

# Bulkley Timber Supply Area

## Vegetation Resources Inventory

### Photo Interpretation Project Implementation Plan

**PREPARED BY:  
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## 1.0 INTRODUCTION

### 1.1 Background Information

#### 1.1.1 Vegetation Resources Inventory

The Vegetation Resources Inventory (VRI) is the Ministry of Forests and Range (MoFR) standard for assessing the quantity and quality of BC's vegetation resources. The VRI process is designed to include a flexible set of sampling procedures for collecting vegetation resource information. The VRI is essentially a toolbox of procedures, which include:

- *Photo Interpretation*: the delineation of polygons from aerial photography or imagery and the estimation of a pre-determined set of resource attributes \*.
- *Ground Sampling*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes.
- *Net Volume Adjustment Factor (NVAF) Sampling*: Stem analysis sampling of individual trees for net volume adjustment.
- *Within Polygon Variation (WPV) Sampling*: Intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values.
- *Statistical Adjustment*: the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit using the values measured during ground sampling.

\*The pre-determined set of resource attributes gathered through photo interpretation is currently found on the Internet at:

[http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri-photointerp2k2/photo\\_interp2k2.pdf](http://ilmbwww.gov.bc.ca/risc/pubs/teveg/vri-photointerp2k2/photo_interp2k2.pdf)

The VRI can be deployed over a management unit measuring selected resources in specific portions of the land base. The VRI sampling process produces spatial and non-spatial databases that can be used in multiple resource management applications including timber, ecosystem, and wildlife habitat management.

The next inventory in the Bulkley Timber Supply Area (TSA) will be a VRI. There will be three phases to this VRI; photo-interpretation, ground sampling, and net volume adjustment factor (NVAF) sampling. It will facilitate the forthcoming Timber Supply Review (TSR) project, and a Predictive Ecosystem Mapping (PEM) project under consideration.

#### 1.1.2 State of the Current Inventory

The current Forest Cover re-inventory was completed between 1995 and 1997, and was delivered in 1997. The aerial photographs were 1993 and 1994 vintage, 1:15,000 black and white hardcopy photos. This inventory, while not necessarily of poor quality, does not meet the needs of the licensee stakeholders.

The Bulkley TSA inventory was last audited in 1994 with the data reported in 1996. The audit was conducted using the previous Forest Cover inventory that was re-inventoried in 1988. As the latest inventory audit conducted does not relate to the existing forest cover inventory, the audit results are not presented here. The inventory audit of the 1988 Bulkley TSA re-inventory can be reviewed at the following site:

<http://www.for.gov.bc.ca/hts/vri/audits/reports&pub/>

No significant forest management issues in the Bulkley TSA were highlighted in the last timber supply review determination (TSR 2 Rationale for AAC determination update, January 1, 2002). The issues that were brought forward by the Bulkley TSA stakeholder group are summarized below.

Emerging data needs were considered to be relevant to the Bulkley TSA and could be addressed with a completed VRI.

1. A more 'operational' level Phase I VRI to address the issues around the partition, specifically refined delineation and more accurate, structure, species composition, age, height, and derived volume estimates to better define those stands that actually fall within the marginal saw log and pulp log criteria as defined by the Harvest Method Mapping (HMM) parameters.
2. Refined delineation and calibration information collection in problem forest and low productivity types.
3. Forest health issues. Improve stand mapping and identification of lodgepole pine in the TSA in support of mountain pine beetle and pine needle blight hazard mapping and salvage opportunities.
4. VRI of the parks due to their contributions to TSA seral stage balances, habitat representation, and old growth management. A financial contribution from the Ministry of Environment, Parks Branch, to cover off a portion of the inventory costs has been discussed and agreed to in principle.
5. Growth and yield linkages. If designed properly from the outset, a VRI (phase I and II) can provide valuable attributes and sample data that can be used to enhance follow-up growth and yield programs.
6. A predictive ecosystem mapping (PEM) project is planned for once the bioterrain delineation based VRI is completed to spatially refine both productivity SI 50 and habitat supply.
7. Market certification requirements can be met through the VRI Phase II by providing a statistically defensible inventory that is subsequently used in timber supply analysis.
8. Localized decay factors (NVAF).

## 1.2 Document Objectives

The Vegetation Resources Inventory Project Implementation Plan (VPIP) is a working document that details the specific operational activities associated with implementation and documentation of the inventory project. It identifies the project geographic areas, priorities, the target areas for new photo interpretation, data sources, availability of aerial photographs, format of base files, project scheduling, plot location coordination, inventory costs by year, and roles and responsibilities for implementation.

As the stakeholders have combined the photo interpretation and ground sampling (including NVAF sampling) into one project, both the photo interpretation and ground sampling /NVAF VPIPs were completed simultaneously.

### 1.3 Land Base

The Bulkley TSA is situated in northwestern British Columbia in the Northern Interior Forest Region. Covering approximately 762,540 hectares, the Bulkley TSA is part of the Skeena-Stikine Forest District and is administered from the district office in Smithers (see Figure 1)

The Bulkley TSA is located on the eastern drainage of the Skeena River. It is bounded by the Hazelton Mountains to the west, the Telkwa River watershed to the south, and the Babine Mountains to the east, and extends north to the headwaters of the Nilkitkwa River. The Bulkley River runs through the center of the southern portion of the TSA. The terrain in the Bulkley TSA varies from wide river valley bottoms to steep sided v-shaped valleys and high mountains.

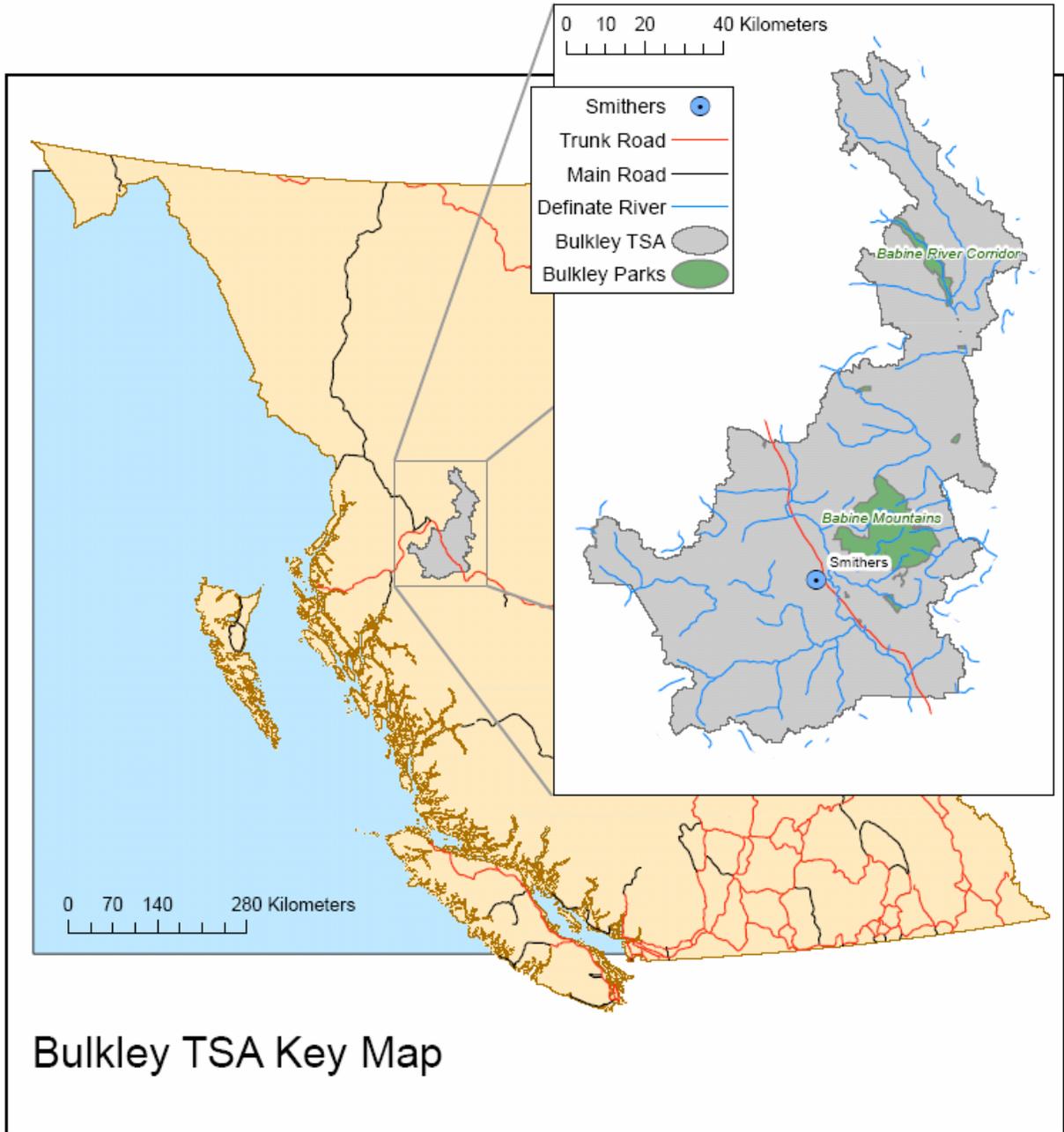
Due to its location between interior and coastal climates, the Bulkley TSA includes diverse ecological features. The dominant tree species in the TSA are sub-alpine fir (48%), spruce (23%), lodgepole pine (25%) and hemlock (4%). Minor deciduous areas are present but these are almost entirely restricted to the private land areas in the TSA. Mountainous terrain and high elevations limit the amount of land considered suitable for timber production in this TSA. In this 'plan', the assumption is made that the forested land base corresponds to the Vegetated Treed (VT) land base according to the BC Land Cover Classification Scheme, or BCLCS.

## 2.0 PHOTO INTERPRETATION PLAN

### 2.1 Project Objectives

The objective of the photo interpretation project is to improve TSA polygon attribute information through photo interpretation in order to facilitate the forthcoming TSR and the PEM project under consideration. In addition to a more operational inventory and general improvement in TSA data, data will be available to better define:

1. The hemlock-balsam height and volume defined problem forest type (PFT) currently subject to a 367 000 m<sup>3</sup> partition for the harvest of marginal saw logs and pulp logs;
2. The volume of lodgepole pine, as first and second leading species, available to mountain pine beetle (the mountain pine beetle infestation has not reached the Bulkley TSA, yet);
3. Grizzly, caribou, and mountain goat habitat using attributes, such as LCC, leading species age and vertical complexity amongst others, that will provide insight into the seral stage and structural components and complexity of each stand; and
4. Provide for an improved inventory foundation (bioterrain based delineation and integrated field program) for the PEM project.



**Figure 1 Bulkley TSA Overview Map**

**Table 1 Bulkley TSA Area Summary \***

<b>Landbase Classification</b>	<b>Area (ha)</b>	<b>Percent (%)</b>
<b>Total TSA area</b>	<b>762,540</b>	<b>100</b>
Not managed by the BCFS (not including parks and protected areas)	56,111	7.4
Parks and Protected Areas	39,121	5.1
Non-forest and non-productive	171,386	22.5
<b>Total forested area managed by the BCFS</b>	<b>495,922</b>	<b>65</b>
Reductions to Crown Forest		
-Non-commercial cover	6,312	0.8
-Inoperable	348	0.0
-Terrain stability in Copper LU	1,698	0.2
-Riparian areas	10,932	1.4
-Helicopter areas	7,388	1.0
-Cable areas	31,320	4.1
-Low productivity sites	44,551	5.8
-Problem forest types	19,020	2.5
-Existing road, trails, and landings	8,340	1.1
-Recreation areas	696	0.1
-Environmentally sensitive areas	7,836	1.0
-Newly created parks	9,499	1.2
-Special management zone 1	8,108	1.1
<b>Total current reductions</b>	<b>156,048</b>	<b>20.5</b>
<b>Current timber harvesting land base (THLB)</b>	<b>339,874</b>	<b>44.6</b>
<b>Future reductions</b>		
-Future roads	15,763	2.2
-Agricultural land reserves	4,841	0.6
<b>Future timber harvesting land base</b>	<b>319,270</b>	<b>41.9</b>

\*Source: TSR II Analysis Report.

The product will be a spatial database consisting of unadjusted photo-interpreted estimates. Ground sampling and NVAF sampling, used to adjust photo-interpreted estimates, will be discussed as a separate process in the ground sampling /NVAF VPIP.

## 2.2 Target Area

The target area for the proposed photo interpretation project will be all lands within the Bulkley TSA, regardless of ownership. This will include all parks and protected areas; the Ministry of Environment – Parks Branch have been consulted on this and have provided input. All lands will be classified to a V inventory standard; that is, a complete VRI label will be given to each and every polygon. Note that all portions of project maps within this Timber Supply Area (TSA) must be completed to VRI standards. No holes, gaps, or blank spaces shall exist in the data for the contiguous portion of the TSA. For partial map sheets along the TSA boundary, only the area within the TSA will be completed.

A woodlot VRI program is nearing completion in the Skeena-Stikine Forest District. This better information (if available to the stakeholders group) will be incorporated into the TSA inventory for all woodlots located within the Bulkley TSA.

### 2.3 Calibration Data Sources

Data sources are used as calibration points for improving the quality of photo interpretation.

Existing data sources include air calls, ground calls, and observations distributed across the TSA installed during previous re-inventories. The data sources from the most recent re-inventory will have been completed to the Forest Cover inventory standards of 1996. These data sources will have volume, not basal area, based species compositions, and no second species data. The standards to which data sources were completed prior to the most recent re-inventory are unknown. Heights and ages in some or all of the previous ground calls may have been collected using the Top Height method. This method describes a polygon's potential, not its current achievement as is described under the VRI, and can lead to exaggerated volume estimates.

As such, polygons containing data sources from previous re-inventories should not be re-visited during the VRI if they are single species stands; that is, the leading species has greater than or equal to 80% composition. Existing data sources in such stands will be used as calibration points to the extent possible. Existing data sources located in mixed species stands will be used for information such as species present, but will not exclude those stands from VRI field calibration.

Cruise plot data from un-logged timber sales can also be used as calibration points. However, one will have to check on the availability, suitability, condition, and compatibility of cruise plot data for use in calibration, and also how accurately the cruise plots were mapped as this will influence how well they can be transferred to the new photos.

Field work in support of the 2002 development and calibration of PEM knowledge tables for the Bulkley TSA will contain soil moisture regime and soil nutrient regime data which will be of utility to the VRI photo-interpretation process. The availability of the PEM field data has yet to be determined.

The degree of field work completed in support of Terrain Stability Mapping projects in the TSA will have been dictated by the Terrain Survey Intensity Level (TSIL) specified for each project. However, little of that data is of any utility to the VRI photo-interpretation process.

It is recommended that 15 single point or three-point ground calls (stand complexity determining), 25 air calls and 12 informal ground and/or air observations be installed on each full map sheet equivalent. The number of ground calls, air calls, and observations installed on each partial map sheet will be prorated by map sheet area. The aforementioned numbers of proposed calibration points are considered to be minimum values for an operational inventory. While the actual number of calibration points should be based on statistical confidence levels and not by available funding, the actual number may increase or decrease in the face of available funding. The number, type (call or observations), and distribution of calibration points installed will reflect on the quality and utility of the resultant inventory.

### 2.4 Inventory Documentation and Archive

The current inventory is a Forest Cover re-inventory that was not completed to VRI standards. It was completed between 1995 and 1997, and was delivered in 1997. The aerial photography was 1993 and 1994, 1:15,000 black and white hardcopy images. This inventory, while not necessarily of poor quality, is a strategic level inventory and no longer meets the needs of the licencees. It

most certainly doesn't meet the needs as a foundation inventory for PEM, a need that was never designed into this Forest Cover inventory.

In preparation for a TRIM II update project and this new inventory, 1:35,000 scale colour photographs were acquired in 2003 in consultation with Base Mapping and Geomatics Services (BMGS) and developed into DiAP *viewer* sets suitable for a softcopy inventory format. All but 12 map sheets within the Bulkley TSA were covered by these photographs. The remaining 12 map sheets were covered by 2001 1:35,000 aerial photographs from the Morice-Lakes IFPA orthophotograph project, which while deemed not suitable for TRIM II by BMGS, were deemed suitable for 'reconnaissance' work.

The scale of these aerial photographs was subsequently assessed by the MoFR in late 2005 for their utility for this project and were deemed not suitable for conducting a softcopy based VRI based on established regional image scale standards. Figure 2 details the 2001 and 2003 digital image coverage in the Bulkley TSA.

Due to the non-suitability of this existing imagery, there is a planned acquisition of 1:20,000 scale colour aerial photographs for the entire Bulkley TSA in the summer of 2006 to facilitate the forthcoming VRI. This will be planned in consultation with BMGS sign off.

Using a softcopy system, boundaries of uniform strata will be delineated into polygons based on the BC Land Cover Classification Scheme (BCLCS), attributes estimated, and attribute and graphic information transferred to base maps. Individual polygons will be given unique numbers. Descriptions of polygon attributes will be entered into the Vegetation Cover Attribute Program (VegCAP), edited and cross-referenced with vegetation cover polygons through unique numbers.

Vegetation resources inventory photo-interpretation in the Bulkley TSA will involve specialized polygon delineation. In addition to the required segregation based on vegetation and land cover, and differences in timber attributes, the delineation of polygons will also have to recognize differences in ecology (specifically bioterrain). This additional delineation criterion will provide for better spatial data with which to model grizzly, caribou, and mountain goat habitat, and will facilitate the follow-up PEM project under consideration.

All base maps for the TSA are to Terrain Resources Inventory Mapping (TRIM) II specifications. A planimetric update of all new roads, trails, and landings will be required as part of the delineation process.

## **3.0 PHOTO INTERPRETATION PROJECT IMPLEMENTATION**

### **3.1 Roles and Responsibilities**

#### **3.1.1 Project Coordinator**

The project coordinator will be an employee of the contractor company that was the winning proponent, and will be subordinate to the Pacific Inland Resources (PIR) contract coordinator for the purposes of this project.

The project coordinator's responsibilities will include, but will not be limited to:

1. coordinating the project;
2. monitoring and communicating project progress;

3. ensuring all contractors are qualified and certified;
4. overseeing photo-interpretation activities;
5. ensuring quality assurance is complete; and
6. assisting in coordinating technical expertise where required.

### 3.1.2 Personnel

Only certified VRI photo interpreters, or photo interpreters under the direct supervision of a certified VRI interpreter will be used to delineate and estimate the attributes of vegetation types. Bioterrain sub-delineation will be conducted by certified VRI photo interpreters with demonstrated experience in bioterrain delineation or by PEM specialists. The certified VRI photo interpreters list is currently found on the Internet at:

[http://www.for.gov.bc.ca/hts/vri/contractinfo/rpt\\_pi\\_list.pdf](http://www.for.gov.bc.ca/hts/vri/contractinfo/rpt_pi_list.pdf)

All certified VRI photo interpreters involved in this undertaking will be required to complete VRI air calls and VRI ground calls within the project area for the purposes of calibration for the photo attribute estimation phase.

### 3.2 Standards

1. Photo Interpretation Procedures Version 2.4 (March 2002).
2. Photo Interpretation Standards Version 1.0 (March 1998).
3. Quality Assurance Procedures for Photo Interpretation Version 2.0 (March 2004).
4. Air Calibration (Air Call) Data Collection Guidelines Version 2.0 (March 2003).
5. Ground Calibration (Ground Call) Data Collection Guidelines Version 3 (March 2004).
6. BC Land Classification Scheme Version 1.3 - March 2002.
7. Preparation and Creation of FRGIS Data Files – Forest Inventory manual Volume 5 (March 1996).

Over and above these ‘standards’, certain levels of enhancement and integration will be undertaken for the VRI Phase I to ensure that it best meets the needs of the follow-up PEM project planned for after the VRI is completed. The delineation will be enhanced to address critical bioterrain breaks (specifically related to soil moisture), and the VRI field calibration programs will be integrated with bioterrain data collection to the degree required to ensure efficient and effective field data collection for the VRI as well as the PEM.

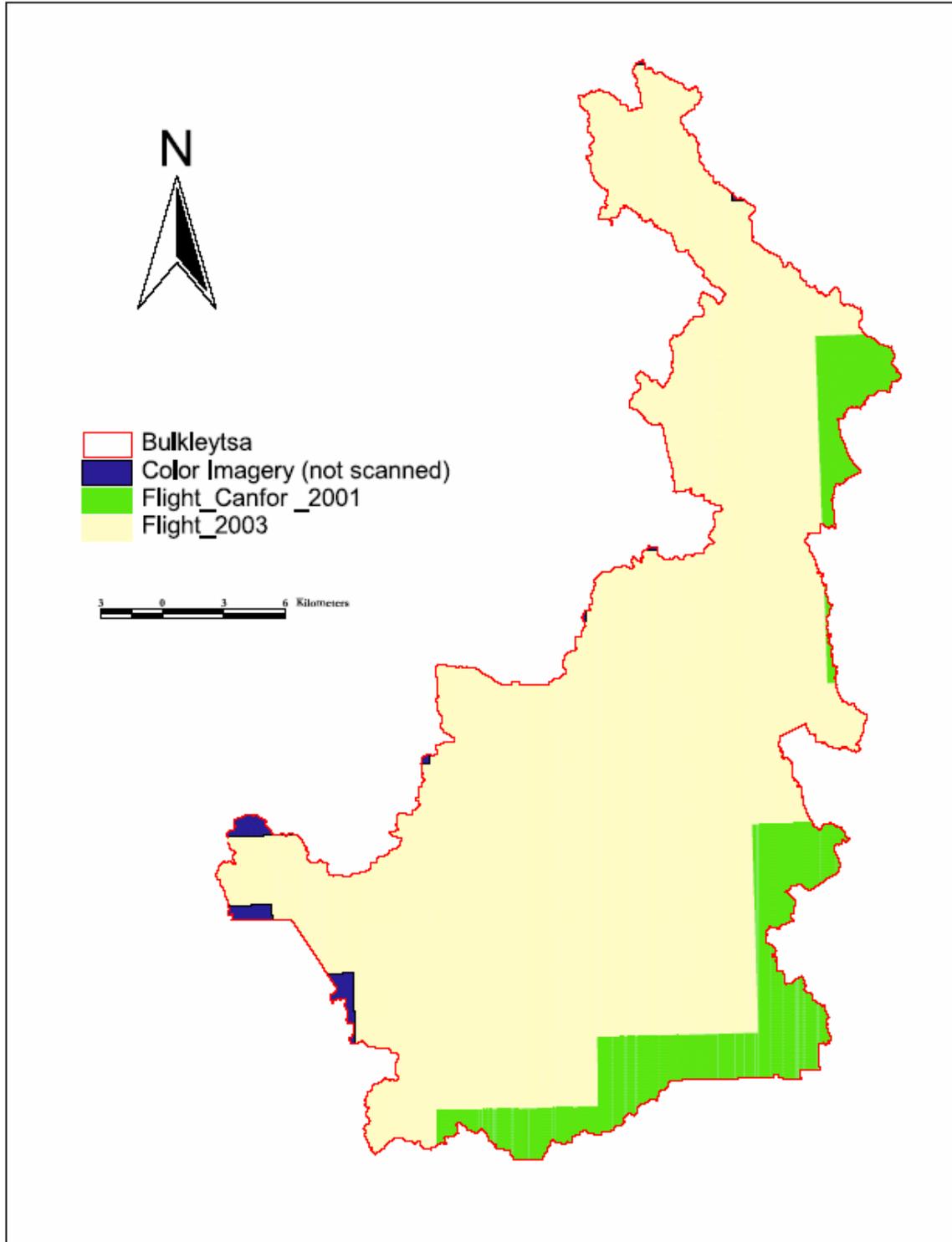
Cross product slivers are polygons less than the minimum permitted size that are commonly created as a result of merging coverages generated from different disciplines. The integrated VRI and bioterrain approach proposed will eliminate slivers between the VRI and bioterrain (PEM) polygons.

### 3.3 Quality Control and Quality Assurance

Internal quality control of delineation, field work, attribute estimation and digital map production will be undertaken by the contractor in accordance with the appropriate standards.

External third-party quality assurance will be undertaken by a consultancy that is not involved in the undertaking, and who is chosen by PIR through an open bidding process. Files will be submitted for third-party quality assurance in batches of at least five or as agreed to by the

contractor and quality assurance contractor. These will be delivered through hard drives or as agreed by the contractor and quality assurance contractor.



**Figure 2 Existing 1:35,000 Scale Digital Image Coverage in the Bulkley TSA**

### 3.3.1 Spatial Data

The Ministry of Forests and Range is in the process of creating a revised format for the submission and storage of spatial and attribute data for the VRI program. The new format and database standards will be available by March 15, 2006. VRI photo interpretation projects initiated after March 31, 2006 will be completed to this new standard.

## 4.0 SCHEDULE

The schedule for this VRI is presented in Table 2.

**Table 2 Bulkley TSA VRI Project Schedule**

Item	End Date
VSIP	21 November 2005
VPIP (Photo Interpretation)	31 January 2006
Aerial Photo Contract established with BMGS	31 January 2006
Aerial Photos Acquired *	31 August 2006
Aerial Photo Scanning, A/T, viewer sets	15 January 2007
Request for Proposals Issued	3 January 2007
Contract Award	15 January 2007
VRI Phase I Photo Interpretation	15 June 2008
VRI Phase II Ground Sampling	15 September 2008 (or earlier)
NVAF Destructive Sampling	15 October 2008 (or earlier)
VRI Updated and Approved	15 December 2008

\*This schedule is dependent on the timely acquisition of aerial photographs during the 2006 aerial photo flying season (from late June to mid September). The success rate for flying in northern BC is traditionally approximately 60%.

## 5.0 COSTS

The approximate costs for this VRI are presented in Table 3.

**Table 3 Costs**

VRI Project Component	Unit Cost (est.)	Total (est.)
1:20,000 Aerial Photo Acquisition	~\$0.08 - \$0.09 / ha.	\$68,500
Scanning, A/T, DiAP viewer sets	~\$0.045 / ha.	\$35,000
VRI Phase 1	\$0.90 - \$1.10 / ha.	\$762,500
VRI Phase 1 QA Audit (Third Party)	~\$0.03 / ha.	\$23,000
VRI Phase 2 Sample Plan	~\$8,000	\$8,000
VRI Phase 2 *	\$1400 - \$1800 / sample	\$108,500
VRI Phase 2 QA Audit (Third Party)	\$1000 / sample	\$6,000
VRI Phase 2 Compilation & Adjustment	~\$10,000	\$10,000
NVAF	\$450 / tree	\$45,000

VRI Project Component	Unit Cost (est.)	Total (est.)
NVAF QA Audit (Third Party)	\$500 / tree	\$5000
<b>All VRI Projects</b>	-	<b>\$1,071,500</b>

\* First 60 samples, exclusive of helicopter costs

## 6.0 APPROVAL AND SIGN-OFF OF THE VPIP:PHOTO INTERPRETATION

I have read and agree that the procedures outlined in this proposal meet current MoFR standards.

\_\_\_\_\_ per Pacific Inland Resources Inc.

\_\_\_\_\_ per Canadian Forest Products Ltd.

\_\_\_\_\_ per Skeena-Stikine Forest District (MoFR)

\_\_\_\_\_ per Northern Interior Forest Region (MoFR)