CONFIDENTIAL

Work Plan For

Vegetation Resources Inventory Pilot Project: Photo Interpretation & Digital Mapping Quesnel TSA Ver. 2.1 FIRS#4787001

Fiscal Year 2007/08

Prepared for:

Quesnel TSA Stakeholders Group

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1 INTRODUCTION

This work plan is submitted in response to a request by Decision Tree Forestry Consulting (on behalf of the Quesnel TSA Stakeholders Group and the B.C. Ministry of Forests and Range (MoFR) for a work plan to complete the remaining phases of the Phase 1 Vegetation Resources Inventory (VRI) pilot project of 10 select map sheets in the Quesnel Timber Supply Area (TSA). Figure 1 shows the Quesnel TSA and the location of the 10 pilot project map sheets.

This work plan outlines the proposed methodology for completing the components of the project in fiscal year 2007/08.

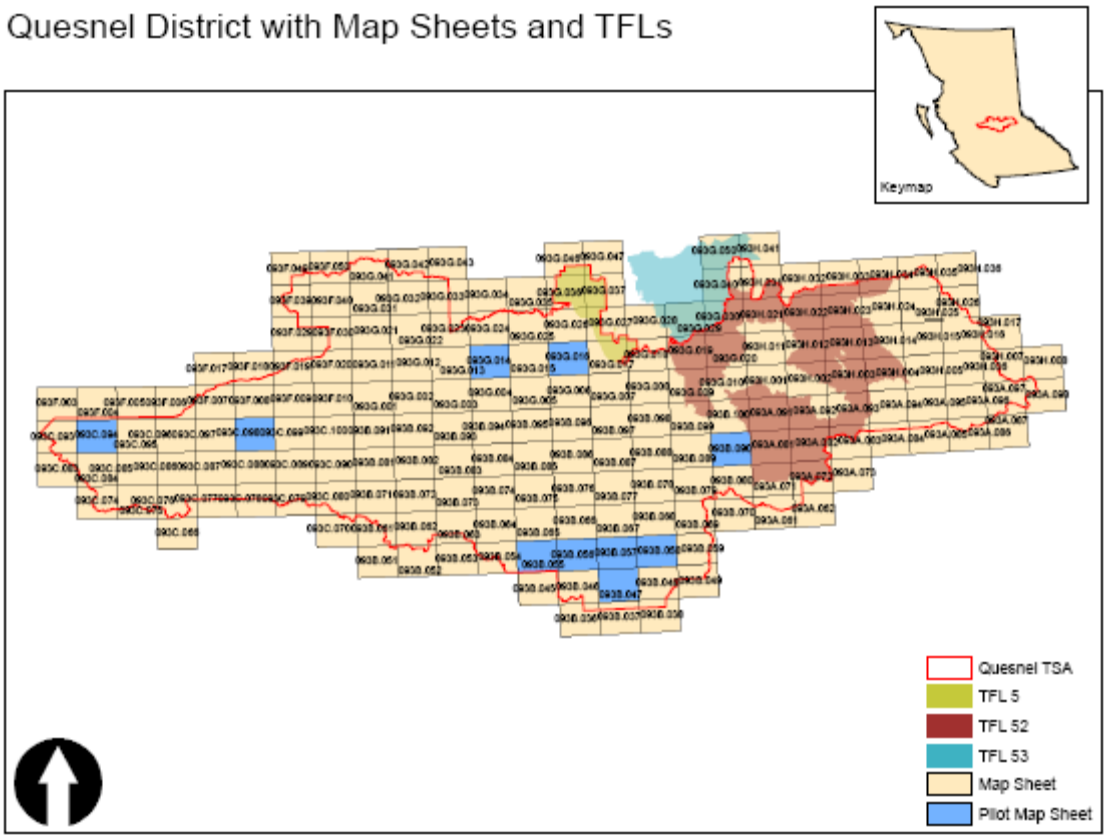

Figure 1 – Quesnel TSA and 10 VRI Pilot Project Area Map Sheets

1.1 Inventory History

The Quesnel TSA was inventoried between 1963 and 1988, with an extensive inventory update completed for all polygons between 1994 and 1995 (Quesnel TSA Inventory Audit Report) by Inland Timber Management of Williams Lake. However, a few partial map sheets in the TSA are still identified as having a reference year from the 1978-1987 inventory period and the Bowron Park's inventory is dated as pre-1960. The Quesnel TSA is past its peak attack by the mountain

pine beetle and as such was selected as a prime TSA in which to conduct inventory trials for a post attack land base.

1.2 Project Objectives

Accurate forest and vegetation inventories are necessary to ensure appropriate forest management and land use decisions. The primary objective of the Quesnel TSA Phase I VRI Pilot Project is to test and validate the methods that will:

- Be used to complete the VRI across the remainder of the Quesnel TSA as well as other land bases that have been severely impacted by the mountain pine beetle;
- Be accurate, cost-effective, meet MoFR standards, and be completed expeditiously;
- Address the inventory issues identified in the MoFR' *Quesnel TSA Inventory Audit (1999)*;
- Address the forest management and inventory issues identified by the Chief Forester in the *Quesnel Timber Supply Area Rationale for Annual Allowable Cut (AAC) Determination* (2004);
- Address the stakeholders strategic planning needs as identified in the *Quesnel TSA Vegetation Resources Inventory Strategic Inventory Plan (VSIP)* (2005) and *Quesnel TSA Vegetation Resources Inventory Project Implementation Plan (VPIP) (2006)*;
- Provide a basis for the TSA stakeholders operational planning needs; and
- Use as an input into shelf-life modelling in conjunction with satellite image analysis for mountain pine beetle attack year determination work trialed in the Central Interior.
- Test the proposed VRI Phase 1 sampling intensity and compare the results to other levels of sampling to:
    - Determine the efficacy of this level of sampling as applied to interpretation of both the overstory and residual forest cover layers;
    - Confirm if this level of sampling or if a less intensive sampling level is required in order to meet the business needs of both the proponent and the key stakeholders;
    - Recommend an optimal sampling level which may generate a net cost savings; and
    - Apply the results from this pilot to both the Quesnel TSA inventory and to other management units impacted by MPB.
    - Ensure that the current Phase 1 photo interpretation standards are suitable for use in areas heavily impacted by MPB.

The Quesnel TSA VRI Pilot Project was started in late fiscal year 2006/07 (delineation and field planning of the 10 selected pilot map sheets across the variety of major Biogeoclimatic zones found in the Quesnel TSA). The following map sheets encompass the VRI Pilot Project area:

- 093B047 (replaces 093B048 due to lack of complete aerial photo coverage between 2005 and 2006)
- 093B055
- 093B056
- 093B057
- 093B058
- 093B090
- 093G014
- 093G016

- 093C094
- 093C098

1.3 Inventory Issues

Numerous inventory issues were identified in the Quesnel TSA MoF Inventory Audit completed in 1998 (data collection) and 1999 (analysis) as well as the Quesnel TSA Timber Supply Review and AAC Determination report completed in 2004. These documents can be reviewed for complete detail at: http://www.for.gov.bc.ca/hts/aac.htm

2 PROJECT METHODOLOGY

2.1 Standards and Specifications

Unless explicitly stated otherwise, all procedures outlined in this work plan conform (as a minimum) to the standards and specifications contained in the Quesnel TSA VRI Pilot Project's Request for Proposal as well as the following publications:

- Quesnel TSA Vegetation Resources Inventory Project Implementation Plan v.3.1 (Oct 2006);
- VRI BC Land Cover Classification Scheme (2002);
- VRI Photo Interpretation Procedures (2002)
- VRI Photo Interpretation Standards (1998);
- VRI Air Calibration Data Collection Procedures and Standards (2003);
- VRI Ground Calibration Data Collection Procedures and Standards (2004);
- Ministry of Forests Vector Cleaning Specifications (1997);
- Forest Resource GIS Specifications and Standards for 1:20 000 Digital Mapping (1998);
- Ministry of Forests, Forest Inventory Manual (1992) Volume 4-Photogrammetry and Photo Interpretation;
- Ministry of Forests, Forest Inventory Manual (1992) Volume 5-Preparation and Creation of FRGIS Data Files (March, 1996 revisions);
- Procedures for Completing the Vegetation Resources Inventory Attribute Form and Vegetation Attributes Data Dictionary (1997);

2.2 Detailed Work Plan

2.2.1 Fiscal Year 2007/08 Implementation Conference

The project manager will meet (in person or conference call) with representatives of the Quesnel Stakeholders Group and MoFR before proceeding with the field and final classification phases of the Quesnel TSA VRI Phase I Pilot Project. The purpose of this meeting is to discuss the innovative field data acquisition methods and calibration intensities planned for the pilot project. Project methodology, material delivery schedules, quality control schedules, quality assurance schedules, project protocol and other pertinent issues will be addressed. The meeting will also be an opportunity to discuss local concerns, needs, and priorities of the Quesnel Stakeholders Group and to determine methods of incorporating them into the Quesnel TSA Pilot Project.

2.2.2 Material Acquisition, Organization and Preparation

2.2.2.1 Data and material supplied by Quesnel Stakeholders Group / MoFR

- 2005/2006 scanned image files;
- Model and surface files;
- AT index;
- 2005/2006 1:20,000 scale aerial photograph indices;
- Digital TRIM files;

- Silviculture RESULTS information (current to 2006);
- Secondary field data from previous surveys;
- List (digital) of all free growing openings/polygons in the project area; and
- Digital copies of map sheets, adjacent to the pilot project area map sheets, which have been previously inventoried (TFL 52 093B090).

2.2.2.2 Inventory Base Maps

The Quesnel Stakeholders Group, through BMGS, supplied or made available to Timberline, MoFR approved BCGS 1:20,000 scale, "FC1" and "UTM" MicroStation design files used as the inventory base maps for this project. The files were current to 2006. The MoFR Reporting Silviculture Updates and Land status Tracking System (RESULTS) data containing silviculture openings and their interior boundaries were provided as well. These data were known to be questionable in terms of accuracy (spatial as well as aspatial). The spatial issues were dealt with during Arc to .dgn conversion and during the delineation phase completed last fiscal year.

2.2.3 Vegetation Cover Polygon Delineation

Delineation is the separation of land into relatively homogeneous types (polygons) based on observable differences in vegetation on the digital image models. The objective of delineation is to minimize variation within polygons in order to provide more consistent and accurate estimations of descriptive attributes.

2.2.3.1 Silviculture Polygons

Timberline followed the most recent MoFR standards and procedures regarding the delineation and description of silviculture polygons. The *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Photo Interpretation* (April 2006) states:

"Special consideration must be given to polygons that exist within silviculture openings. The MoFR Update Section based in Kamloops must be contacted in advance of initiation of a VRI photo interpretation inventory project to ensure compliance with existing protocols related to silviculture openings. As a general guideline:

- Retain existing opening numbers and provide VRI attributes for the largest polygon of the silviculture opening (based on VRI source files). If opening numbers are not in the VRI source files, obtain the opening numbers from the RESULTS spatial file. Ministry of Forests and Range VRI Update Section can provide access to the RESULTS data as required.
- Add new openings that are not in the VRI source files, obtain the opening number from RESULTS, and provide full VRI attributes. Additional internal polygon delineation and attribute estimation is not required.
- Internal stratification of openings is required where an opening has been declared Free Growing in RESULTS. Each polygon requires full attribution plus the designation free-to-grow (FTG) in the VegCAP polygon record project field.
- Any polygons from the VRI source files that have FTG in the project field must be re-interpreted to VRI standards and the FTG designation retained."
- The provincial contact person can be identified on the 'Provincial Contact Vegetation Update Zone Map' located at: http://www.for.bc.ca/hts/vcu/
- The MoFR VRI Update Section in Kamloops will provide a report identifying all FTG openings within the project area.

The block boundary information from RESULTS indicated some degree of block misalignment when viewed in softcopy. The majority of openings fit reasonably well, but others had to be moved to fit spatially with the images. In these cases the openings were either fenced and dragged to a correct alignment or re-delineated to fit. The new spatial locations will be available to the Kamloops update section for re-introduction into RESULTS when the pilot area is completed.

2.2.3.2 Non- Silviculture Polygons and Free Growing Silviculture Polygons

The photo interpreters stereoscopically identified and delineated homogeneous vegetated and non-vegetated types at an effective image scale of about 1:6,000 using a softcopy system. The following delineation criteria (based on the British Columbia Land Classification Scheme) were used:

- Vegetated vs. non-vegetated land;
- Treed vs. non-treed land;
- Stand structure (i.e. vertical complexity and layers);
- Pattern;
- Crown closure;
- Species composition;
- Average stand age;
- Average stand height;
- Basal area;
- Density;
- The presence or absence of lesser vegetation (i.e. shrubs, herbs and bryoids);
- Disturbance; and
- Soil moisture variations where evident by topography and aspect.

The minimum type sizes (as a general rule) were approximately two hectares for non-treed polygons and five hectares for treed polygons. As this is a guideline, consideration was given to types with localized operational significance to ensure that the VRI delineation, particularly the non-productive, was not broader than the forest cover delineation it will be replacing. There is value in using the previous delineation to guide identification of possible site conditions and stand development (volume variation and openings) in stands blurred by significant beetle attack. All line transfer met current Provincial TRIM II mapping standards and specifications.

When the quality issues associated with the 2005 and 2006 aerial photo scanning came to light (during the delineation phase completed last fiscal), additional reliance was placed on the licencee and MoFR direction from the VPIP to use the existing forest cover delineation, where it fit, as much as possible. Only one or two of the maps delineated by Timberline indicated a suitable degree of alignment between the forest cover lines and the forest types they represented to retain at least some of the forest cover line work. Even on these sheets the forest cover line work was used mainly to guide the delineation process where the quality of the imagery failed. However, on the map sheets where the line work did not align suitably, it was used as a general reference to assist with placement of VRI type lines, specifically in the mountain pine beetle killed pine stands where the colour image files appeared panchromatic and adequate type separation was thus hindered. The forest cover line work was turned on an off during delineation to facilitate improved type identification. Not all forest cover type lines had current relevance and were not used to assist with the re-delineation.

The delineation procedures utilized for the pilot project area will be reviewed in greater detail in the pilot project final report.

The photo interpreters also stereoscopically reviewed the position and classification of all roads, trails, and landings visible on the digital images and digitized any amendments directly into the new digital inventory base maps on Level 49. Minimal update was required.

2.2.4 Field Calibration Data Collection

The purpose of the field data collection program is to establish Calibration Points (ground-truthing) that will familiarize the photo interpreter with local characteristics, conditions, and variations. These data will ensure accurate and consistent photo-interpreted descriptions of forest and vegetation attributes. In the VRI pilot project, new plot configurations and additional attributes have been identified as requirements to better address a post mountain pine beetle attacked land base. In addition to the standard single-point, and three-point ground calibration plots, a grid based nine-point calibration plot configuration (a nine point understory grid plot laid over a standard three point VRI calibration plot) has been designed with a 50m x 25m spacing. and attendant customized data collection requirements. All plot configurations will as a minimum collect data to the standards set out in the VRI Ground Calibration Data Collection Procedures and Standards (2004).

Additionally, a more intensive visitation percentage was proposed by the Quesnel Stakeholders Group in the Phase I VPIP. Various visitation levels will be tested across the 10 pilot project map sheets to assess the proposed visitation level. Two of the 10 map sheets will be assessed at the visitation level proposed in the Quesnel TSA VPIP, two at 50% of the proposed visitation, and the remaining six map sheets be completed with a visitation level closer to typical TSA VRI levels. Comparative analysis, based on results of implementing full enhanced calibration as recommended in VPIP, will be used to compare results to the two alternate (lower) levels of calibration. These variations in visitation intensity will not be applied to the 70mm LSP. Comparisons will be made as to the level of conformity with attribution or photo-estimation of stand parameters (basal area, species percentages, gross volume and site index) using the three calibration sampling intensities for air and ground calls. As well, the 70mm LSP plots may be held in reserve to act as accuracy assessment plots for the VRI. If it is not apparent from the analysis as to which calibration scenario is "best" then a Within Polygon Variation (WPV) inventory sample scheme will likely be used to establish a "base" for comparison. WPV would require sampling of +/- 15 polygons with +/- 40 plots in each polygon. WPV is described at:

http://www.for.gov.bc.ca/hts/vri/reports&pub/technical/wpc_proc.pdf

An alternative to specific WPV sampling is to utilize existing harvest block cruise data from blocks within the Pilot area. The three alternatives to providing an accuracy assessment base will be evaluated and discussed with FAIB staff.

2.2.4.1 Field Data Collection – Intensity, Type and Distribution of Calibration Points

The *Quesnel TSA Phase I VRI Project Implementation Plan* (VPIP), of October 2006, was ratified by all TSA stakeholders. This approved plan states the following assumptions relating to calibration intensity, type and distribution:

Assumptions from the Quesnel TSA VPIP:

- Average polygon size of 10 hectares.

- Number of samples based on a visitation intensity for the 1,232,949 ha area for the productive forest land base in the Quesnel TSA – **approximately 60% of the above area summary of 2,058,454 hectares**.
- Proportion of calibration points will be 65% / 25% / 10% air calls / ground calls / 70 mm large scale photography (LSP).
- The 70 mm LSP program* will provide more calibration points than conventional ground sampling, particularly in more inaccessible areas. 70 mm LSP will be used for both stand classification and quantifying the understory components for the VRI, but if desired can be held back and used for understory model validation.
- Ground calls will be a mix of traditional single point and three point plots (with attribute enhancements) selected based on species complexity, and newly proposed nine-point grid based plot configuration (understory) plots for predominantly pine stands (>60% composition).

**70mm LSP will be the final field program conducted for the pilot area and should be completed (field) in mid-July.*

An additional air call program will be undertaken for the large parks in the Quesnel TSA as listed in the TSA Area Summary at an approximate polygon visitation rate of 5%. No park areas are represented within the 10 map sheet pilot project area.

The Quesnel TSA VRI Pilot Project (as specified in the RFP) covers approximately 135,000 hectares (or 10 full map sheet equivalents distributed across the TSA as shown in Figure 1). Timberline proposes to follow a variation of the approved Quesnel TSA VPIP specified visitation intensity and establish a variety of visitation intensities, calibration plot type configurations, and distribution of calibration points across the 10 map sheets to properly test and compare the proposed numbers. Two of the 10 map sheets will be tested at the visitation level proposed in the Quesnel TSA VPIP, two at 50% of the proposed visitation, and the remaining six map sheets be completed with a visitation level closer to traditional TSA VRI levels. These variations in visitation intensity will not be applied to the 70mm LSP detailed further in this work plan. Calibration visitation intensities (proposed) by pilot project map sheet are provided in Appendix 4.

This comparison will validate or refute the benefits of increasing the field calibration intensity in the post mountain pine beetle attacked land base and determine a desired level of visitation over such a land base. The pilot will therefore test to see if the VPIP proposed level of field calibration intensity is required to achieve the desired Phase I VRI outcomes, namely improved information on stand structure, understory, and post mountain pine beetle attack stand condition. The pilot project will also investigate and report on the proportional distribution of calibration plot types proposed in the Quesnel TSA VPIP as discussed above. The assessment of visitation level can be made qualitatively by the interpreters but as several interpreters will be working on the attribute estimation the results will be difficult to quantify and will be largely subjective. More calibration plots are always better, but at what point (based on local variation of stand types) does it become redundant and simply add to the project cost with marginal return on utility? The use of WPV sampling to establish a “base” for comparison may be implemented as discussed in Sec. 2.2.4.

2.2.4.2 Field Data Collection Planning

The candidate types for Phase I VRI field calibration will include:

- A range of representative treed and non-treed types.
- A range of representative Problem Forest Types (e.g. mixed-wood stands, immature stands) as identified in the most recent MoFR Inventory audit;
- Types not previously field surveyed;
- A general cross section (age, height, densities) of mountain pine beetle attacked stands.

Timberline will utilize up to date GIS technology and statistical methods to complete the Phase I VRI field work plan for the Quesnel TSA VRI Phase 1 Pilot Project. A comprehensive analysis of current forest cover descriptions and existing inventory data sources on the pilot project map sheets was completed in the previous fiscal year to aid the field calibration planning process. This analysis identified the knowledge gaps that currently exist and provided information to focus the Phase I VRI data collection program in the most important priority types. The number of Phase I VRI samples proposed for each priority type will depend on the total area that each type currently occupies in the project area and the number of existing inventory data sources that are located in these types. The pilot project area may not contain the typical distribution of target strata as identified in the VPIP for the entire TSA. This will be considered when planning the calibration plot distribution within the pilot project map sheets.

Once the analysis is complete, the photo interpreter will stereoscopically review all the digital images and corresponding 3D inventory base maps using the DiAP digital photogrammetry system. Proposed air and ground calibration points will be pre-located, assigned unique reference numbers and recorded in the 3D inventory base map file.

Proposed ground calibration points will only proportionately address those stands identified in Table 6 of the *Quesnel TSA VPIP October 2006*. Proposed air calibration and 70mm LSP* points will target the remaining priority types. Ground calibration points will not be established in Provincial Parks, Park or Ecological Reserves, Protected Areas, Private Land, Woodlots, First Nations Reserves or areas under silviculture management not declared FTG.

A digital report summarizing the type of calibration point, the unique reference number, the map sheet number and the X and Y coordinates will be produced. The proposed locations will be transferred to a sample location map that will be forwarded to the MoFR (Kamloops) and contract administrator for approval. All ground and air call / 70mm LSP will be located with GPS units (Garmin 76S).

Three point calibration plots will generally occur in polygons with mixed species composition and no evident understory. Single point plots will be placed in pure (>80% leading species) stands that indicate no evidence of understory. The nine point plots will be installed in stands with a pine component (regardless of attack) of greater than 30% and evidence of understory occurrence. Appendix 3 provides a more detailed plot description of the nine point calibration point.

2.2.4.3 Field Data to be Collected

Air Calibration Points

- Estimate of species composition;
- Estimates of the average age and height of the two leading species;

- Estimates of lesser vegetation attributes, if applicable (e.g. shrub height and percentage cover, percentage herb cover, percentage bryoid cover, type and percentage of non-vegetated cover);
- Snag information (**estimated snags per hectare, species composition, average age, height**)[1] ;
- **Stand structure classification**[2]
- Other attributes, where applicable (e.g. presence, severity, and stage of attack of insects [or disease]); and
- Global Position System (GPS) location

70mm LSP Calibration Points

- Species composition;
- Estimates of the average age and measurement of height of the two leading species;
- Measurements of lesser vegetation attributes, if applicable (e.g. shrub height and percentage cover, percentage herb cover, percentage bryoid cover, type and percentage of non-vegetated cover);
- Snag information (**estimated snags per hectare, species composition, age, height**);
- Stand structure classification;
- Other attributes, where applicable and visible (e.g. presence, severity, and stage of attack of insects, bark condition).
- GPS location

Ground Calibration Points (single point and three-point)

- Species composition;
- Age and height of the two leading species;
- Basal area;
- **Call grading/net factoring of pine;**
- **Stand structure classification;**
- Stand density (stems per hectare);
- Snag information (**measured snags per hectare, species composition, average age, height**);
- Estimates of lesser vegetation attributes, where applicable;
- **Other attributes, where applicable (e.g. presence, severity, and stage of attack of insects, bark condition).**
- GPS location

Ground Calibration Points (three-point + nine-point 'understory' grid)

- Species composition;
- Age and height of the two leading species;
- Basal area;

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[1] Snags assessed as if "live", an accurate estimate of date of death requires dendrochronological sampling; determination of d.o.d. will be applied to inventory from monitoring functions and/or Phase 2 adjustment

[2] see *Field Guide for Identifying Stand Structure Classes in the Cariboo Forest Region* - C. Farnden; I. Moss; T. Earle. March 2003

- **Call grading/net factoring of attacked pine;**
- **Stand structure classification;**
- Stand density (stems per hectare);
- Snag information (**measured snags per hectare, species composition, age, height**);
- Estimates of lesser vegetation attributes, where applicable;
- **Nine 2.52m radius understory sub-plots to collect a dot tally of understory tree species information by height and dbh class. Appendix 2 shows the Understory Plot card and displays the height and dbh classes used in this project. Configuration will be as per the plot configuration diagram in Appendix 3.**
- **Other attributes, where applicable (e.g. presence, severity, and stage of attack of insects, bark condition).**
- GPS location

Air Observations

- Estimate of species composition and/or;
- Estimate of age and height of the two leading species and/or;
- Estimates of lesser vegetation attributes, if applicable;
- Estimates of other attributes, if applicable.

Ground Observations without Measurements

- Estimate of species composition and/or;
- Estimate of age and height of the two leading species and/or;
- Estimates of lesser vegetation attributes, if applicable;
- Estimates of other attributes, if applicable.

2.2.4.4 Field Data Collection Hardware and Software

Timberline's team will utilize up to date forest mensuration technologies for the Quesnel TSA Pilot Phase I VRI project. This will include the use of GPS units for accurately determining the location of all calibration points). Digital cameras will be used to collect visual stand condition information in each ground calibrated polygon as well as numerous air called polygons.

2.2.4.5 Data Source Transfer

The location of all calibration points established will be transferred to Level 14 of the project's inventory base maps using the DiAP viewers. All field information collected will be forwarded to the MoFR and contract administrator, as it is completed, in hardcopy and/or digital form as per MoFR requirements. The data source layer (new plots) will be provided as part of the MicroStation deliverable requirements and the new but as yet unknown VRI ArcInfo deliverable requirements of the MoFR.

2.2.4.6 Field Safety

The safety of our field crews is our most important concern. Timberline will only utilize two-person sampling crews on this project. Each crewmember will carry approved bear-spray repellent, crack and light flares, firearms where staff have the appropriate licencing, and first aid kits. In addition, each crew will carry two-way radios or cell/satellite phones as required and will be in constant communication with other crews and/or helicopter pilots.

Timberline staff have many years of field experience and are fully aware of and prepared to deal with encounters with potentially dangerous wildlife. Timberline will provide the Quesnel Stakeholders Group a copy of its detailed Field Safety Plan, if requested.

2.2.5 Vegetation Cover Polygon Descriptions

2.2.5.1 Silviculture Polygons

Timberline will follow the most recent MoFR standards and procedures regarding the delineation and description of silviculture polygons as described previously in section 2.2.3.1.

2.2.5.2 Non- Silviculture (or Free Growing Silviculture) Polygons

The photo interpreters will acquire and review the current Phase I VRI field data for the area in order to familiarize themselves with local forest conditions.

The photo interpreters will then stereoscopically review all delineated vegetated and non-vegetated polygons at an effective image viewing scale of about 1:6,000 to 1:7,500 using the colour 1:20,000 scale project digital images. A complete detailed VRI description will be derived for each non-silviculture and FTG polygon based on:

- Current inventory field calibration data;
- Field data from previous inventory surveys (existing data sources);
- Digital tree height measurements (taken as required to assess observed stand height variations);
- Field data from other disciplines (e.g. Cruise data); and
- The photo interpreter's local knowledge, skills, and experience.

The following attributes will be 'assigned' to all non-silviculture polygons, as applicable:

- Map sheet number;
- Polygon number;
- Ecological Information (including Surface Expression, Modifying Processes, Site Position, and Alpine Designation);
- Soil moisture and nutrient regimes (pre-populated into the database using the Quesnel PEM)
- BC Land Classification;
- Tree layer (live as well as attacked);
- For all tree layers regardless of being alive or dead (attacked) will be have the following attributes assigned:
    - Tree crown closure;
    - Tree cover pattern;
    - Vertical complexity;
    - Species composition;
    - Age of the first species;
    - Age data source code;
    - Height of the first species;
    - Age of the second species;

    - Height of the second species;
    - Basal area;
    - Stand density;
    - Site index;
    - Site index species;
    - Snag frequency;
    - Stand structure class (live only and live and dead stems)
- Silviculture opening number;
- Stand disturbance and treatment history;
- Snag frequency;
- Descriptions of lesser vegetation (shrubs, herbs, bryoids); and
- Description of non-vegetated components.

With the exception of providing full descriptions of attacked stands as a dead tree layer 9not just a snag frequency), all data as a minimum will be reported according to VRI specifications.

2.2.5.3 Existing Data Source Information

According to the *VRI Photo Interpretation Procedures* (2002), the photo interpreter "is responsible for projecting previous data sources to the year of photography". For example, a Ground Calibration point established in 1975 that has the following attributes – lodgepole pine 100%, 42 years of age, 15.5 meters in height must be "projected " to the year of the current photography. In the past, most interpreters have used a combination of site-index tables, photo interpretation and intuition to do this. As a result, there is often little consistency between interpreters.

Timberline will use the MoFR's VDYP (Variable Density Yield Prediction) program to project attributes for all existing inventory data sources. The results will be available to all photo interpreters assigned to the Quesnel TSA Pilot project. As a result, photo interpretation of VRI attributes based on existing inventory data source information will be more consistent between interpreters.

2.2.5.4 Basal Area and Stand Density Estimates

Timberline will compile and analyze all current field data collected for the Quesnel TSA Pilot Project and create localized look-up tables for the basal area and stand density attributes. The tables will be species-specific and be incorporated into Timberline's custom data entry program. The photo interpreter will have predicted values (based on local field information) available as a guide when making his final estimations for basal area and stand density. As a result, the reliability of photo-interpreted attributes of these VRI attributes will be improved.

2.2.6 Polygon Attribute Description Data Recording

The vegetation cover descriptions will be entered directly into a digital database using Timberline's custom data attribute entry and editing program. The software has extensive contextual on-line help functions, superior edit and validation functions and is also fully customizable. The program will ensure that all data entries are valid, that recorded species are only those found in the Quesnel TSA Pilot Project area, and that all descriptions for common polygons between adjacent map sheets are identical.

Data output will be in Microsoft Access™ .mdb format to facilitate final data validation using the MoFR VegCAP software and to facilitate data transfer to the required ArcInfo format deliverables.

2.2.7 Digital Map Production

2.2.7.1 Completion of MicroStation Inventory Base Maps

Upon completion of the polygon attribute description phase, the digital inventory base map will be forwarded to the digital mapping supervisor for final processing.

The digital mapping supervisor will electronically compare the noded inventory base map file to the digital forest cover attribute file to ensure that there is an exact one-to-one correspondence. Any errors or omissions will be noted and, if necessary, the files will be returned to the photo interpreter for correction.

The digital inventory base map file will then be vector and polygon cleaned, with Sierra's Maps3D software, to eliminate any topological line work errors that may have been introduced by the photo interpreter during the final edit/correction phase. Concurrently, the following items will be checked to ensure compliance with the Quesnel TSA Pilot Project's standards and specifications:

- Transfer and coding of all new roads, trails and landings;
- Location and coding of field data sources;
- Accuracy and completeness of all work, including the legibility of the map; and
- All edge-ties for line work and polygon descriptions.

2.2.8 Conversion of MicroStation Inventory Base Maps to ArcInfo Format

The creation of ArcInfo format digital mapping deliverables was not specified in the project's RFP; however, based on discussions with the MoFR these will now be required. The MoFR is moving towards an ArcInfo environment, but that 2007/08 will be an overlap year requiring both IGDS and Arc format deliverables. [3]

The verified digital inventory base map and digital VRI attribute files will be forwarded to the digital mapping supervisor for conversion to the required ArcInfo format and the following will be completed:

- Set the working units of the inventory base map file to meters and set the global origin to its correct value;
- Import the inventory base map file into ArcInfo, and ensure that it is topologically correct;
- Join the forest cover attribute file with its respective AAT and PAT databases;
- Convert the inventory base map TEXT field from character to numeric for preparation of database linkage for polygonal and point coverages;
- Project the ArcInfo coverages to the Quesnel Stakeholders Group specified projection and rebuild for polygons, points and lines;
- Convert the forest cover attribute MS Access file to Dbase in preparation of importation to ArcInfo;
- Import Dbase files into ArcInfo;

[3] Pers. Comm. Doug Cunningham MoFR (April 2007)

- Link imported Dbase files to the forest cover ArcInfo coverages and ensure a one to one correlation between the polygons and the database;
- Build the coverage for polygons, points and lines and ensure that the coverages are topologically clean;
- Format PAT and AAT databases to standards and specifications;
- Calculate PAT and AAT values from existing forest cover base map/database values;
- Drop working database fields from PAT and AAT; and
- Export the master coverages to E00 files for delivery to the MoFR and Quesnel Stakeholders Group.

Final deliverables will be as per the RFP or as negotiated.

3 PROJECT INITIATIVES AND INNOVATIONS

3.1 Use of Existing Ecological Data

Field observations by the ecologists completing the Cariboo Predictive Ecosystem Mapping (PEM) and PEM accuracy assessment indicated that natural regeneration (species and abundance post mountain pine beetle) in the Quesnel TSA is strongly correlated to the regional climate (i.e., biogeoclimatic [BGC] zone, sub-zone, and variants) at the landscape level and to the ecosystem unit (i.e., site series) at the site level. Since the Quesnel TSA has a completed PEM with known site series accuracy, Timberline will take full advantage of the existing PEM data to enhance our ability to 'predict' or quantify understory regeneration. Specifically, Timberline proposes to analyze collected field data for understory regeneration based on BGC units and site series, and build a conceptual model.

3.2 Basal Area and Stand Density Estimates

Timberline will compile and analyze all current field data collected for the Quesnel TSA Pilot Project and create localized look-up tables for the basal area and stand density attributes. The tables will be species-specific and be incorporated into Timberline's custom data entry program. The photo interpreter will have predicted values (based on local field information) available as a guide when making his final estimations for basal area and stand density. As a result, the reliability of photo-interpreted attributes of these VRI attributes will be improved.

3.3 70mm Large Scale Photos

One of the types of data acquisition tools requested in both the Quesnel TSA VPIP and the Quesnel TSA Phase I VRI Pilot Project RFP is the use of 70mm LSP to better quantify stand structure and understory characteristics, particularly in polygons affected by mountain pine beetle. Timberline offers the following innovation.

3.3.1 70 mm Large Scale Photography

Figure 2 – Timberline's 70mm Camera Boom System in flight: Cariboo Forest Region

Timberline has the capability to establish fixed-radius aerial survey plots using a 70mm large-scale LSP system. The system consists of twin 70 mm Hasselblad cameras mounted in a camera boom secured to a 206B Jet Ranger helicopter.

The advantages of 70mm LSP include:

- Improved distribution of field calibration points by sampling inaccessible stands;
- Improved identification of tree species and accuracy of species composition estimates;
- Improved estimates of stand height through accurate photo measurements;
- Improved stand density (stems per hectare) estimates through accurate photo measurements of fixed area plots;
- Improved identification and differentiation of understory species and lesser vegetation (advanced regeneration, shrubs, herbs, and bryoids);
- Improved and reduced cost of quality control and quality assurance as audits are completed in the office.

All 70mm LSP samples will be flown at a scale of between 1:800 and 1:1500 and will each consist of three randomly located point samples. Samples will be exposed using Agfa Aviphot Chrome 200 or equivalent diapositive film to provide the best resolution for subsequent photo interpretation and measurements.

All 70mm LSP samples will be visually navigated to during field data collection. A GPS unit is interfaced with the 70mm Camera Boom and corrected Universal Transverse Mercator (UTM) coordinates will be determined for each 70mm LSP photo plot. These coordinates will indicate the precise location of the 70mm LSP photo sample.

Analysis of the 70mm LSP samples will be conducted using a Ross Stereocomparator SFS-3 measuring device and will collect the following data for each tree layer present:

- Species composition;
- Estimated age of the first two leading species;
- Measured height of the first two leading species (to nearest 0.1 meter);

- Measured tree crown closure (to nearest 1%);
- Measured stems per hectare (to the nearest stem)
- Estimated basal area per hectare;
- Measured snag frequency (to the nearest stem);
- Stand structure classification; and
- Determination of insect attack incidence and severity.

Other measurements and estimations will include:

- Measured lesser vegetation crown closure (to the nearest 1%);
- Estimates of lesser vegetation attributes.

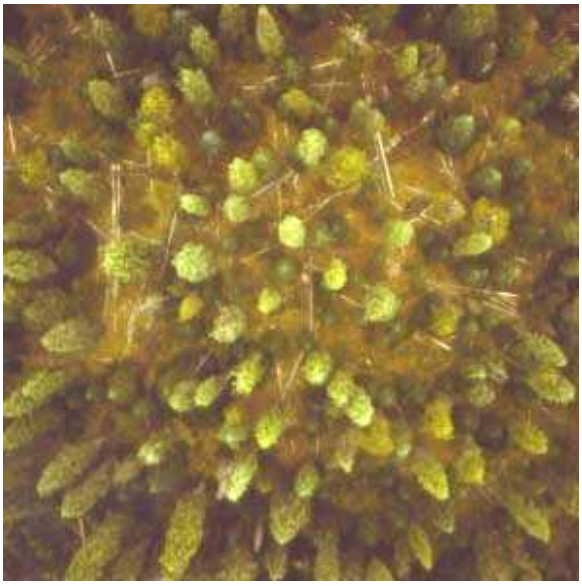


Figure 3 – 70 mm LSP of a Spruce / Pine / Balsam stand (approx scale 1: 1100)

The location of all 70mm LSP samples will recorded on Level 14 of the MicroStation format inventory base maps using the DiAP *viewer* system.

4 PROJECT DELIVERABLES

4.1 Vegetation Resources Inventory

- One copy of each complete and validated Microsoft Access™.mdb attribute database linked to the vegetation inventory base maps (MicroStation .dgn as well as ArcInfo);
- One copy of each VegCAP validation report;
- One copy of the digital record of ground and air calibration points in Microsoft Excel™ format;
- One copy of the original hardcopy ground and air calibration point forms;
- All quality control documentation; and
- Final report evaluating the procedures and results of the pilot project objectives.
- Report assessing options and providing recommendations for VRI implementation in the remainder of the Quesnel TSA.

4.2 Photogrammetry and Digital Map Production

- One copy of each completed, vector and polygon clean 2D and 3D vegetation inventory map data file in MoFR Digital Standard format (Intergraph Design File (IGDS) Format, Version 8.0 or later);
- Completed ArcInfo format vegetation inventory map data files (if this format is requested);
- All quality control documentation; and
- One CD or DVD with all final Microsoft Access™ (.mdb) attribute files, all final 2D graphic files and all final 3D graphic files.

4.3 Schedules

- Contract Implementation (April – July/August):
- Field data collection preparation (April/May);
- Pre-work meeting and site familiarization (May/June);
- Data Collection -establish air, 70mm LSP, and ground calibration points (June/July);
- Summarize and record field data (June/July).
- Quality Control and Quality Assurance of field data collection (June/July);
- Polygon attribute estimation (August-Oct.);
- Quality Control of polygon attribute estimation (August-Oct.);
- Quality Assurance of polygon attribute estimation (August-Oct.);
- Final digital mapping (Sept/Oct.);
- Quality Control of digital mapping (Oct.);
- Preparation of final project deliverables (Sept/Oct);

- MoFR review and acceptance of final project deliverables (Sept/Oct);
- Pilot Project Evaluation and Final Report (Oct/Nov).

4.3.1 2007/2008 Fiscal Year – Schedule of Project Deliverables

Work to be completed in the 2007/2008 fiscal year includes all field calibration (air calls, 70mm LSP, and ground calls) and final attribute estimation for the 10 map sheets scheduled to be completed for the VRI pilot project. Timberline intends to complete the following:

Phase	**Completion Date**
Air Calls	June 22, 2007
Ground Calls	July 15, 2007
70mm LSP acquisition	July 25, 2007
70mm LSP interpretation	August 15, 2007
Final Attribute Estimation	October 31, 2007
Final Analysis and Report	November 15, 2007

The above schedule assumes that the Quesnel Stakeholders Group will supply Timberline all of the necessary materials and quality assurances services in a timely manner (i.e. within ten working days of request for material or services).

5 QUALITY ASSURANCE

Field Data Collection

An independent third party contactor will be employed to conduct an unbiased Quality Assurance sample on calibration data points. Due to the nature and objectives of the Pilot approximately 10% of air calls and 5% of ground calls will be checked.

Polygon Attribution

An independent third party contactor will be employed to conduct Quality Assurance on each of the 10 map sheets in the Pilot area. A representative sample of at least 2% of polygons on all 10 pilot map sheets will be checked.

6 BUDGET ESTIMATE

VRI Pilot Activity	Units	Unit Cost ($/Unit)	Total Cost ($)
DATA ACQUISITION, PRE-WORK, AND PLANNING			
Project Planning			$12,000.00
Training (CGNF, Stand Structure)			$15,000.00
Organize and Process RESULTS Data			$3,887.00
Sub-Total			*$30,887.00*
FIELD PLANNING (GROUND, AIR, 70MM LSP)			
Single, Three, and Nine Point Ground Calibration Plots			$9,710.00
Air Calibration Points			$3,595.00
70mm Large Scale Photos (LSP)			$2,900.00
Sub-Total			*$16,205.00*
FIELD DATA COLLECTION			
Single, Three, and Nine Point Ground Calibration Plots			$53,705.00
Air Calibration Points			$5,850.00
70mm Large Scale Photos (LSP) & Film Processing			$9,567.00
Sub-Total			*$69,122.00*
HELICOPTER SUPPORT			
Ground Calibration Plots (heli access)	4.4	$870.00	$3,800.00
Air Calibration Points	29.6	$870.00	$25,750.00
70mm Large Scale Photos (LSP)	15.3	$870.00	$13,300.00
Sub-Total			*$42,850.00*
ATTRIBUTE ESTIMATION			
Field Data Compilations			$5,237.00
Attribute Data File Customizing			$4,535.00
Enhanced VRI Attribute Estimation			$68,595.00
Sub-Total			*$78,367.00*
GIS AND MAPPING			
GIS and IGDS Processing and Mapping			$12,305.00
Sub-Total			*$12,305.00*
Quality Assurance			$21,000.00
PROJECT MANAGEMENT AND ADMINISTRATION			
Final Report			$6,500.00
Project Management, Supervision and Administration			$32,775.00
Sub-Total			*$24,275.00*
Total			***$310,011.00***

APPENDIX 1

DETAILED FIELD DATA COLLECTION PROCEDURES

The purpose of establishing calibration points is to familiarize the photo interpreter with local conditions and to gather sufficient field information to allow a reasonable photo interpreted estimation of the entire polygon's attributes (and, through comparison, the estimation of adjacent polygons' attributes).

Only stand characteristics that can be seen or be reasonably inferred from aerial photographs will be field estimated. Both field and photo estimates of tree attributes will be based on the main canopy (Crown Classes 1, 2 and 3) and in the case of the Quesnel TSA interpretable understories, as advanced understories are a major forest management consideration of post major insect infestation. Most understory information will be derived through the understory modelling project using existing data and understory data collected during the Phase I field calibration program.

Air Calibration Points

- Consult the Flight Plan work-map and the appropriate Flight Plan spreadsheet. Identify the Flight Plan photographs required. Retrieve the photographs from their storage unit and place in sequential order;
- Stereoscopically review all potential air calibration points shortly before boarding the helicopter. Note any unusual characteristics of the polygons to be surveyed (e.g. the presence of more than one tree layer) and record as a note on the photograph;
- Navigate the helicopter to the tie point for the first air calibration point (as identified on the Flight Plan photo);
- Determine the actual location and direction of the air calibration survey strip and relay the information to the helicopter pilot;
- Make a low level pass over the polygon (As low and as slow as you and the helicopter pilot are comfortable with). For each layer present, estimate the polygon's species composition (to the nearest 10 percent), the average age of each of the first two leading species (to the nearest 10 years), the average height of each of the first two leading species (to the nearest meter) and the GPS coordinates. Record these estimates on the Air Calibration Tally Sheets or digital VRI Air Calibration Form. Also note and record any other significant VRI attributes that may be present. For example:
- Presence and abundance of lesser vegetation (shrubs, herbs, bryoids);
- Presence and abundance of non-vegetated areas;
- Record any VRI Air Observations directly on the Flight Plan photo as you navigate between Air Calibration points. Data observed can include one or more of the following:
- Species composition;
- Average age of the leading species;
- Average height of the leading species;
- Average age of the second leading species;
- Average height of the second leading species;
- Presence and abundance of snags Level of attack of mountain pine beetle infested stands (green, red, or grey attack and a rough % of polygon attacked)
- Presence and abundance of lesser vegetation (shrubs, herbs, bryoids);
- Identification of the stand structure class;
- Presence and abundance of non-vegetated areas;
- Navigate the helicopter to the tie point for the next air calibration point (as identified on the Flight Plan photograph). Repeat until all proposed air calibration points are completed for the Flight Plan;

- When practical, periodically confirm aerial estimates by landing and measuring representative tree ages and heights. Record any information collected directly on the photograph as an "Observation".
- Package and store all Air Calibration Tally Sheets in the designated storage unit, or download the air calibration .mdb file from the tablet and store in the project folder;
- Return all Flight Plan photographs to their designated storage unit;
- Update the Inventory Project Status Report.

Ground Calibration Points

- Stereoscopically review all potential calibration points. Note any unusual characteristics of the polygons to be surveyed (e.g. the presence of more than one tree layer) and record as a note on the photograph;
- Locate the photo tie point in the field;
- Establish the plot center in the direction indicated on the photograph a minimum of 75 meters from the photo tie point
- Record the ground calibration point number on a plot center stake (XGV 23);
- Make a preliminary estimate of the stand structure, the average stand diameter, the species composition and the basal area factor (BAF) or plot radius that should be used.
- Record plot location using GPS.

If the average stand diameter is greater than 15 cm at breast height…

- Use the point sample (variable radius) sampling method;
- Select a diameter limit (4.0 cm +, 7.5 cm+, 12.5 cm+, 17.5 cm+, 22.5 cm+ or 27.5 cm+) and a BAF that will yield a minimum of 6 "in" trees; Record on the Ground Calibration Tally Sheet;
- Record the tree number, the species and the measured diameter at breast height (DBH) on the tally sheet for each tree in the plot. Also record the presence of insects or disease, if applicable;
- Measure all "borderline" trees and confirm their status. Maximum distance = Plot Radius Factor (PRF) x DBH where PRF = 0.5, divided by the number of bands used. If the actual distance from plot center to the center of the tree is less than the maximum distance, then the tree is "in". If the actual distance from plot center to the center of the tree is more than the maximum distance, then the tree is "out". (Note: BAF = number of bands squared);
- Mark each tree in the plot with ribbon or paint (see the "marking" section of these instructions).
- Examine the most representative tallied "in" trees of the leading species for potential use as a sample tree. It must be representative of the main canopy (dominants and co-dominants) and be free of major defects (major defects are allowed only if the majority of stems in stand also have major defects). If there are no suitable trees, choose a nearby suitable tree of the same species (and number as tree 99). Measure its height with the Vertex Hypsometer and determine its age by boring the tree at breast height. Repeat for the second species, if present.
- Record the age and height of the sample trees on the tally sheet.
- Estimate the snag frequency based on your observations made at the plot center, the adjacent areas and observations made along the tie line. Record in the "comments" section of the tally sheet;

- Indicate on the plot card under damage the green, red, or grey attack condition of all mountain pine beetle attack in each plot where evident and note the degree of attack for the polygon in general.
- Where advanced regeneration (understory) is found, fixed radius plots will be established to tally all trees in the understory, below the pre-selected diameter limit down to 10cm (by predetermined classes). Suitably representative trees from the understory will be selected for age counts by sawing them off just above point of germination and counting the growth rings.
- Complete call grading and net factoring 'lite' for all pine trees in the plot.
- Identify the stand structure class.
- Understory plot radius is fixed at 2.52m for each of the nine grid based understory plots (nine point 'understory' plot configuration);
- Estimate shrub, herb, and non-vegetated attributes, if required (i.e. these polygon characteristics are visible on the aerial photographs). Record in the "comments" section of the tally sheet;
- Check the validity of the measured or estimated attributes and modify them, if necessary based on your observations. Record in the "comments" section of the tally sheet;
- Ribbon the tie line back to the tie-point;
- Record GPS location.

If the average stand diameter is less than 15 cm at breast height…

- Use the fixed radius sampling method;
- Choose a plot radius (3.99, 5.05, 5.64, 7.98, 9.77, 11.28 or 12.62 meters) that will give you a minimum of 8 'in' trees that make up the main canopy.
- Record the tree number, the species and the measured diameter at breast height (DBH) on the tally sheet for each tree in the plot. Also record the presence of insects or disease, if applicable;
- Measure all "borderline" trees and confirm their status. Maximum distance = PRF x DBH where PRF = 0.5 divided by the number of bands used. If the actual distance from plot center to the center of the tree is less than the maximum distance, then the tree is 'in'. If the actual distance from plot center to the center of the tree is more than the maximum distance, then the tree is 'out'.;
- Mark each tree in the plot with ribbon or paint (see the "marking" section of these instructions).
- Examine the most representative tallied trees of the leading species for potential use as a sample tree. It must be representative of the main canopy (dominants and co-dominants) and be free of major defects (major defects are allowed only if the majority of stems in stand also have major defects). If there are no suitable trees, choose a nearby suitable tree of the same species (and number as tree 99). Measure its height with the Vertex Hypsometer and determine its age by boring the tree at breast height. Repeat for the second species, if present.
- Record the age and height of the sample trees on the tally sheet.
- Estimate the snag frequency based on your observations made at the plot center, the adjacent areas and observations made along the tie line. Record in the "comments" section of the tally sheet;
- Estimate shrub, herb, and non-vegetated attributes, if required (i.e. these polygon characteristics are visible on the aerial photographs). Record in the "comments" section of the tally sheet;
- Complete call grading and net factoring for all pine trees in the plot;

- Identify the stand structure class;
- Check the validity of the measured or estimated attributes and modify them, if necessary based on your observations. Record in the "comments" section of the tally sheet;
- Ribbon the tie line back to the tie-point; and
- Record GPS location.

If the Stand Structure includes "Vets"…

- Definition - a tree more than 40 years older than the main stand (usually more than 10 meters taller) with 1% to 5% crown closure (as estimated from aerial photographs). **The presence of "Vets" must be identified stereoscopically on the photographs before the calibration point is established and any measurements are made;**
- If a "Vet" layer is deemed to be present, sample the main layer as per the instructions above and record all main layer trees in your plot as "Layer 2";
- If a "Vet" tree falls in your plot –record it as "Layer 1". Estimate the species composition of the "Vet" layer. If practical, select representative sample trees of the first two leading species and measure and record their ages and heights on the tally sheet. If suitable "Vet" sample trees are not present, estimate the average ages and heights for the "Vet" layer;
- **Do not** consider "Vets" when estimating average diameter for the main stand.

If the Stand Structure includes "Multiple Layers"…

- Definition- each layer must be more than 40 years older (and usually more than 10 meters taller) than the next lowest layer and each layer must have more than 6% crown closure (as estimated from aerial photographs). **The presence of "Multiple Layers" must be identified stereoscopically on the photographs before the Calibration Point is established and any measurements are made;**
- Treat each layer as a unique and separate stand occupying the same site. Sample accordingly. Call the tallest layer "Layer 1", the next tallest "Layer 2" etc.;
- The minimum number of trees in each plot per layer equals four for a variable radius plot and six for a fixed radius plot;
- Do not use a BAF of less than 1.0

Marking

- Determine the breast height (1.3m measured up from the high side of the tree) of a plot tree using a DBH Stick. Paint a short horizontal line at point that DBH was measured.
- Paint a 30 cm high number on tallied trees (near breast height) facing towards the plot center, using orange tree marking paint;
- If the plot tree is a sample tree, place a vertical arrow (near breast height) on the side of the tree that the height was measured;
- Ribbon the tie-line from the plot center to the photo tie-point;
- Double ribbon the photo tie-point and record the XGV number on the ribbon (e.g. XGV 23);
- If there is dense underbrush, place single ribbons from the photo tie-point back to the helicopter landing spot or the edge of the road;
- Use ribbon to mark trees that are too small to paint. This will include most trees in observed understories.

QUALITY CONTROL

Air Calibration Points

Field Personnel

- Discuss and confirm the assessment of the polygon's attributes with the co-surveyor prior to recording the particulars of the call on the Air Calibration Tally Sheets;
- Once back on the ground, stereoscopically review all recorded attribute descriptions to ensure that they are reasonable and that they were established in the correct locations.

Quality Control

- Field-check the project-specified percentage of Air Calibration Points and independently assess the polygon's attribute descriptions;
- Record all findings on an Air Calibration Audit Form;
- Discuss the results of the audit with the field personnel.

Ground Calibration Points

Field Personnel

- The field crew's compassman measures all diameters and ages;
- The field crew's tallyman measures all heights and identifies all plot trees;
- The compassman and tallyman check each other's work before leaving the plot center.

Quality Control Officer

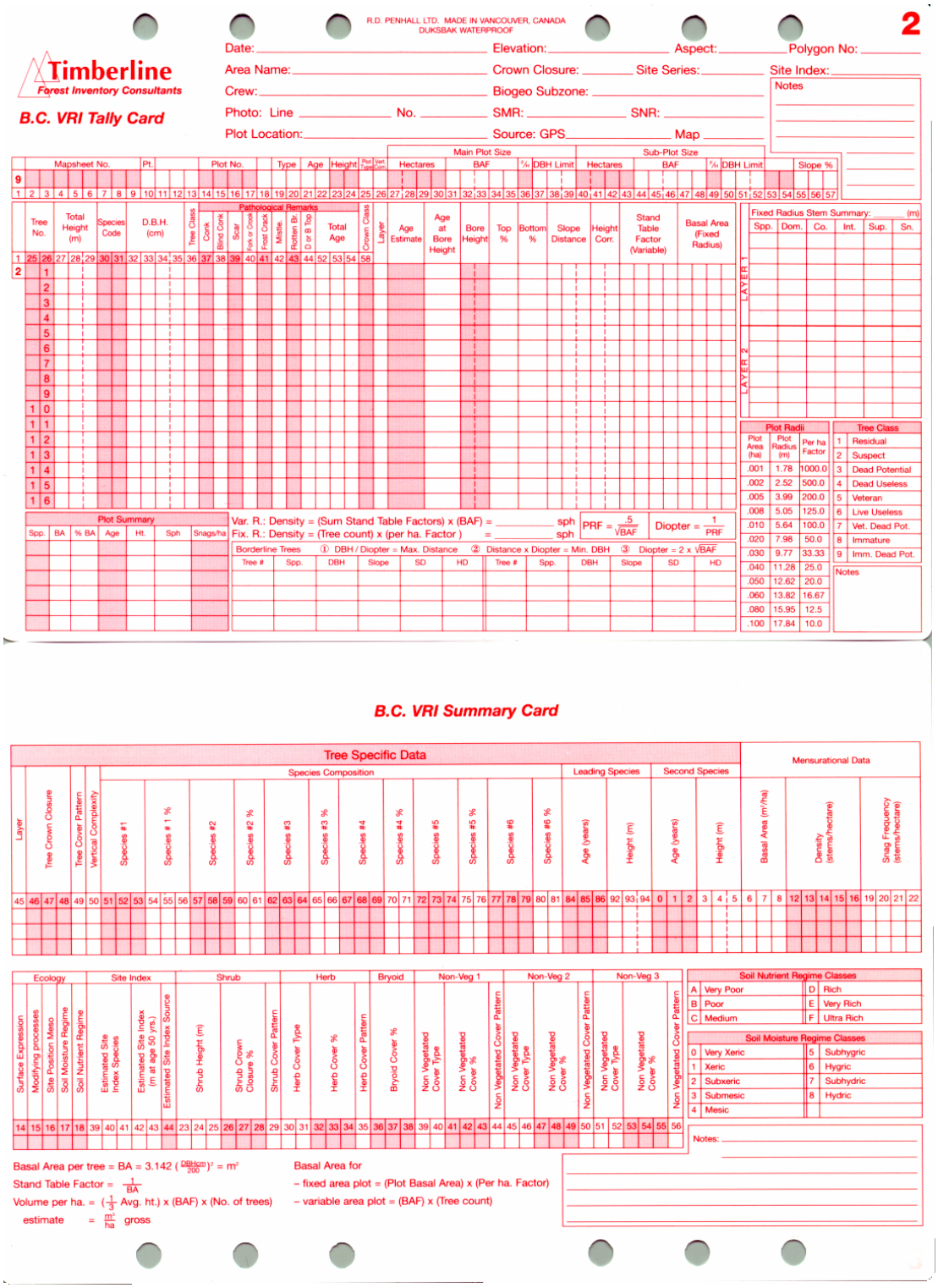
- Field-check the project-specified percentage of ground calibration points and independently assess the polygon's attribute descriptions;
- Record all findings on a Ground Calibration Audit Form;
- Discuss the results of the audit with the field personnel.

REFERENCE DOCUMENTATION

- Project-specific work instructions;
- Timberline BC VRI Quality Control Work Instructions;
- MoFR Vegetation Resources Inventory Air Call (Air Calibration) Data Collection Procedures and Standards Version 2.0, March 2003;
- MoFR Vegetation Resources Inventory Ground Call (Ground Calibration) Data Collection Procedures and Standards Version 3.0, March 2004;
- Magnetic declination tables;
- Timberline Occupational Health & Safety Manual.

APPENDIX 2

PILOT PROJECT PLOT CARDS



VRI Plot Card

Call Grade / Net Factor Plot Card

Timberline
Natural Resource Group

Quesnel TSA VRI Pilot Understory Plot

VRI Calibration Plot #

Understory Plot #1	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #2	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #3	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #4	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #5	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #6	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #7	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

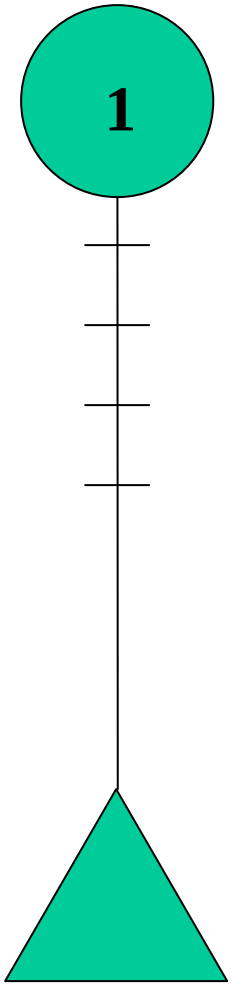
Understory Plot #8	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

Understory Plot #9	Species					
Ht / DBH class	1.	2.	3.	4.	5.	6.
0.1 - 0.3m ht.						
0.31 - 1.30m ht.						
0 - 4.0cm dbh						
4.1 - 7.5cm dbh						
7.51 – 12.5cm dbh						

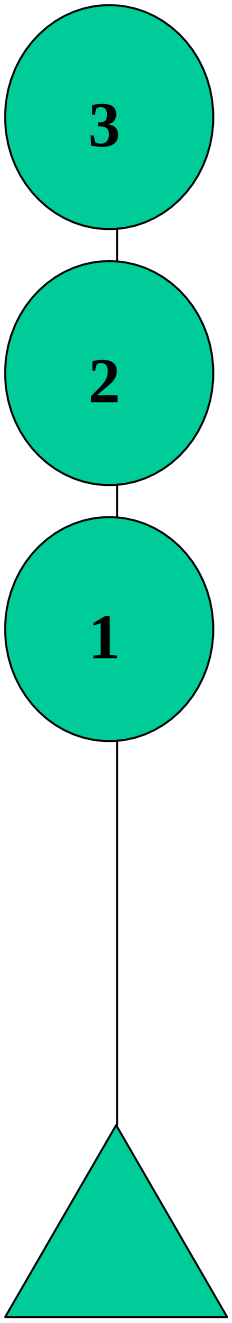
Notes

Understory Plot Card

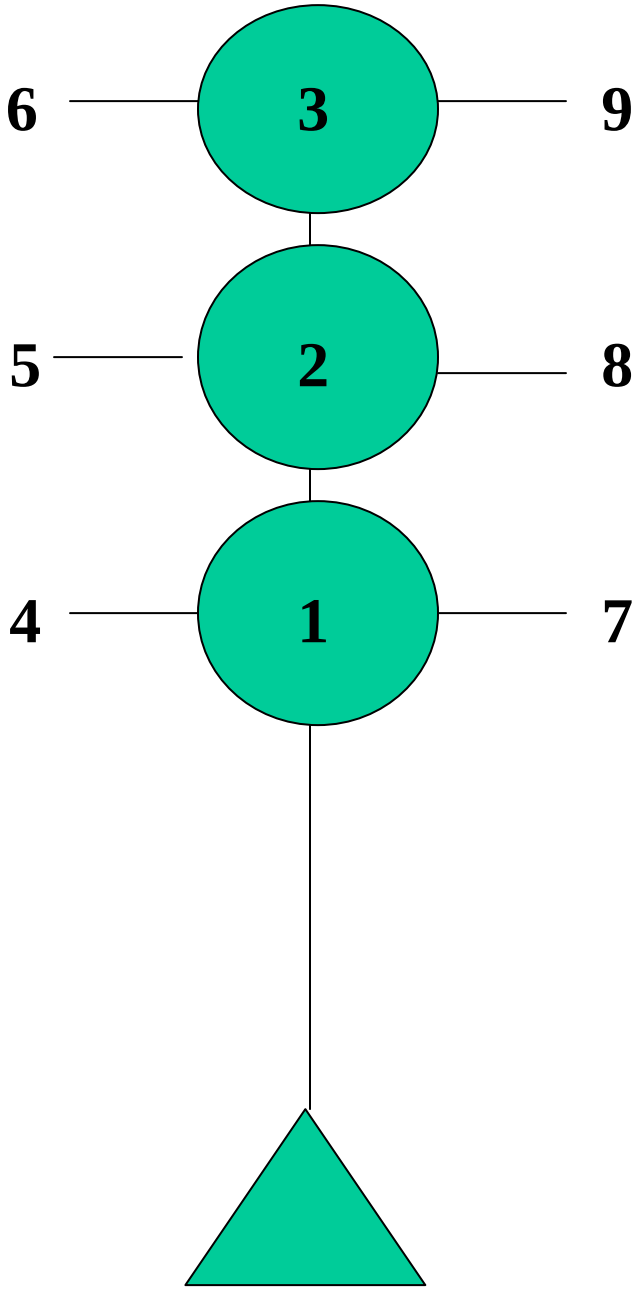
APPENDIX 3
PLOT CONFIGURATIONS



Single point plot with four prism sweep stations at 20 meter intervals prior to the plot location. Reserved for homogenous and pure species composition stands (>80% leading species) with no observable understory.



Three point plot. Stations along plot transect are at 50m intervals. Reserved for mixed species composition stands (<80% leading species) with 'no' observable understory. Will be used predominantly in non Pl mixed species types. If understory is evident this plot configuration can be changed quickly to the nine point plot.



Nine point plot. Same basic configuration as the three point plot (with 50m plot station intervals along main transect) with the addition of nine 2.52m fixed radius understory plots as indicated by the numbers. Understory plots 1-3 share the plot center with the variable radius VRI plot stations. To be used primarily in mountain pine beetle attacked stands with some observed understory. Understory plots 4-9 are located 25m perpendicular from the main plot transect.

APPENDIX 4

CALIBRATION

Quesnel Pilot - PROPOSED Air Calls

Mapsheet	093 B058	093 B090	093 B057	093 G016	093 B048	093 B055	093 B056	093 C094	093 C098	093 G014
Intensity	Full	Full	50%	50%	36%	36%	36%	36%	36%	36%
Type										
At Pure	1	1	1	1	1	0	1	1	0	0
At Mix	3	3	2	2	1	0	1	2	0	1
Bl Pure	0	1	0	0	0	0	0	0	0	2
Bl Mix	0	0	0	0	0	0	0	0	0	0
Ep Pure	0	1	0	0	0	0	0	0	0	0
Ep Mix	1	1	0	1	1	0	0	0	0	0
Fd Pure	5	5	2	2	2	0	0	0	0	0
Fd Mix	3	3	2	2	2	0	0	0	0	0
Pl Pure	13	18	8	9	7	13	7	7	7	7
Pl Mix	17	17	9	9	7	4	6	7	7	7
S Pure	3	9	3	5	2	2	3	7	5	4
S Mix	1	17	8	9	5	4	6	7	7	7
Other Pure	0	0	0	0	1	0	0	0	0	0
Other Mix	0	0	0	0	1	0	0	0	0	0
TOTAL	**47**	**76**	**35**	**40**	**30**	**23**	**24**	**31**	**26**	**28**
TOTAL AIR CALLS		360								

Quesnel Pilot - PROPOSED Ground Calls

Mapsheet	093 B058	093 B090	093 B057	093 G016	093 B048	093 B055	093 B056	093 C094	093 C098	093 G014
Intensity	Full	Full	50%	50%	36%	36%	36%	36%	36%	36%
Type								Heli Access	Heli Access	
At Pure	1	1	1	0	0	0	2	0	0	0
At Mix	1	1	1	1	1	0	1	0	0	0
Bl Pure	0	0	0	0	0	0	0	0	0	0
Bl Mix	0	0	0	0	0	0	0	0	0	0
Ep Pure	0	1	0	0	0	0	0	0	0	0
Ep Mix	1	1	0	0	0	0	0	0	0	0
Fd Pure	2	1	1	1	1	0	0	0	0	0
Fd Mix	1	1	1	1	1	0	0	0	0	0
Pl Pure	4	6	4	4	3	5	4	2	3	3
Pl Mix	7	7	3	3	3	0	2	2	3	2
S Pure	0	4	1	1	1	0	0	3	3	1
S Mix	0	7	3	3	1	2	2	3	3	2
Other Pure	0	0	0	0	0	0	0	0	0	0
Other Mix	0	0	0	0	0	0	0	0	0	0
TOTAL	**17**	**30**	**15**	**14**	**11**	**7**	**11**	**10**	**12**	**8**
TOTAL GROUND CALLS		**135**								