

Central Coast LRMP Area

Vegetation Resources Inventory Strategic Inventory Plan (VSIP)

**PREPARED FOR
THE MID COAST TIMBER SUPPLY AREA (TSA) VRI COMMITTEE**

FEBRUARY 2008

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EXECUTIVE SUMMARY

This Vegetation Resources Inventory (VRI) Strategic Inventory Plan (VSIP) outlines the current status of VRI in the area covered by the Central Coast Land and Resource Management Plan (CCLRMP) and the activities required to address forest management and inventory issues as identified by the Mid Coast TSA VRI committee and other stakeholders. The VRI committee members include International Forest Products Ltd., Western Forest Products Ltd., British Columbia Timber Sales, Heiltsuk Coastal Forest Products Ltd and the Ministry of Forests and Range (Coast Forest Region, Forest Analysis and Inventory Branch and the North Island-Central Coast Forest District). This will contribute to the overall goal of provincial VRI completion by 2015.

The committee identified the following VRI activities and products as being required consistent with Resources Information Standards Committee (RISC) standards

1. Conduct a new Phase I VRI where it is presently absent to provide users of the data with more confidence in the delineation and estimation of tree and vegetation attributes using photo interpretation and provide more accurate and consistent spatial (polygon) and attribute data to support timber supply analysis, implementation of the CCLRMP under the Ecosystem Based Management (EBM) model and government's initiatives to address First Nations interests and international reporting requirements linked to climate change and carbon storage.
2. Conduct Phase 2 ground sampling and Net Volume Adjustment Factor (NVAF) sampling over those areas to be determined and described in subsequent VPIPs. This will allow the adjustment of the Phase I estimates and provide statistically valid measures of timber volumes and tree, vegetation and ecological attributes on the land base.
3. VRI activities will be implemented across the various management units within the CCLRMP area, starting with the Mid Coast TSA and continuing on to the TFLs, Parks and Protected Areas. Separate VPIPs will be prepared for each sub-area as appropriate and necessary. The Mid Coast TSA VRI committee is only responsible for implementing VRI across the following units: Mid Coast TSA, TFL 25 Block 5 and TFL 39 Block 7.

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ACKNOWLEDGEMENTS

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1. INTRODUCTION

1.1 BACKGROUND

This Vegetation Resource Inventory (VRI) Strategic Inventory Plan (VSIP) outlines the VRI activities and products needed to address forest and land management and inventory issues in the Central Coast Land and Resource Management Plan (CCLRMP) area as identified during the Mid Coast VRI Committee meeting and subsequent discussions with stakeholders. This document represents the overall strategic plan for photo interpretation and ground sampling activities in the CCLRMP area.

Timberline Natural Resource Group, Ministry of Forests and Range (MFR) and International Forest Products Ltd. (Interfor) prepared this document in consultation with the Mid Coast TSA licencees, TFL licencees and other stakeholders, which include Interfor, Western Forest Products Ltd., British Columbia Timber Sales, Heiltsuk Coastal Forest Products Ltd. and the Ministry of Forests and Range (Forest Analysis and Inventory Branch, Coast Forest Region and Campbell River North Island-Central Coast Forest Districts).

1.2 VRI OVERVIEW

The VRI is a vegetation inventory process that has been approved by the former Provincial Resources Inventory Committee (RIC) to assess the quantity and quality of BC's timber and vegetation resources. The VRI estimates overall population totals and averages, as well as individual polygon attributes, for timber and non-timber resources. Its design is simple, reasonably efficient, statistically defensible, and addresses issues raised by the Forest Resources Commission in its 1991 report, *The Future of Our Forests*.¹

The VRI consists of several components (Appendix II):

1. Photo Interpreted Estimates (Phase I).
2. Ground Sampling (Phase II) – timber emphasis, ecology, coarse woody debris.
3. Net Volume Adjustment Factor (NVAF) sampling.
4. Change Monitoring Inventory (CMI).
5. Statistical Adjustment.

One or more of these components can address specific forest management or inventory issues. For more detailed information, visit <http://ilmbwww.gov.bc.ca/risc/pubs/teveg/index.htm>.

¹ Forest Resources Commission. 1991. *The Future of Our Forests – Executive Summary*. Unpublished, Victoria. 41 pp.

2. METHODOLOGY

2.1 PHASE I - PHOTO INTERPRETATION

Prior to commencing the Phase I of a VRI project, a VPIP for photo interpretation is prepared for review and sign-off by MFR and the lead proponent/licensee. This plan covers photo acquisition requirements, the VRI Phase I process, adherence to Standards, and details the photo interpretation work that will be carried out.

Phase I is the photo interpretation phase of a VRI and entails polygon delineation and attribute estimation by certified photo interpreters through the use of traditional aerial photographs or softcopy images. The delineation identifies the location of the forest resources and the interpretation component provides estimates of attributes including land cover type, crown closure, tree species, height, age, stand structure, basal area, density, slope position, moisture and nutrient regimes, snags, shrubs, herbs, and bryoids.

Estimation of attributes from field reference points is based upon field procedures using a combination of air and ground calibration points. Any available historical data will be provided by the MFR and will be used to determine information gaps to focus field calibration to areas of need.

2.2 PHASE II - GROUND SAMPLING

Prior to commencing Phase II work, a VPIP for ground sampling for each target population will be completed and approved by the MFR. These plans detail the Phase II sample selection process and adherence to Standards.

Specifically the Phase II VPIP(s) will:

- Detail the Phase II project and sampling objectives;
- Identify current and past timber supply issues that should be addressed through the Phase II program;
- Identify target and sample populations, sample selection, stratification, and sample size details;
- Identify gaps in the sample coverage;
- Quantify any additional sample data that will be needed to address these gaps;
- Include discussion of the field program;
- Include a list of sample polygons and point locations;
- Discuss the proposed data compilation, analysis, and statistical adjustment;
- Identify the roles and responsibilities; and,
- Include the proposed implementation schedule.

The samples selected for the Phase II ground sampling are based on the delineated polygons and attributes estimated during Phase I. Samples are selected in an unbiased manner from the target population. The initial goal of the Phase II program will be to achieve a sampling error of +/-

10% (95% confidence), however, following consultation with MFR and licensees, this objective may be amended to focus sampling on those components identified as key issues in timber supply analysis (i.e., emerging management issues and those strata deemed sensitive in previous TSRs). The Phase II VPIP also includes details on the proposed NVAF program including sample size and sample selection.

The TFL blocks may be included in an overall sampling and adjustment program, but if not separate Phase II VPIPs will need to be prepared for them.

2.2.1 Net Volume Adjustment Factor Sampling

As per MFR VRI standards, all new VRI programs must include NVAF sampling, which involves detailed stem analysis of sample trees that have been randomly selected from the Phase II plots. The NVAF is used to correct estimates of net close tree utilization volume for all species. The NVAF adjusted VRI ground sample volumes are used to adjust the Variable Density Yield Prediction (VDYP) yield table model volumes.

2.2.2 Statistical Analysis and Adjustment

The final step is the statistical analysis of the data and resulting adjustments whereby the Phase II plot estimates are used to adjust the Phase I photo interpretation attribute estimates. NVAF data is used to adjust the Phase II sample estimates for hidden decay and taper equation bias. The final product is a statistically valid inventory.

3. BUSINESS CONSIDERATIONS

3.1 LAND BASE

The Central Coast LRMP area covers approximately 4.3 million hectares located on the mainland coast of B.C. The plan area (Figure 2) covers the entire Mid Coast TSA, mainland portions of the Kingcome and Strathcona TSAs, a number of TFL units including TFL 25 Blocks 2 and 5; TFL 39 Blocks 3, 5 and 7; TFL 43 (Kingcome River block); TFL 45, and number of Parks and Protected areas the largest of which is the portion of Tweedsmuir Provincial Park located within the boundaries of the Coast Forest Region.

Much of the terrain is variable and rugged and the outer coast portions of the LRMP area consist primarily of numerous low-lying islands with relatively low forest productivity. Further inland, the terrain is very mountainous with productive forests in the valley bottoms and along the many steep sided inlets. Another major feature is the large expanse of non-forested areas (alpine and sub-alpine) and ice fields at higher elevations.

The forested area is dominated by western redcedar, hemlock and balsam with lesser proportions of yellow cedar, Sitka spruce, lodgepole pine, Douglas-fir and deciduous species. Most of the forested land area is occupied by older stands (age 141+).

Approximately 40% of the CCLRMP area is considered productive forest area (~1.7 million hectares) and the timber harvesting land base is currently assessed at about 10% of the total area. An overview map of the area is shown in Figure 1 and a summary of the management units across the land base is provided below in Table 1.

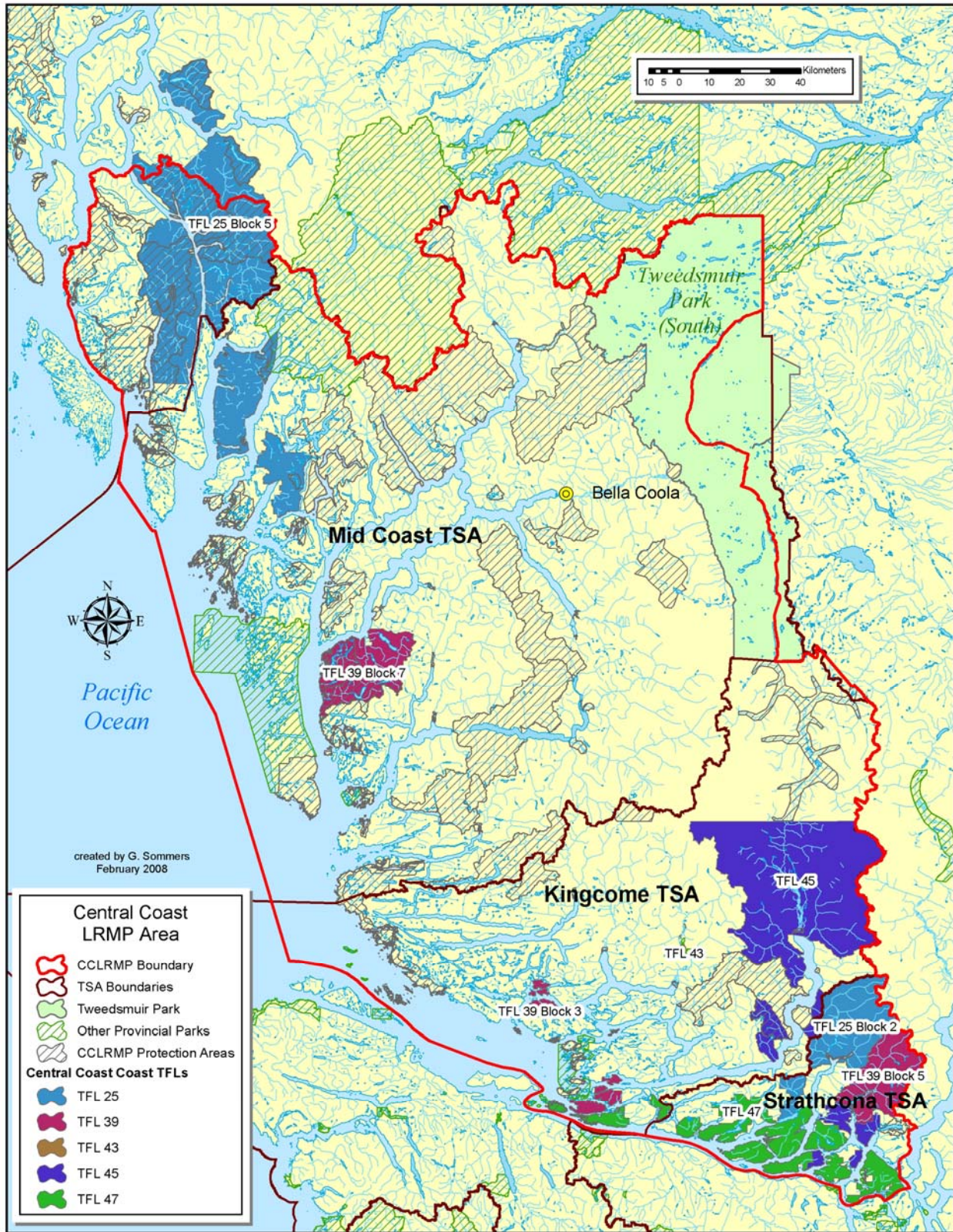


Figure 1. Overview map of the Central Coast LRMP area and its management units

Table 1. CCLRMP land base management units

Management Unit	Forest District	Area (ha)
Mid Coast TSA	NICC	2,211,930
Kingcome TSA (mainland portion)	NICC	1,026,570
TFL 25 Block 5–NICC portion (WFP)	NICC	53,955
TFL 39 Block 3 (WFP)	NICC	15,750
TFL 39 Block 7 (WFP)	NICC	56,340
TFL 43 - Kingcome River (Scott Paper)	NICC	956
TFL 45 (Interfor)	NICC	231,900
Tweedsmuir Provincial Park	NICC	390,000
Strathcona TSA (Loughborough S.B.)	Campbell R	79,740
TFL 25 Block 2 (WFP)	Campbell R	66,650
TFL 39 Block 5 (WFP)	Campbell R	47,000
TFL 47–Johnstone Strait block (TW)	Campbell R	85,400
Total project area		4,266,220

NICC = North Island – Central Coast Forest District (combination of the Mid Coast and Port McNeill Forest Districts)

3.2 FIRST NATIONS

As of 2000, five First Nations identified traditional land claims in the Mid Coast TSA. These First Nations included the Heiltsuk Nation, the Nuxalk Nation, the Kitasoo/Xaixais Nation, the Wuikinuxw (formerly Oweekeno) Nation, and the Gwa'Sala-'Nakwaxda'xw. At that time the First Nations were in different stages of the treaty process. The recent advent of the EBM framework has resulted in First Nations participating more directly in forest management planning within the TSA. Other First Nations may have claims outside the Mid Coast TSA, but within the CCLRMP boundaries.

3.3 CURRENT FOREST INVENTORY STATUS

The current status of forest inventory, either VRI or otherwise, for each management unit is summarized in Table 2 below. Of the twelve units which comprise the CCLRMP area, six are without VRI and the Kingcome TSA is complete except for the Klinaklini Supply Block, north of TFL 45, which covers approx. 250,000 hectares. For those units that either lack VRI data completed or have VRI work underway, this section of the plan briefly outlines the history and present condition of those inventories which require replacement and the current status of new photo acquisition.

Table 2. Inventory status of management units within CCLRMP area

Management Unit	Inventory type	Comments
Mid Coast TSA	FIP	
Kingcome TSA (mainland portion)	VRI/FIP	VRI complete except for Klinaklini SB
TFL 25 Block 5–NICC portion (WFP)	WFP standard	Completed 1985
TFL 39 Block 3 (WFP)	MB standard	Dates from 1964 and 1981
TFL 39 Block 7 (WFP)	MB standard	Dates from 1964 and 1981
TFL 43 - Kingcome River (Scott Paper)	VRI	Complete
TFL 45 (Interfor)	VRI	Complete
Tweedsmuir Provincial Park	Pre-FIP	MOF Unit Survey from 1950s. No digital data available
Strathcona TSA (Loughborough S.B.)	VRI	Phase I complete Phase II in progress
TFL 25 Block 2 (WFP)	VRI	Complete
TFL 39 Block 5 (WFP)	MB standard	Dates from 1964 and 1981
TFL 47–Johnstone Strait block (TW)	VRI	Phase I complete Phase II in progress

Note: FIP refers to the MOF standard in place prior to introduction of VRI

Units that do not have VRI completed are as follows:

Mid Coast TSA

The Mid Coast TSA was last reinventoried between 1988 and 1990 using 1977-79 photography. The reference year for some data, particularly from the outer coast areas, is from an earlier era, in some cases as far back as the 1950s unit surveys. It is likely that this inventory is partially comprised of data carried over from the previous inventory completed in the mid-1970s. The inventory file has been continually updated to December 1998 for most disturbances and silviculture history with further depletion updates to 2004.

An inventory audit conducted in 1994 found that timber volumes in mature (older than 60 years) stands were overestimated by 6% overall and 11% in the operable land base. More relevant was the finding that attribute (classification) bias resulted in volume overestimates for the overall and operable land base of 20% and 21%, respectively. This attribute overestimate was partially offset by an opposite bias in the yield prediction model.

Other audit findings were that: i) on average, leading species was correct 63% of the time in mature stands and 50% in immature stands; ii) site index for immature stands was generally inaccurate., i.e. within +/- 5 metres less than 40% of the time. These results reflect overall averages for the TSA land base, but the experience of those using the inventory has been that on a sub-unit or polygon level the attributes are quite unreliable. For those map sheets that still carry very old data typing is very broad and does not reflect the variability that exists on the ground.

Kingcome TSA – Klinaklini Supply Block

This part of the TSA was last reinventoried in the mid-1970s using 1:15,000 scale black and white photos. When the Kingcome TSA VRI project was initiated in 1997, this area which is considered completely inoperable was excluded from the project as it did not contribute to the AAC. The TSA inventory audit did include some samples in this area, but not enough to draw meaningful conclusions about the accuracy of the old inventory.

TFL 25 Block 5 (WFP)

Existing inventory completed in 1985 using a combination of 1960 and 1978-1980 photos. The work was done generally following MOF standards of the day. No MOF inventory audit was conducted on this unit.

TFL 39 Blocks 3, 5 and 7

Inventories for these blocks date back to 1964 with areas considered inoperable or inaccessible at that time subsequently photo-classified in 1981 by the original licensee, MacMillan Bloedel (MB). No inventory audits were done by MOF on any of these three blocks, however, MB did undertake “self-audits” during the late 1990s using a non-standard approach which compared volumes on a part of the inventory (no sampling of immature stands) but did not provide any statistical measures of attribute accuracy.

Tweedsmuir Provincial Park

The entire Park area was inventoried by MOF between 1955 and 1964 to the Unit Survey standard of the day. This resulted in very broad classification with large areas typed as non-productive or alpine forest even though they contained patches of productive forest. This inventory is believed to exist in digital form (format unknown) but is not available on-line.

Status of New Photography

In 2006, in preparation for VRI, the licensees initiated a project to capture new colour aerial photography at 1:20,000 scale across the North and Central Coast LRMP areas. As of Oct 1, 2007 new imagery is now available for all TSA and most TFL areas without VRI and for that portion of Tweedsmuir Prov Park lying within the Coast Forest Region. The only gaps that still exist are for TFL 39 Blocks 3 and 5, however, these areas may be covered by recent photo projects over adjacent lands. Thus, over 95% of the project area without VRI has brand new photography which is now being scanned into TIF format prior to completion of Aerial Triangulation (AT) and production of the DiAP soft-copy stereo models which will be used for new delineation and attributing.

3.4 INVENTORY AND FOREST MANAGEMENT ISSUES

As described in the previous section, all of the existing pre-VRI inventories are now between 17 and 43 years old, and Tweedsmuir Park could be considered nearly 50 years old if not a actual data gap. Inventory age is more properly measured by the date of the photo base used, so this means that the youngest inventory, that portion of the Mid Coast TSA completed in 1990, is actually 28 years old as the photos were mostly flown in 1979. The age of the inventories, the very broad typing, inconsistent data and delineation standards across the various units and the absence of key attributes in some cases makes the building of a seamless dataset for planning and land management purposes almost impossible. These are compelling enough reasons to undertake VRI across the Plan area. Added to this are the deficiencies identified in the Mid Coast inventory audit in 1994 and the TSR 2 determination of June 1, 2000 and the overarching need for consistent, seamless forest inventory that is more accurate at both strategic and sub-unit levels and can be used with confidence to support the implementation of Ecosystem-Based Management (EBM) across the land base that is now mandated by government-to-government agreements signed by the Province and First Nations.

It is important to note that the Mid Coast TSA stakeholders meeting held in August 2007 did not have participation from some important CCLRMP players though drafts of this document were later circulated for input and comment from those who were unable to attend. The scope of that stakeholders meeting was limited to the Mid Coast TSA with some discussion of the needs and issues pertaining to TFL 39 Block 7, TFL 25 Block 5 and Tweedsmuir Provincial Park. Subsequently, the scope of this VSIP was expanded to encompass the entire CCLRMP area with the focus on those units which do not already have completed VRI. The forest management issues listed below were generated primarily from these initial discussions and may not fully cover some issues relevant to the additional units now included. That said, the overarching data needs for LRMP implementation under an EBM regime apply equally to the entire plan area. Further stakeholder discussions prior to finalizing the VPIP(s) will be directed toward identification of any other important issues which have so far not been covered and these will be included in the subsequent implementation plans.

In keeping with the scope of the stakeholders meeting and management issues identified there, the Mid Coast TSA VRI committee will only be responsible for producing the necessary VPIPs and undertaking VRI work for the Mid Coast TSA, TFL 25 Block 5 and TFL 39 Block 7.

Implementation of VRI across other management units with older inventories that lie within the Kingcome and Strathcona areas (TFL 39 Blocks 3 and 5, Kingcome TSA - Klinaklini SB), and Tweedsmuir Provincial Park is not a commitment placed upon the Mid Coast TSA VRI committee. Future discussions between MFR and interested parties will address the need to complete seamless VRI across the full CCLRMP area.

Table 3 below summarizes the existing and emerging needs and issues that can be addressed with a new VRI:

Table 3. Forest Management Issues

ISSUE	PHASE I IMPACT	PHASE II IMPACT	COMMENT
1. <i>Volume Estimates For Existing Natural Stands</i>	High	High	Through the Phase I, Phase II activities and statistical adjustment, the volume estimates for natural stands will be improved. Accurate volume estimates are important for making informed land use decisions, particularly for harvest scheduling, silviculture, and financial planning. Of particular concern are outer coast stands of red cedar and inner coast hemlock/balsam stands. ²
2. <i>Ecosystem Based Management</i>	High	High	The Central Coast Land and Resource Management Plan (CCLRMP) recognizes that under this plan, EBM practices will be applied in areas that are not protected. EBM is the management of human activities in a way that allows ecosystems (and their components) to continue development at appropriate temporal and spatial levels. ³ EBM information needs are substantial and data obtained through the Phase I and Phase II VRI will improve management of the forest resource.
3. <i>Critical Wildlife Habitat (goat, grizzly, marbled murrelet)</i>	Med	Low	Habitat prediction requires accurate polygon estimates and delineation provided through a Phase I VRI. This information can then be used in habitat models. Specific habitat attributes could also be collected or derived from Phase II field sampling to calibrate or monitor the performance of the models. An improved inventory will provide forest managers with better information to manage habitat and identify sensitive areas.
4. <i>Operability</i>	Med	High	The VRI will provide better information

² AAC Rationale for Mid Coast TSA (June 1, 2000).

³ Coast Zone Strategic Plan http://ilmbwww.gov.bc.ca/lup/lrmp/coast/cencoast/docs/AIP_coastal_zone_plan.pdf

ISSUE	PHASE I IMPACT	PHASE II IMPACT	COMMENT
<i>Criteria</i>			on the distribution and types of merchantable timber in the TSA by improving the accuracy in defining the location of the operability lines. Preliminary operability work is planned in advance of the VRI.
5. <i>Stand & Landscape Biodiversity</i>	Med	Med	Spatial data derived from the photo interpretation and ground sampling (specifically coarse woody debris and succession sampling) may provide additional information used in delineating wildlife tree patches, ungulate winter ranges, and seral stage and stand attributes.
6. <i>Riparian Management</i>	Med	Low	Spatial data from photo interpretation may provide information for riparian area designations.
7. <i>Land Use Planning</i>	High	Low	VRI data will provide improved forest cover data for land use planning, including old growth retention strategies.
8. <i>Visual Quality Objectives</i>	Med	Low	The VRI will provide updated spatial information to assess the visual impact of timber harvesting activities.
9. <i>Productivity</i>	Low	Med	Conclusions from site productivity projects across BC show that site productivity is generally underestimated by inventory file data. In the Central Coast LRMP, localized studies have not been completed to date, however a site index adjustment (SIA) approach is planned for the upcoming year.
11. <i>Problem Forest Types</i>	Med	Med	VRI can provide improved information on areas identified as unmerchantable or low-productivity stands (<425m ³ /ha). ⁴ Better photo estimates with ground sampling will be used to reclassify those areas that are

⁴ AAC Rationale for Mid Coast TSA (June 1, 2000).

ISSUE	PHASE I IMPACT	PHASE II IMPACT	COMMENT
12. <i>Ecosystem Mapping</i>	Med	Low	<p>improperly typed.</p> <p>Ecosystem mapping is an important information source used in EBM. TEM projects are underway on the TSA and have been completed to various levels. In some cases Phase I can be used as an information source for eco-mapping.</p>

3.5 VRI ACTIVITIES AND PRODUCTS

The following VRI activities and products are needed to address the forest management issues identified for the Central Coast LRMP. These recommendations address the issues identified in Section 3.4 and Table 3:

1. Complete new photo interpretation (Phase 1) to bring inventory attributes up to VRI standards and provide more accurate, reliable and up-to-date spatial and attribute data.
2. Conduct Phase II ground sampling of selected areas (determined in VPIPs) of the LRMP area to adjust Phase I estimates. This will provide statistically valid timber and individual polygon volumes and other tree attributes to support timber supply review. Tree taper factors will be updated following NVAF sampling and analysis.
3. Conduct VRI ground sampling to collect timber, ecological, range and coarse woody debris data for select areas of the LRMP. This will provide spatial and non-spatial baseline data for EBM and other purposes.
4. Complete a CMI program to monitor the midterm timber supply, improve the input data into yield curves, and monitor the areas of high sensitivity and/or priority in EBM terms.

4. INVENTORY PLAN IMPLEMENTATION

This section outlines the proposed approach and schedule for delivering the specific VRI products discussed in Section 3.5 and the requirements for VPIPs for both Phase I and Phase II.

At this time, a Phase I VRI for Tweedsmuir Provincial Park will not proceed pending a resolution of whether the Forest Investment Account (FIA) will fund VRI in large Parks and Protected Areas. For the smaller Park and Conservancy areas that are scattered throughout the Central Coast LRMP area these will be included and funded as they share Landscape Units with the adjacent “operational” areas.

The initial focus for Phase I will be the Mid Coast TSA and a VPIP will be prepared following the approval of this VSIP. Subsequently, one or more VPIPs will be produced to cover the work required in the Kingcome TSA, the TFL blocks and possibly Tweedsmuir Park.

4.1 PHOTO-INTERPRETATION (PHASE I)

4.1.1 Objective

The objective is to provide better delineation and estimation of forest and non-forest cover types and fill data gaps across the CCLRMP area using photo interpretation supported by an adequate level of field calibration data. The delivered product is a spatial database consisting of unadjusted photo-interpreted estimates.

4.1.2 Target Area

The target area for Phase I work under this VSIP is the entire CCLRMP land base which currently lacks VRI and will include the entire land base of the following management units:

- Mid Coast TSA
- Kingcome TSA – Klinaklini Supply Block
- TFL 25 Block 5 – portion within NICC FD
- TFL 39 Blocks 3, 5 and 7
- Tweedsmuir Provincial Park – portion within CCLRMP area

The total land area covered by these units is 2.635 million hectares out of the total CCLRMP area of 4.27 million hectares.

4.1.3 Target Attributes

All attributes listed on the VRI photo interpretation attribute form will be captured. These attributes will be interpreted to current VRI photo interpretation standards utilizing as much historical calibration, silviculture and cruise data as possible.

4.1.4 Photo Interpretation Approach

The photo interpretation objectives will be achieved with the use of VRI-certified photo interpreters using aerial photography in a softcopy environment. The photo interpreters will use a variety of existing and new information sources to enable them to produce more detailed and accurate estimates. These data sources will include:

1. Any historical data available from MFR and licencees, including old document photos, ground samples, ground calls/observations and air calls
2. New field calibration data (ground calls and air calls) collected by the interpreters to fill in data gaps especially in second-growth stands and problem forest types
3. RESULTS data for young stands and recently disturbed areas
4. Historical silviculture records held by licencees and MFR
5. Suitable cruise data

Photo interpretation VPIPs will be developed following the MFR guidelines in Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Photo Interpretation. VPIP preparation involves identifying attributes to be improved (attributes or delineation), and identifying where, and how to improve them.

4.2 PHASE II – GROUND SAMPLING

4.2.1 Ground Sampling Objectives

The objective of the Phase II program is to provide overall statistical estimates of volume and other key attributes and allow adjustments to be made by installing enough samples to estimate the net merchantable volume in the target population (unit) with a sampling error of $\pm 10\%$ (95% confidence level).

The licensee committee intends to complete a Phase II VRI program once the Phase I is complete. The Phase II and NVAF programs for TFL 39, TFL 25 and other units will be identified during the development of the VPIPs for each of these land bases.

4.2.2 Target Population

The target populations within the CCLRMP area are yet to be determined and this will be discussed further among the stakeholders and MFR and described in the Phase II VPIP(s).

4.2.3 Sample Size

The estimated number of sample clusters to be installed in the target populations has not yet been determined. Taking the entire project area as the population to be sampled and based on the mature volume data from the 1994 Mid Coast TSA inventory audit, the coefficient of variation (CV) for the ratio of means was 34%.⁵ If this value is increased to 45% (which is typically requested by the MFR), the number of plots required to meet the desired sampling error is approximately 85 ground samples, but to achieve acceptable sampling errors by stratum considerably more would be required. The CV for areas outside the Mid Coast TSA may well be larger and that would necessitate more samples. Interim analysis should be completed on a subset of ground sample plots to finalize the number of plots required during the field program.

⁵ The CV of the ratio of means was calculated using the 1994 Mid Coast TSA inventory audit results for the analysis of mature volumes.

4.2.4 Sampling Approach

Either full VRI samples or Timber Emphasis Plots (TEP) or a combination of both will be used to gather data to the most current VRI ground sampling standards. These samples could provide a sampling framework for additional sampling, such as monitoring (where a subset would be re-measured over time). The sample types and target population will be finalized in the Phase II VPIP.

4.2.5 Sample Selection

Sample locations will be selected according to MFR standards (Sample Selection Procedures for Ground Sampling version 3.3). First, polygons will be selected using the probability proportional to size with replacement (PPSWR) method. Second, a random point will be selected within the selected polygon using the provincial 100-m grid.

4.2.6 Implementation

The inventory should be coordinated with photo interpretation work and be implemented as follows:

- Step 1 - a small batch of sample clusters (e.g., 50) should be installed over the target population in the first field season (or first half of field season). Complete an interim analysis, and re-calculate the sample size based on new CV estimates.
- Step 2 - install remaining plots in the second field season (or the second half of a field season), if required.

4.3 NET VOLUME ADJUSTMENT FACTOR SAMPLING

NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume. This ratio is used to statistically adjust the estimate of net merchantable volume of VRI ground samples.

4.3.1 Objective

The objective is to estimate NVAF ratios with a sampling error of $\pm 7.5\%$ at a 95% confidence level.

4.3.2 Sample Size

The MFR recommends a minimum sample size of 100 NVAF trees of which 90 are live and 10 dead. The final sample size and distribution by species will be determined during development of the Phase II VPIP. The relative species distribution (in terms of net merchantable volume) will be estimated and the actual sample size for each species group will be determined based on the species distribution. The finalized Phase II VPIP(s) will provide additional details on stratification of destructive sampling plots.

The VRI committee specifically noted that tree taper is an area of uncertainty and believe that current taper equations do not adequately model trees in the Mid Coast TSA. A well-designed NVAF program will identify taper issues and focus sampling in these areas of uncertainty. This may require a larger sample size of trees to allow for a reasonable assessment of the perceived taper issue.

4.3.3 Sample Selection

The number of VRI Phase II plots that will be enhanced for NVAF sampling will be determined following discussion with the MFR and will be updated in the VRI Phase II VPIP. Typically, the MFR recommends enhancing one plot for every three trees destructively sampled. Following completion of the first stage of the Phase II ground sampling program, a tree matrix will be built with trees measured from the NVAF-enhanced samples. The sample in each matrix cell will be selected systematically with a random start after the tree list in the cell is sorted by species and diameter at breast height (dbh).⁶

4.4 CHANGE MONITORING INVENTORY

CMI is an important component to track the modeling assumptions used for second-growth stands. The VRI committee may decide to implement a CMI program in regenerating stands. Monitoring may also be important to assess the performance of EBM practices in sensitive or high priority areas. Currently this is a low priority for the VRI committee; however this may be reevaluated when the Phase II activities are initiated.

⁶ Net Volume Adjustment Factor Sampling Standards and Procedures, MSRM, Version v4.0, March 2004.

4.5 ESTIMATED VRI COSTS

Table 4. Estimated VRI costs for the Central Coast LRMP area

VRI Activity	Units	Unit Cost (\$/Unit)	Total Cost (\$)	Estimated Projected Fiscal Year
PHASE I (PHOTO INTERPRETATION)				
VSIP	1		\$10,000	2007/2008
1:20,000 Color Photo Acquisition / Scanning, AT, Digital Models	Approx. 3 million ha.		\$800,000	2006/2007
Phase I estimation incl. field calibration	Approx. 3 million ha.	~\$1.00/ha	\$3,000,000	Start 2008/2009
Quality Assurance			\$50,000	Ongoing
<i>Sub-Total</i>			<i>\$3,860,000</i>	
PHASE II (GROUND SAMPLING)				
Phase II VPIPs	1	\$10,000	\$10,000	2008/2009
Prep of sample packages		\$8,000	\$8,000	2009/2010
Full VRI Plots	100	\$1,800/sample	\$180,000	2009/2010
Helicopter*		\$2,000/sample	\$200,000	2009/2010
Quality Assurance	10	\$1,500	\$15,000	Ongoing
<i>Sub-Total</i>			<i>\$413,000</i>	
STATISTICAL ADJUSTMENT				
Data Compilation	1	\$1,000	\$1,000	2009/2010
Report	1	\$20,000	\$20,000	2009/2010
<i>Sub-Total</i>			<i>\$21,000</i>	
NVAF				
VPIP Update / Tree Selection	1	\$5,000	\$5,000	2009/2010
Destructive Sampling	100	\$1000/tree	\$100,000	2009/2010
Helicopter*	1	\$2,000/tree	\$200,000	2009/2010
NVAF Analysis and Reporting	1	\$5,000	\$5,000	2009/2010
Quality Assurance (including helicopter)		\$12,000	\$12,000	Ongoing
<i>Sub-Total</i>			<i>\$322,000</i>	
CMI				
CMI VPIP	1	\$10,000	\$10,000	2009/2010
Sample Packages	60	\$100	\$6,000	2009/2010
Plot Establishment	60	\$1,600	\$96,000	2009/2010
Helicopter*		\$2,000/sample	\$120,000	2009/2010
Quality Assurance	6	\$1,500	\$9,000	Ongoing
Analysis & Installation Report	1	\$5,000	\$5,000	2009/2010
<i>Sub-Total</i>			<i>\$246,000</i>	
Total			\$4,862,000	

*All helicopter costs are estimates, and are based on previous projects completed on the coast.

5. SIGN-OFF SHEET

I have read and concur that the Central Coast LRMP VRI Strategic Inventory Plan dated October, 2007 meets current VRI standards and business needs and considerations. 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.

*International Forest Products Ltd.
(lead proponent Mid Coast TSA)*

Date

*Western Forest Products Ltd.
(lead proponent TFL 25 Block 5)*

Date

*British Columbia Timber Sales
(lead proponent TFL 39 Block 7)*

Date

*Jon Vivian, RPF
Manager Vegetation Resources Inventory
Forest Analysis and Inventory Branch
Ministry of Forests and Range*

Date

APPENDIX I – VRI COMMITTEE

Table 5. List of the VRI committee participants for the Mid Coast TSA area.

Agencies	Participant
MFR Coast Forest Region	Derek Challenger
MFR Forest Analysis and Inventory Branch	Gary Johansen
MFR Forest Analysis and Inventory Branch	Laurence Bowdige

Licensees	Participant
BC Timber Sales	Deidre Haight
Heiltsuk Coastal Forest Products Ltd.	Rina Gemeinhardt
International Forest Products Ltd.	Gerry Sommers
Western Forest Products Inc.	Pat Bryant

Facilitator	Participant
Forsite Consultants Ltd.	Ian Robertson

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APPENDIX II – GLOSSARY OF TERMS

Inventory Unit

An inventory unit is the target population from which the samples are chosen. The inventory unit could be a specific geographic area (e.g. TFL or TSA) where a specific set of attributes is needed. The size of the inventory unit depends upon the sampling objectives.

Landcover Classification

The BC Land Cover Classification Scheme (BCLCS) was designed specifically to meet VRI requirements, in addition to providing general information useful for “global vegetation accounting” and “integrated resource management.” The BCLCS is hierarchical and reflects the current state of the landcover (e.g., presence or absence of vegetation, type and density of vegetation) and such fixed characteristics as landscape position (i.e., wetland, upland, alpine). There are two main classes of polygons: Vegetated and Non-Vegetated.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. NVAF sampling involves 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). The NVAF (and VRI net factoring) replaces the existing loss factors for inventory applications. It does not, however, replace the loss factors for revenue applications.

Photo Interpretation

Photo interpretation involves subjective delineation of polygons and photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs (1:15,000) are most often used in photo interpretation.

Post-Stratification

Post-stratification involves dividing inventory unit into mutually exclusive sub-populations (strata) *after* ground sampling has been completed. Samples that fall in each post-stratum are analyzed separately and the results are applied to the corresponding population post-strata to improve the precision of the inventory’s overall averages and totals.

Pre-Stratification

Pre-stratification divides an inventory unit into mutually exclusive sub-populations (strata) *before* ground sampling to provide estimates for specific areas, or to increase the confidence in the overall estimates by considering special characteristics of each stratum.

Sample Size

The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet the target precision.

Statistical Analysis

Statistical analysis or adjustment is the process of adjusting the values of the photo-interpretation variables using ground sampling observations. Ground observations are compared to photo-

estimated values to develop adjustment factors by species groups. These factors are then applied to the polygons in the photo interpretation database to produce the final adjusted database.

Vegetation Resources Inventory (VRI)

VRI is an improved vegetation inventory process for assessing 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 and the estimation of resource attributes.
- *Ground Sampling*: the establishment of plot clusters in selected polygons to measure timber, ecological, and/or range attributes.
- *NVAF Sampling*: stem analysis sampling of individual trees for net volume adjustment.
- *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 VRI can be deployed over the entire province measuring timber and non-timber resources, or over a large management unit (management VRI) measuring selected resources in specific portions of the landbase. 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.

APPENDIX III – VRI PLANNING PROCESS

The VRI planning process requires that a VSIP and VPIPs are developed for defined units (e.g. TSA, Tree Farm Licence [TFL]). A VSIP outlines VRI products to address forest management issues and provides strategic direction for implementing the inventory activities. A VPIP details the operational activities identified in the VSIP (e.g., ground sampling or photo interpretation projects) and identifies project areas, priorities, and roles and responsibilities.

The VRI planning process is an important component of the overall VRI process and related activities (see Figure 1). The intent of the VRI planning process is to ensure that baseline products meet a range of applications and they are efficiently implemented. These processes and activities include:

1. Forest management decision processes (land integration planning);
2. Identifying forest management issues;
3. VRI strategic planning (prepare a VSIP);
4. VRI operational planning (prepare VPIPs); and,
5. Implementation, including development and maintenance of procedures and standards
 - a) Management inventories;
 - b) Data base management; and,
 - c) Data interpretation.

The steps for preparing a VSIP include:

1. Licensee VRI committee work with MFR staff to develop issue statements related to VRI.
2. The Mid Coast licensees, including all agencies and the VRI committee, meet to refine issues and discuss why these issues need to be considered fundable. The purpose of this meeting is to:
 - a) Introduce the VRI tools and process;
 - b) Table new issues and revisit existing issues;
 - c) Discuss issues to fund (under current funding mechanisms) and provide general direction for developing the VSIP. This discussion also affects the extent of photo interpretation and the number and type of VRI plots; and,
 - d) Suggest the VRI tools to address currently fundable issues as well as those issues that may be funded in the future.
3. Meeting minutes are prepared and circulated to all participants for review and feedback. A final VSIP is prepared incorporating items agreed to in Steps 2 and 3 and is signed off by the lead proponent and the Manager of the VRI Forest Analysis and Inventory Branch.
4. VPIP process begins.

The VPIP details the activities under the VSIP (Phase I Photo Interpretation or Phase II Ground Sampling) by providing project areas, priorities, scheduling, identifying the population and strata for sampling, and sample size. The steps for preparing the VRI Phase I & Phase II/NVAF VPIPs include:

1. Review and update VSIP recommendations.

2. Secure funding.
3. Identify project activities, geographic areas, and costs.
4. Specify roles and responsibilities for project implementation.
5. Prepare VPIP.

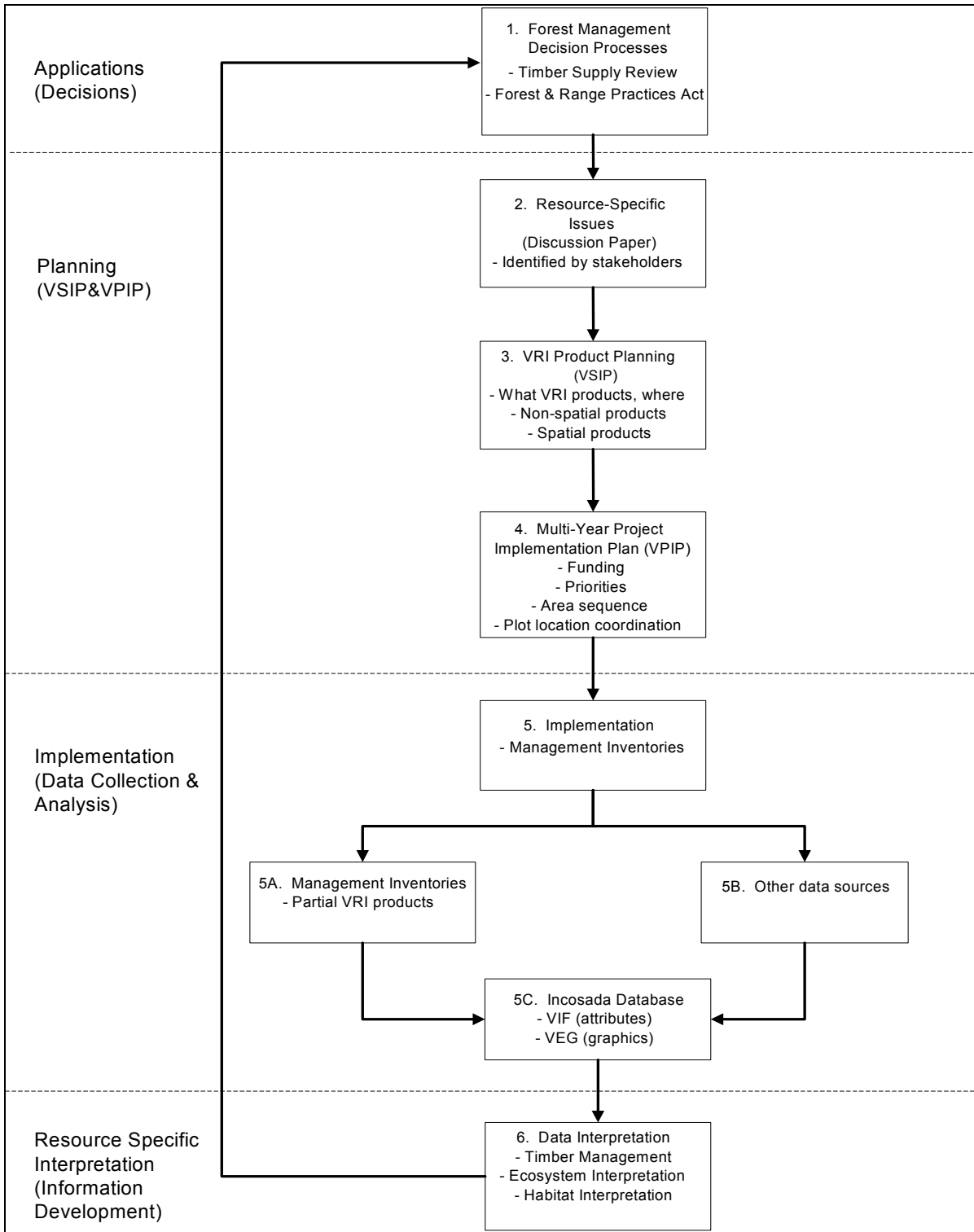


Figure 2. The VRI management inventory process.