Cassiar Timber Supply Area

Vegetation Resources Inventory
Strategic Inventory Plan

PREPARED BY:
LM FOREST RESOURCE SOLUTIONS

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Hubert Burger, Ministry of Forests and Range, Kalum District.
Kim Haworth, Kingfisher Consulting.

EXECUTIVE SUMMARY

This Vegetation Resource Inventory (VRI) Strategic Inventory Plan (VSIP) for the Cassiar TSA was prepared in consultation with BC Ministry of Forests and Range representatives involved in inventory work in the area. The purpose of the plan is to outline the VRI activities and products needed to address identified forest management issues and perceived business needs. It is expected that this document will be used by stakeholders to assist in inventory planning and to help guide the development of a VRI Project Implementation Plan (VPIP).

Although AAC for the TSA is currently set at 305,000 m^3/year, relatively little timber harvesting has taken place in recent years. Several new initiatives are underway, however, including the development of a number of landscape level resource use plans and a potential new forest license to be issued to the Kaska Dene First Nation for up to 86,000 m^3/year in the Dease-Liard timber supply block. In the southern part of the TSA, the Tahltan First Nation hold a license for 120,000 m^3/year in the Iskut-Boundary supply block. There are also minor levels of harvesting that occur near Atlin and the Taku River Tlingit may be interested in pursuing timber harvesting in the area as well.

The Cassiar TSA is an enormous area of land (more than 13 million ha) that is relatively remote, making it difficult to economically conduct a vegetation resources inventory. The existing inventory is old and inaccurate with respect to height and volume estimates and existing photography is also old and eclectic. Based on the difficult economic conditions described above, what is known of the geographic location of the timber harvesting landbase, existing operational interests, and the location of existing infrastructure, it is recommended that a targeted phase one re-inventory be conducted in three discrete locations totalling up to 400,000 ha (3% of the TSA [other options to complete the remaining 97% of the TSA should be investigated]). A second less expensive option would be to conduct Phase II ground and NVAF sampling in a larger corridor corresponding to the area most likely to be suitable for timber harvesting (1.9 million ha). This approach would also be feasible but doesn't provide the same level of utility as a Phase I re-inventory.

Costs to undertake this work were estimated to vary from ~$263,000 for phase II sampling with a 15% sampling error, to $660,000 for a targeted Phase I re-inventory with new air photos and a database to VRI standards.

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1. INTRODUCTION

1.1 SCOPE AND OBJECTIVES

A Vegetation Resources Inventory Strategic Inventory Plan (VSIP) provides strategies for one or more inventory activities including such things as photo acquisition and interpretation, ground sampling, monitoring, and decay and taper estimates. Activities recommended in this VSIP address inventory issues identified in a 1997 inventory audit and in the Chief Forester's last AAC determination, as well as business needs identified by stakeholders in the Cassiar TSA. Stakeholders who provided input for this plan include:

- Ministry of Forests and Range (MoFR) representatives from the Skeena - Stikine District.
- Representatives from the Kaska Dene First Nation.
- Representatives from the MoFR Forest Analysis and Inventory Branch.
- Kim Haworth, Kingfisher Consulting.

Based on the strategic direction provided in the plan, it is expected that stakeholders will develop one or more VRI Project Implementation Plans (VPIP) specifying how inventory activities will be implemented over the next four or five years.

1.2 VEGETATION RESOURCES INVENTORY OVERVIEW

The Chief Forester is responsible for determining allowable annual cut (AAC) for TSAs (and TFLs) in accordance with Section 8 of the Forest Act. Up until recently, the responsibility for preparing a data package, undertaking timber supply analysis, and providing key information that is considered by the chief forester in making an AAC determination, was the responsibility of the BC Timber Sales (BCTS) manager and the holders of replaceable forest licenses (the DFAM group). The legislation supporting the DFAM initiative was never brought into force, however, and in February, 2007 the Chief Forester declared that the program would be discontinued. The Chief Forester is encouraging licensees to voluntarily complete scheduled TSR data packages and timber supply analyses using the Forest Investment Account's (FIA) Land Based Investment Funding. Fundamental to this task is ensuring that the quality of forest inventory supporting timber supply analysis and the AAC determination is sufficient to provide a useful level of accuracy. Forest licensees (and other forest resource users) also need land and resource information to undertake other forest management activities such as timber harvesting, forest protection, and wildlife, water, and range management.

Inventory information supporting timber supply analysis and forest management operations, must answer two fundamental questions:

1. Where is the resource located?
2. How much of a given vegetation resource (for example, timber or coarse woody debris) is there?

The process to answer these two questions is carried out in two phases. Phase I (photo acquisition and interpretation) involves the delineation of polygons and the estimation of resource

attributes from aerial photography and ground calls. Phase II (ground sampling) is the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes. This includes measurements of tree and stand attributes from sample clusters established randomly within the target population, and includes stem analysis of individual trees to assess taper and decay (net volume adjustment factor measurements - NVAF). A third, less common type of Phase II sampling is "within polygon variation" - intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values. The information from ground samples is used to adjust or correct the photo-interpreted estimates for all polygons in an inventory unit or management unit.

1.3 VRI OVERRIDING PRINCIPLES

A vegetation resources inventory is guided by a number of fundamental principles:

- The inventory must satisfy the business needs of stakeholders.
- Inventory activities must be conducted to Resource Inventory Committee standards.
- Inventory activities must be coordinated.
- There must be adequate statistical confidence in timber value estimates.

To help ensure these principles are followed, standards and methods for VRI products have been produced (available at http://www.for.gov.bc.ca/hts/vri/standards/index.html). Periodic reviews of the standards are coordinated by a Resources Inventory Committee.

1.4 VRI PLANNING

The VRI planning process requires that a Strategic Inventory Plan and a Project Implementation Plan be developed for a defined forest management unit (e.g. TFL or TSA). A VSIP outlines the VRI products required to address forest management issues and provides strategic direction for implementing the inventory activities. A The VPIP more specifically identifies the need for vegetation resource information, and provides the details for implementation of the VRI including target areas, scheduling, priorities, plot location, coordination, estimated inventory costs by year, and roles and responsibilities. Guidelines for preparing a VSIP and VPIPs are available at http://www.for.gov.bc.ca/hts/vri/standards/index.html.

1.5 FUNDING

A stakeholder steering committee (such as the Forest Investment Accountant (FIA) land base investment program steering committee) is normally formed to identify the type and quality of inventory information they will need to achieve their business goals. Stakeholders who might have a business need in the Cassiar TSA include the Integrated Land Management Bureau, who are leading a number of land use planning processes in the area, BC Timber Sale's Skeena Business Unit, the Tahltan First Nation, the Kaska Dene, the Taku River Tlingit, and potentially, a number of mining interests. A number of government representatives from this group met prior to the development of this VSIP to outline potential business needs.

The primary source of funding for inventory activities has been the Forest Investment Account's (FIA) land base investment program. The FIA allocation for the Cassiar for 2006/2007 was only $163,000. The program is in transition and it is expected that funding for future inventory work will likely come from Focussed Funding within the FIA program. The VRI Advisory Council is currently developing a set of criteria to rank TSAs and TFLs in terms of their forest inventory priorities. It is expected that only VRI projects attaining the *highest priority* ranking will be eligible. At present no figures are available regarding magnitude of funding and there is no guarantee of surplus funds for lower priority inventory units.

To date, no other source of agency funding for vegetation resources inventory work has been identified, although given the relatively high proportion of pine in the TSA, it may be possible that funding could be acquired through the $100 million federal mountain pine beetle initiative. In the absence of outside agency funding, stakeholders are encouraged to enter into partnerships to minimize the costs associated with the implementation of the activities outlined in this plan. It is government's intention that businesses invest in the necessary information, infrastructure, and human capital to run their business effectively.

2. BUSINESS CONSIDERATIONS

2.1 LANDBASE

The Cassiar Timber Supply Area (TSA) is situated in the northwest corner of the province in the Northern Interior Forest Region (figure 1). This TSA is the largest in British Columbia at over 14.8 million hectares, covering approximately one-sixth of the province. The boundary for the TSA was amended in January 2000 when the Muska-Kechika management area (1.6 million hectares) was transferred from the Cassiar TSA to the Fort Nelson TSA, leaving a land base of 13.2 million hectares (figure 2). This included a reduction in the timber harvesting landbase (THLB) of 27,452 ha. According to a timber supply analysis conducted in 2001, approximately 75% of the TSA is rock, water bodies, swamp, and alpine areas, while 25% (3.7 million ha) is productive forest land. Only about 5.4% of the productive forest land (~190,000 ha) was considered to be part of the THLB (see table 1).

The TSA is part of the Skeena - Stikine Forest District, which also includes the Bulkley, Kispiox, and Cranberry TSAs. The Cassiar TSA is administered from the Skeena - Stikine district office in Smithers and a field office in Dease Lake. The TSA is bordered on the west by Alaska, to the north by the Yukon Territory, to the east by the Fort Nelson and Mackenzie TSAs, and to the south by the Nass and Prince George TSAs. In the west, the Cassiar TSA consists of rugged, ice-capped mountains, dissected by several major river valleys. East of this, the majority of the TSA is characterized by mountains and plateaus separated by wide valleys and lowlands.

The TSA has a variety of forest types including coastal forests (in the west), interior transition forests, and boreal forests in the east and north. Lodgepole pine and white and black spruce are the predominate tree species in the Cassiar TSA. Lodgepole pine dominates in 49% of forest stands within the timber harvesting land base, mainly in the northern part of the TSA, and spruce dominates in 47% of stands, mainly in the southern portion of the TSA. In a small portion of the

area, subalpine fir is predominant (~4%). Although western hemlock grows in parts of the TSA, there are no hemlock leading stands within the THLB. More than 50% percent of stands in the THLB are >240 years of age.

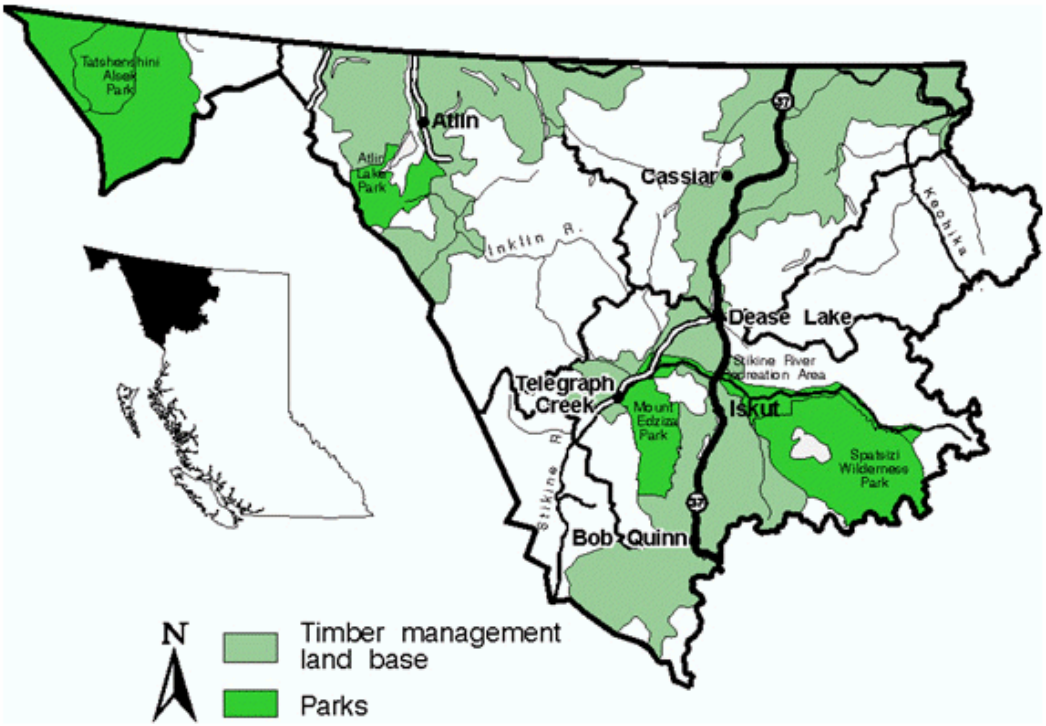

Figure 1. Geographic extent of the Cassiar TSA prior to the transfer of the MK management area.

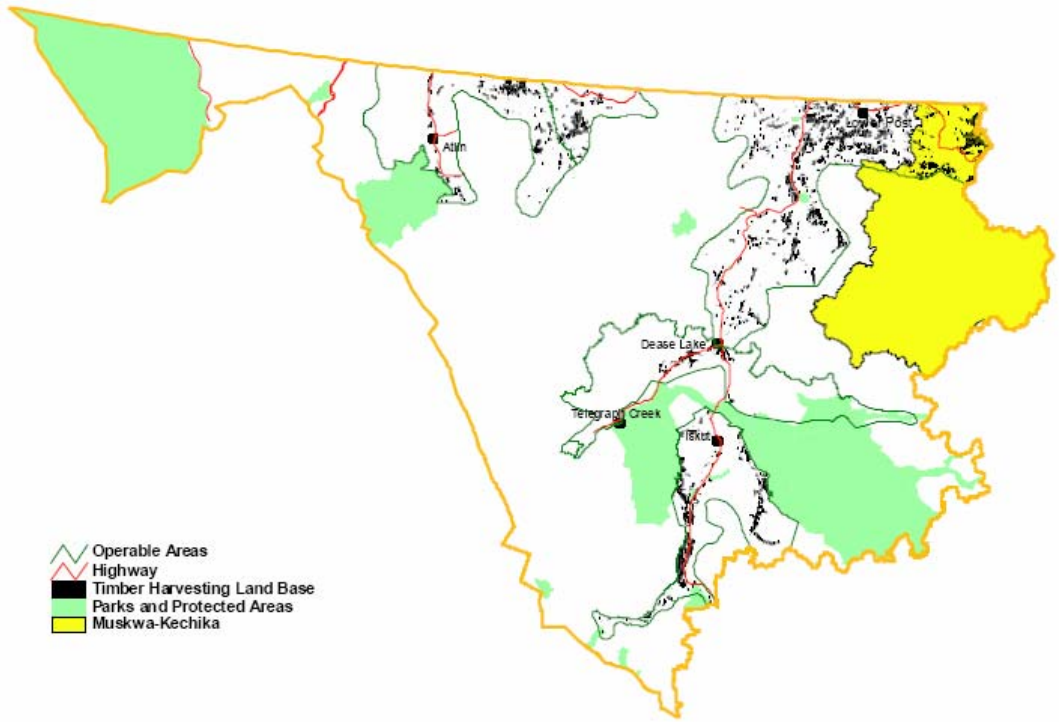

Figure 2. The THLB and MK management area within the Cassiar TSA.

Table 1. A summary of the 2001 Cassiar TSA timber supply analysis THLB net down.

Classification	Productive forest area by classification (hectares)	Area (hectares)	Per cent (%) of total TSA area	Per cent (%) of Crown forest
Total TSA area		14 800 323	100.0	
Not managed by the B.C. Forest Service		2 590 893	17.5	
Non-forest		8 500 936	57.4	
Total productive forest managed by the Forest Service (Crown forest)		**3 708 494**	**25.1**	**100.0**
Reductions to Crown forest:				
Non-commercial cover (brush)	116 825	116 825	0.8	3.2
Environmentally sensitive areas (ESAs)	41 062	41 062	0.3	1.1
Inoperable areas	2 052 173	1 954 577	13.2	52.7
Sites with low-growth potential	2 654 981	1 184 062	8.0	31.9
Problem forest types	387 427	49 025	0.3	1.3
Visually sensitive corridor	44 260	12 190	0.1	0.3
Current roads, trails and landings[a]		723	0	0
Riparian areas[a]		33 193	0.2	0.9
Wildlife tree patch (WTP) area[a]		12 673	0.1	0.3
Low-volume pine	720 996	7 310	0	0.2
Marginally operable	448 868	43 788	0.3	1.2
Pulpwood stands	1 310 719	26 846	0.2	0.7
Muskwa-Kechika	805 665	27 452	0.2	0.7
Total current reductions		**3 509 726**	**23.7**	**94.7**
Current timber harvesting land base (includes 7 874 hectares not satisfactorily restocked (NSR)* land)		**198 768**	**1.3**	**5.4**
Future reductions				
Future roads, trails and landings		13 131	0.09	0.35
Long-term timber harvesting land base		**185 637**	**1.25**	**5.0**

(a) For these categories, the area exclusions were derived using percentages of the timber harvesting land base. They are not mapped features, and therefore total productive forest area covered is not available.

In the last AAC determination, cut level was reduced from 400,000 cubic metres per year to 305,000 m^3 per year. Much of the reduction was as a result of uncertainties associated with poor quality inventory information. The 305,000 cubic metres was partitioned as follows: Dease-Liard supply block – 153,000 m^3, Atlin supply block – 32,000 m^3, and the Iskut - Boundary supply block - 120 000 m^3. The actual volume of timber harvested, however, has been much lower than this. Glen Buhr (pers. comm. 2007) indicated that the annual harvest level between 2002 and 2004 was only approximately 57,000 cubic metres, primarily in the Iskut - Boundary supply block.

2.2 INVENTORY HISTORY

According to the 2001 timber supply analysis, forest inventory for the area was completed in the early 1970s. The FIP (Forest Inventory Planning) files have been updated to 1993 to account for changes in ownership, growth, and denudation through harvesting or fire but no new linework or attribute estimation has occurred. MoFR staff estimate that, in the period from 1993 to 2001, approximately 520 hectares of harvesting and fire disturbance within the timber harvesting landbase have not been updated. Various levels of reconnaissance have also been completed since then to define what might be operable land and what could be considered to be part of the THLB, however, none of this work constitutes a re-inventory.

A SIBEC study was also completed in 1998 in which 108 plots were established to obtain better estimates of site productivity. These plots involve measuring tree heights and ages on a few trees within each plot but measurements are not sufficient to use the plots in a phase two statistical adjustment.

2.3 INVENTORY AUDIT

An inventory audit was performed in the TSA in 1997. The inventory audit tested three components of the current inventory:

- the accuracy of timber volumes in mature forested areas (forest stands older than 60 years),
- the accuracy of the site growth potential (site index) of immature stands (younger than 60 years of age but older than free growing age),
- the accuracy of the photo-interpreted classification of non-forest types in the inventory (areas such as lakes, gravel pits, and alpine meadows).

Audit results for mature volume were stratified by location; Dease Lake North and Dease Lake South. It was found, for Dease Lake North, that:

- inventory heights were 17% greater than audit heights.
- there was a statistically significant bias in attribute estimates, particularly volume which was 44% (53 m3) more than the audit volume.

For Dease Lake South it was found that:

- mature volume was overestimated by 14% in the inventory database but that this was not statistically significant.

The audit also revealed that the inventory estimate of site index in young stands was within 3m of the audit site index in only 5 of 19 stands (26% of the time). Site index in the inventory database was at least three metres less than the audit site index in 11 of 19 stands (58% of the time) and exceeded the audit site index by at least three metres in three of 19 stands (16% of the time). With respect to non-forest classification, 80% of stands assessed for non-forest classification were correct (the provincial minimum standard is 85%), indicating that non-forest classification did **not** meet provincial standards.

During the timber supply review in 2001, audit results were recompiled for the timber harvesting landbase to assist in sensitivity analysis. In the timber supply review exercise, audit data were re-stratified into coastal/transitional areas or interior areas. Recompiled results indicate that the inventory overestimates volume by 14% for coast and transition areas and 49% for interior areas. In a different exercise, SIBEC estimates of site productivity were used instead of site index in the inventory database to test timber supply sensitivity to potential bias in inventory site index estimates. This test resulted in a 4% increase in allowable harvest levels.

2.4 INVENTORY ISSUES

Inaccuracies in the existing inventory for the Cassiar TSA will cast doubt on any strategic level planning, timber supply analysis, or planning of timber harvesting operations. It will also make it difficult to make implementation decisions such as where to construct roads or harvest timber. Key issues include:

1. **Fragmented air photo coverage and inadequate photo quality.** Existing photo coverage for the TSA includes a great number of dates, scales, and locations. In the early 1970's relatively continuous cover of black and white photography was acquired at a variety of scales including 1:15,000, 20,000, 30,000, and 40,000. In almost every year since, up until 2001, aerial photographs have been produced for small pieces of the TSA. Examples include 1:15,000 scale 1993 and 1994 photos of approximately three mapsheets around the Bob Quinn area, three or four mapsheets with 1994, 1:15,000 scale black and white photos along the road to Telegraph Creek, approximately six mapsheets along the Yukon border with 1:20,000 colour photography from 1992, approximately 5 mapsheets with 1:15,000 black and white photos from 1995 near the MK management area, and 1:35,000 scale black and white photos for a small section on the eastern side of the Dease-Liard supply block dating from 2001. There are many other dates and scales. There is nothing recent, however, covering a substantial portion of the TSA or even of the operable corridor (see bullet four below). None of the existing photography would be adequate for VRI photo interpretation and it may not be suitable for other forestry applications because it doesn't reflect recent changes to vegetation resulting from fires or other types of disturbance.

2. **Uncertainty in volume estimates.** Inaccuracies in height and volume estimates in the Dease Lake North/interior sections of the TSA, noted in both the timber supply review and in the inventory audit, resulted in substantial over-estimates of mature volume. The Kaska Dene, Tahltan, and Taku River Tlingit all foresee some level of timber harvesting activity in the coming months or years and the mining industry is also very active in the area. These initiatives will need accurate forest cover maps and volume estimates in order to plan road construction, select areas for timber harvesting, locate OGMAs, and conduct analyses like habitat supply or forest health hazard and risk assessments (see also section 3.1). The database is not only inaccurate, but is in the old format and does not include any of the new attributes available with a modern VRI.

3. **Potentially inaccurate site index estimates.** As noted in section 2.3, the inventory audit indicated that site index estimates for immature stands are relatively poor. Within the timber harvesting landbase, young stands represent less than about 30,000 ha, however. On the other hand, the audit also indicated that height estimates for mature stands are overestimated by 17% (Dease North). The implication with this finding is that site index estimates for mature stands may also be inaccurate. Site index is a primary driver of timber volume forecasts.

4. **Operability boundaries**. In his 1995 timber supply review, the chief forester increased AAC by almost three-fold. The increase elicited considerable public concern and so the MoFR initiated a study to better define areas that were actually operable (Evaluation of Potential Short-Term Operating Areas in the Cassiar Timber Supply Area 1997). This led to the delineation of an "operable corridor" based on the inventory database and BEC information as well as economic considerations. It is expected that future timber harvesting opportunities will be restricted to this corridor despite the fact that its derivation is based on an inaccurate database and linework (polygon delineation) that is out of date and based on old technology and different standards. The timber harvesting landbase within this corridor is also suspect for the same reasons.

One other point about the accuracy of the inventory database is that there has been so little timber harvesting in the area, that the accuracy of decay estimates is unknown. Concern has been expressed in adjacent inventory units to the south about timber recovery and decay estimates but it is not known whether similar concern is merited in the Cassiar TSA.

2.5 VRI ACTIVITIES AND PRODUCTS

2.5.1 Overview

There are a number of different procedures that can be used for collecting vegetation resource information in B.C. The most commonly used include:

- Retrofitting: the process of translating and upgrading an existing photo-based inventory to VRI standards. If the polygon linework and attributes are of acceptable quality, the existing FIP database is translated to a VIF (Vegetation Inventory Files) database and the additional attributes required by the VRI are estimated from aerial photographs. Retrofitting is not currently an accepted VRI standard practice.
- Phase I Photo-interpretation: subjective delineation of polygons and photo estimation of attributes for all polygons in an inventory unit from medium scale aerial photographs (1:15,000 or 20,000). This includes interpretation of conventional attributes such as: species, age, and height, as well as additional attributes such as: basal area, and soil moisture and nutrient classification.
- Phase II Ground sampling: the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within selected sample polygons to use in statistical adjustment of the database. Sample polygons are selected using the probability proportional to size with replacement (PPSWR) method and plots are established in clusters within selected polygons. Statistical adjustment is the process of adjusting the

values of the photo-interpretation variables using the ground sampling observations. In each sampled polygon, field measurements are compared to photo-estimated values to develop adjustment factors, usually by groups (e.g. leading species). These factors are then applied to all polygons in the photo interpretation database group to produce the final adjusted database.

- NVAF Sampling: detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimated net volume is obtained from net factoring and taper equations). NVAF data is used to adjust the estimated net tree volume to account for hidden decay and taper equation bias. NVAF should be performed in conjunction with ground sampling plots. The application of NVAF produces statistically valid VRI ground sample volumes, and it is a mandatory activity of a VRI ground sample inventory.

These tools can be used over an entire management unit, measuring timber and non-timber resources, or over a smaller area measuring selected attributes. In the Cassiar TSA it is not economically practical to undertake phase one activities over the entire TSA because it is so large (over 13 million ha) and because timber harvesting activity is occurring at very low levels. An alternative approach is to restrict inventory work to the Operable Corridor (3.7 million ha), or a narrower corridor around the Timber Harvesting Landbase (1.94 million ha) (figure 3). Restricting it to the individual pieces comprising the THLB itself, however, is not recommended because the pieces are small and scattered, photos need to be acquired for contiguous strips, and because it would eliminate the possibility of doing larger scale planning like access planning, old growth management area delineation, or habitat analyses.

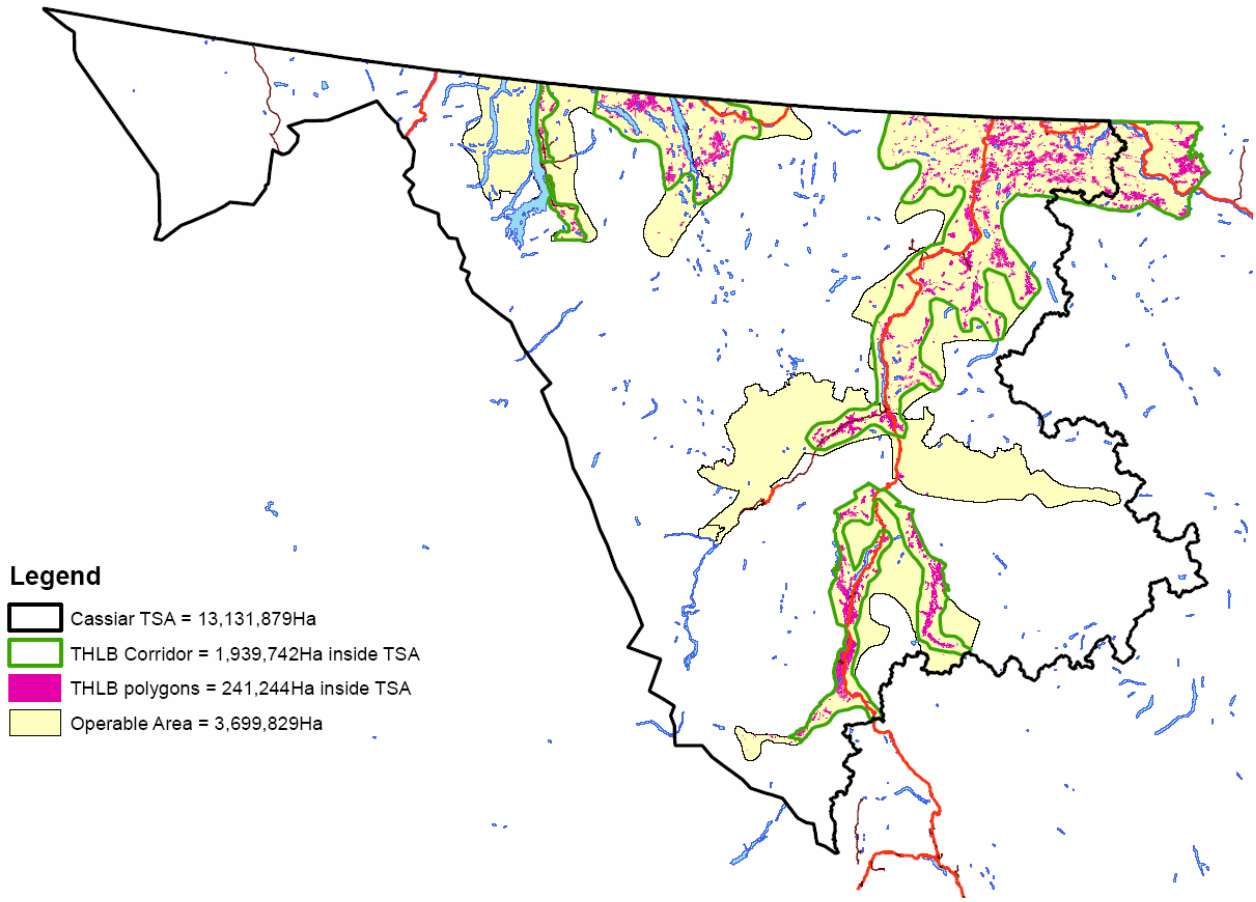

Figure 3. Timber harvesting area within the Cassiar TSA.

Within either the operable corridor or the THLB corridor, there are a number of options that could be used to develop an inventory that might meet stakeholder needs. These are discussed below. Actual recommendations are summarized in Section 3.0 – the inventory plan.

2.5.2 Remote Sensing

Remote sensing to acquire digital satellite imagery from any of the three sources acceptable to MoFR (Landsat, SPOT and IRS) has been proposed. With pixel sizes in the order of 5 to 30m, resolution is sufficient to at least provide broad vegetation classes such as coniferous and deciduous, young versus old, and burn versus no burn. In other jurisdictions Landsat has been used to produce a dozen or more vegetation classes and provide coarse attributes for each. In BC its primary application in inventory work has been change detection (e.g. to identify burns, harvested areas, road and landing locations, large scale forest health outbreaks, etc). SPOT 5 imagery (multispectral or panchromatic) is capable of 5m pixels but it is more expensive ($1.33/ha vs 0.03/ha with Landsat) and is not available over large areas of the province. It has been suggested that SPOT 5 MSS (10m pixel) merged with Landsat multispectral can be used to identify all road and transport features, vegetation patterns, and current cut block openings but not the VRI attributes needed for timber supply analysis or detailed harvest planning.

If the primary use of imagery were to update thematic mapping for depletions or disturbances such as fire and/or to identify roads and landings, the acquisition of Landsat imagery would be appropriate. Costs for the operable corridor would exceed $100,000. Such an approach would not be a suitable substitute for a conventional inventory but might be used in conjunction with a targeted VRI product to assist in landscape level planning. More information on standards for each of the three types of imagery can be obtained at http://www.for.gov.bc.ca/hts/rs/.

2.5.3 Phase One Photo Acquisition and Interpretation

The traditional approach for an area with an inventory history like the Cassiar TSA would be to undertake a Phase I inventory to delineate polygons and estimate forest cover attributes from medium scale aerial photographs (1:15,000 or 20,000) acquired for the entire landbase (excluding parks and protected areas). A retrofit is not really feasible because the existing photos are not suitable. With photo acquisition and scanning costs of up to $0.60/ha and interpretation costs of up to $1.10 per hectare, it is also clearly not feasible to undertake a Phase I reinventory for the entire landbase or the operable corridor. Even if costs for a Phase I inventory could be spread amongst a variety of resource users (such as the MoFR, MoEPR, the mining sector, guide outfitters in the area, and First Nations), and smaller scale, black and white photos (1:20,000 or 30,000) were acquired and used with softcopy within the THLB corridor only, it is still unlikely to be justifiable to undertake a full phase one inventory. The cost for the whole THLB corridor would be in the order of $3.2 million dollars ($1.70/ha). Economics are such that it will only likely be possible to develop a new inventory for smaller contiguous sections within the THLB corridor. Target areas would need to be based on proposed future activities and coordinated amongst potential stakeholders.

Benefits from conducting this work could include:

- New photos for identified operation areas. The photos would be useful in many other forest management applications beyond the Phase I inventory.
- Improvement in the accuracy of polygon attribute values. More accurate attribute values lead to more accurate future timber supply analyses and operational analyses such as timber harvest planning, WTP, RMZ, VQO, and OGMA delineation, and post-harvest survey work.
- Improved quality/accuracy of information available for inoperable stands, which may lead to a reconsideration of their accessibility and merchantability.

2.5.4 Phase Two Ground Sampling and Net Volume Adjustment Factors

If funding levels limit the amount of inventory work that can be done, the most practical approach to improving confidence in the existing database would be to undertake Phase II ground sampling within the THLB corridor, including NVAF sampling. This information would be used to statistically adjust the existing database and upgrade affected mapsheets to the new VRI format. If a coefficient of variation for volume of 50% were assumed, it is estimated that approximately 100 sample clusters would be required to achieve an overall sampling error for volume, for all strata combined, of 10% (at a 95% level of probability). This sample size is a based on the formula: Sample Size = t^2 x CV^2/SE^2. If a sampling error of 15% were acceptable, only 45 samples would be required. Costs to achieve a sampling error of 10% would be

~$325,000. If 100 NVAF trees were also sampled to obtain adjustments for net tree volume to account for hidden decay and taper equation bias, an additional cost of ~$130,000 could be expected. If only 45 polygons were sampled with, for example, 80 NVAF trees, costs might be as low as $263,000.

The primary use of this type of information will be in operational applications like timber harvesting and road construction, silviculture and forest health treatment planning and analysis, fuel management planning, and research analyses. The approach would do little to improve landscape level planning initiatives or analyses because of its limited geographic extent and lack of new photos. Benefits from conducting this work would include:

- More accurate volume estimates.
- More accurate decay estimates.
- Better estimates of derived site index.
- A modern database for these areas with all the new VRI attributes.

3. INVENTORY PLAN

3.1 OVERVIEW AND RATIONALE

This section outlines a preliminary strategic inventory plan that could be used to address the inventory issues identified in section two and meet some of the resource information needs of stakeholders in the area. AAC for the TSA is currently set at 305,000 m^3/year, partitioned by supply block as follows: in the Iskut-Boundary block (Bob Quinn area) – 120,000 m^3/year, in the Dease-Liard – 153,000 m^3/year, and in Atlin – 32,000 m^3/year. Although the Dease-Liard supply block has not yet been apportioned, it is anticipated that with the completion of the Forestry and Wildlife chapters of the SRMP in 2005, this apportionment could take place in the near future. The Ministry of Forests has offered the Kaska Dene a replaceable forest license for up to 86,000 m^3/year in the Dease-Liard and, per Norm MacLean (pers. comm. 2007), there is potential interest by the Kaska in developing the tenure.

In the Iskut-Boundary supply block the Tahltan First Nation currently has a license to harvest 120,000 m^3/year although in recent years little activity has occurred. It is expected that, once the Tahltan have developed more capacity to deal with proposed mining in the area, further harvesting will occur. In Atlin, small scale harvesting continues to occur and it is expected that this level of activity will continue in the foreseeable future. The Taku River Tlingit may also be interested in exploring potential timber harvesting. As noted in preceding sections there are also a number of resource management planning initiatives in the area and a great deal of mining activity. Having a better idea of potential volume, based on an up to date inventory, will help ensure that planning in these areas is accurate and useful in guiding operations.

Based on economic constraints, the geographic location of the timber harvesting landbase, existing and potential interests described above, and the location of existing infrastructure, it is recommended that a phase one re-inventory be conducted in three discrete areas totalling up to 400,000 ha. The areas are:

- an area of approximately 200,000 ha in the Dease-Liard supply block north of Boya Lake in the Blue River and Old Faddy areas, likely east of highway 37 towards the Dease River,
- an area of approximately 150,000 ha in the Iskut-Boundary supply block near Bob Quinn, and
- an area of approximately 50,000 ha in the Atlin area or south of Teslin Lake.

One or more sections could be deferred if funding levels were insufficient to support a re-inventory in all areas at once. It is expected that multiple funding sources would need to be engaged in order to cover all costs. As noted in section 2.5.3, another reasonable alternative would be to undertake phase two sampling in these three areas without acquiring new photos or doing the phase one photo interpretation. This approach would be less expensive but would not provide as much utility. Whichever approach is chosen will need to be discussed with stakeholders, revised as necessary, and then used to develop a Vegetation Resources Inventory Project Implementation Plan (VPIP).

3.2 PHOTO ACQUISITION AND INTERPRETATION

3.2.1 Objectives

Existing air photos are mostly out of date and of insufficient quality to use in VRI. In addition, it is difficult to use photos with various scales and dates because of the physical difficulty in setting them up for stereo viewing and because the interpreter needs to re-calibrate with each new set. The objective in acquiring new photos is to ensure information on disturbance is current, photos are of sufficient quality to accurately interpret forest cover, and information is consistent across the entire sampling area. The photos will be used to produce an updated VRI with more accurate attribute information and polygon delineation. Interpretation should include conventional attributes such as species, age, and height as well as new information on basal area and soil moisture and nutrient classification. The final product will be an unadjusted VRI inventory database complete with forest cover maps. The production of orthophotos is not foreseen at this time.

3.2.2 Target Area

It is expected that air photo acquisition and scanning would be completed for three separate areas totalling about 400,000 ha as described in section 3.1. Final area to be flown will depend on existing access, planned harvest levels, stakeholder perceptions about potential volume, non-timber information needs, and budget. Specific locations will need to be more precisely defined during the development of the VRI Project Implementation Plan but it is envisioned that each of the three areas will be contiguous blocks that make a logical unit in terms of flight logistics.

3.2.3 Target Attributes

All attributes listed on the VRI photo interpretation attribute form should be targeted. A list of these attributes can be found at: http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri-photointerp2k2/photo_interp2k2.pdf.

3.2.4 Standards

Air photo acquisition and scanning will be conducted in accordance with the Base Mapping and Geomatic Service (BMGS) standards. These can be found through the ILMB - BMGS website: http://ilmbwww.gov.bc.ca/bmgs/. Photo interpretation and ground call calibration will be conducted in accordance with the Resource Information Standards Committee (RISC) standards and those can be found at the ILMB - RISC website http://ilmbwww.gov.bc.ca/risc/pubs/teveg/index.htm. It is recommended that at least 10 air calls and 10 ground calls be established per mapsheet during the interpretation phase as it is expected that existing acceptable calibration data sources will be infrequent.

3.3 IMPLEMENTATION

3.3.1 Timelines

There are four general categories of work to be completed:

1. air photo acquisition and scanning,
2. ground and air call calibration,
3. air photo interpretation, and
4. map and database preparation.

Suggested timelines to complete these tasks are shown in Table 2.

Table 2. VRI timelines with photo acquisition.

	2007 Su	2007 Wi	2008 Su	2008 Wi	2009 Su	2009 Wi
Photo acquisition						
Ground and air calls						
Photo interpretation						
Map and dbase prep						

The timelines indicated in the Table 2 could be achieved if all aspects of the project went smoothly, there certified crews were available, FIA funding allocations were made early in fiscal 2007, and there were sufficient funding. Weather and air quality issues (owing to frequent fires in the area) could easily result in the project delays. It is also entirely possible that funding will be insufficient necessitating further delays while stakeholders determine how to pool resources and/or identify other funding opportunities.

3.3.2 Project Implementation Plan

Once stakeholder input and approval of this VSIP has been obtained, a VPIP must be prepared in accordance with the most current version of the *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Photo Interpretation.* If the timelines in section 3.3.1 are implemented, it will be necessary to prepare the VPIP in May or June 2007.

3.3.3 Roles and Responsibilities

It is expected that the majority of on-the-ground work will be conducted by qualified inventory contractors. Major stakeholders that could be involved managing the contractors and implementing the project include: potential licensees such as the Tahltan, Kaska Dene, and Taku River Tlingit First Nations, BCTS, and possibly one or more mining sector representatives, the Ministry of Forests Analysis and Inventory Branch, and the Integrated Land Management Bureau. Roles and responsibilities of each in the VRI process are summarized below.

First Nations and Other Licensees:

- Identify funding sources and relative priorities.
- Approve VSIP and VPIP products.
- Manage the implementation of the project implementation plan.
- Submit plans to the FIA fund manager (Price Waterhouse Coopers) for funding approval.
- Submit plans to Forest Analysis and Inventory Branch for technical review.
- Submit data to Forest Analysis and Inventory Branch.

Forest Analysis and Inventory Branch

- Develop standards and make them available to Licensee and inventory contractors.
- Develop yield models used in the inventory and timber supply analysis process.
- Provide technical advice and support.
- Review and approve plans and analysis to ensure the products will meet MoF business needs.
- Undertake inventory audits and report them to stakeholders.

Integrated Land Management Bureau

- Develop data archiving standards and make them available to inventory proponents.
- Maintain the Land and Resource Data Warehouse.
- Upload all inventory information to the LRDW.
- Ensure inventory users have appropriate access to the data warehouse.

4. COSTS

A preliminary cost estimate has been provided for completing a Phase I re-inventory with 1:20,000 scale colour photos for selected areas within the Cassiar TSA totalling 400,000 ha (table 3). More accurate and detailed costs for VRI activities will need to be developed in a project implementation plan once stakeholder feedback is received. If 1:30,000 scale photos were used instead of 1:20,000 photos, costs to complete a Phase I re-inventory could be as low as ~$550,000. As noted in section 2.5.4, if a re-inventory were not completed and ground sampling with only 45 polygons and 80 NVAF trees were used instead to statistically adjust the existing database, costs might be as low as $263,000.

Table 3. Potential costs for Phase I VRI activities in selected sections of the Cassiar TSA.

VRI Project Component	Approx. Unit Cost	Total Cost
Photo acquisition[a]	$0.25/ha	$100,000
Scanning, A/T, DiAP Viewer Sets	$0.15/ha	$60,000
Orthophotos	$0.05/ha	$20,000
Interpretation and Map Production	$1.10/ha	$440,000
VRI Phase 1 QA audit (Third Party)	$0.05/ha	$20,000
Total Phase 1 Costs[1]		**$660,000**

a. assuming 1:20,000 colour photos and softcopy interpretation for 400,000 ha.

5. APPROVAL

I have read and concur with the Cassiar TSA VRI Strategic Inventory Plan, dated September 2007. It is understood that this is an agreement-in-principle and does not commit the signatories to completing the inventory activities outlined within the plan. Any major modifications to this plan will need to be reviewed and approved by the signatories.

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BC Timber Sales,
Skeena Business Area

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Jon Vivian, RPF
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