 – 4.0 ha	Minimum of 41 plots/opening
4.1 – 24.0 ha	Minimum of 64 plots/opening
24.0+ ha	Minimum of 2.77 plots/ ha

Appendix 7. Summary of line and plot spacing

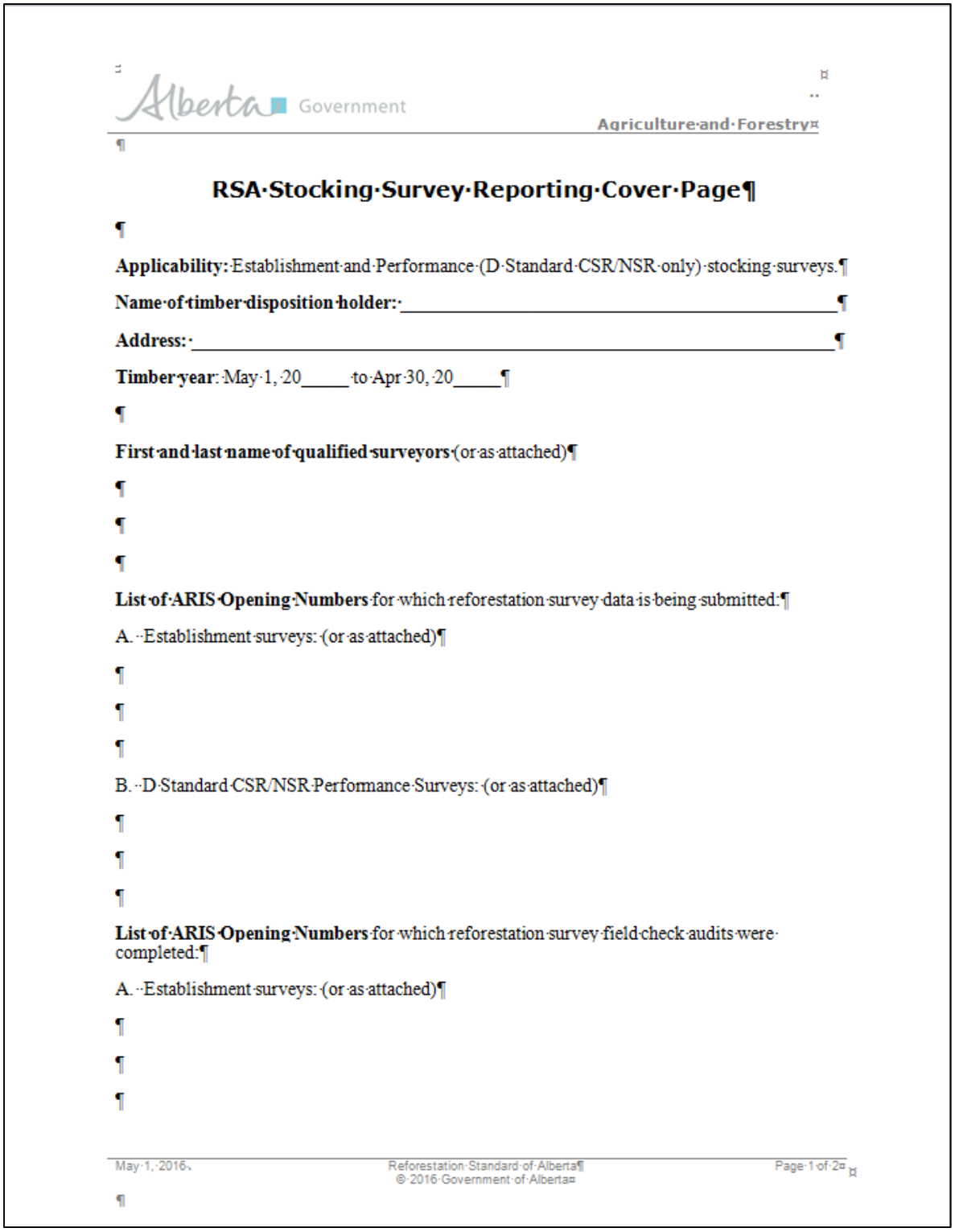
Table 12-4. Line and plot spacing, number of plots, and allowable error by opening or NAA area

Opening area (ha)	Square metres per plot	Square spacing (m)	Number of plots (plots/ha)	Number of plots	Allowable error (±%)
0.5	806.45	28.40	12.40	6	32.66
1.0	806.45	28.40	12.40	12	22.19
1.5	806.45	28.40	12.40	19	18.35
2.0	487.80	22.09	20.50	41	12.50
2.5	609.76	24.69	16.40	41	12.50
3.0	731.71	27.05	13.67	41	12.50
3.5	853.66	29.22	11.71	41	12.50
4.0	975.61	31.23	10.25	41	12.50
4.5	703.13	26.52	14.22	64	10.00
5.0	781.25	27.95	12.80	64	10.00
5.5	859.38	29.32	11.64	64	10.00
6.0	937.50	30.62	10.67	64	10.00
6.5	1015.63	31.87	9.85	64	10.00
7.0	1093.75	33.07	9.14	64	10.00
7.5	1171.88	34.23	8.53	64	10.00
8.0	1250.00	35.36	8.00	64	10.00
8.5	1328.13	36.44	7.53	64	10.00
9.0	1406.25	37.50	7.11	64	10.00
9.5	1484.38	38.53	6.74	64	10.00
10.0	1562.50	39.53	6.40	64	10.00
10.5	1640.63	40.50	6.10	64	10.00
11.0	1718.75	41.46	5.82	64	10.00
11.5	1796.88	42.39	5.57	64	10.00
12.0	1875.00	43.30	5.33	64	10.00
12.5	1953.15	44.19	5.12	64	10.00
13.0	2031.25	45.07	4.92	64	10.00
13.5	2109.38	45.93	4.74	64	10.00
14.0	2187.50	46.77	4.57	64	10.00
14.5	2265.63	47.60	4.41	64	10.00

Opening area (ha)	Square metres per plot	Square spacing (m)	Number of plots (plots/ha)	Number of plots	Allowable error (±%)
15.0	2343.75	48.41	4.27	64	10.00
15.5	2421.88	49.21	4.13	64	10.00
16.0	2500.00	50.00	4.00	64	10.00
16.5	2578.13	50.78	3.88	64	10.00
17.0	2656.25	51.54	3.76	64	10.00
17.5	2734.38	52.29	3.66	64	10.00
18.0	2812.50	53.03	3.56	64	10.00
18.5	2890.63	53.76	3.46	64	10.00
19.0	2968.75	54.49	3.37	64	10.00
19.5	3046.88	55.20	3.28	64	10.00
20.0	3125.00	55.90	3.20	64	10.00
20.5	3203.13	56.60	3.12	64	10.00
21.0	3281.25	57.28	3.05	64	10.00
21.5	3359.38	57.96	2.98	64	10.00
22.0	3437.50	58.63	2.91	64	10.00
22.5	3515.63	59.29	2.84	64	10.00
23.0	3593.75	59.95	2.78	64	10.00
23.5	3671.88	60.60	2.72	64	10.00
24.0	3750.00	61.24	2.67	64	10.00
24.5	3610.11	60.08	2.77	68	9.71
25.0	3610.11	60.08	2.77	69	9.61
25.5	3610.11	60.08	2.77	71	9.52
26.0	3610.11	60.08	2.77	72	9.43
26.5	3610.11	60.08	2.77	73	9.34
27.0	3610.11	60.08	2.77	75	9.25
27.5	3610.11	60.08	2.77	76	9.17
28.0	3610.11	60.08	2.77	78	9.08
28.5	3610.11	60.08	2.77	79	9.00
29.0	3610.11	60.08	2.77	80	8.93
29.5	3610.11	60.08	2.77	82	8.85
30.0	3610.11	60.08	2.77	83	8.78
30.5	3610.11	60.08	2.77	84	8.70

Opening area (ha)	Square metres per plot	Square spacing (m)	Number of plots (plots/ha)	Number of plots	Allowable error (±%)
31.0	3610.11	60.08	2.77	86	8.63
31.5	3610.11	60.08	2.77	87	8.56
32.0	3610.11	60.08	2.77	89	8.50
32.5	3610.11	60.08	2.77	90	8.43
33.0	3610.11	60.08	2.77	91	8.37
33.5	3610.11	60.08	2.77	93	8.30
34.0	3610.11	60.08	2.77	94	8.24
34.5	3610.11	60.08	2.77	96	8.18
35.0	3610.11	60.08	2.77	97	8.12
35.5	3610.11	60.08	2.77	98	8.07
36.0	3610.11	60.08	2.77	100	8.01
36.5	3610.11	60.08	2.77	101	7.96
37.0	3610.11	60.08	2.77	102	7.90
37.5	3610.11	60.08	2.77	104	7.85
38.0	3610.11	60.08	2.77	105	7.80
38.5	3610.11	60.08	2.77	107	7.75
39.0	3610.11	60.08	2.77	108	7.70
39.5	3610.11	60.08	2.77	109	7.65
40.0	3610.11	60.08	2.77	111	7.60
40.5	3610.11	60.08	2.77	112	7.55
41.0	3610.11	60.08	2.77	114	7.51
41.5	3610.11	60.08	2.77	115	7.46
42.0	3610.11	60.08	2.77	116	7.42

Appendix 8. RSA Stocking Reporting Cover Page



Alberta Government

Agriculture and Forestry

RSA Stocking Survey Reporting Cover Page

Applicability: Establishment and Performance (D Standard CSR/NSR only) stocking surveys.

Name of timber disposition holder: _____

Address: _____

Timber year: May 1, 20_____ to Apr 30, 20_____

First and last name of qualified surveyors (or as attached)

List of ARIS Opening Numbers for which reforestation survey data is being submitted:

A. Establishment surveys: (or as attached)

B. D Standard CSR/NSR Performance Surveys: (or as attached)

List of ARIS Opening Numbers for which reforestation survey field check audits were completed:

A. Establishment surveys: (or as attached)

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B. D Standard CSR/NSR Performance Surveys: (or as attached)

Summary of preventive and corrective actions - from Quality Assurance/Quality Control Program for openings included in this submission (or as attached; if none, please indicate)

Declaration:

This submission, including this signed cover page and attached reforestation surveys:

1) Was prepared by me, or under my direct supervision, or was prepared by a third party(ies) and has been reviewed and accepted by me; and,

2) Was prepared in accordance with the timing, methods, procedures, and format required by the RSA; and,

3) Was prepared in accordance with a documented Quality Assurance/Quality Control program which meets the requirement defined in Section 10 and used qualified surveyors to properly collect all survey information; and,

4) To the best of my knowledge and the best of my professional ability, recognizing the standard of care expected of a professional doing this work, is in my professional opinion, true, accurate and complete.

Signature: _____ **Print name**: _____

Professional organization: _____ **Registration number**: _____

Date: _____

If applicable

Appendix 9. Forest Areas

ARIS requires the submission of a Forest Area code for each opening. The Forest Area codes are historical despite the creation of new Forest Area boundaries on 15 January, 2002.

Table 12-5. Forest Area codes.

Code	Forest Area
NEB1	Waterways
NEB2	Lakeland
NEB3	Athabasca
NES1	Foothills
NES2	Yellowhead
NES3	Woodlands
NWB1	Wapiti River
NWB2	MacKenzie
NWB3	Upper Hay
NWB5	Martin Hills
NWB6	East Peace
NWB7	Lakeshore
NWB8	Smoky River
SES1	Crowsnest
SES2	Bow
SES3	Clearwater
SES4	Brazeau

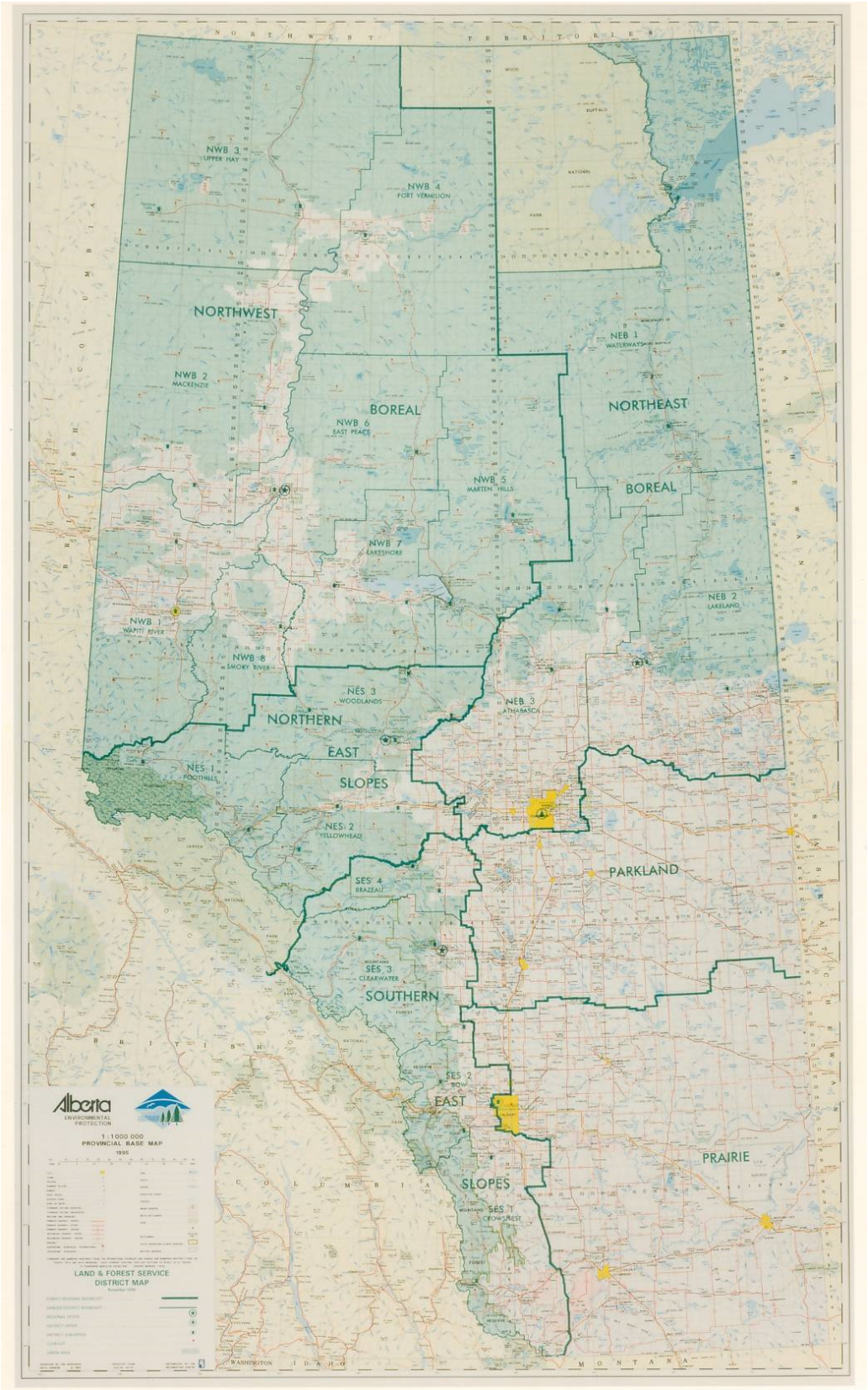


Figure 12-1. Map of Forest Areas.

Appendix 10. Acquisition of aerial photography data dictionary

Table 12-6. Data dictionary for dBase attribute file

Field name	Format	Description	Note
TDH	$4.0	ARIS stakeholder code for the timber disposition holder requesting photo acquisition	E.g., “RCTL”
DISPOS	$10.0	Disposition refers to the legal document that grants the right to harvest timber. Reforestation liability is attached to the disposition.	E.g., “FMA0900088”, “CTQA130010”, etc.
OPENING	$11.0	Unique ARIS number based on legal location of the centroid of the harvested area	E.g., “4230750229A”
FIELD_NUM	$12.0	The number assigned by the timber disposition holder to the opening that appears on the AOP or harvest plan map.	E.g., “12A”
SKID_DATE	$10.0	Skid clearance date or disturbance date, whichever is more recent, in YYYY-MM-DD	E.g., “1997-01-23”
AREA_HA	7.2	Net harvested hectares for the opening	Eligible codes: 0.01 to 9999.99
SHAPE_LENG	13.7	Length of polygon in m	Eligible codes: 0.00000000001 to 99999.9999999
SHAPE_AREA	13.5	Area of polygon in m^2	Eligible codes: 0.00000000001 to 9999999.99999

Note: Arc defaults may preclude setting fieldnames and formats as per Table 11-6. However, to ensure consistency of all shape file submissions please ensure that the ‘fieldname’ order in Table 11-6 is followed.

Appendix 11. Sampling Unit and Poorly Regenerated Areas stratification data dictionaries

Table 12-7. Interp1: Data dictionary for interpreted Sampling Unit attribute data (Aerial Stratification System only)

Field Name	Format	Description	Note
PHOTO_Y	4.0	Year of photography	For example: 2008, 2009, 2010, etc. (no blanks allowed)
PHOTO_M	2.0	Month of photography	Eligible codes: 1 to 12
PHOTO_D	2.0	Day of photography	Eligible codes: 1 to 31
EMULSION	$3.0	Emulsion of photography TC = True color, CIR = Color infrared; BW = Black and white	Eligible codes: “TC”, “CIR”, “BW” (no blanks allowed)
SCALE	$10.0	Scale of photography	For example: "20000", "15000", for conventional photography; “20” for digital photography (no blanks allowed)
LEAF	$8.0	Indicator of season of photography	Eligible codes: "leaf-on", "leaf-off"
INTRP_Y	4.0	Year of interpretation	For example: 2008, 2009, 2010, etc. (no blanks allowed)
INTRP_M	2.0	Month of interpretation	Eligible codes: 1 to 12
INTRP	$20.0	Name of interpreter	For example "Elihu Steward", "Reginald Loomis", etc. (no blanks allowed)
OPENING	$11.0	Opening number consistent with ARIS	For example: "423075229A", etc. (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	For example: "001", "002", "003" etc. (no blanks allowed)
UNIQUE_ID	$16.0	Unique identifier is made up of opening number and polygon	For example: "423075229A_001", "423075229A_002", etc. (no blanks allowed)
AREA_HA	7.2	Area (hectares) of polygon	Eligible codes: 0.01 to 9999.99
HIGHER_STRAT	$5.0	Descriptor for higher-level stratification	For example: “SA”, “UF”, “LF” or “Tend1”, “Tend2”. If not applicable, then “0”,
NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, or 2

Field Name	Format	Description	Note
SP1	$2.0	Species code of most dominant species in the regeneration layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
SP1_PER	2.0	SP1's contribution to species composition to nearest 10%	Eligible codes: 0, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP2	$2.0	Species code of second most dominant species in the regeneration layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
SP2_PER	2.0	SP2's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP3	$2.0	Species code of third most dominant species in the regeneration layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
SP3_PER	2.0	SP3's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP4	$2.0	Species code of fourth most dominant species in the regeneration layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
SP4_PER	2.0	SP4's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP5	$2.0	Species code of fifth most dominant species in the regeneration layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
SP5_PER	2.0	SP5's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
SP_CL	$4.0	Species composition class (derived field based on SP1 through SP5)	Eligible codes: blank, “Hw”, “HwPl”, “HwSx”, “SwHw”, “PlHw”, “SbHw”, “Sw”, “Pl”, “Sb”, “Fd”

Field Name	Format	Description	Note
DENSITY	6.0	Total density (stems per ha) call for the regeneration layer	Eligible codes: 0 to 999999
DEN_CL	$2.0	Density class (derived field based on DENSITY)	Eligible codes: blank, “L”, “M”, “H”, “D”
AVE_HT	4.1	Average height of the regeneration layer in meters	Eligible codes: 0 to 99.9
SPATIAL	1.0	Spatial distribution call for the regeneration layer	Eligible codes: 0, 1, 2, 3, 4, 5
MIXED	$1.0	Mixedwood pattern call for the regeneration layer	Eligible codes: blank, “I”, “A”, “P”
R_SP1	$2.0	Species code of most dominant species in the residual layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
R_SP1_PER	2.0	R_SP1's contribution to species composition to nearest 10%	Eligible codes: 0, 4, 5, 6, 7, 8, 9, 10
R_SP2	$2.0	Species code of second most dominant species in the residual layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
R_SP2_PER	2.0	R_SP2's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
R_SP3	$2.0	Species code of third most dominant species in the residual layer	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
R_SP3_PER	2.0	R_SP3's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
R_DEN	6.0	Total density (stems per ha) call for the residual layer	Eligible codes: 0 to 999999
R_CC	2.0	Crown closure of the residual layer to the nearest 10%	Eligible codes: 0, 2, 3, 4, 5, 6, 7, 8, 9, 10
R_AVE_HT	4.1	Average height of the residual layer	Eligible codes: 0 to 99.9

Field Name	Format	Description	Note
R_SPT	1.0	Spatial distribution call for the residual layer	Eligible codes: 0, 1, 2, 3, 4, 5

Table 12-8. Interp2: Data dictionary for interpreted Poorly Regenerated Areas attribute data (Aerial Stratification System only)

Field Name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	For example: "423075229A", etc. (no blanks allowed)
POLYGON	$5.0	Unique poorly regenerated polygon number within an opening	For example: "PR1", "PR2", "PR3" etc. (no blanks allowed)
UNIQUE_ID	$17.0	Unique identifier is made up of opening number and polygon	For example: "423075229A_PR1", "423075229A_PR2", etc. (no blanks allowed)
AREA_HA	7.2	Area (hectares) of polygon	Eligible codes: 0.1 to 9999.9
NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, or 2
PR_SP1	$2.0	Species code of most dominant species in the poorly regenerated area	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
PR_SP1_PER	2.0	SP1's contribution to species composition to nearest 10%	Eligible codes: 0, 4, 5, 6, 7, 8, 9, 10
PR_SP2	$2.0	Species code of second most dominant species in the poorly regenerated area	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
PR_SP2_PER	2.0	SP2's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
PR_SP3	$2.0	Species code of third most dominant species in the poorly regenerated area	Eligible codes: blank, “Sw”, “Se”, “Sb”, “Pl”, “Pj”, “Pw”, “Pf”, “Fb”, “Fa”, “Fd”, “La”, “Lt”, “Lw”, “Aw”, “Pb”, “Bw”, “P”, “A”
PR_SP3_PER	2.0	SP3's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
PR_SP_CL	$4.0	Species composition class (derived field based on SP1 through SP3)	Eligible codes: blank, “Hw”, “HwPl”, “HwSx”, “SwHw”, “PlHw”, “SbHw”, “Sw”, “Pl”, “Sb”, “Fd”

PR_DEN	6.0	Total density (stems per ha) call for the poorly regenerated area	Eligible codes: 0 to 199
PR_AVE_HT	4.1	Average height of the poorly regenerated area in meters	Eligible codes: 0 to 99.9

Table 12-9. Interp3: Data dictionary for optional interpreted Sampling Unit stocking data (Aerial Stratification System only)

Field Name	Format	Description	Note
PHOTO_Y	4.0	Year of photography	For example: 2008, 2009, 2010, etc. (no blanks allowed)
PHOTO_M	2.0	Month of photography	Eligible codes: 1 to 12
PHOTO_D	2.0	Day of photography	Eligible codes: 1 to 31
EMULSION	$3.0	Emulsion of photography TC = True color, CIR = Color infrared; BW = Black and white	Eligible codes: “TC”, “CIR”, “BW” (no blanks allowed)
SCALE	$10.0	Scale of photography	For example: "20000", "15000", for conventional photography; “20” for digital photography (no blanks allowed)
LEAF	$8.0	Indicator of season of photography	Eligible codes: "leaf-on", "leaf-off"
INTRP_Y	4.0	Year of interpretation	For example: 2008, 2009, 2010, etc. (no blanks allowed)
INTRP_M	2.0	Month of interpretation	Eligible codes: 1 to 12
INTRP	$20.0	Name of interpreter	For example "Elihu Steward", "Reginald Loomis", etc. (no blanks allowed)
OPENING	$11.0	Opening number consistent with ARIS	For example: "423075229A", etc. (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	For example: "001", "002", "003" etc. (no blanks allowed)
UNIQUE_ID	$16.0	Unique identifier is made up of opening number and polygon	For example: "423075229A_001", "423075229A_002", etc. (no blanks allowed)
AREA_HA	7.2	Area (hectares) of polygon	Eligible codes: 0.01 to 9999.99
HIGHER_STRAT	$5.0	Descriptor for higher-level stratification	For example: “SA”, “UF”, “LF” or “Tend1”, “Tend2”. If not applicable, then “0”,
NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, or 2
PS_SG1	$2.0	Species code of most dominant species in the regeneration layer	Eligible codes: “AW”, “PL”, “SB”, “SW”

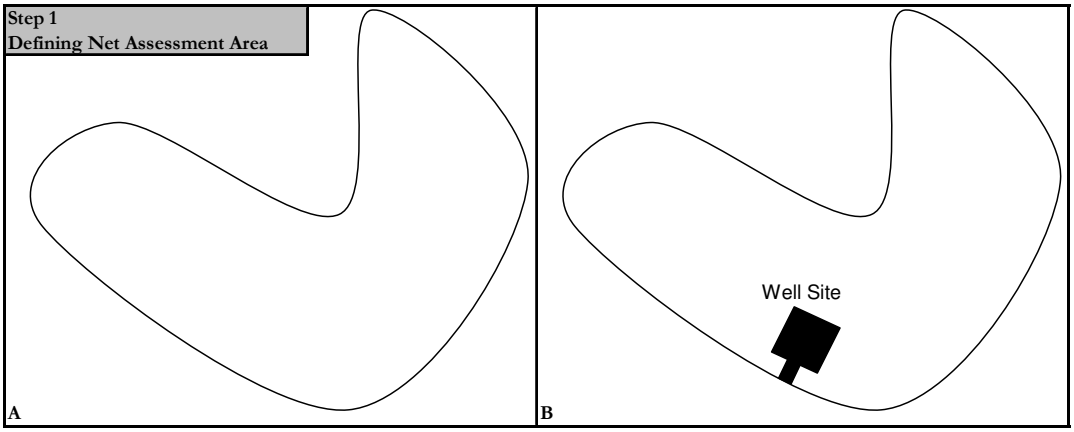
Field Name	Format	Description	Note
PS_SG1_PER	2.0	SP1's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
PS_SG2	$2.0	Species code of second most dominant species in the regeneration layer	Eligible codes: blank, “AW”, “PL”, “SB”, “SW”
PS_SG2_PER	2.0	SP2's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
PS_SG3	$2.0	Species code of third most dominant species in the regeneration layer	Eligible codes: blank, “AW”, “PL”, “SB”, “SW”
PS_SG3_PER	2.0	SP3's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
PS_SG4	$2.0	Species code of fourth most dominant species in the regeneration layer	Eligible codes: blank, “AW”, “PL”, “SB”, “SW”
PS_SG4_PER	2.0	SP4's contribution to species composition to nearest 10%	Eligible codes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
PS_SP_CL	$4.0	Species composition class (derived field based on PS_SP1 through PS_SP5)	Eligible codes: blank, “Hw”, “HwPl”, “HwSx”, “SwHw”, “PlHw”, “SbHw”, “Sw”, “Pl”, “Sb”, “Fd”
PS_CON	3.0	Conifer species group stocking (nearest 1%) call for the regeneration layer	Eligible codes: 0 to 100
PS_TOTAL	3.0	Total stocking (nearest 1%) call for the regeneration layer	Eligible codes: 0 to 100

Appendix 12. Examples of net downs and hierarchical delineation of Sample Units

Step 1: Define the Net Assessment Area (NAA).

This step nets out any land use dispositions or natural deletions, as outlined in Section 8.4.3.4.

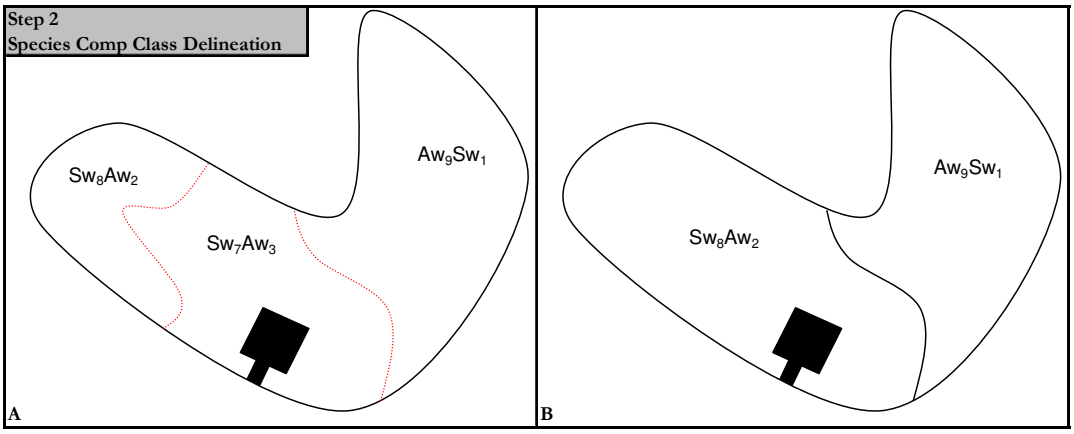
For example, Graphic A shows the original opening boundaries prior to net-down. Graphic B shows the NAA after a well site is netted out.



Step 2: Delineate the Sampling Units within the NAA based on regeneration layer species composition:

- Where tree species composition class differs (Table 8-4); and,
- Where the tree species composition percentage of a single species within the cover type differ by more than 10%; and,
- Where Sampling Unit size (minimum 2 ha) and width (minimum 50 m) criteria are met.

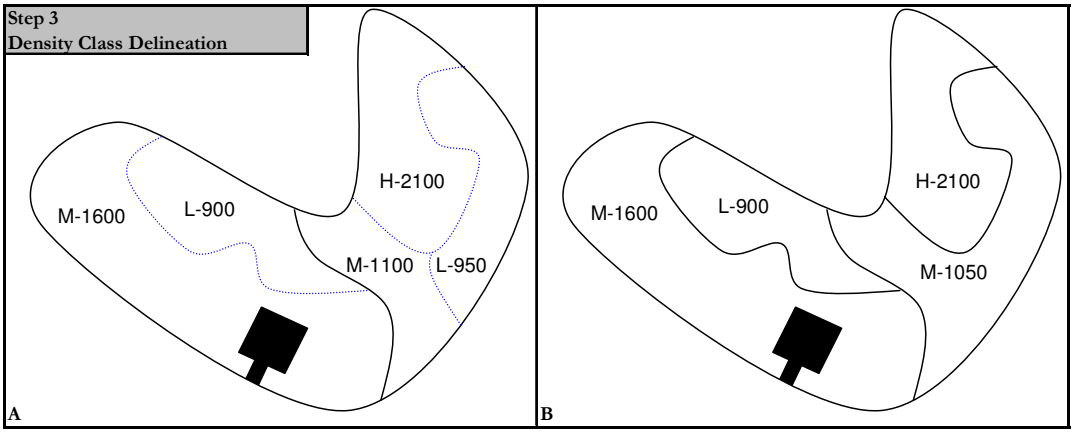
For example, Graphic A (below) shows the preliminary line work based on differences in species composition class (as defined in '1' above). Graphic B (below) shows the final line work for species composition. The line between Sw_8Aw_2 and Sw_7Aw_3 is not drawn because the criterion 2 (above) is not met. In this case, the differences in the second species composition did not differ by more than 10%.



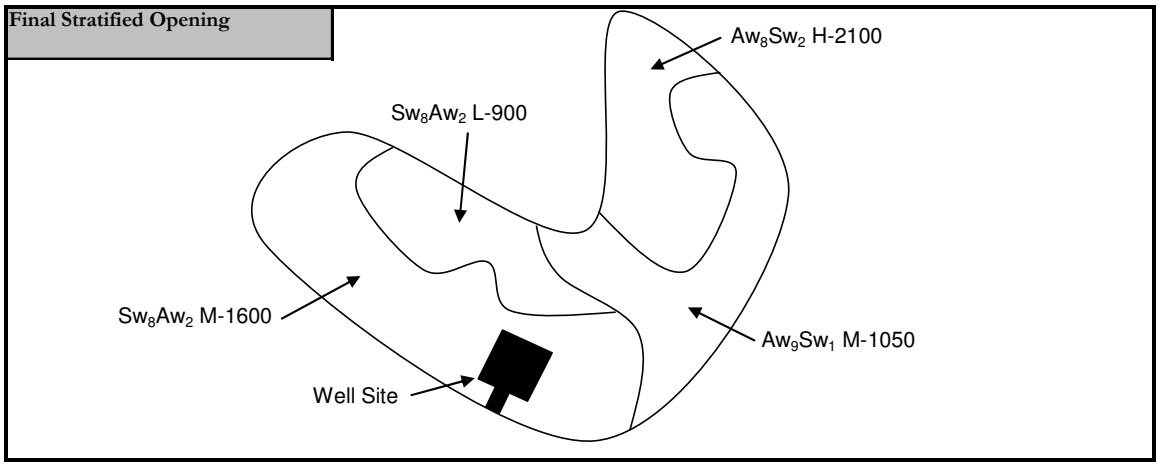
Step 3: Delineate the Sampling Units based on regeneration layer density:

- Where total density class differs (Table 8-5); and
- Where total density differs by more than the minimums outlined in Table 8-6; and
- Where Sampling Unit size (minimum 2 ha) and width (minimum 50 m) criteria are met.

For example, Graphic A (below) shows the preliminary line work based on total density class differences (as define in '1' above). Graphic B (below) shows the final line work for density class. The line between M-1100 and L-950 is excluded because it did not meet the second density delineation criterion (i.e., densities did not differ by more than 200 stems per hectare).



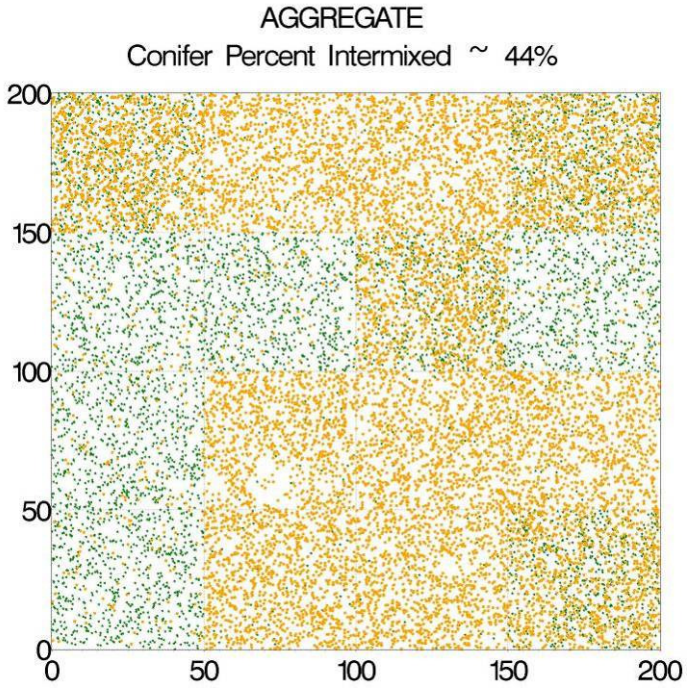
The Final Stratified Opening graphic (below) shows the correct stratification for the opening. For each Sampling Unit, all attributes are interpreted and recorded.



Appendix 13. Process to determine mixedwood pattern

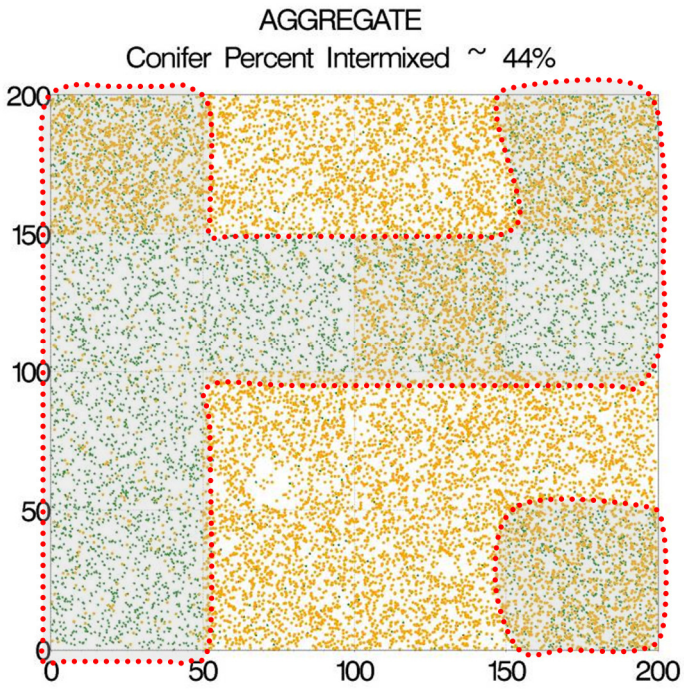
The following graphics illustrate a two-step process interpreters may use when making the mixedwood pattern call.

The graphic represents a 4 ha Sampling Unit composed of a mixture of coniferous and deciduous stems. Coniferous trees are represented by green dots while deciduous trees are represented by orange dots. While there are trees throughout the Sampling Unit, the relative distribution of coniferous trees versus deciduous trees is variable.



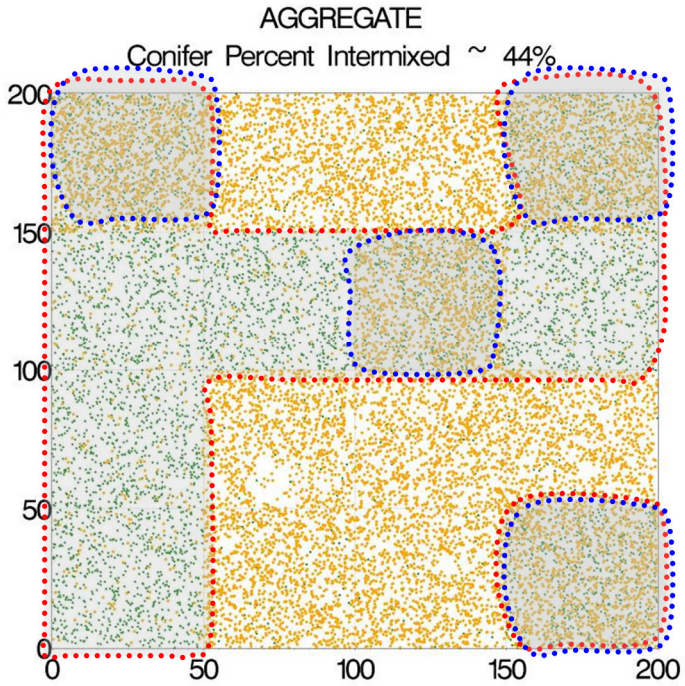
Step 1: Consider the spatial distribution of coniferous trees.

Interpreters should visually scan the Sampling Unit and focus in on the areas with a high concentration of primarily coniferous trees (areas outlined with red dots). Although coniferous trees are present outside of the highlighted areas, the focus is on where significant (i.e. greater than 200 stems per hectare) concentrations of coniferous trees exist.



Step 2: Determine the general proportion of the area where coniferous trees occur in the presence of significant deciduous trees.

The following graphic identifies the areas where significant (i.e. greater than 200 stems per hectare) deciduous occurs.



The majority of the area occupied by conifer stems occurs in patches in the absence of significant deciduous stems. Thus, in this example, the 'aggregate' mixedwood pattern code would be assigned to this Sampling Unit. Note that this example is intended to be a simplified supporting rationale for how a mixedwood pattern call is made. In general, an interpreter should simply scan the Sampling Unit with this process in mind and be able to assign a mixedwood pattern code based on the estimated level of conifer and deciduous intermixing.

Appendix 14. Master Opening List data dictionary

Table 12-10. Opening1: Data dictionary for Master Opening List (Aerial Stratification and Non-photo Systems).

Field name	Format	Description	Note
SYSTEM_TYPE	$1.0	Type of performance assessment	Eligible codes: “A” or “N”
DISPOSITION_HOLDER	$28.0	Timber Disposition Holder: the legal name of the forest company or organization that retains the reforestation liability for the opening	E.g., “River City Timber Ltd.”
DISPOSITION	$10.0	Disposition: refers to the legal document that grants the right to harvest timber. Reforestation liability is attached to the disposition.	E.g., “FMA0900088”, “CTQA130010”, “DTAA090001”, etc.
FOREST_AREA	$4.0	The Alberta administrative unit (region/area) where the opening is located.	Eligible codes: “NEB1”, “NEB2”, “NEB3”, “NES1”, “NES2”, “NES3”, “NWB1”, “NWB2”, “NWB3”, “NWB5”, “NWB6”, “NWB7”, “NWB8”, “SES1”, “SES2”, “SES3”, “SES4”
FIELD_NUMBER	$12.0	The number assigned by the Timber Disposition Holder to the opening that appears on the AOP or harvest plan map.	E.g., “1234”
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
NET_HARVEST_HECTARES	7.2	Area (hectares) from ARIS	Eligible codes: 0.01 to 9999.99
UPDATE_AREA	7.2	Updated Area (hectares) from ARIS	Eligible codes: blank or 0.01 to 9999.99
SKID_YEAR	4.0	Year of Skid Clearance or Year of Disturbance (as reported in ARIS), whichever is more recent.	Eligible codes: 1994 to 2058
SKID_MONTH	2.0	Month of Skid Clearance or Month of Disturbance (as reported in ARIS), whichever is more recent.	Eligible codes: 1 to 12

SKID_DAY	2.0	Day of Skid Clearance or Day of Disturbance (as reported in ARIS), whichever is more recent.	Eligible codes: 1 to 31
PR_AREA	7.2	Poorly regenerated area (hectares) – Where the system type is Non-photo this must be provided by the user. Where the system type is Aerial it can be left blank.	Eligible codes: blank or 0.00 to 9999.99

Appendix 15. Mechanics of the field sample selection computer program

Repealed 1 May, 2014.

Appendix 16. Performance sheets

PERFORMANCE SURVEY INFORMATION SHEET	
Master Opening List information	
System type (Aerial, Non-photo)	
Disposition holder	
Disposition	
Forest Area	
Field number	
Opening	
Net harvested ha (ARIS)	
Update area (ARIS)	
Skid year	
Skid month	
Skid day	
Poorly regenerated area (ha)	
Unit header information	
Polygon	
Area final	
Strata	
Surveyor ID1	
Surveyor ID2	
Survey year (YYYY)	
Survey month (1 - 12)	
Survey date (1 - 31)	
Number of Basic plots	
Number of Detailed plots	
Optional diam (Y/N)	
GPS make	
GPS model	
GPS coordinate system	
GPS latitude/Longitude format	
GPS UTM Zone	
	PSIS2011

Please refer to the data dictionaries in Appendix 14 and 17 for format requirements and descriptions of fields.

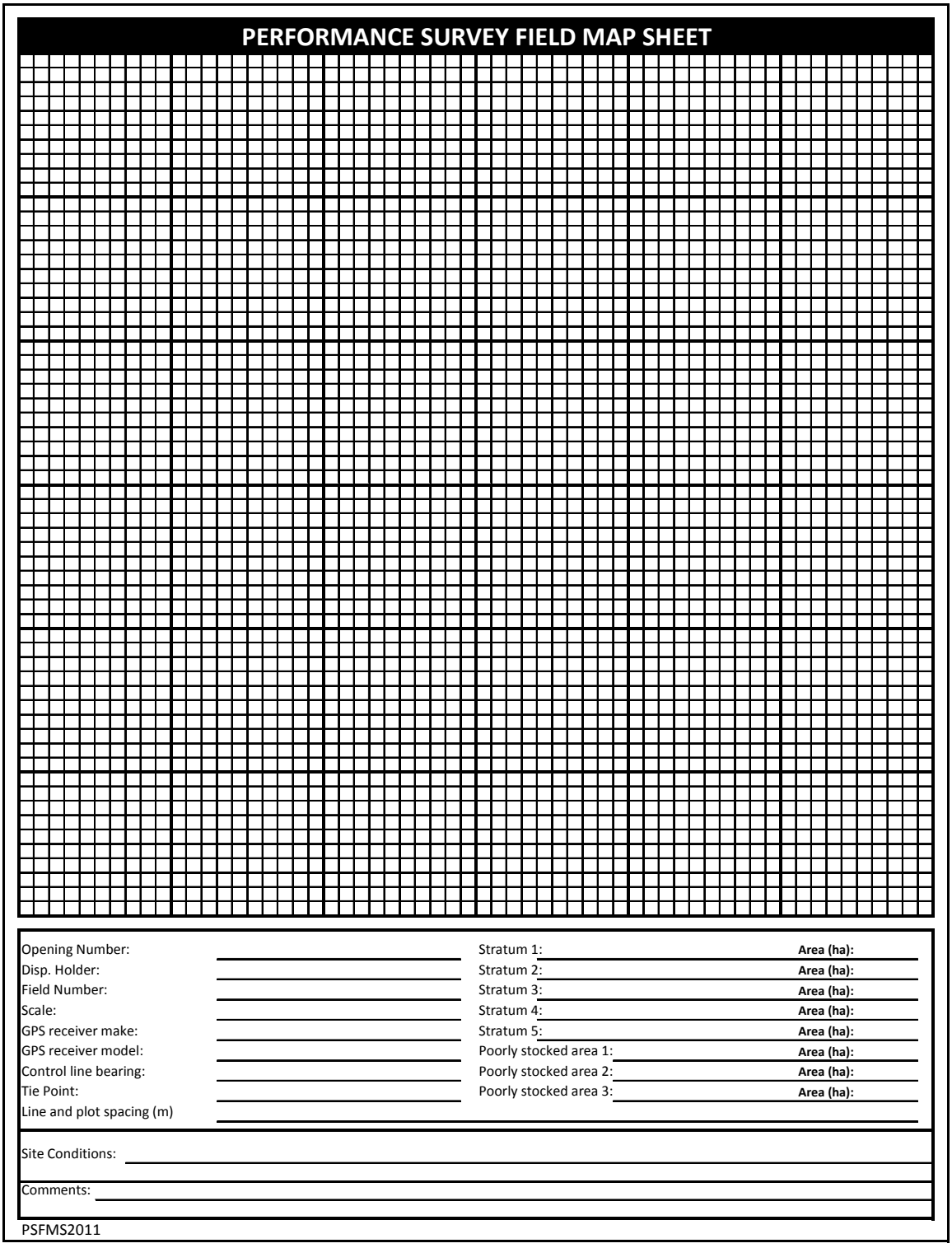
PERFORMANCE SURVEY TALLY SHEET

Opening number:_______________________

Stratum information		Plot information		Basic Plot - All plots (1.78 m radius)					Detailed Plot - every 4th plot (5.64 m radius)		
									Top height trees - SDL ONLY		
Polygon	Stratum[1] (for Aerial or Non-photo)	Plot ID	Plot type (B =Basic or D=Detailed)	Species	WGR[2] (Y or leave blank)	SDL tally by species (conifer ≥30 cm; decid ≥130 cm)	ADV tally by species (conifer ≥30 cm; decid ≥130 cm)	Cover (%) for shrubs ≥30 cm (max. 100%)	Species	Height (cm)	Total age (years)

1 Aerial: Stratum from Sample Selection Tool; Non-photo System: Species class - Hw, MxPl, MxSw, Pl, Sw, Sb Density class - L, M, H 2 Assign 'Y' to WGR if Western Gall Rust encircles ≥ 50% of the main stem

Please refer to the data dictionaries in Appendix 13 and 16 for format requirements and descriptions of fields



A description of each field in the Performance Survey Field Map Sheet is as follows:

Opening number: Record the Opening number. The Opening number is a unique number based on the legal location of the centroid of the harvest area (e.g., 4230755229A; no blanks allowed).

Timber Disposition Holder: Record the Timber Disposition Holder. The timber disposition holder is the legal name of the forest company or organization that carries the reforestation liability for the opening.

Field number: Record the field number. The Field number is the number assigned by the Timber Disposition Holder to an opening that normally appears on the Annual Operating Plan (AOP) or harvest plan map.

Sampling Unit unique ID: Record the Sampling Unit unique ID. The Sampling Unit unique ID is the unique identifier for the Sampling Unit within an opening. It is composed of the Opening Number and the Sampling Unit number (e.g., 4230755229A_1).

Sampling stratum: Record the sampling stratum. This field could be a combination of higher-level stratification and species composition or aggregated strata (Aerial Stratification System) or species composition and density classes (Non-photo System).

Scale: Record the scale for the map. The scale is a measure of map distance and the equivalent measure of distance on the ground expressed as a representative fraction. Survey maps shall be provided to a scale of 1:5,000 or larger.

Tie Point: Record the location of the tie point. A tie point is a location on or close to the opening boundary that is easily found on a map or air photo and on the ground. Tie points are necessary to indicate where surveyors entered openings to access Sampling Units for audit purposes. Tie points shall be clearly marked in the field with flagging. Surveyors shall write the following information using waterproof ink on the flagging at each tie point:

- The surveyor(s) first and last initial and date of the survey;
- The distance in meters and compass bearing in degrees to the first plot. If using GPS, a track log is acceptable.

Line and plot spacing: Record line and plot spacing in meters (e.g., 35.1 × 35.1)

GPS receiver make: Record the make of the GPS receiver (e.g., Garmin, Trimble).

GPS receiver model: Record the model of the GPS receiver (e.g., Map 76CSx).

Site conditions: Record site conditions, where applicable. Site conditions to record may include:

- Fire kill;
- Flooded areas;
- Wind-throw; and,
- Heavy duff.

In addition to the above, all maps submitted shall have the following information recorded for each opening/Sampling Unit:

- Opening boundaries;
- Total opening area;

- North arrow;
- Plot numbers; and,
- Location and size of permanent deletions.

Appendix 17. Performance field survey data dictionaries, Aerial Stratification and Non-photo Systems

Table 12-11. Ground1: Unit header data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
AREA_FINAL	7.2	Area (hectares) of Sampling strata following field assessment.	Eligible codes: 0.01 to 9999.99
STRATA	$16.0	Where SYSTEM_TYPE is A: Sampling Strata: Combination of higher-level strata and species composition (SP_CLASS) or aggregated strata Where SYSTEM_TYPE is N: Name of stratum (polygon) within the Opening	Where SYSTEM_TYPE is A: Without higher strat E.g., “0_Pl”, “0_Sw/Sb”, “0_HwSw”, etc With higher strat E.g., “T1_Sw”, “T2_Sw”, ”T1_SwHw”, etc. Where SYSTEM_TYPE is N, then eligible codes: “Hw-L”, “MxPl-L”, “MxSx-L”, “Sw-L”, “Pl-L”, “Sb-L”, “Hw-M”, “MxPl-M”, “MxSx-M”, “Sw-M”, “Pl-M”, “Sb-M”, “Hw-H”, “MxPl-H”, “MxSx-H”, “Sw-H”, “Pl-H”, “Sb-H”
SURVEYOR_ID1	$30.0	Name (first and surname) of primary qualified surveyor	E.g., “Elihu Steward” (no blanks allowed)
SURVEYOR_ID2	$30.0	Name (first and surname) of qualified surveyor	E.g., “Reginald Loomis”
SURVEY_YEAR	4.0	Year of field survey	For example: 2009, 2010, etc. (no blanks allowed)
SURVEY_MONTH	2.0	Month of field survey	Eligible codes: 1 to 12
SURVEY_DAY	2.0	Day of field survey	Eligible codes: 1 to 31
N_BASIC_PLOTS	3.0	Number of Basic plots	Eligible codes: 1 to 999
N_DETAILED_PLOTS	3.0	Number of Detailed plots	Eligible codes: 1 to 999
OPTIONAL_DIAM	$1.0	Flag to indicate the measurement of optional diameter sample.	Eligible codes: “Y” or “N”

Field name	Format	Description	Note
GPS_MAKE	$10.0	GPS receiver make	E.g., “Garmin”, blank if GPS not used.
GPS_MODEL	$20.0	GPS receiver model	E.g., “GPSmap 76CSx”, blank if GPS not used.
GPS_COOR_SYS	$3.0	Identifies the GPS coordinate system used: longitude and latitude (LL) or Universal Transverse Mercator (UTM). Use “NA” where GPS was not used.	Eligible codes: “LL”, “UTM”, ”NA”
GPS_LL_FORM	$13.0	GPS coordinate system format when reporting plot locations using longitude and latitude (LL). Three common formats are: • degrees, minutes, and seconds; • degrees and decimal minutes; and, • decimal degrees	Eligible longitude and latitude position formats: “hddd°mm’ss.s””; “hddd°mm.mmm’”; “hddd.dddd°” Blank if UTM is recorded in the GPS_COOR_SYS field or if GPS not used.
GPS_UTM_ZONE	$3.0	Identifies the GPS UTM Zone (N to designate northern hemisphere) when recording plot locations using the UTM coordinate system.	Eligible codes: “11N”, “12N”. Blank if “LL” is recorded in the GPS_COOR_SYS field or if GPS not used.

Table 12-12. Ground2: Plot header data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
PLOT_ID	$8.0	Unique plot identifier, not more than 8 alphanumeric characters.	(no blanks allowed)
PLOT_TYPE	$1.0	Identifies the type of plot as Basic (B) or Detailed (D)	Eligible codes: “B” or “D”
PLOT_X_COOR	$14.0	GPS X coordinate for the plot. • If the GPS_COOR_SYS is LL, then the X coordinate is longitude (negative with west longitude). • If the GPS_COOR_SYS is UTM, then the X coordinate is a measurement of the East-West position in meters (Easting; mE). • If the GPS_COOR_SYS is NA, then the X coordinate is blank.	LL examples, “-W114°47’14.8” “-W114.7874°” UTM examples, 0569842 630084
PLOT_Y_COOR	$14.0	GPS Y coordinates for the plot. • If the GPS_COOR_SYS is LL, then the Y coordinate is latitude. • If GPS_COOR_SYS is UTM, then the X coordinate is a measurement of the North-South position in meters (Northing; mN). • If the GPS_COOR_SYS is NA, then the Y coordinate is blank.	LL examples, “N043°38’33.24”” “N043.6425°” UTM examples, 4282182 4833438
SHRUB_COVER	3.0	Percent cover of shrubs ≥30 cm	Eligible code: 0

Table 12-13. Ground3: Basic plot data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
PLOT_ID	$8.0	Unique plot identifier, not more than 8 alphanumeric characters.	(no blanks allowed)
SPECIES	$2.0	Species code. Where no tree species are present in basic plot enter “No”.	Eligible codes: “Sw”, “Sb”, “Se”, “Pl”, “Pj”, “Pw”, “Pf”, “Lt”, “Lw”, “Ls”, “Fb”, “Fd”, “Fa”, “Aw”, “Pb”, “Bw”, “No”
WGR	$1.0	“Y” if WGR encircles ≥50% of the main stem diameter	Eligible code: “Y”, blank
SDL_TALLY	3.0	Tally of the number of acceptable coniferous SDL ≥30 cm and deciduous SDL ≥130 cm by species	Eligible codes: 0 to 999
ADV_TALLY	3.0	Tally of the number of acceptable coniferous ADV ≥30 cm and deciduous ADV ≥130 cm by species	Eligible codes: 0 to 999

Table 12-14. Ground4: Detailed plot data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
PLOT_ID	$8.0	Unique plot identifier, not more than 8 alphanumeric characters.	(no blanks allowed)
SPECIES	$2.0	SDL Species code. Where no tree species are present in detailed plot enter “No”.	Eligible codes: “Sw”, “Sb”, “Se”, “Pl”, “Pj”, “Pw”, “Pf”, “Lt”, “Lw”, “Ls”, “Fb”, “Fd”, “Fa”, “Aw”, “Pb”, “No”
TOPHT	4.0	Height (cm) of largest diameter SDL tree (i.e., top height tree)	Eligible codes: 30 to 9999, where species ”No” then blank
TH_DBH	3.0	Diameter at breast height of largest diameter SDL tree (mm) (i.e., top height tree) (optional measurement)	Eligible codes: 1 to 999, blank
TOTAL_AGE	2.0	Total age of largest diameter SDL tree (years) (i.e., top height tree)	Eligible codes: 1 to 20, where species “No” then blank

Table 12-15. Ground 5: Optional diameter measurements data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
PLOT_ID	$8.0	Unique plot identifier, not more than 8 alphanumeric characters.	(no blanks allowed)
SPECIES	$2.0	SDL Species code. Where no tree species taller than 130cm are present in basic plot enter “No”.	Eligible codes: “Sw”, “Sb”, “Se”, “Pl”, “Pj”, “Pw”, “Pf”, “Lt”, “Lw”, “Ls”, “Fb”, “Fd”, “Fa”, “Aw”, “Pb”, “Bw”, “No”
TREE_NUM	2.0	Unique tree identifier by species group.	Eligible code: 1 to 99
TREE_TYPE	$3.0	Identifies the tree as seedling tree (SDL) or advanced tree (ADV)	Eligible codes: “SDL” or “ADV”; if SPECIES = “No”, then blank
DBH	3.0	Sample tree diameter at breast height (mm)	Eligible codes: 1 to 999”; if SPECIES = “No”, then blank
HEIGHT	4.0	Height of sample tree (cm) (optional measurement)	Eligible codes: 130 to 9999, blank

Table 12-16. Ground 6: Optional ≥130 cm coniferous tree tally data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
PLOT_ID	$8.0	Unique plot identifier, not more than 8 alphanumeric characters.	(no blanks allowed)
SPECIES	$2.0	SDL Species code. Where no coniferous tree species taller than 130cm are present in basic plot enter “No”.	Eligible codes: “Sw”, “Sb”, “Se”, “Pl”, “Pj”, “Pw”, “Pf”, “Lt”, “Lw”, “Ls”, “Fb”, “Fd”, “Fa”, “No”
WGR	$1.0	“Y” if WGR encircles ≥50% of the main stem diameter	Eligible code: “Y”, blank
SDL_TALLY_130	3.0	Tally of the number of acceptable SDL ≥130 cm in height by species	Eligible codes: 0 to 999
ADV_TALLY_130	3.0	Tally of the number of acceptable ADV ≥130 cm in height by species	Eligible codes: 0 to 999

Appendix 18. Compiled GYPSY input variable descriptions and data dictionaries

The section describes the GYPSY input variables including:

- Stand age;
- Density by species;
- Total age by species group;
- Site index by species group;
- Percent stocking by species group; and,
- Basal area by species group (optional).

Compiled GYPSY input variables data dictionary are show in Table 12-18.

Stand age

Stand age (opening age) is determined using skid clearance date and survey date. Stand age (STANDAGE) is calculated as follows:

$$STANDAGE = SURVEY\_YR - SKID\_YR$$

SURVEY_YR shall be determined as follows:

- If SURVEY_MONTH is ≤4, then SURVEY_YR = SURVEY YEAR;
- If SURVEY_MONTH is >4, then SURVEY_YR = (SURVEY_YEAR + 1).

SKID_YR shall be determined as follows:

- If SKID_MONTH is ≤4, then SKID_YR = SKID_YEAR;
- If SKID_MONTH is >4, then SKID_YR = (SKID_YEAR + 1).

Density by species group

GYPSY defines stand density as follows:

- For deciduous tree species, density refers to stems per hectare of the subject tree species >130 cm in height (DEN13); and,
- For coniferous tree species, density refers to stems per hectare of the subject tree species >30 cm in height (DEN03).

Density (DEN) shall:

- Be compiled by tree species group based on the tree tallies from the Basic plots.

- Include both SDL and ADV trees for a given tree species.
- Not include the WGR = "Y" tally.

DENSITY shall be compiled as follows:

- Within each plot, the tally shall be summed for all SDL and ADV tree species within a tree species group.
- Within each plot, the tree species group summed tally (1 above) shall be multiplied by 1,000 to estimate density (i.e., stems per hectare). Where there are no tallies for a given tree species group within a given plot, density shall equal zero.
- For each Sampling Unit (polygon), the mean density (stems per hectare) shall be calculated by tree species group.
- Where the mean density for a species group within a Sampling Unit is less than 50 stems per hectare, density shall equal zero.

Total age by species group

Total age (TAGE) refers to the number of years since time of germination. It is determined using the top height tree measurements from the Detailed plots.

The mean total age and number of observations (n) shall be calculated by tree species group for each Sampling Unit (polygon).

In instances where the Sampling Unit (polygon) specific estimate of total age is not supported by a minimum of three observations (i.e., n<3) for a given tree species group, total age shall be calculated using the mean age offset (AGE_OFFSET) for the population, as follows:

$$TOTAL\_AGE = STANDAGE - \chi AGE\_OFFSET$$

where,

STANDAGE is determined using the procedures described above; and,

AGE_OFFSET is the mean age offset for the tree species group within the sample population, calculated as follows:

$$\chi\text{AGE\_OFFSET} = \frac{\Sigma(\text{STANDAGE} - \text{TOTAL\_AGE})}{\text{Number of Sampling Units}}$$

Where no observation of total age for a given species group is available for a population, an age offset of two (2) shall be assumed to allow an estimate of total age for that species group to be made. Total age will then calculated using the formulae above.

For the Aw species group, if the resulting total age is found to be less than the estimated years to breast height (Y2BH), which is estimated from the site index for the species group, then total age shall be adjusted to equal Y2BH.

Site index by species group

Site index is a measure of site quality or site productivity. It is an index of the capacity of a given parcel of land to grow species-specific trees. Site index is defined as the average height that undamaged trees can achieve at 50 years of growth above breast height.

Site index (SITE_INDEX) is determined using the top height (TOPHT) and total age (TOTAL_AGE) data collected in Detailed plots.

The steps to compile data and calculate SITE_INDEX shall be as follows:

- Observations where TOTAL_AGE is less than the values shown in Table 12-17 shall be excluded.
- SITE_INDEX for each tree species within each Detailed plot shall be calculated using the remaining paired TOPHT and TOTAL_AGE data.

Table 12-17. Total age exclusion criteria by tree species group.

Tree species group	Total age
Aw	8
Pl	8
Sw	10
Sb	10

- For each Sampling Unit (polygon), the mean SITE_INDEX and number of observations (n) shall be calculated by:
    - tree species; and,
    - tree species group.
- For the population (i.e., all available SITE_INDEX data for the annual program), the mean SITE_INDEX and number of observations (n) shall be calculated by tree species group.

The decision key shown in Figure 11-2 shall be used to determine the appropriate tree species group SITE_INDEX value to use for a Sampling Unit as input into GYPSY.

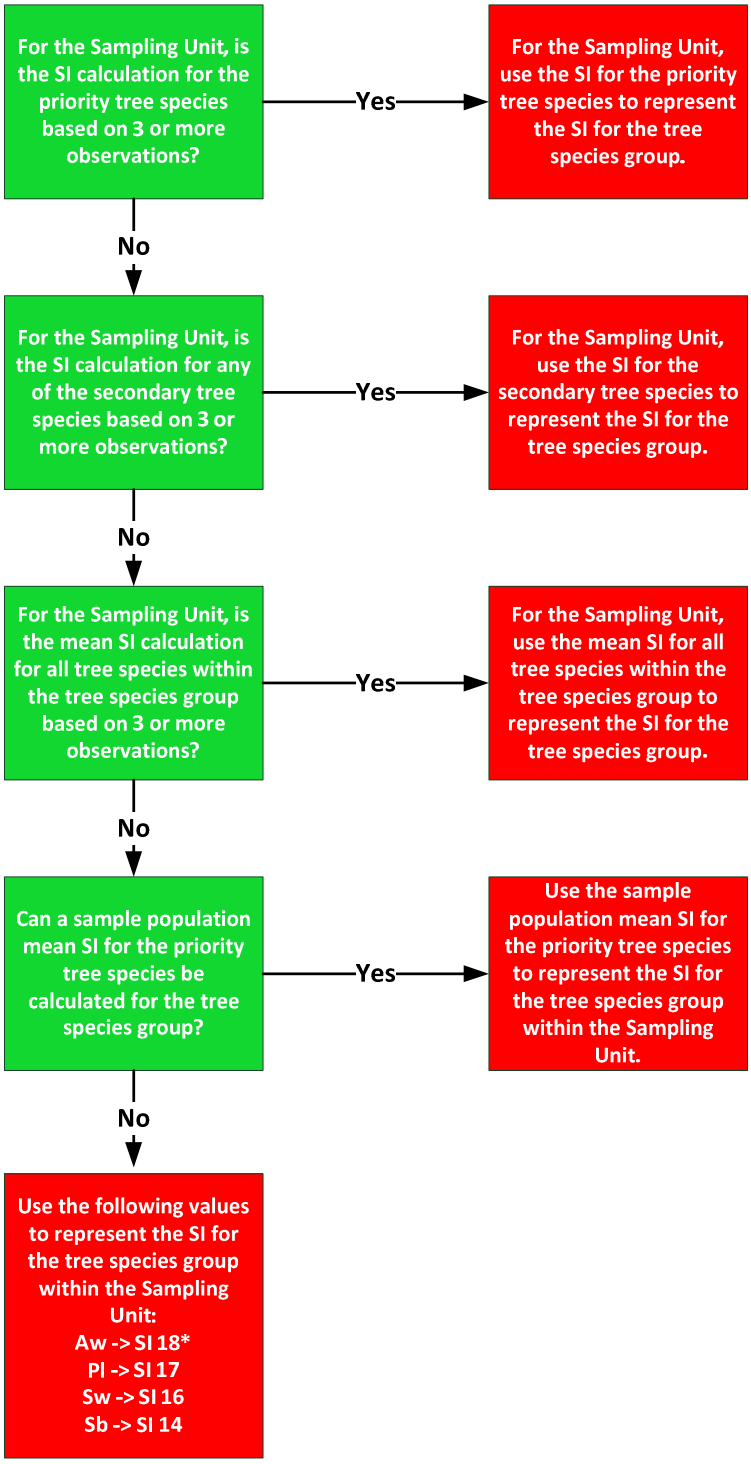


Figure 12-2. Decision key to determine the appropriate SITE_INDEX value to use for a tree species group within a Sampling Unit. Priority tree species are: trembling aspen (Aw) for the Aw tree species group; lodgepole pine (Pl) for the Pl tree species group; white spruce (Sw) for the Sw tree species group; and, black spruce (Sb) for the Sb tree species group.

* Site Index estimate based on a provincial mean for managed stands.

Percent stocking by species group

Percent stocking refers to the proportion (expressed as a percent) of the total number of 10 m^2 Basic plots in the survey grid where at least one (1) tree representative of a tree species group meets the density count requirement. Thus, percent stocking is inferred from the density measurements.

Percent stocking (PERCENT_STOCKING) shall:

- Be compiled by tree species group based on the tallies from the Basic plots using the same height thresholds as DENSITY;
- Include both SDL and ADV trees for a given tree species; and,
- Not include the WGR = "Y" tally.

PERCENT_STOCKING shall be compiled as follows:

- If there is a non-zero tally of SDL or ADV for a tree species group within a Basic plot, then the plot shall be considered stocked;
- Where the DENSITY for a tree species group within a Sampling Unit (polygon) is less than 50 stems per hectare, the PERCENT_STOCKING shall equal zero.
- PERCENT_STOCKING for a tree species group within a Sampling Unit shall be calculated as follows:

$$\text{PERCENT\_STOCKING} = \frac{\text{Number of plots with an acceptable tree representative of the tree species group}}{\text{Total number of plots within the Sampling Unit}} \times 100$$

Basal area by species group (optional)

Optional SDL diameter at breast height (DBH) measurements, where collected, shall be used to compute basal area (m^2 per hectare) for each tree species group present in the Sampling Unit.

There are three steps involved in the compilation of basal area (BA):

- Estimation of mean basal area per stem for each species group.
    - Records where TREE_TYPE = "ADV" shall be excluded.
    - Calculate the mean basal area per stem for each species group in each Detailed plot.
    - Calculate the density per hectare above the 130 cm height threshold (DEN13) for each species group for each detailed plot. Only "SDL" tallies shall contribute to this density estimate.
    - Where a minimum of three Detailed plots provide basal area estimates for a given species group, the weighted mean of basal area per stem for that species group weighted by the plot level DEN13 shall be calculated.
- Estimation of density to 130m height threshold (DEN13) for each species groups.

- Calculate the DEN13 for each conifer species group in each Detailed plot, using both "SDL" and "ADV" tallies. Sum all Detailed plot DEN13 for each coniferous tree species group for the Sampling Unit.

- Calculate the density per hectare above the 30cm height threshold (DEN03) for each coniferous tree species group in each Detailed plot, using both "SDL" and "ADV" tallies. Sum all Detailed plot DEN03 for each coniferous tree species group for the Sampling Unit.

- For each Sampling Unit calculate the estimated ratio of DEN13 to DEN03.

- Using the Sampling Unit densities and the ratio calculated above to estimate the Sampling Unit DEN13 for coniferous tree species groups.

- The Aw tree species group's DEN13 is measured so no conversion is necessary.

- Expansion of mean basal area per stem to a basal area per hectare estimate.

The mean basal area per stem by tree species is then multiplied by the respective DEN13 to calculate the basal area per hectare for each tree species group for a Sampling Unit.

Table 12-18. GYPSY Input: Compiled GYPSY input variables and data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
AREA_FINAL	7.2	Area (hectares) of Sampling strata following field assessment.	Eligible codes: 0.01 to 9999.99
STRATA	$16.0	Where SYSTEM_TYPE is A: Sampling Strata: Combination of higher-level strata and species composition (SP_CLASS) or aggregated strata Where SYSTEM_TYPE is N: Name of stratum (polygon) within the Opening	Where SYSTEM_TYPE is A: Without higher strat E.g., “0_Pl”, “0_Sw/Sb”, “0_HwSw”, etc With higher strat E.g., “T1_Sw”, “T2_Sw”, ”T1_SwHw”, etc. Where SYSTEM_TYPE is N, then eligible codes: “Hw-L”, “MxPl-L”, “MxSx-L”, “Sw-L”, “Pl-L”, “Sb-L”, “Hw-M”, “MxPl-M”, “MxSx-M”, “Sw-M”, “Pl-M”, “Sb-M”, “Hw-H”, “MxPl-H”, “MxSx-H”, “Sw-H”, “Pl-H”, “Sb-H”
N_BASIC_PLOTS	3.0	Number of Basic plots	Eligible codes: 1 to 999
N_DETAILED_PLOTS	3.0	Number of Detailed plots	Eligible codes: 1 to 999
OPTIONAL_DIAM	$1.0	Flag to indicate the measurement of optional diameter sample	Eligible codes: “Y”, “N”
RUN_ID	10.0	GYPSY unique run identifier.	Eligible codes: 1 to 9,999,999,999
SPATIAL	$1.0	Flag indicating GYPSY projection with spatial or non-spatial version of GYPSY	Eligible code: “Y”
BA_KNOWN	$1.0	Flag indicating projection with known basal areas or predicted basal areas	Eligible codes: “Y”, “N”
STANDAGE	5.1	Age of opening	Eligible codes: 1 to 99

Field name	Form at	Description	Note
TAGE_AW	5.1	Total age in years for the Aw tree species group	Eligible codes: 0.1 to 99.9, blank
SI_BH_AW	4.1	Site index for Aw tree species group (top height in meters at 50 years)	Eligible codes: 0.1 to 99.9, blank
DEN13_AW	6.0	Density for the Aw tree species group (stems per hectare with 130 cm tally)	Eligible codes: 50 to 999,999, blank
PS_AW	5.1	Stocking (%) for the Aw tree species group	Eligible codes: 0.1 to 100.0, blank
BA_AW	7.5	Basal area for the Aw tree species group (basal area at breast height in m^2/ha)	Eligible codes: 0.00001 to 9.99999, blank
TAGE_SB	5.1	Total age in years for the Sb tree species group	Eligible codes: 0.1 to 99.9, blank
SI_BH_SB	4.1	Site index for Sb tree species group (top height in meters at 50 years)	Eligible codes: 0.1 to 99.9, blank
DEN03_SB	6.0	Density for the Sb tree species group (stems per hectare with 130 cm tally)	Eligible codes: 50 to 999,999, blank
PS_SB	5.1	Stocking (%) for the Sb tree species group	Eligible codes: 0.1 to 100.0, blank
BA_SB	7.5	Basal area for the Sb tree species group (basal area at breast height in m^2/ha)	Eligible codes: 0.00001 to 9.99999, blank
TAGE_SW	5.1	Total age in years for the Sw tree species group	Eligible codes: 0.1 to 99.9, blank
SI_BH_SW	4.1	Site index for Sw tree species group (top height in meters at 50 years)	Eligible codes: 0.1 to 99.9, blank
DEN03_SW	6.0	Density for the Sw tree species group (stems per hectare with 130 cm tally)	Eligible codes: 50 to 999,999, blank
PS_SW	5.1	Stocking (%) for the Sw tree species group	Eligible codes: 0.1 to 100.0, blank

Field name	Format	Description	Note
BA_SW	7.5	Basal area for the Sw tree species group (basal area at breast height in m^2/ha)	Eligible codes: 0.00001 to 9.99999, blank
TAGE_PL	5.1	Total age in years for the Pl tree species group	Eligible codes: 0.1 to 99.9, blank
SI_BH_PL	4.1	Site index for Pl tree species group (top height in meters at 50 years)	Eligible codes: 0.1 to 99.9, blank
DEN03_PL	6.0	Density for the Pl tree species group (stems per hectare with 130 cm tally)	Eligible codes: 50 to 999,999, blank
PS_PL	5.1	Stocking (%) for the Pl tree species group	Eligible codes: 0.1 to 100.0, blank
BA_PL	7.5	Basal area for the Pl tree species group (basal area at breast height in m^2/ha)	Eligible codes: 0.00001 to 9.99999, blank

Appendix 19. Compiled GYPSY output data dictionary

Table 12-19. MAI Output: Compiled GYPSY output variables and data dictionary.

Field name	Format	Description	Note
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
AREA_FINAL	7.2	Area (hectares) of Sampling strata following field assessment.	Eligible codes: 0.01 to 9999.99
STRATA	$16.0	Where SYSTEM_TYPE is A: Sampling Strata: Combination of higher-level strata and species composition (SP_CLASS) or aggregated strata Where SYSTEM_TYPE is N: Name of stratum (polygon) within the Opening	Where SYSTEM_TYPE is A: Without higher strat E.g., “0_Pl”, “0_Sw/Sb”, “0_HwSw”, etc With higher strat E.g., “T1_Sw”, “T2_Sw”, ”T1_SwHw”, etc. Where SYSTEM_TYPE is N, then eligible codes: “Hw-L”, “MxPl-L”, “MxSx-L”, “Sw-L”, “Pl-L”, “Sb-L”, “Hw-M”, “MxPl-M”, “MxSx-M”, “Sw-M”, “Pl-M”, “Sb-M”, “Hw-H”, “MxPl-H”, “MxSx-H”, “Sw-H”, “Pl-H”, “Sb-H”
N_BASIC_PLOTS	3.0	Number of Basic plots	Eligible codes: 001 to 999
N_DETAILED_PLOTS	3.0	Number of Detailed plots	Eligible codes: 001 to 999
OPTIONAL_DIAM	$1.0	Were optional diameter measurements taken?	E.g., “Y”, “N”
SDOB_CON	4.1	Utilization standard stump height diameter outside bark (cm) for coniferous trees	E.g., 15.0, etc. (no blanks allowed)

Field name	Format	Description	Note
TDIB_CON	4.1	Utilization standard top diameter inside bark (cm) for coniferous trees	E.g., 10.0, etc. (no blanks allowed)
STHT_CON	4.2	Utilization standard stump height (m) for coniferous trees	E.g., 0.30, etc. (no blanks allowed)
SDOB_DEC	4.1	Utilization standard stump height diameter outside bark (cm) for deciduous trees	E.g., 15.0, etc. (no blanks allowed)
TDIB_DEC	4.1	Utilization standard top diameter inside bark (cm) for deciduous trees	E.g., 10.0, etc. (no blanks allowed)
STHT_DEC	4.2	Utilization standard stump height (m) for deciduous trees	E.g., 0.30, etc. (no blanks allowed)
MODEL_ID	$20.0	Model Identification	E.g. “GYPSY Version 1.0”, etc.
PRIMARY_SP	$3.0	Identifies which broad group was used to define point of culmination	Eligible codes: “CON”, “DEC”
CULMINATION_AGE	3.0	Opening age of merchantable volume culmination for the primary species	Eligible codes: “10”, “20”, “30”, “40”, “50”, “60”, “70”, “80”, “90”, “100”, “110”, “120”, “130”, “140”, “150”, “160”, “170”, “180”, “190”
CON_MAI	4.2	Merchantable mean annual increment (m3/ha/year) of coniferous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
DEC_MAI	4.2	Merchantable mean annual increment (m3/ha/year) of deciduous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
SB_MAI	6.4	Merchantable mean annual increment (m3/ha/year) of Sb species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
SW_MAI	6.4	Merchantable mean annual increment (m3/ha/year) of Sw species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999

Field name	Format	Description	Note
PL_MAI	6.4	Merchantable mean annual increment (m3/ha/year) of Pl species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
MODEL_COMMENT	$20.	Alternate model approval date and descriptor.	E.g. “Approval 21/12/2011”, etc.

Appendix 20. Opening MAI and label compilation procedures and data dictionaries

Aerial Stratification System

These steps form the basis for the procedures the RSA Compiler uses to compute sample strata-level MAIs, apply sampled strata-level MAIs to the population of openings, compute area-weighted MAI for openings, and generate area-weighted strata composition labels for openings.

STEP 1: Computing sampled strata-level MAI

Computing strata-level MAIs is a step exclusive to the Aerial Stratification System.

Information from the following files is required in order to compute strata-level MAI:

- Sample Selection Tool output file; and,
- GYPSY MAI output file (e.g., MAI_Output.csv).

Prior to any computations, timber disposition holders must ensure that they click **Calculate Inclusion Probabilities** (a macro) on the **Sample Selection** menu and follow the prompts (see the Sample Selection Tool User's Manual for details).

When computing strata-level MAIs, only include those Sampling Units which received ground plots (i.e., those Sampling Units listed in the GYPSY MAI output file). The following Sampling Units shall be included in the computation of strata-level MAIs:

- All Sampling Units selected by the Sample Selection Tool and field sampled; and
- All CONTINGENCY Sampling Units selected by the Sample Selection Tool and field sampled in order to meet the minimum sample size requirements.

The procedures for computing strata-level MAI are described below. The procedures are described from the perspective that the information from the Sample Selection Tool output file is used as the basis for computing strata-level MAI. However, the GYPSY MAI output file may also be used as the basis from which strata-level MAI can be computed.

Procedures:

- Create a new dataset by replicating the information in the SU_SAMPLE_LIST worksheet (Sample Selection Tool output file);
- Remove all strata that were not field sampled (the list of UNIQUE_ID should be the same as the list of UNIQUE_ID from the GYPSY output file);
- Update AREA_X[42];

[42] AREA_X is sampled area within a Sampling Unit. AREA_X shall not be greater than 16 ha. However, AREA_X may have changed between the time of aerial photography and field sampling due to new land use dispositions or fire. If AREA_X has changed, then an update is required.

- Using the MAI information from the GYPSY output file, add the corresponding CON, SB, SW, PL, and DEC MAI;

- Using the information in the INCLUSION_PROB worksheet (Sample Selection Tool output file), add the corresponding SEL_WEIGHT;

- Calculate COMP_WEIGHT by dividing AREA_X by SEL_WEIGHT; and,

- Compute weighted MAI values for CON, DEC, SB, SW, and PL for each STRATA. These are the STRATA level MAIs: CON_MAI_STRAT, DEC_MAI_STRAT, SB_MAI_STRAT, SW_MAI_STRAT, and PL_MAI_STRAT.

In the Aerial Stratification System, openings are selected for field sampling based on unequal probability sampling without replacement. In the sample selection process, openings are assigned weights for selection for field sampling based on the Sampling Units which make up the opening. The probability that an opening is selected is different for the first opening compared with the second, third, fourth, etc. In addition, the weighting scheme is designed to give higher weighting (i.e., higher sampling priority) to openings composed of rarer strata. In order to compensate for this frontend sample selection bias, procedures e, f, and g (above) are necessary. These steps compute a weighted COMP_WEIGHT for each sampled strata at the backend which compensates for the bias created during sample selection. The weighted COMP_WEIGHT is used to compute a weighted strata-level average coniferous and deciduous MAI.

STEP 2: Applying sampled strata-level MAI to population of openings

Information from the following file is required in order to apply strata-level MAI to the population of openings:

- Sample Selection Tool output file.

The procedures for applying strata-level MAI to the population of openings are described below.

Procedures:

- Create a new dataset by replicating the information in the INCLUSION_PROB worksheet (Sample Selection Tool output file)[43];

- Update AREA_HA[44];and,

- Using the FINAL_STRATA field, add the following values for each Sampling Unit (SU) in the population of openings: CON_MAI_STRAT, DEC_MAI_STRAT, SB_MAI_STRAT, SW_MAI_STRAT, and PL_MAI_STRAT.

STEP 3: Computing area-weighted MAI for openings

[43] Note that this dataset contains the list of Openings in the population. The inclusion probabilities (SEL_WEIGHT) contained within this dataset is not needed to complete the remaining steps.

[44] AREA_HA is the area (ha) of the Sampling Unit. AREA_HA may have changed between the time of aerial photography and field sampling due to new land use dispositions or fire. If AREA_HA has changed, then an update is required.

The procedures for computing an area-weighted MAI for each opening in the population are described below.

Procedures:

- Sum the area (updated AREA_HA) of each Sampling Unit (POLYGON) within each opening to determine the total area for the opening;
- Compute the proportionate area of each Sampling Unit in each opening by dividing each Sampling Unit area (AREA_HA) by the summed total area for the opening (procedure 'a' above);
- Compute an area weighted CON MAI, DEC MAI, SB MAI, SW MAI, and PL MAI for each Sampling Unit within each OPENING as follows:

  CON_MAI_STRAT × Sampling Unit proportionate area;

  DEC_MAI_STRAT × Sampling Unit proportionate area;

  SB_MAI_STRAT × Sampling Unit proportionate area;

  SW_MAI_STRAT × Sampling Unit proportionate area; and,

  PL_MAI_STRAT × Sampling Unit proportionate area.

- For each Opening, sum the area weighted CON MAI, DEC MAI, SB MAI, SW MAI, and PL MAI across all Sampling Units.

STEP 4: Generating area-weighted strata composition labels for openings

The composition label identifies the sampling strata (Final_Strata) and their area (ha) proportions which created the coniferous and deciduous MAI for the opening. The composition labels are not strata labels as produced from the stratification process but rather opening MAI composition labels based on the strata generated by the Sample Selection Tool.

The procedures for generating an area-weighted composition label for each opening in the population are described below.

Procedures:

- Multiply the proportionate area for each Sampling Unit within each opening by 100 and round to near 1% (these values are used as the percentages in the opening label and should add up to 100 for the opening);
- Determine which openings received ground plots and which one did not;
- For those openings that received ground plots, use "G";
- For those openings that did not receive ground plots, use "A"; and,
- Use "G" or "A" modifier, Final_Strata, and percent of total area of each Final_Strata within each opening to construct a composition label for the opening.

The Opening composition label shall be composed of the following (in sequence):

- An opening round bracket "(";
- A modifier which flags the Opening as having been sampled or not sampled. The modifier options are:
    - **"G"**, which indicates Performance survey ground plots **were** established in one or more Sampling Units within the opening; or,
    - **"A"**, which indicates Performance survey ground plots **were not** established in any of the Sampling Units within the opening.
- A colon ":";
- A listing of Final_Strata and area weighted percentages in order from highest to lowest.
- A colon shall separate Final_Strata and percent values.
- A closing round bracket ")".

The Final_Strata contains a reference to HIGHER_STRAT (i.e., higher level stratification) and the sampling strata. When compiling the composition label for the opening, use the entire string as listed in the Final_Strata regardless of whether higher level stratification was used.

Where the same Final_Strata occurs more than once within an opening, the area weighted percentages shall be summed. In other words, each unique Final_Strata should only occur once in an Opening composition label (see Example below).

Box 12: Making declarations using FMA or FMU specific landbase designation code

Opening 4230520796A has the following Final_Strata, final area (ha), and final area (percent of total area for the Opening). The Opening had strata that received ground plots.

Final_Strata	***Final area (ha)***	***Final area (%)***
T1_Sw/Sb	*25.28*	*64*
T1_Sw/Sb	*3.56*	*9*
T1_SwHw/HwSx	*7.74*	*20*
T1_SwHw/HwSx	*2.75*	*7*

Opening 4230520796A received ARS Performance Survey ground plots therefore, the composition label shall be:

*"**(G:T1_Sw/Sb:73:T1_SwHw/HwSx:27)**".*

Non-photo System

These steps form the basis for the procedures the RSA Compiler uses to compute area-weighted MAIs for openings and generate area-weighted strata composition labels for openings.

STEP 1: Computing area-weighted MAI for openings

The procedures for computing an area-weighted MAI for each opening in the population are described below.

Procedures:

- Sum the area (updated AREA_HA) of each Sampling Unit (POLYGON) within each opening to determine the total area for the opening;

- Compute the proportionate area of each Sampling Unit in each opening by dividing each Sampling Unit area (AREA_HA) by the summed total area for the opening (procedure 'a' above);
- Compute an area weighted CON MAI, DEC MAI, SB MAI, SW MAI, and PL MAI for each Sampling Unit within each OPENING as follows:

  CON_MAI_STRAT × Sampling Unit proportionate area;

  DEC_MAI_STRAT × Sampling Unit proportionate area;

  SB_MAI_STRAT × Sampling Unit proportionate area;

  SW_MAI_STRAT × Sampling Unit proportionate area; and,

  PL_MAI_STRAT × Sampling Unit proportionate area.

- For each opening, sum the area weighted CON MAI, DEC MAI, SB MAI, SW MAI, and PL MAI across all Sampling Units.

STEP 2: Generating area-weighted strata composition labels for openings

The composition label identifies the sampling strata (Final_Strata) and their area (ha) proportions which created the coniferous and deciduous MAI for the opening. The composition labels are not strata labels as produced from the stratification process but rather opening composition labels based on the strata generated by the Sample Selection Tool.

The procedures for generating an area-weighted composition label for each opening in the population are described below.

Procedures:

- Multiply the proportionate area for each Sampling Unit within each opening by 100 and round to near 1% (these values are used as the percentages in the opening label and should add up to 100 for the opening);

- For each opening, use "N" to indicate Non-photo System; and,

- Use “N” modifier, Final_Strata, and percent of total area of each Final_Strata within each opening to construct a composition label for the opening.

The Opening composition label shall be composed of the following (in sequence):

- An opening round bracket “(“;
- **“N”**, which indicates the Opening was assessed using the Non-photo System;
- A colon “:”;
- A listing of STRATA and area weighted percentages in order from highest to lowest;
- A colon shall separate STRATA and percent values (see example below).
- A closing round bracket “)“.

Box 13: Making declarations using FMA or FMU specific landbase designation code

Opening 4230520976A has the following Final_Strata, final area (ha), and final area (% of total area for the Opening).

Final_Strata	***Final area (ha)***	***Final area (%)***
Sw-M	*25.28*	*71*
MxSx-M	*7.64*	*21*
MxSx-H	*2.75*	*8*

Opening 4230520976A was assessed using the Non-photo System therefore, the composition label shall be:

“(N:Sw-M:71:MxSx-M:21:MxSx-H:8)”.

Table 12-20. Strata-level: Sampling stratum reporting, Aerial Stratification System.

Field name	Format	Description	Note
STRATA	$16.0	Sampling Strata: Combination of higher-level strata and species composition (SP_CLASS) or aggregated strata	Without higher strat E.g., “0_Pl”, “0_Sw/Sb”, “0_HwSw”, etc With higher strat E.g., “T1_Sw”, “T2_Sw”, ”T1_SwHw”, etc.
HIGHER_STRAT	$5	Descriptor for higher-level stratification	For example: “SA”, “UF”, “LF” or “Tend1”, “Tend2”. If not applicable, then “0”,
SP_CL_STRAT	$14.0	Final species class strata following rare strata lumping.	Eligible codes: “Hw”, “HwPl”, “HwSx”, “SwHw”, “PlHw”, “SbHw”, “Sw”, “Pl”, “Sb”, “Fd”, “HwPl/PlHw”, “PlHw/HwPl”, “HwSx/SwHw”, “SwHw/HwSx”, “HwSx/SbHw”, “SbHw/HwSx”, “SwHw/SbHw”, “SbHw/SwHw”, “HwSx/SwHw/SbHw”, “SwHw/HwSx/SbHw”, “HwSx/SbHw/SwHw”, “SbHw/HwSx/SwHw”, “SwHw/SbHw/HwSx”, “SbHw/SwHw/HwSx”, “Sw/Sb”, “Sb/Sw”
POPULATION_AREA	7.2	Area (hectares) of the Sampling Strata	Eligible codes: 0000.01 to 9999.99
POPULATION_SUS	3.0	Number of SU’s of this stratum in the population	Eligible codes: 1 to 999
TARGET_SAMPLE_SIZE	3.0	Target sample size	Eligible codes: 1 to 999
SU_SAMPLE_PLAN	3.0	Number of SU’s planned for sample	Eligible codes: 1 to 999
AREA_SAMPLE_PLAN	7.2	Area planned for sample	Eligible codes: 0.01 to 9999.99
STATUS_PLAN	$8.0	Planned status	Eligible codes: “CENSUS”, “COMPLETE”

Field name	Format	Description	Note
SU_SAMPLE_ACTUAL	3.0	Number of SU's actually sampled	Eligible codes: 1 to 999
AREA_SAMPLE_ACTUAL	7.2	Area actually sampled	Eligible codes: 0.01 to 9999.99
STATUS_ACTUAL	$8.0	Actual status	Eligible codes: "CENSUS", "COMPLETE"
OPTIONAL_DIAM	$1.0	Were optional diameter measurements taken?	E.g., "Y", "N"
CON_MAI_STRAT	4.2	Merchantable mean annual increment (m3/ha/year) of coniferous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
DEC_MAI_STRAT	4.2	Merchantable mean annual increment (m3/ha/year) of deciduous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
SB_MAI_STRAT	6.4	Merchantable mean annual increment (m3/ha/year) of Sb species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
SW_MAI_STRAT	6.4	Merchantable mean annual increment (m3/ha/year) of Sw species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
PL_MAI_STRAT	6.4	Merchantable mean annual increment (m3/ha/year) of Pl species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
MODEL_COMMENT	$20.	Alternate model approval date and descriptor.	E.g. "Approval 21/12/2011", etc.

Table 12-21. SU Level: Sampling Unit reporting, Aerial Stratification and Non-photo Systems.

Field name	Format	Description	Note
SYSTEM_TYPE	$1.0	Type of performance assessment	Eligible codes: “A” or “N”
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
POLYGON	$3.0	Unique Sampling Unit number within an opening	E.g., “001”, “002”, “003” etc. (no blanks allowed)
AREA_HA	7.2	Area (hectares) of the Sampling Unit or stratum	Eligible codes: 0000.01 to 9999.99
HIGHER_STRAT	$5.0	Descriptor for higher-level stratification	For example: “SA”, “UF”, “LF” or “Tend1”, “Tend2”. If not applicable, then “0”,
NAA	2.0	Net Assessment Area indicator	Eligible codes: 0, 1, or 2
SP_CL	$4.0	Species composition class (derived field based on SP1 through SP5)	Eligible codes: blank, “Hw”, “HwPl”, “HwSx”, “SwHw”, “PlHw”, “SbHw”, “Sw”, “Pl”, “Sb”, “Fd”
DEN_CL	$2.0	Density class (derived field based on DENSITY)	Eligible codes: blank, “L”, “M”, “H”, “D”

Field name	Format	Description	Note
STRATA	$16.0	Where SYSTEM_TYPE is A: Sampling Strata: Combination of higher-level strata and species composition (SP_CLASS) or aggregated strata Where SYSTEM_TYPE is N: Name of stratum (polygon) within the Opening	Where SYSTEM_TYPE is A: Without higher strat E.g., “0_Pl”, “0_Sw/Sb”, “0_HwSw”, etc With higher strat E.g., “T1_Sw”, “T2_Sw”, ”T1_SwHw”, etc. Where SYSTEM_TYPE is N, then eligible codes: “Hw-L”, “MxPl-L”, “MxSx-L”, “Sw-L”, “Pl-L”, “Sb-L”, “Hw-M”, “MxPl-M”, “MxSx-M”, “Sw-M”, “Pl-M”, “Sb-M”, “Hw-H”, “MxPl-H”, “MxSx-H”, “Sw-H”, “Pl-H”, “Sb-H”
SP_CL_STRAT	$14.0	Final species class strata following rare strata lumping.	Eligible codes: “Hw”, “HwPl”, “HwSx”, “SwHw”, “PlHw”, “SbHw”, “Sw”, “Pl”, “Sb”, “Fd”, “HwPl/PlHw”, “PlHw/HwPl”, “HwSx/SwHw”, “SwHw/HwSx”, “HwSx/SbHw”, “SbHw/HwSx”, “SwHw/SbHw”, “SbHw/SwHw”, “HwSx/SwHw/SbHw”, “SwHw/HwSx/SbHw”, “HwSx/SbHw/SwHw”, “SbHw/HwSx/SwHw”, “SwHw/SbHw/HwSx”, “SbHw/SwHw/HwSx”, “Sw/Sb”, “Sb/Sw”
RAND_NUM	11.9	Random number used for selection of that sampling unit. Required for audit purposes.	Eligible codes: blank, 0 to 1
SELECTION	2.0	Selection sequence for each Sampling unit by stratum.	Eligible codes: blank, 1 to 99

Field name	Format	Description	Note
CONTINGENCY	2.0	Contingency sampling unit selection sequence for each sampling unit by stratum.	Eligible codes: blank, 1 to 99
SAMPLE_FLAG	$1.0	Sampling unit sampled in the field: Y=yes, N=no	Eligible codes: “Y”, “N”
SEL_WEIGHT	7.5	Proportion of times the unit is selected in 5000 simulated samples.	Eligible codes: blank, 0.00001 to 1.00000
SU_FLAG	1.0	Flag identifying sampling units that were included in the original population but are now longer part of the population to be reported to ARIS. This will likely only be necessary in Aerial programs. Coded as 1 for flag to no longer be in the population.	Eligible codes: 0 or 1
SU_COMMENT	$50.0	Comment indicating why the sampling unit is no longer part of the population.	E.g. blank, “Fire – portion of opening to have start clock date rest”, “Well site – entire sampling unit disturbed” etc.
SURVEY_YEAR	4.0	Year of field survey	Eligible codes: 2008 to 2058
SURVEY_MONTH	2.0	Month of field survey	Eligible codes: 1 to 12
SURVEY_DAY	2.0	Day of field survey	Eligible codes: 1 to 31
N_BASIC_PLOTS	3.0	Number of Basic plots	Eligible codes: 1 to 999
N_DETAILED_PLOTS	3.0	Number of Detailed plots	Eligible codes: 1 to 999
OPTIONAL_DIAM	$1.0	Were optional diameter measurements taken?	E.g., “Y”, “N”
AREA_FINAL	7.2	Area (hectares) of Sampling strata following field assessment.	Eligible codes: 0.01 to 9999.99
MODEL_ID	$20.0	Version of GYPSY used to make forecasts	Determined by GYPSY publication

Field name	Format	Description	Note
PRIMARY_SP	$3.0	Identifies which broad group was used to define point of culmination	Eligible codes: “CON”, “DEC”
CULMINATION_AGE	3.0	Opening age of merchantable volume culmination for the primary species	Eligible codes: “10”, “20”, “30”, “40”, “50”, “60”, “70”, “80”, “90”, “100”, “110”, “120”, “130”, “140”, “150”, “160”, “170”, “180”, “190”
CON_MAI	4.2	Merchantable mean annual increment (m3/ha/year) of coniferous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
DEC_MAI	4.2	Merchantable mean annual increment (m3/ha/year) of deciduous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
SB_MAI	6.4	Merchantable mean annual increment (m3/ha/year) of Sb species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
SW_MAI	6.4	Merchantable mean annual increment (m3/ha/year) of Sw species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
PL_MAI	6.4	Merchantable mean annual increment (m3/ha/year) of Pl species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
CON_MAI_STRAT	4.2	Merchantable mean annual increment (m3/ha/year) of coniferous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99
DEC_MAI_STRAT	4.2	Merchantable mean annual increment (m3/ha/year) of deciduous trees at CULMINATION_AGE	Eligible codes: 0.00 to 9.99

Field name	Format	Description	Note
SB_MAI_STRAT	6.4	Merchantable mean annual increment (m3/ha/year) of Sb species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
SW_MAI_STRAT	6.4	Merchantable mean annual increment (m3/ha/year) of Sw species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999
PL_MAI_STRAT	6.4	Merchantable mean annual increment (m3/ha/year) of Pl species group at CULMINATION_AGE	Eligible codes: 0.0000 to 9.9999

Table 12-22. Opening-level: Opening reporting, Aerial Stratification and Non-photo Systems.

Field name	Format	Description	Note
SYSTEM_TYPE	$1.0	Type of performance assessment	Eligible codes: “A” or “N”
DISPOSITION_HOLDER	$28.0	Timber Disposition Holder: the legal name of the forest company or organization that retains the reforestation liability for the opening	E.g., “River City Timber Ltd.”
DISPOSITION	$10.0	Disposition: refers to the legal document that grants the right to harvest timber. Reforestation liability is attached to the disposition.	E.g., “FMA0900088”, “CTQA130010”, “DTAA090001”, etc.
FOREST_AREA	$4.0	The Alberta administrative unit (region/area) where the opening is located.	Eligible codes: “NEB1”, “NEB2”, “NEB3”, “NES1”, “NES2”, “NES3”, “NWB1”, “NWB2”, “NWB3”, “NWB5”, “NWB6”, “NWB7”, “NWB8”, “SES1”, “SES2”, “SES3”, “SES4”
FIELD_NUMBER	$12.0	The number assigned by the Timber Disposition Holder to the opening that appears on the AOP or harvest plan map.	E.g., “1234”
OPENING	$11.0	Opening number consistent with ARIS	E.g., "423075229A" (no blanks allowed)
NET_HARVEST_HECTARES	7.2	Area (hectares) from ARIS	Eligible codes: 0.01 to 9999.99
UPDATE_AREA	7.2	Updated Area (hectares) from ARIS	Eligible codes: blank or 0.01 to 9999.99
SKID_YEAR	4.0	Year of Skid Clearance or year of disturbance (as recorded in ARIS), whichever is more recent.	Eligible codes: 1994 to 2058

Field name	Format	Description	Note
SKID_MONTH	2.0	Month of Skid Clearance or month of disturbance (as recorded in ARIS), whichever is more recent.	Eligible codes: 1 to 12
SKID_DAY	2.0	Day of Skid Clearance or year of disturbance (as recorded in ARIS), whichever is more recent.	Eligible codes: 1 to 31
PR_AREA	7.2	Poorly regenerated area (hectares)	Eligible codes: blank or 0.00 to 9999.99
GROSS_INTERP_AREA	7.2	Gross area of the opening.	Eligible codes: 0.01 to 9999.99
NAA_INTERP	7.2	Sum of the NAA=0 AREA_HA's in the opening	Eligible codes: 0.01 to 9999.99
PHOTO_Y	4.0	Year of photography	For example: 2008, 2009, 2010, etc. (no blanks allowed)
PHOTO_M	2.0	Month of photography	Eligible codes: 1 to 12
PHOTO_D	2.0	Day of photography	Eligible codes: 1 to 31
INTERP_Y	4.0	Year of interpretation	For example: 2008, 2009, 2010, etc. (no blanks allowed)
INTERP_M	2.0	Month of interpretation	Eligible codes: 1 to 12
SELECTION_Y	4.0	Year of sample selection	For example: 2008, 2009, 2010, etc. (no blanks allowed)
SELECTION_M	2.0	Month of sample selection	Eligible codes: 1 to 12
SELECTION_D	2.0	Day of sample selection	Eligible codes: 1 to 31
NAA_FINAL	7.2	Net assessment area of the Opening following field assessment.	Eligible codes: 0.01 to 9999.99
CON_MAI_WT	4.2	Area weighted mean merchantable mean annual increment (m3/ha/year) of coniferous trees for the opening	Eligible codes: 0.00 to 9.99

Field name	Format	Description	Note
DEC_MAI_WT	4.2	Area weighted mean merchantable mean annual increment (m3/ha/year) of deciduous trees for the opening	Eligible codes: 0.00 to 9.99
TYPE_FLAG	$1.0	Performance Assessment flag for the opening. Same flag as used in ARIS_LABEL.	Eligible codes: “A”, “G”, or ”N”
ARIS_LABEL	$250.0	Performance Assessment Opening Label	E.g. “(A:0_Pl:100)”, “(G:0_Sw:83:0_Hw:17)”, “(G:0_Sw/Sb:100)”, “(N:Sw-H:53:Hw-M:47)”, “(N:MxSx-L:100)”, etc.
ASSESSMENT_Y	4.0	Year of performance assessment for ARIS reporting	For example: 2008, 2009, 2010, etc. (no blanks allowed)
ASSESSMENT_M	2.0	Month of performance assessment for ARIS reporting	Eligible codes: 1 to 12
ASSESSMENT_D	2.0	Day of performance assessment for ARIS reporting	Eligible codes: 1 to 31
OPENING_FLAG	1.0	Flag identifying openings that were included in the original population but are no longer part of the population to be reported to ARIS. This is only applicable in Aerial programs. Coded as 1 for flag to no longer be in the population.	Eligible codes: 0 or 1
OPENING_COMMENT	$50.0	Comment indicating why opening is no longer part of the population.	E.g. blank, “Fire – opening to have start clock date rest”, etc.

Appendix 21. Aerial Stratification and Non-photo System performance survey reporting checklist and validation

PERFORMANCE SURVEY STANDARD - Reporting checklist and validation (pg. 1)				
Aerial Stratification		Non-photo		Forest management unit:

Timber disposition holder(s)		Initial(s) of company rep(s):			
				Reporting date:	
				Agriculture and Forestry (A and F) use only	
				Received by:	
				Date:	

Names of qualified interpreters and surveyors (or as attached)

Interpreters:		Surveyors:	

Instructions

All required elements listed below must be reported to the Forest Management Branch in order for the submission to be deemed complete.

All reforestation obligations holders with openings included in this program shall initial in the box beside each element if the element has been enclosed at the time of reporting.

Photo acquisition (Aerial Stratification System only)						A and F initial
Shape files						

Softcopy (Aerial Stratification System only)													A and F initial
File type	DiAP Viewer				Purview				Summit Evolution (DAT/EM)				
Image													
Camera													
Surface (if used)													
Project													

Stratification spatial and attribute data							A and F initial
Element		Aerial Stratification				Non-photo	
Stratification line-work spatial data							
Attribute data	Interp1: Sampling Units						
	Interp2: Poor regen area						

Sample selection (Aerial Stratification System only)						A and F initial
Sample Selection output file						

Field data, computation of MAI, Opening MAI, and composition label compilation						A and F initial
Element	Aerial Stratification				Non-photo	
RSA Compiler Microsoft Access file (*.mdb)						
Field Map Sheet or digital field map						

Quality assurance						A and F initial
Stratification audit forms						
Field audit sheets						

Summary Report							A and F initial
Element	Aerial Stratification System				Non-photo System		
Opening boundary changes							
Planned versus actual field sampled SU							
Allocation of plots							
Contingency plots							
Audited outcomes and corrective actions							

PERFORMANCE SURVEY STANDARD - Reporting checklist and validation (pg. 2)
Aerial Stratification and Non-photo Systems

DECLARATION

This submission, including this signed cover page and all required elements;

Was prepared by me(us) or under my(our) direct supervision or was prepared by a third party(ies) and has been reviewed and accepted by me; and,

Was prepared in accordance with the timing, methods, procedures, and format required by the RSA; and

Was prepared in accordance with the RSA quality assurance requirements (Section 10) and used qualified interpreters and surveyors to properly collect all survey information; and,

To the best of my knowledge and the best of my professional ability, recognizing the standard of care expected of a professional doing this work, is in my professional opinion true, accurate and complete.

Printed name	Title	RFP number or Seal
Signature	Date	
Printed name	Title	RFP number or Seal
Signature	Date	
Printed name	Title	RFP number or Seal
Signature	Date	
Printed name	Title	RFP number or Seal
Signature	Date	
A and F reviewer's printed name	A and F reviewer's title	RFP number or Seal
A and F reviewer's signature	Date	

Appendix 22. Glossary

Term	Definition
Acceptable tree:	A tree that meets the following criteria: Acceptable tree species which may vary by approved Forest Management Plan (FMP) and, therefore, are FMA/FMU specific (Appendix 2); and, Achieved the minimum coniferous or deciduous height requirement (See height requirements specific to Establishment (Section 4) and Performance (Section 5) surveys; and, Is alive; and, On-site for a minimum number of growing seasons Originated from seed, suckering or coppice or layering (Sb) (Note: Each stem originating from coppice growth may be considered a separate acceptable tree.)
Accuracy:	The closeness of measured or computed value to its true value.
Advance regeneration:	A tree that meets all criteria for an acceptable tree, established prior to harvest or between skid clearance date and disturbance date, will likely be alive at next harvest.
Basic plot	A plot type used in Performance surveys that is 1.78 m (10 m^2) in radius where SDL and ADV tallies by tree species are determined and shrub cover is assessed.
CSR:	Conditionally satisfactorily restocked condition assigned to an opening after an Establishment D Standard survey. CSR is a historical stocking status that no longer applies effective May 1, 2010. Openings declared CSR prior to May 1, 2010, require a CSR/NSR D Standard Performance survey to be completed no sooner than 8 years and later than 14 year after the end of the Timber Year of Cut.
Coniferous tree:	Needle-leafed trees which produce cones (includes larch spp.)
Control line:	A line established at 400 m intervals for control of plot location. The control line runs across the long axis of the opening and is marked at points where survey lines cross it.
Coppice:	A natural regeneration process similar to suckering where the seedling or sapling regenerates from the cut or damaged stump. A number of healthy stems may be observed coming from one stump. Found primarily in birch, but also in other deciduous species.
Deciduous tree:	Broadleaved tree species that lose their leaves in the fall.
Detailed plot	A plot type used in Performance surveys that is 5.64 m (100 m^2) in radius where SDL top height tree are selected by tree species group and measured for height and age.
Disposition:	The legal document that provides the timber rights to harvest the timber to the disposition holder.

Term	Definition
Drainage class:	Actual water content in excess of field moisture capacity, and the extent during which such excess water is present in the plant rooting zone. Seven classes are provided, ranging from very rapidly to very poorly drained.
Establishment survey:	The Establishment survey is the first survey required after harvesting. The survey shall be carried out in a specified time relative to when harvest is complete.
Field number:	The number assigned to an opening and which normally appears on the AOP map of harvest plan map.
FMA:	Forest Management Agreement.
FMP:	Forest Management Plan prepared by a timber disposition holder.
FMU:	Forest Management Unit.
Forest Area:	A geographic administrative unit within Alberta.
Hybrid:	The offspring of two plants of different varieties. They are the result of tree improvement programs to improve the growth or other characteristics of the native varieties.
Intensive survey:	An Establishment survey conducted on the ground by a qualified surveyor establishing plots at the required intensity across the opening and collecting data to determine the stocking status.
Lammas growth:	An additional whorl of branches or a second flush of leader growth occurring late in the growing season. (Dunster and Dunster, 1996)
MAI:	Mean Annual Increment (MAI) is the average growth of a tree or stand of trees. MAI is calculated by dividing yield at age_x by age_x.
Natural subregion:	A geographic area, containing sites with similar characteristics, and defined by plant species composition and abundance of reference ecosites.
NSR	Not satisfactorily restocked according to type of survey, species, height, etc.
Opening:	An area created by timber harvest which is the unit for reforestation management (i.e., Regeneration surveys) and tracking of reforestation activities in the Alberta Regeneration Information System (ARIS). Openings have a unique administrative identification, contain one reforestation stratum, and a single timber disposition holder with reforestation responsibility.
Opening number:	A unique number assigned based on the legal location of the centre of the harvest area.
Overlapping plot:	A plot that contains both a coniferous tree and a deciduous tree of minimum height.
Poorly stocked:	Not satisfactorily restocked. The term may refer to an individual plot, a portion of an opening, or an entire opening.

Term	Definition
Population:	A population is a complete collection of objects about which inferences are made. In terms of the RSA Performance surveys, a population is a complete collection of stratified openings within a forest management unit (TSA coincident with a FMA or FMU) about which MAI inferences are made.
Precision:	The closeness of repeated measurements of the same quantity.
Re-classified strata Standard:	In some situations, the disposition holder may be allowed to change the original strata standard for an area harvested.
Reconnaissance survey:	A visual evaluation of an opening by a qualified surveyor to determine stocking. The visual assessment of the opening can be performed by walking through or flying over the opening.
Regulated Forestry Professional (RFP):	A Regulated Professional Forester (RPF) on the Regulated Professional Foresters Register of the College of Alberta Professional Foresters or a Regulated Professional Forest Technologist (RPFT) on the Regulated Professional Forest Technologists Register of the College of Alberta Professional Forest Technologists.
Sample plot:	A regeneration survey sample stocking plot is 1/1000 ha or 10m2 in size, circular in shape. It has a radius of 1.78 m. A Top Height sample plot is 1/100 ha or 100m2 in size, circular in shape. It has a radius of 5.64 m.
Sampling Unit:	Sampling Unit is one of a set of objects that is drawn to make inferences about population of objects. In terms of the RSA Performance surveys, the Sampling Unit is a polygon within an opening, defined by tree species composition and density classes, which is drawn for field sampling in order to make MAI inferences about an annual population of openings.
Seedling:	A tree that meets all criteria for an acceptable tree that established post-harvest or post-disturbance date, as defined in ARIS.
Site index:	A relative measure of site quality based on the height of dominant trees in a stand at some reference age.
SR:	Satisfactorily restocked according to type of survey, species, height, etc. The term may refer to an individual plot, a portion of an opening, or an entire opening.
Stocking (%):	The sum of all the satisfactorily restocked plots on the opening, divided by the total number of valid plots, multiplied by 100 to express term as a percent.
Strata:	An opening is placed in one of Base 10 strata plus any FMP specific EFM strata. Minimum performance standards are defined for each stratum.
Survey line:	Survey lines run perpendicular to the control lines, parallel with each other and at a calculated spacing. Plots are located along the survey line.

Term	Definition
Sustained Yield Unit:	Defined as a FMA, FMU, or as approved by Alberta. It is the geographical area upon which the FMP specific timber supply analysis was run.
Timber year:	The period of time between May 1 of any given year and April 30 of the following calendar year
Tree height:	The height of the tree is measured from the base of the tree at the average ground level. The height of coniferous trees measured prior to August 1st shall be measured to the base of the current year's growth. After August 1st, height is measured to the top of the terminal bud or the furthest reaching living bud. For deciduous trees, the current season's growth is to be measured. Height and age measurements shall correspond.
Under height tree	A tree that has all the characteristics of an acceptable tree except that the coniferous or deciduous minimum tree height requirements are not met. The minimum height requirements for under height trees is 15 cm, if coniferous (10 cm and on site for two or more years for Fd), or 30 cm, if deciduous.
Valid plot:	A plot within the Regeneration Survey that is established via a field grid and is assessed for its attributes in order to establish its stocking condition. A "Deleted Plot" is not a Valid Plot.