



Ministry of Forests, Lands and Natural Resource Operations

VRIMS
Contractor Guide to
RESULTS Forest Inventory
Data Preparation

Version 2.2
January, 2019

Table of Contents

Contents

1	Introduction	1
1.0	Background.....	1
1.1	Document Objective	1
1.2	Terms of Reference	1
1.3	Project Plan	2
2	Polygon Processing	3
2.0	Positional Review	3
2.1	Overlapping RESULTS Openings	4
2.2	Editing Gaps and Overlaps.....	6
2.3	Editing Block Boundaries Adjacent to Lakes and Rivers.....	7
2.4	Editing Non-productive Roads and Landings	9
2.5	External WTP's and Non-Productive Areas	11
2.6	Polygons Less Than 1ha	11
2.7	Non Productive Codes.....	13
2.7.1	VRI Photo Interpretation RESULTS preparation	13
2.7.2	Backlog Free Growing - NSR	13
2.7.3	Backlog Free-Growing - Non NSR	14
2.8	Holes.....	15
3	DATA PROCESSING	16
3.0	Adding Missing RESULTS Attributes	16
3.1	Geometry/Topology Checks	17
3.2	FME Processing	19
3.3	VEGCAP Processing.....	20
3.4	VegCap Validation	23
3.5	Deliverable Packaging	24
4	Standards	25
5	Software/Hardware Requirements and Source Data.....	26
5.0	Hardware and Software Requirements	26
5.1	Source Data.....	26
	Appendix A – Crown Closure Lookup Table	28
	Appendix B – VegCAP Non-productive Codes.....	29

1 Introduction

1.0 Background

The Vegetation Resources Inventory (VRI) is continuously updated to reflect changes from man-made and natural disturbances such as harvesting, fire, insects and disease. The update process includes the identification, mapping and description of changes that occur on the forest landbase using the best data sources available.

Vegetation Resource Inventory Management System (VRIMS) has the mandate to update the Provincial forest inventory.¹ The VRI is generally replaced on a 20 year rotation schedule. VRIMS integrates several sources of data into the VRI, one of which is the Reporting Silviculture Updates and Land Status Tracking System (RESULTS). Licensees report their silviculture activities to RESULTS along with forest cover updates that include both spatial and attributes. The VRIMS system is updated daily to reflect new RESULTS forest cover updates. These forest cover updates usually occur three times during the lifecycle of a silviculture opening: 1) new harvest, 2) regeneration and 3) Free Growing (FG). There are approximately 270,000 openings loaded into RESULTS for use in VRI.

The VRI updates are generally done on large land bases with new interpretations from the latest images. Images for the entire province are now available at regular intervals. This image data combined with updated daily RESULTS spatial and attribute data will provide for a more up-to-date inventory. There is now an option for extracting the disturbed areas, including both spatial and attributes from RESULTS for the project area. The RESULTS spatial and attribute data undergo a rigorous audit regime, which is outlined in this document. Once the RESULTS extracted data passes the audit, it is used in the new inventory and excluded from interpretation.

1.1 Document Objective

The objective of this document is to:

Provide a set of procedures and standards for preparing RESULTS Inventory data for use by inventory contractors.

1.2 Terms of Reference

This document was prepared by Certes Applied & Natural Sciences Ltd (Certes) for the Forest Analysis and Inventory Branch (FAIB). The FAIB project lead was Marc Rousseau, RFT and Certes update project manager George Jennings, GISP. This document is based on the “VRIMS Contractor Guide to RESULTS Free Growing Data Preparation.”²

¹ VRI – Vegetation Cover Update Homepage: <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/forest-cover-inventories/forest-inventory-update>

² VRIMS Contractor Guide to RESULTS Free Growing Data Preparation V2.1, November 2017.

VRIMS Contractors have prepared over 30,000 RESULTS FG openings from 2013 to 2015 using procedures outlined in the VRIMS document.² The Ministry of Forests, Lands and Natural Resource Operations (FNLRO) has prepared and updated the remaining openings (e.g. Approved).

Certes has prepared over 2,500 RESULTS openings during the Spring of 2016/2017 with the objective to develop and test the process in preparation of RESULTS inventory data for VRI contractors. This document summarizes the steps in preparing RESULTS Inventory data that were successfully used by Certes, but these may not cover all possible scenarios that may be encountered.

1.3 Project Plan

The FAIB Update Team will deliver to update contractor:

1. FAIB RESULTS Extract – A FAIB produced Personal Geodatabase that contains openings from the RESULTS Forest Cover Inventory SVW, RESULTS Opening SVW and FTEN Cut Block Poly datasets that includes all openings within the project area. These layers were merged and filtered using an FME script to remove duplicate openings where possible. There may be some duplicate spatial openings that are present in this dataset from multiple sources (the source can be identified in the “Spatial_Source” field).
2. Photo image – SPOT 1.5m BlackBridge Geomatics/Streaming_Image_Content
3. FME Workspace (RESULTS_FC_2_VRIMS_PGDB)
4. A blank formatted VRIMS PGDB
5. VegCap for Contractors (most current version)

The FAIB RESULTS Extract is examined and modified for spatial accuracy and completion of attribution, then a FME workspace (Section 3.2) is run by the RESULTS preparation contractor to transform the extract to a VRIMS PGDB format. This VRIMS file can either be utilized by Re-inventory contractors to incorporate RESULTS information into new inventory projects, or loaded directly to the Ministry corporate warehouse, depending on the goals of the preparation contract,

The most accurate and efficient way to process the FAIB RESULTS Extract to meet the standards outlined in Section 4 is to split the work into the following 14 steps:

- 1) **Positional Review** (Section 2.0)
- 2) **Overlapping RESULTS Openings** (Section 2.1)
- 3) **Editing Gaps and Overlaps** (Section 2.2)
- 4) **Editing Block Boundaries Adjacent to Lakes and Rivers** (Section 2.3)
- 5) **Editing Non-productive Roads and Landings** (Section 2.3)
- 6) **Deleting External WTP’s** (Section 2.5)
- 7) **Editing Polygons Less Than 1ha** (Section 2.6)

- 8) **NSR_NP Code Attributes** (Section 2.7)
- 9) **Non-Productive Attributes** (Section **Error! Reference source not found.**)
- 10) **Processing Holes** (Section 2.9)
- 11) **Adding Missing RESULTS Attributes** (Section 3.0)
- 12) **Geometry/Topology Checks** (Section 0)
- 13) **FME Processing** (Section 3.2)
- 14) **VegCAP Processing** (Section 3.3)
- 15) **Deliverable Packaging and Submission** (Section 3.5)

All openings rejected and removed from the deliverable must be tracked in an Excel spreadsheet. Openings should also be tracked where assumptions were made and the openings were still processed and added to the deliverable (Figure 1).

Opening_ID ▾	Removed from the deliverable ▾	Reason for rejection ▾	Description ▾
77224	YES	Too Small	Opening less than 0.3 ha
77242	YES	Too Small	Opening less than 0.3 ha

Figure 1. Tracking spreadsheet

2 Polygon Processing

2.0 Positional Review

The RESULTS system can receive forest cover updates that are not in the correct spatial location. Each opening should be reviewed against the imagery to identify the ones that will be processed. The RESULTS opening spatial may be used as reference to identify the correct spatial location. Spatial should be available for all openings except those that have been partially or fully harvested after the date of the image.

Shift or rotate all openings clearly more than 20m away from their true location (Figure 2). Process openings that can't be shifted or rotated into their true location by digitizing the opening boundary using the imagery. All openings rejected and removed from the deliverable must be noted in the tracking spreadsheet.

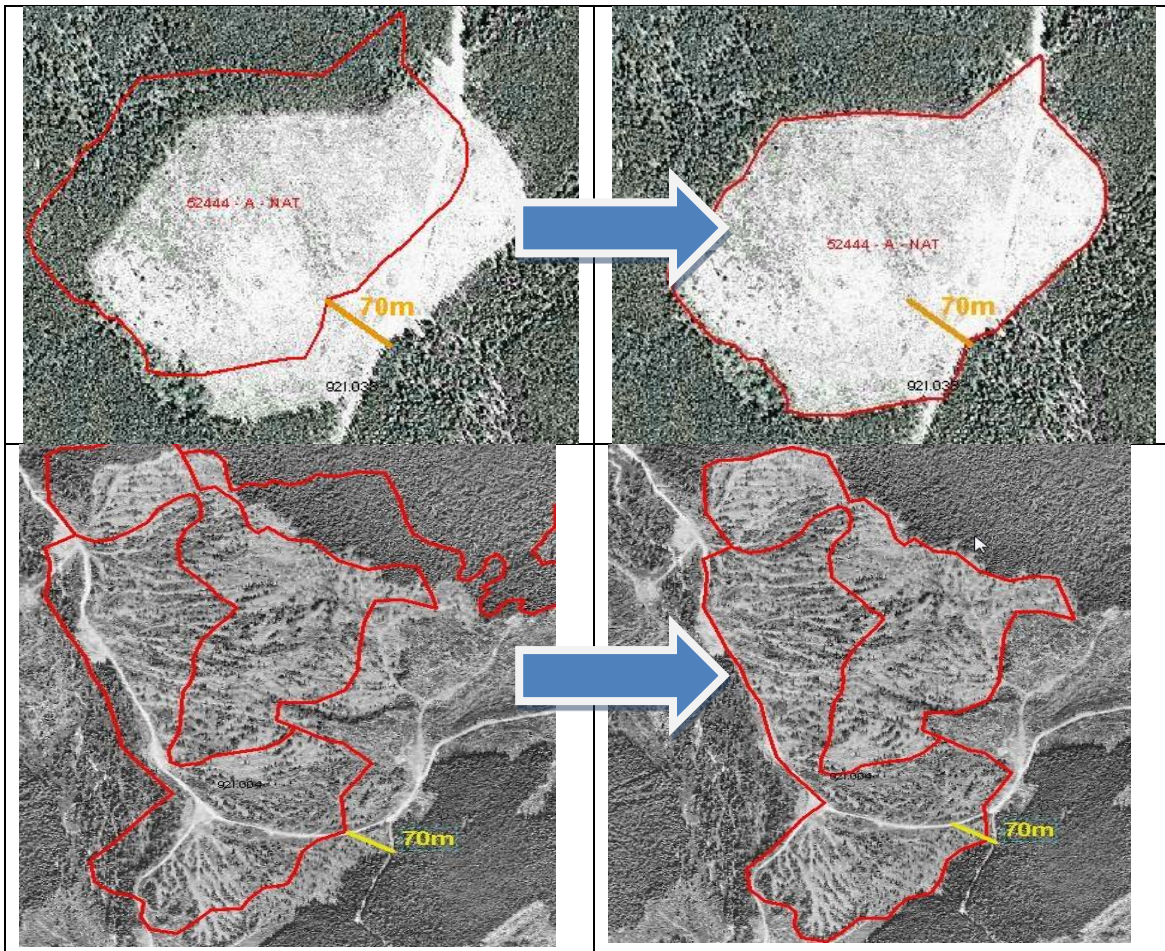


Figure 2. Example of two shifted openings.

2.1 Overlapping RESULTS Openings

RESULTS can also receive forest cover updates that are legitimate overlaps for a few reasons:

1. Old partial cut openings that have since been clearcut under a different tenure. These openings are accurately mapped as overlapping tenures. RES_INV_SVW, RESULTS_Opening or FTEN openings that are overlapped more than 1 ha by a newer RESULTS Forest Cover Inventory submission should be removed from the deliverable and noted in the tracking spreadsheet (Figure 3).

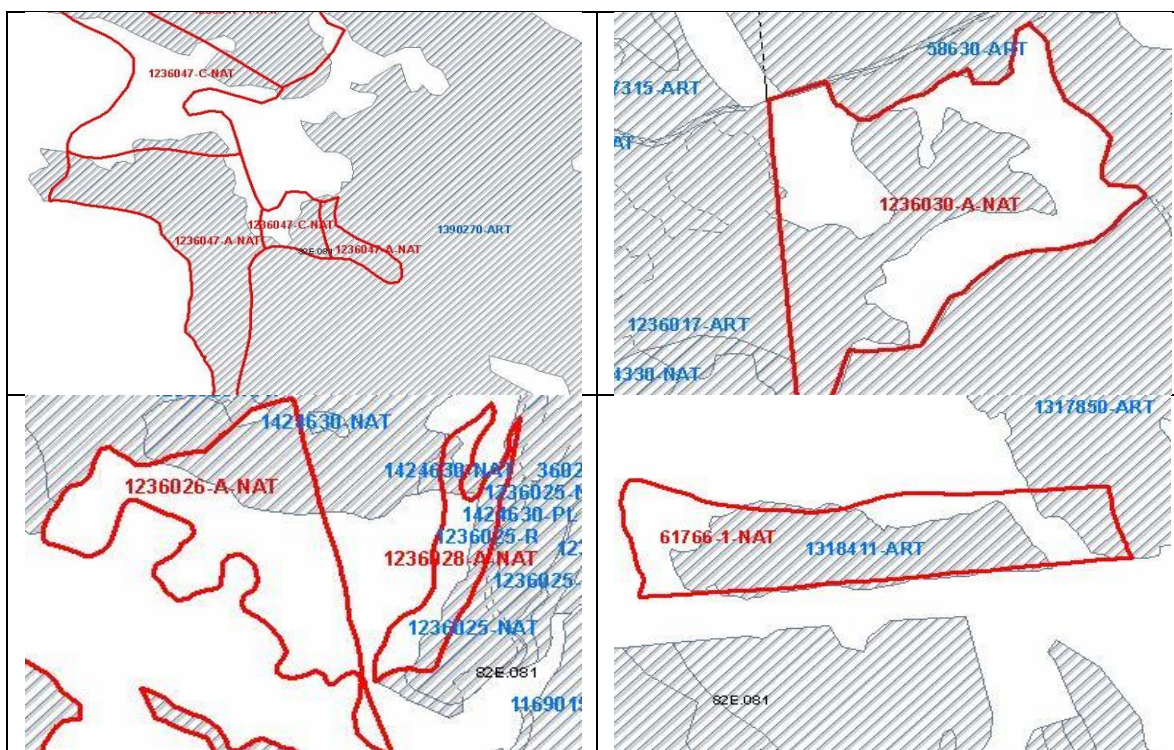


Figure 3. Example of four openings overlapped by newer openings. The FG openings with a spatial source of RESULTS_Opening are in red and the newer openings from the RESULTS Forest_Cover in the Spatial Source field are in the blue crosshatch.

2. Boundary overlaps caused by adjacent polygons being entered years apart.

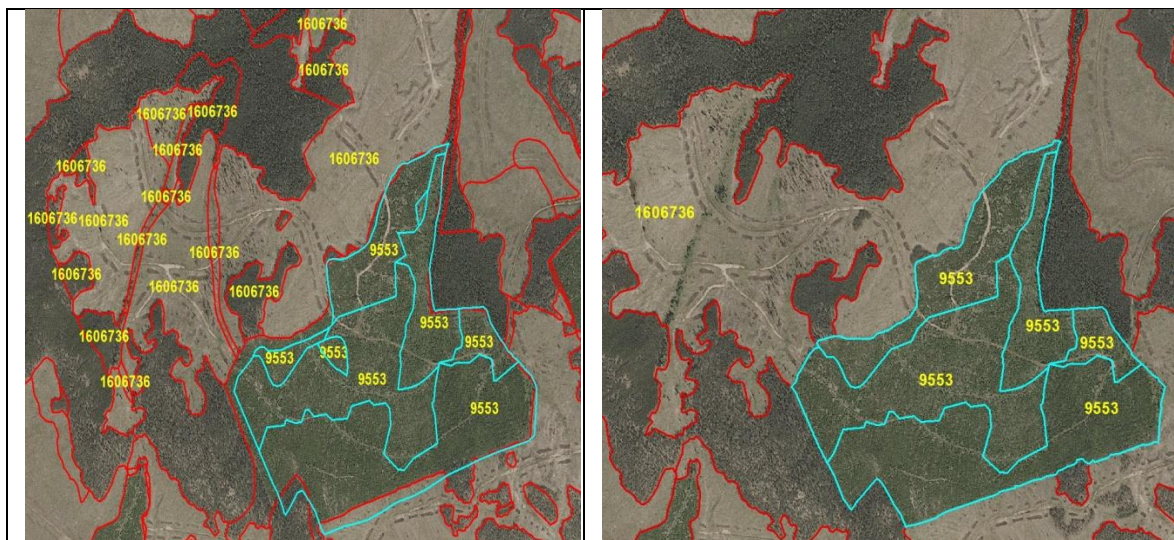


Figure 4: The left image displays pre-processed openings and the right image displays post-processed openings. The opening 9553 could not be simply moved to solve the offset problem. The boundaries were adjusted to fit the newer opening 1606736. The east boundary was adjusted to fit the image. Also, opening 9553 being Free to Grow (FG) retained the internal lines while opening 1606736 being approved (APP) the internal lines were dissolved based on the largest Standards Unit (SU).

2.2 Editing Gaps and Overlaps

The RESULTS system routinely receives openings that have boundaries with overlaps and/or gaps with adjacent openings. Review all shared opening boundaries in the FAIB RESULTS Extract to ensure the vertices are identical in both geometries.

Remove all overlaps and gaps (excluding roads and landings discussed in Section 2.3) less than 1.0 ha in size or less than 20 m between openings. Apply the following rules to this review:

- Where the spatial line work of one of the submissions clearly appears to be more accurate, maintain the more accurate submission and fill the gap with the other submission.
- Identify the submission with the most recent Update_Timestamp and fill the gap with the older submission.
- Review the resulting line work with the image and digitize any adjustments necessary.

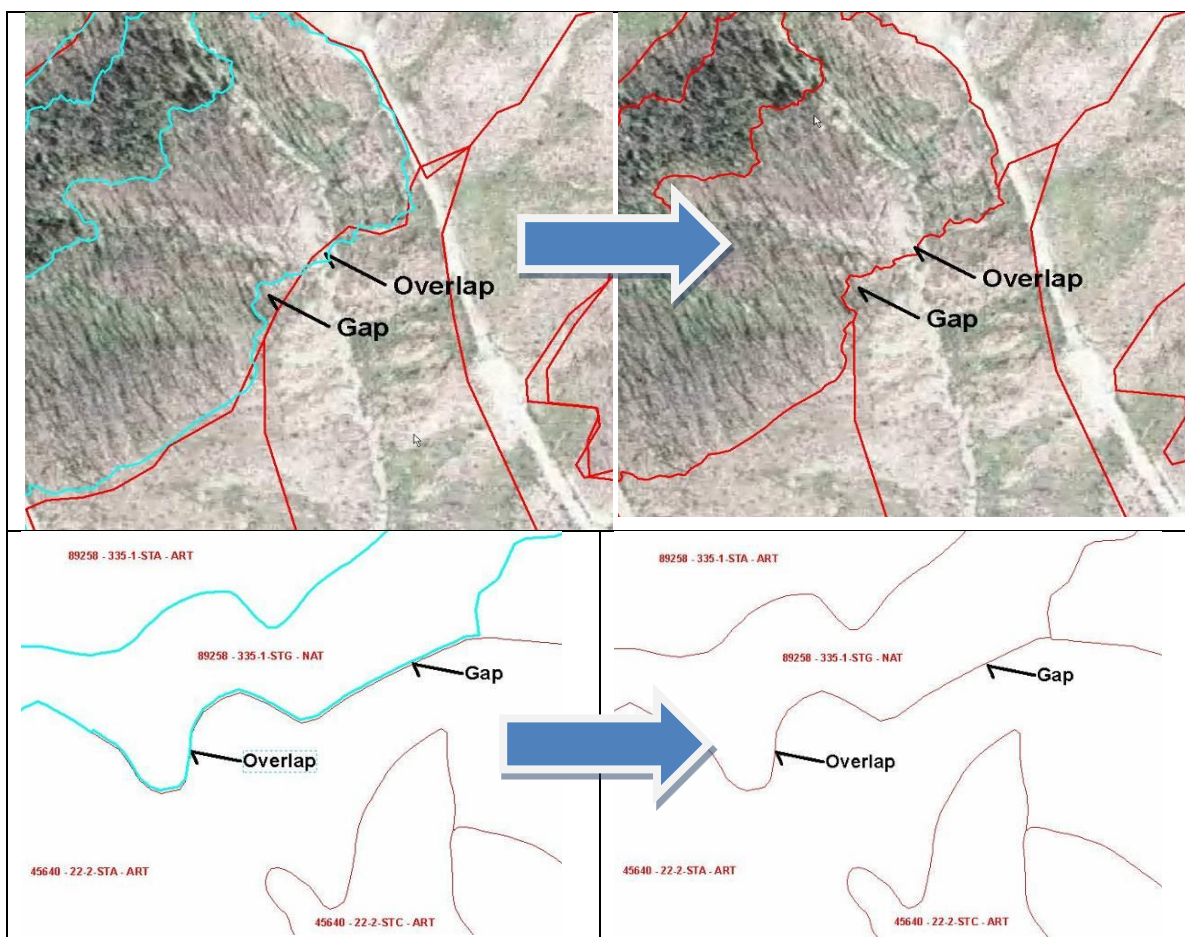


Figure 5. Gaps and overlaps between openings were edited retaining the spatial line-work of the blue opening that visually appears to be more accurate.

2.3 Editing Block Boundaries Adjacent to Lakes and Rivers

Cutblocks that are adjacent to double Line water features (major rivers) and lakes should be clipped to match the river or lake

Where an opening overlaps a lake (Figure 1), the opening is to be clipped to the lake poly as in Figure 2 below or Figure 3 below.

Figure 1

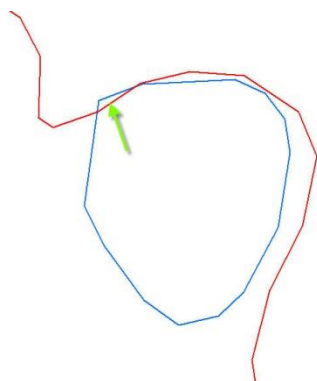


Figure 2

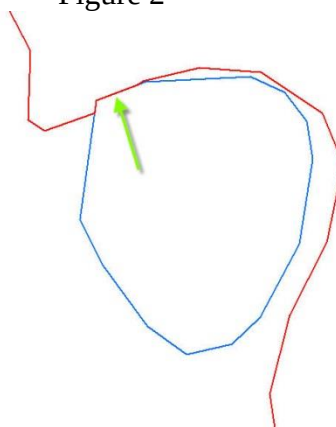
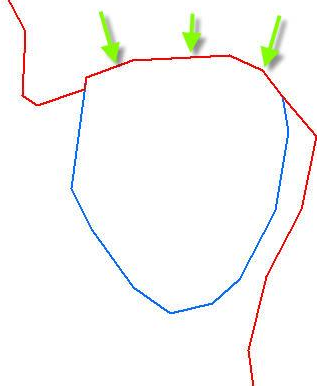


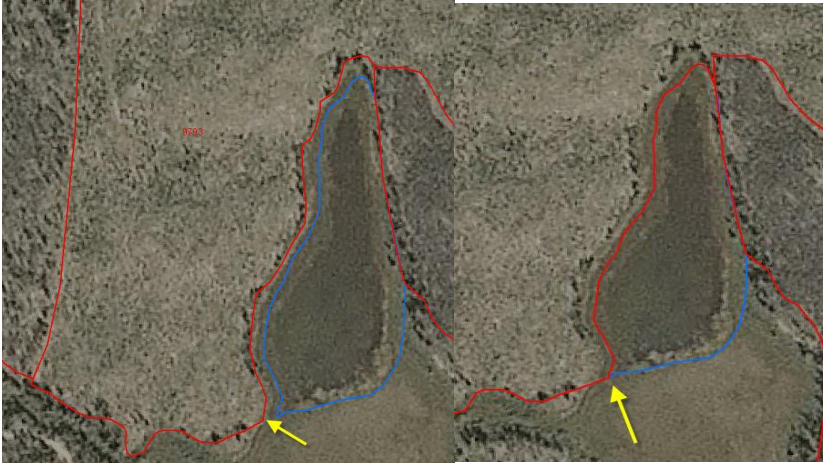
Figure 3



Where a lake polygon and an opening polygon could create a long thin finger with a width less than the 10 to 20 m tolerance as shown in Figure 4 below, remove the long thin finger as in Figure 5 below.

Figure 4

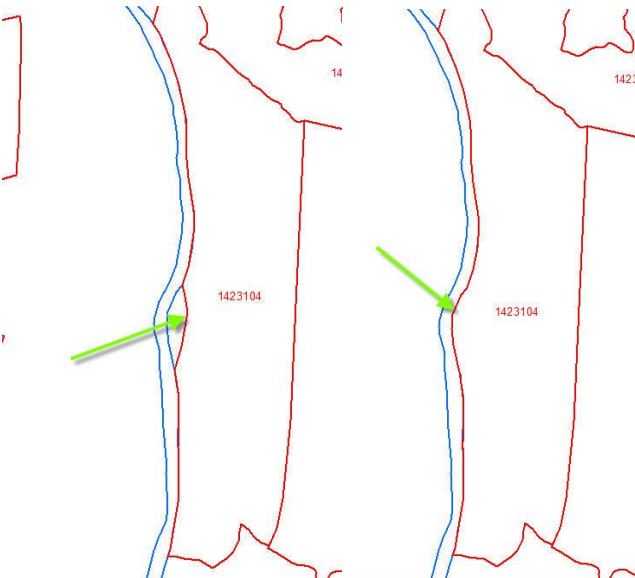
Figure 5



Where an opening connects to a double line water feature (River) and creates a small gap as in Figure 6 below, remove the gap as in Figure 7 below.

Figure 6

Figure 7



2.4 Editing Non-productive Roads and Landings

Non-productive roads and landings are not mapped in the VRI and need to be dissolve and merged into the largest adjoining polygon.

There are 2 sources of non-productive roads and landings:

- Polygons identified with a STOCKING_STATUS_CODE of “NP” and STOCKING_TYPE_CODE of “UNN” or “RD.”
- Visual identification using the imagery – a 40 m or less gaps between two or more openings in the FAIB RESULTS Extract that is clearly a result of roads and/or landings (Figure 6).

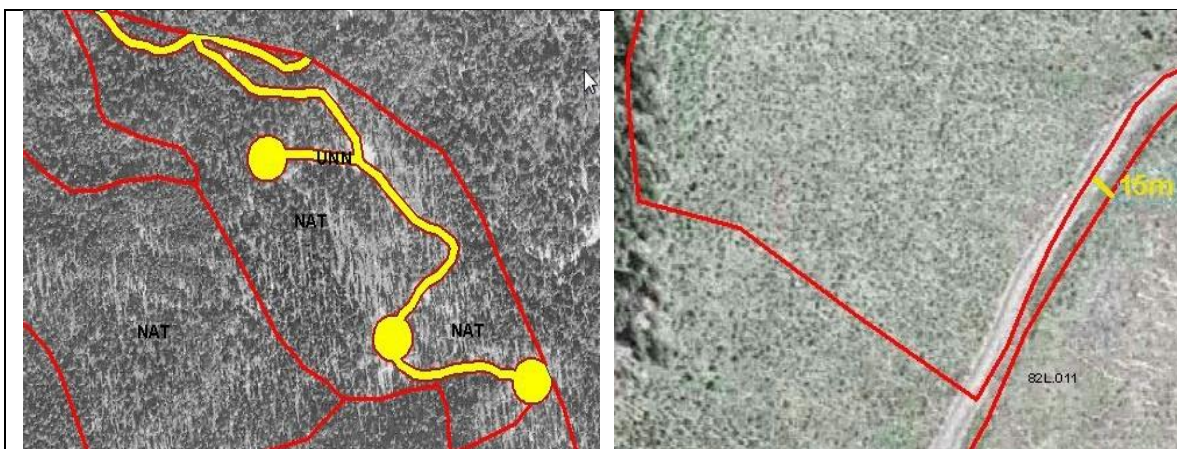


Figure 6. The example on the left is of a road polygon identified with a stocking type of “UNN” or “RD” (highlighted in yellow). The example on the right is a road polygon identified in the imagery as a 40m or less gap between two openings caused by a road right-of-way.

Apply the following 4 rules to fill gaps left by non-productive roads and landings:

- 1) Fill and merge the gaps with the largest adjoining polygon.
- 2) Where gaps left by the non-productive roads and landings split a forest cover polygon/stratum (be certain that the 2 forest cover polygons are the same), merge the resulting polygons (Figure 7).
- 3) Where the road polygon is the forest cover polygon/stratum boundary, merge the road polygon with the largest of the polygons (Figure 8).
- 4) Where the opening polygon is adjacent but not including a road, as seen on the image, adjust the boundary to include the road. The only exceptions are roads that are wider than 40 m as per the VRI Photo Interpretation Procedures.³ These should not be delineated as part of this process unless they are a hole.

³ Vegetation Resources Inventory – Photo Interpretation Procedures – Prepared by Ministry of Forest, Lands and Natural Resource Operations, Forest Analysis and Inventory Branch, Version 3.3., March 2017.

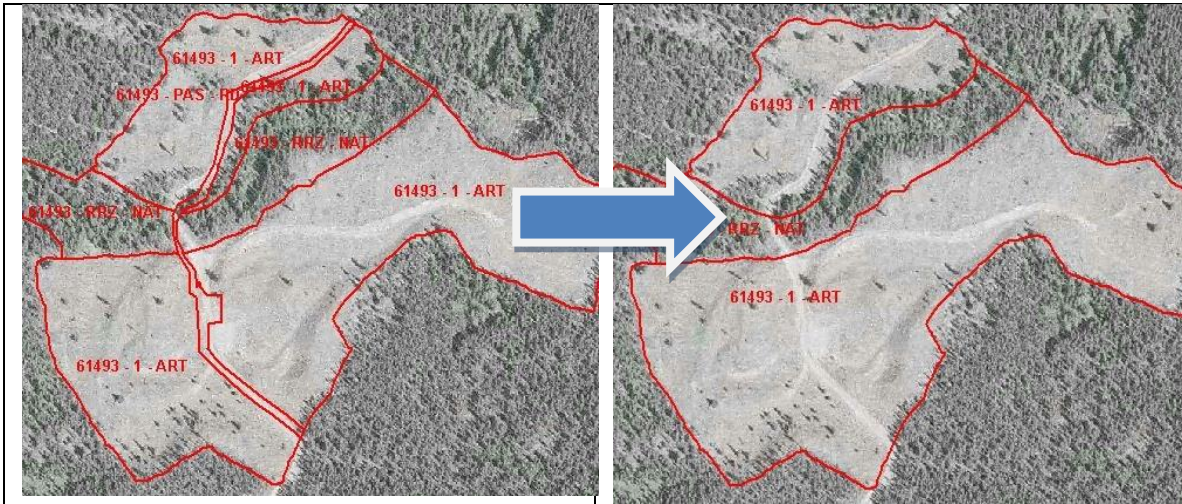


Figure 7. Example of a road polygon split and merged with the adjacent polygons. The labels drawn in this example are: OPENING_ID – SILV_POLYGON_NUMBER – STOCKING_TYPE_CODE.

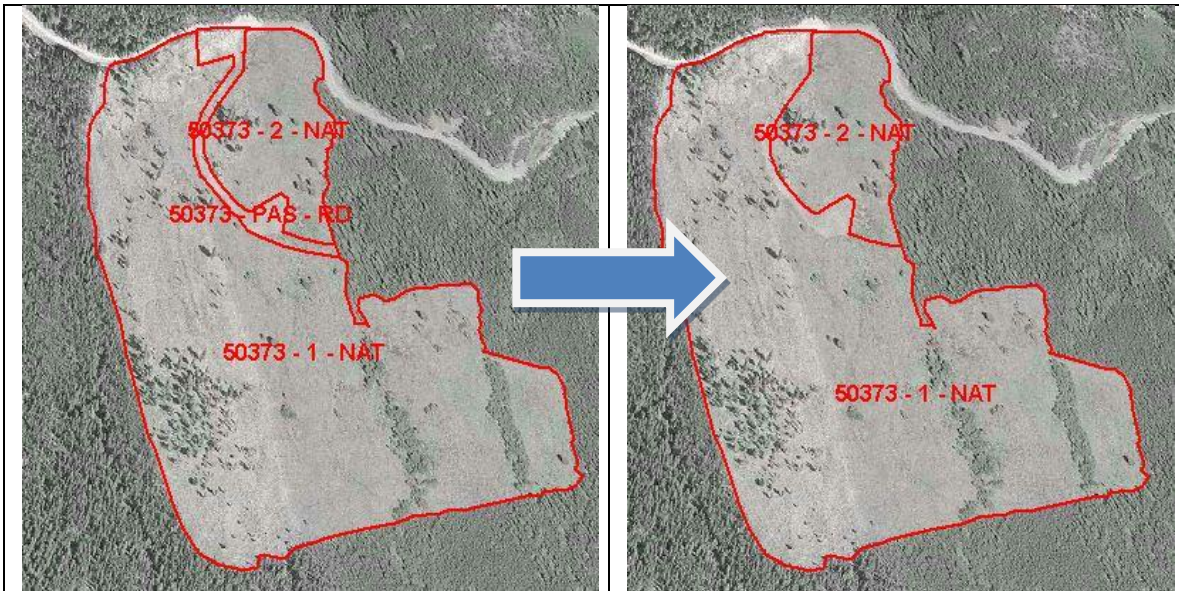


Figure 8. Example of a road polygon merged with the adjacent polygon with the largest area (FG Opening).

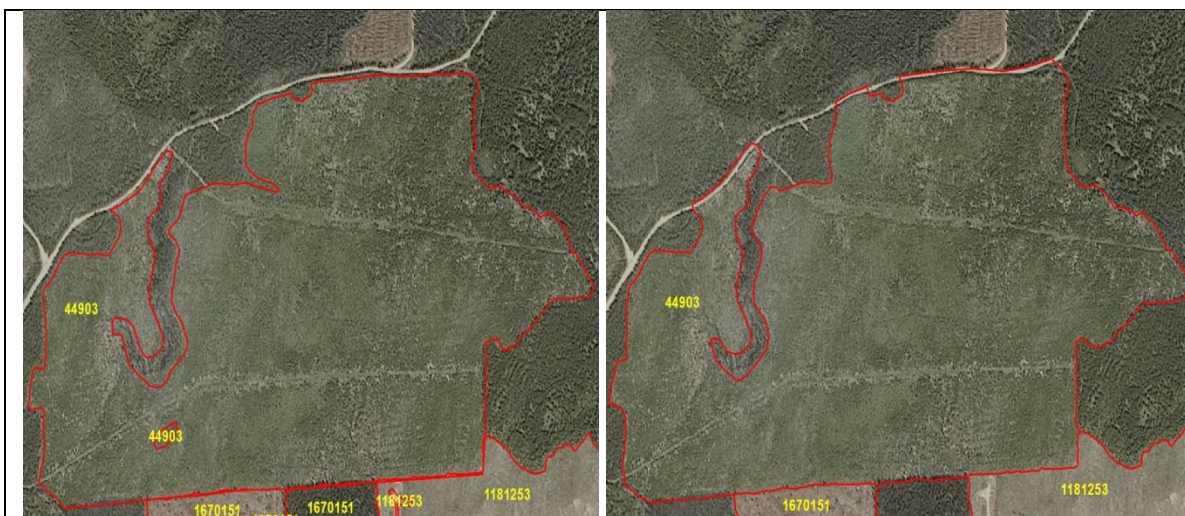


Figure 9. Example of a road being brought into the area of opening 44903. Left image pre-processing and the right image post-processing.

2.5 External WTP's and Non-Productive Areas

Delete all WTPs and non-productive areas that are external to an opening and are not an island within harvested blocks.

2.6 Polygons Less Than 1ha

Unless otherwise specified in a RESULTS preparation contract, RESULTS polygons less than 1 ha in size are only mapped in the VRI if they are:

- Harvested polygons in a patch cut that are greater than or equal to 0.5 ha (Figure 10)
- Standalone harvested polygons that are greater than or equal to 0.5 ha.
- Single standalone polygon greater than or equal to 0.3 ha.

Delete or merge all other polygons less than 1 ha. Determine the area of polygons after gaps, overlaps and non-productive roads and landings are processed. Apply the 4 rules below to determine if the small polygons are to be deleted or merged:

- 1) Delete standalone harvested polygons less than 0.5 ha.
- 2) Delete single standalone harvested polygons less than 0.3 ha.
- 3) Delete other polygons if all 3 criteria below are met:
 - a. It is a retention (e.g. WTP) or non-productive area; and
 - b. It is along the outside of the opening; and
 - c. It won't create a gap with another opening; and
- 4) Merge all other polygons with the largest adjacent polygon within the opening if one or more of the 3 criteria above is not met (Figure 11 and Figure 12).

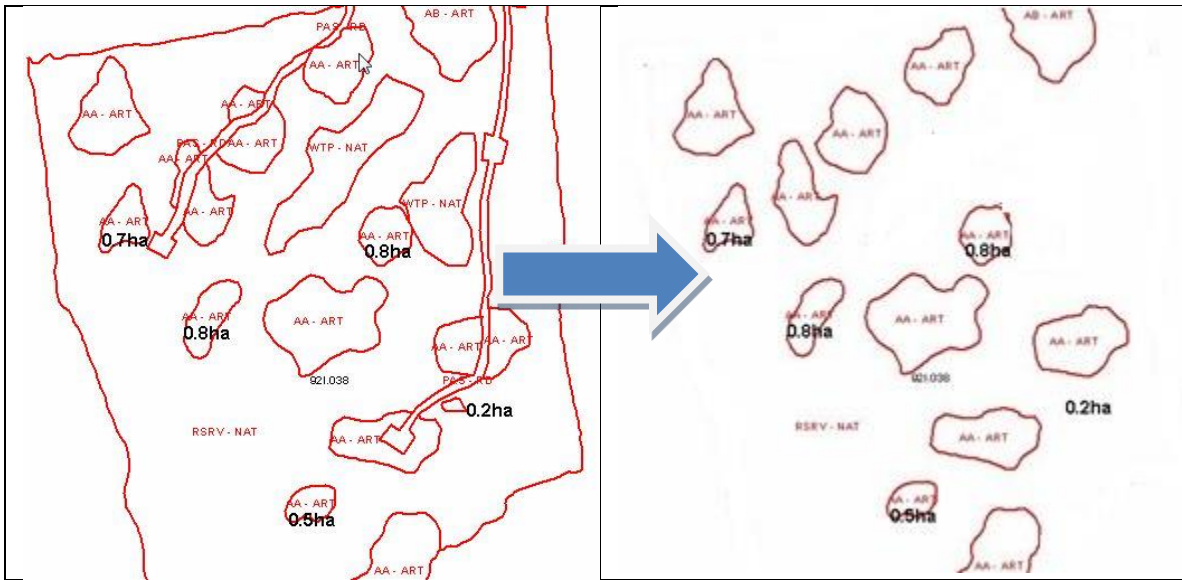


Figure 10. Patch cut example with harvested polygons greater than 0.5ha. Note that only the 0.2ha patch cut was dissolved into the surrounding mature reserve area and that all patches greater than 0.5ha were kept. The RSRV-NAT and WTP-NAT polygons were deleted and added to the area to be inventoried. The road and landing polygons were processed as discussed in Section 2.3.

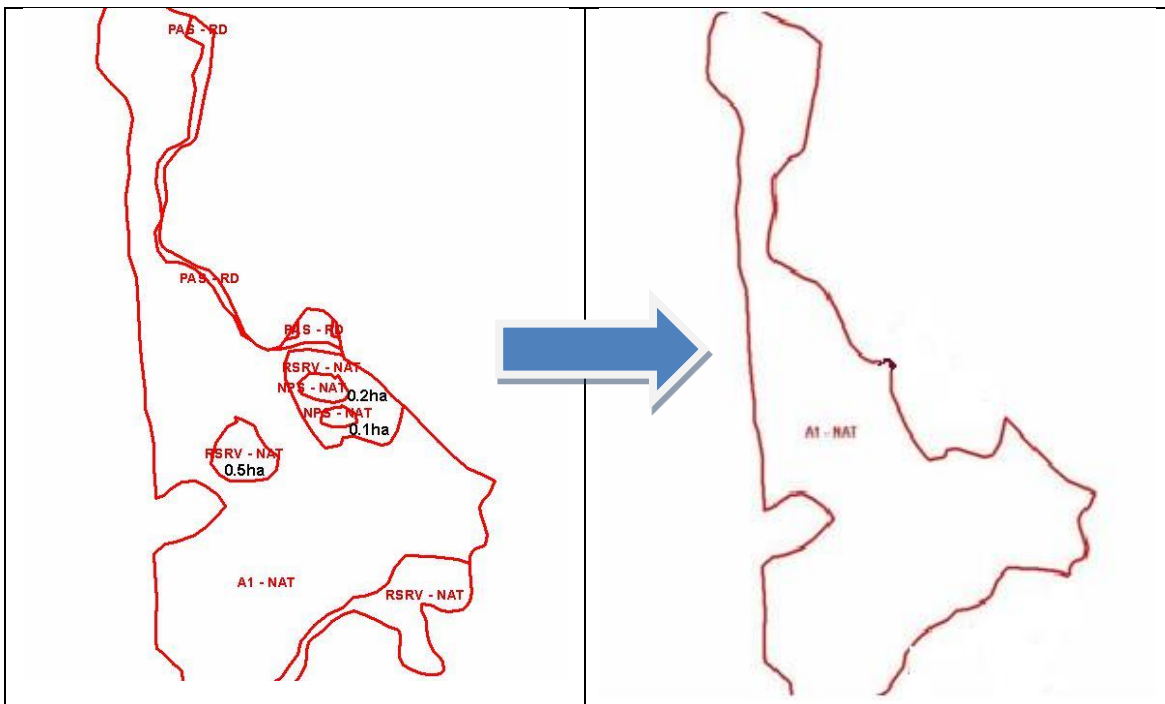


Figure 11. Example of polygons less than 1ha being processed. The 0.5ha polygon is a mature reserve that was dissolved into the surrounding immature 'A1' polygon. The 0.2ha and 0.1ha polygons are non-productive natural that were dissolved into the surrounding 'RSRV' polygon. The RSRV polygons were deleted as they were along the outside of the opening. Once the RSRV polygons were deleted this left a small area linked by a thin (<20m) neck which was deleted. The road and landing polygons are discussed in Section 2.3.

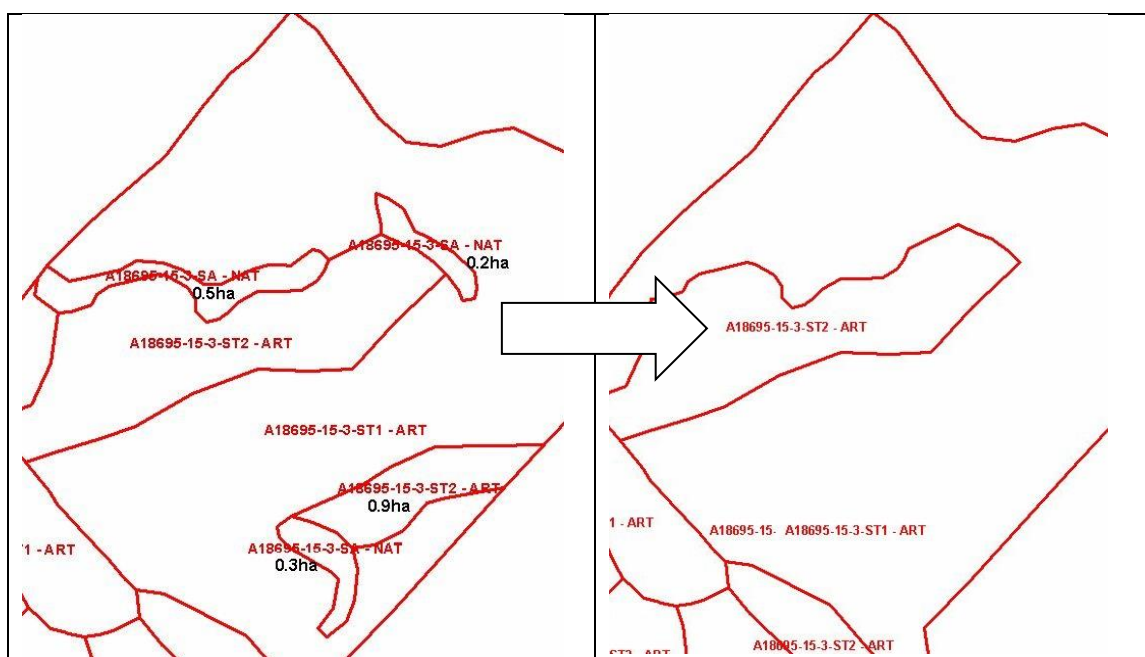


Figure 12. Example of FG opening polygons less than 1ha being processed. The 0.2ha and 0.5ha polygons were adjacent to 2 internal polygons and were dissolved into the largest ‘ST1’ polygon (not ‘ST2’).

2.7 Non Productive Codes

Preparation of RESULTS polygons that contain non-productive codes differs depending on whether the RESULTS data is being prepared for VRI Photo Interpretation or Backlog Free Growing. The contractor must ensure that the final VRIMS output for Backlog Free Growing projects matches appendix B.

2.7.1 VRI Photo Interpretation RESULTS preparation

Where a polygon is non-productive, has one or more tree layers, and visually appears to have been disturbed, steps 2.7.2 and 2.7.3 must be ignored (do not add an “NP CODE” to the FAIB RESULTS Extract). Data from RESULTS will be transferred to the output deliverable formats, and may not pass VegCap validation. The RESULTS preparation contractor will not be responsible for determining missing attributes to meet the “I” standard code.

2.7.2 Backlog Free Growing - NSR

Polygons with ‘STOCKING_STATUS_CODE’ = NSR polygons are only given an NSR NP_CODE if they do not have species, age, height and density as shown in Table 1. If an NP_CODE of NSR is added, ‘SITE_INDEX’, ‘SITE_INDEX_SOURCE_CODE’ and an ‘I_SPECIES_CODE_1’ need to be determined. The ‘I_SPECIES_CODE_1’ is used to populate the VRI site index tree species.

Table 1. NSR lookup Table

STOCKING STATUS	STOCKING TYPE	NP_Code	Description
-----------------	---------------	---------	-------------

CODE	CODE		
NSR	NAT	NSR	Not Satisfactorily Restocked Natural
NSR	NPL	NSR	Not Satisfactorily Restocked Non-Plantable
NSR	PL	NSR	Not Satisfactorily Restocked Plantable

2.7.3 Backlog Free-Growing - Non NSR

A number of RESULTS forest cover polygons are reported with a non-productive ‘STOCKING_STATUS_CODE’ and ‘STOCKING_TYPE_CODE’. Table 2 provides a lookup to correctly identify non-productive labels. Delete all non-productive areas on the edge of a RESULTS opening. Merge non-productive areas that are within a RESULTS opening and less than 1 ha with the largest adjacent polygon. Treat all non-productive areas that are within a RESULTS opening but larger than 1 ha like holes (see Section 2.8).

Table 2. NP Code lookup table.

STOCKING_STATUS_CODE	STOCKING_TYPE_CODE	NP Code	Description
A	NAT	NC-FOR	Alpine
AF	FOR	NC-FOR	Alpine Forest
C	UNN	NP-UNN	Cultivated
G	NAT	ROCK	Gravel Bar
L	NAT	LAKE or RIVER	Lake. Use RIVER where the water body is clearly a river or stream.
M	NAT	NC-FOR	Meadow
NC	BR	NC-FOR	Non-Commercial Brush
NC	FOR	NC-FOR	Non-Commercial Forest
NF	NAT	NP-NAT	Non-Forest Natural
NP	FOR	NP-NAT	Non-Productive Forest
NP	NAT	NP-NAT	Non-Productive Natural
NP	RD	NP-UNN	Non-Productive Unnatural (not including roads and landings – gravel pits only)
NP	UNN	NP-UNN	Non-Productive Unnatural (not including roads and landings – gravel pits only)
NSR	NAT	NSR	Not Satisfactorily Restocked Natural
NSR	NPL	NSR	Not Satisfactorily Restocked Non-Plantable
NSR	PL	NSR	Not Satisfactorily Restocked Plantable
OR	NAT	NP-NAT	Open Range
R	NAT	ROCK	Rock
S	NAT	SWAMP	Swamp
U	UNN	NP-UNN	Urban
		RETENTION	New requirement to flag retention areas so

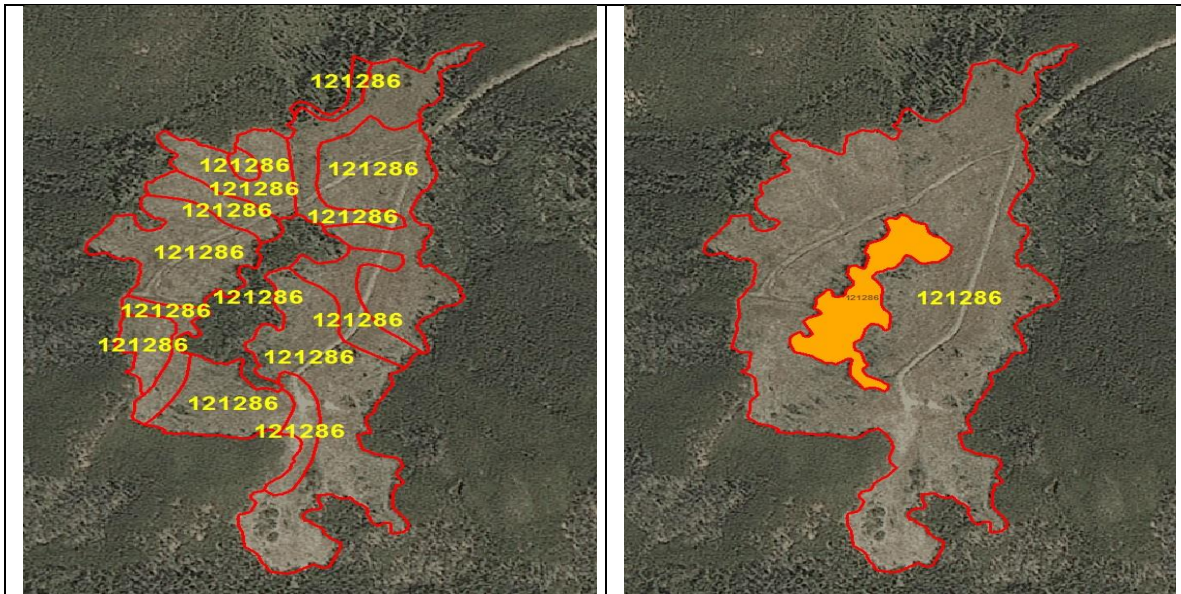
			that FME will remove the Disturbance attributes
--	--	--	---

2.8 Holes

Holes are reserve polygons greater than or equal to 1 ha entirely contained within an opening or within several openings (Figure 13). Create holes in ArcMap in a personal geodatabase as a feature class including the word ‘hole’ in the feature class name. All holes may be created from the codes shown in Table 3. The final FAIB RESULTS EXTRACT should not contain any ‘hole’ polygons or any “MAT NAT” polygons. Hole polygons are either made up of single or multiple polygons that will require classification by the inventory contractor.

Table 3. Hole Code lookup table.

STOCKING STATUS CODE	STOCKING TYPE CODE	SILVICULTURE RESERVE CODE	SILVICULTURE RESERVE OBJECTIVE CODE	Description
MAT	NAT	All Codes	All Codes	Mature Natural
IMM	NAT	Not NULL	Not NULL	Immature Natural



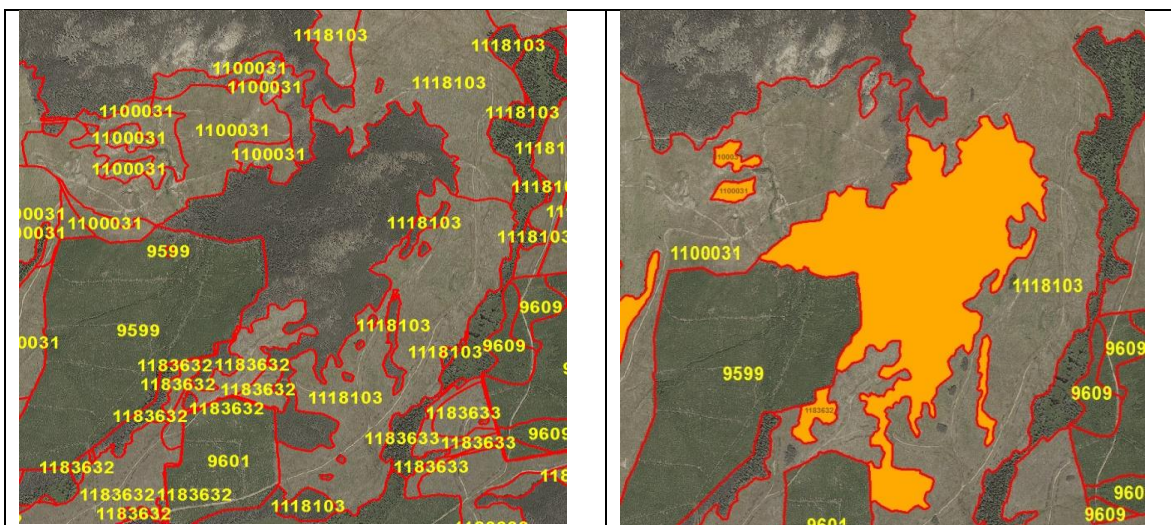


Figure 13. Types of holes (depicted in solid orange). Left are pre-processing and Right are post-processing. The top pair show a hole within Opening 121286. The bottom pair show a hole as a result of mature timber encircled by several Openings namely 1100031 1118103 9599 and 9601.

3 DATA PROCESSING

3.0 Adding Missing RESULTS Attributes

For an average forested RESULTS polygon, there are over 25 attributes that are required by the VRI. Most of these attributes are either always required by RESULTS or are automatically created in the FME translation from the FAIB RESULTS Extract to the deliverable VRIMS Personal Geodatabase format. The exceptions are the following attributes in the FAIB RESULTS Extract that may come to the service provider with Null values:

1. SITE_INDEX
2. SITE_INDEX_SOURCE_CODE
3. X_TOTAL_STEMS_PER_HA
4. X_SPECIES_CODE_X
5. X_SPECIES_PERCENT_X
6. X_SPECIES_AGE_1
7. X_SPECIES_HEIGHT_1
8. X_CROWN_CLOSURE_PERCENT

Fill all null values in the above attributes with the best available information (for a given area of interest) before continuing to the Geometry/Topology Checks and the VegCAP processing, based on the following.

Review the following list of data sources (in this order) to find the information needed to populate the null values:

- 1) RESULTS silviculture layers
- 2) Crown Closure Lookup table (Appendix A)

RESULTS preparation for Backlog Free Growing will also use the following data sources to populate missing attributes. The following data sources will NOT be used for Re-inventory RESULTS preparation.

- 3) RESULTS forest cover history (prorate ages and heights based on the reference years)
- 4) RESULTS attachments
- 5) RESULTS forest cover comments
- 6) RESULTS previous stand information (site index only)
- 7) SiteTools to generate a missing age or height or site index
- 8) Overlapping VRI polygons (ensure that the STOCKING_STATUS_CODE of IMM fit the VRI attributes used)⁴
- 9) Adjacent VRI polygons with similar stand structure in the best available imagery³

Where the 'FOREST_COVER_INV_TYPE' = 'UNKNOWN', the 'I' layer attributes must be moved to the appropriate layer in the multi-layer stand (I1, I2, I3 or I4) then change the 'UNKNOWN' to 'UNEVEN' and populate the impacted I#_FOREST_COVER_LAYER_ID with a unique value so that the stand is processed in FME as a multi-layer stand.

The contractor must ensure that if tree attributes are available in RESULTS they are transformed into the VRIMS PGDB database..

3.1 Geometry/Topology Checks

Complete one or more rounds of geometry checks on the working version of the FAIB RESULTS Extract to ensure that all gaps and overlaps have been corrected. Topology checks should include the following 3 steps:

- 1) Explode all polygons – in ArcMap use the “Explode multi-part feature” (Figure 14). Check the number of records before and after the tool is run. Where new records are created, ensure they meet the appropriate standards described in the sections above.

⁴Change the reference year in the RES_INV_SVW to match the VRI if projected age and height are taken from the VRI. When populating the X_TOTAL_STEMS_PER_HA use the Total Live + Total Dead Stems per Ha from the VRI. Also add the crown closure and change the FOREST_COVER_WHO_UPDATED to the name of your company and the FOREST_COVER_WHEN_UPDATED to the current date if using VRI.

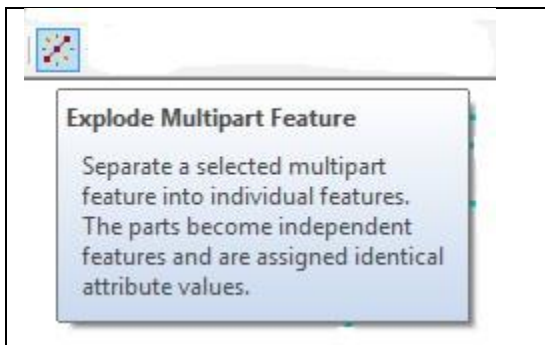


Figure 14. Explode Multipart Feature

- 2) Repair Geometry – In ArcToolbox under Data Management Tools under Features run Repair Geometry on FAIB RESULTS Extract (Figure 15). Check under Geoprocessing open Results tab and check warning (Figure 16). No action will be taken on Self intersections. Any other type of warnings or errors must be fixed.

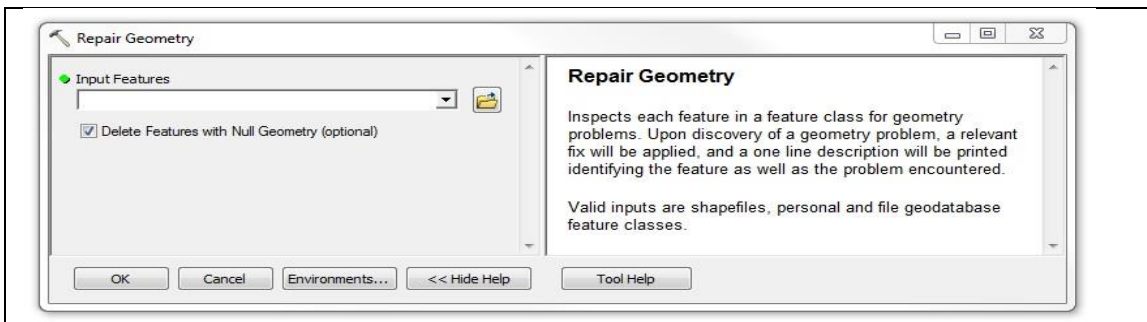


Figure 15. Repair Geometry window

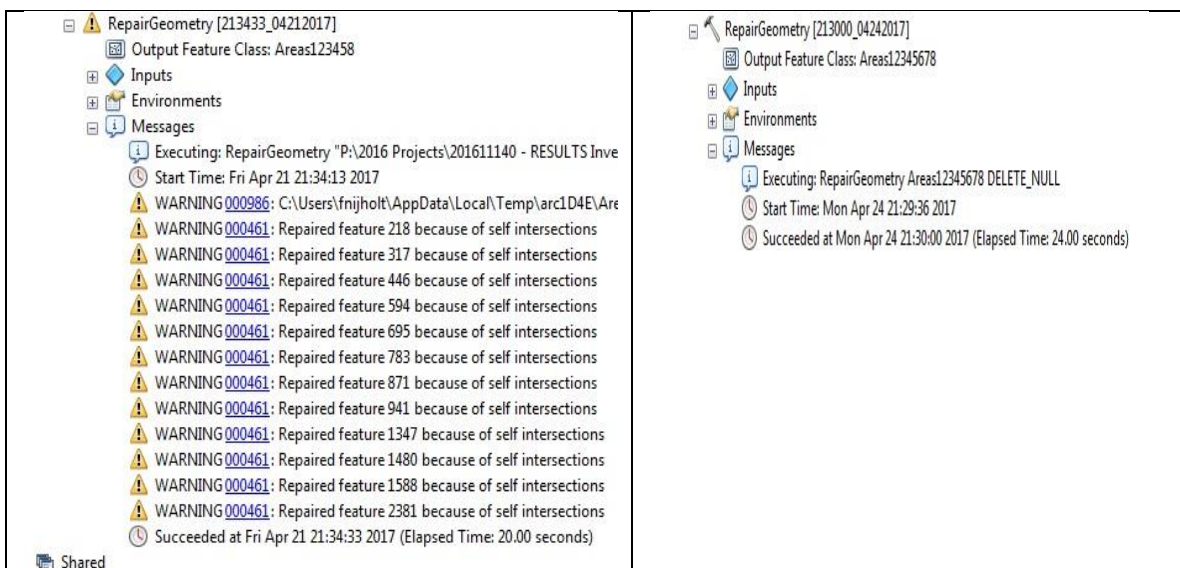


Figure 16. Results window – left panel showing Repair Geometry with repaired self intersection warnings and the right panel showing a successful final Repair Geometry no warnings.

- 3) Build and Check Topology – The VRIMS Personal Geodatabase Structure and Use document - Appendix A⁵ provides cluster tolerance documentation as well as a link to complete topology documentation on how to process topology checks (as below).

<http://resources.arcgis.com/en/help/main/10.1/index.html#//006200000003000000>

The processes outlined in the link must be followed:

- a) Use a cluster tolerance of 0.001 (default)
- b) Add a “Must not overlap” rule
- c) Add a “Must not have gaps” rule

All overlaps must be fixed and there should only be one gap per contiguous polygon. All errors must be reviewed at least once.

The resultant personal geodatabase showing clean topology must be made available to the FAIB Update Team if requested.

3.2 FME Processing

Complete the following steps before running validation in VegCAP:

- Prior to running FME define the openings that you want processed. Populate the “Delivery_Date” and the “Delivery_Mapsheet” in the FAIB RESULTS Extract for the openings of interest.
- Update the “Delivery_Mapsheet” attribute filter to select only the polygons of interest and update the attribute creator in the FME workspace to provide your resultant with the correct “Interpreter” and “Project_Name” variables. The FME workspace creates a deliverable dataset in the ESRI version that is installed on the machine with FME. All ESRI personal geodatabase versions from v9.2 to 10.1 are currently supported. All other versions will need to be tested by the FAIB Update Team before being accepted.

The FAIB RESULTS Extract dataset needs to be converted to the deliverable VRIMS Personal Geodatabase format prior to VegCAP processing and final deliverable packaging. An FME workspace will be provided to complete this conversion. To run the FME workspace, there are 5 key edits that need to be made:

1. Update the “Source ESRI Geodatabase” (A) path to the FAIB RESULTS Extract dataset.
2. Update the “Destination ESRI Geodatabase” (B) path to a new location on a local server.
3. Update the “DELIVERY_BATCH” (C) to filter only the openings that are going to be added to the output. Re-connect the black arrow coming out of the “AttributeFilter” to connect it with the “Timestamp” below.

⁵Ministry of Forests and Range. 2015. VRIMS Personal Geodatabase – Structure and Use. Version 2.0. January, 2015. 69 pp.

4. Update the “PROJECT_NAME” (D).
5. Add a ‘Fanout Dataset’ (E) to batch the deliverables in FME.

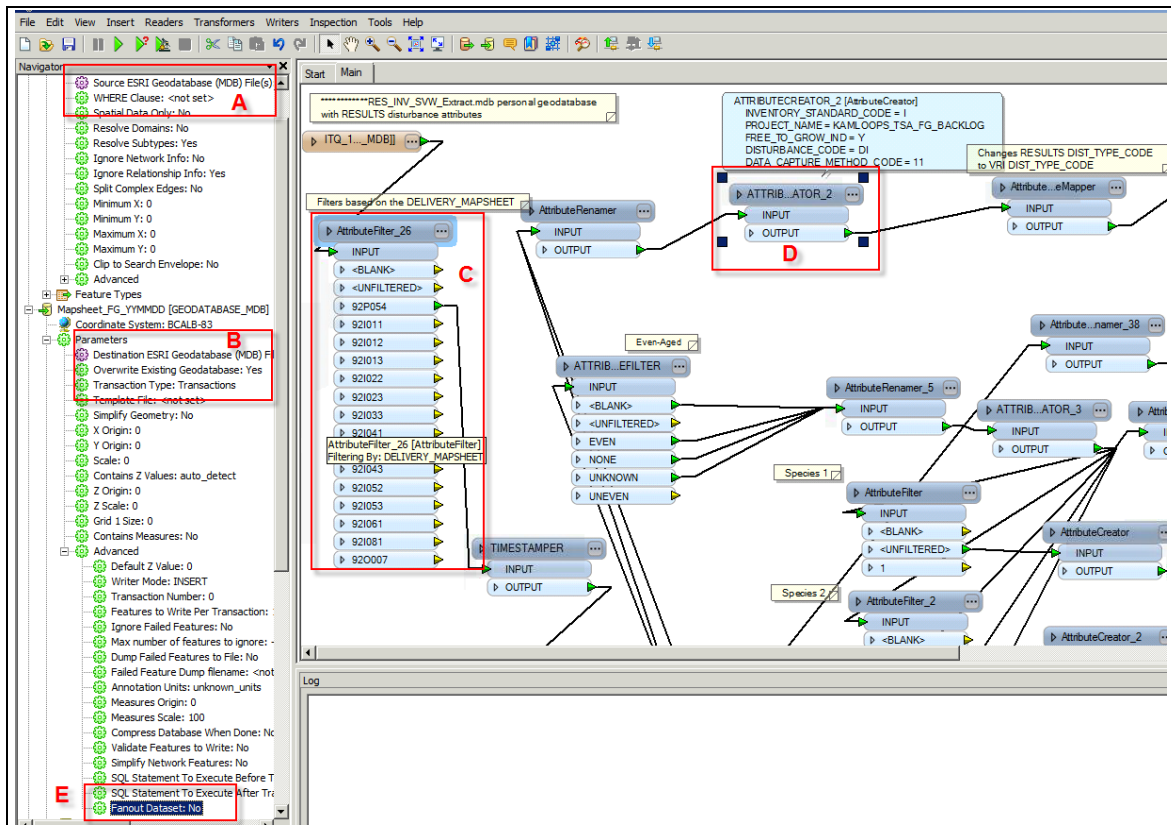


Figure 17. FME workspace.

Do not alter any of the paths (black arrows) or transformers (blue boxes) without consulting the FAIB Update Team first.

3.3 VEGCAP Processing

The FME output results in 3 to 6 files but there is a total of 7 required:

1. FOREST_COVER_OBJECT
2. LAND_COVER_COMPONENT_EST
3. NON_VEGETATIVE_COVER_EST
4. TRANSACTION
5. TREE_COVER_LAYER_ESTIMATED
6. TREE_SPECIES_ESTIMATED
7. VEGETATION_COVER_POLYGON_EST

A Blank VRIMS format table is provide so that the missing tables can be copied to the final deliverable. Only the “TRANSACTION” table must be exported to the FME output. The blank tables include:

- LAND_COVER_COMPONENT_EST

- NON_VEGETATIVE_COVER_EST
- TRANSACTION
- VEGETATION_COVER_POLYGON_EST

The VegCap Process is as follows:

- 1) In ArcMap startup the VegCap-II-for-Contractors.mxd (Figure 18).

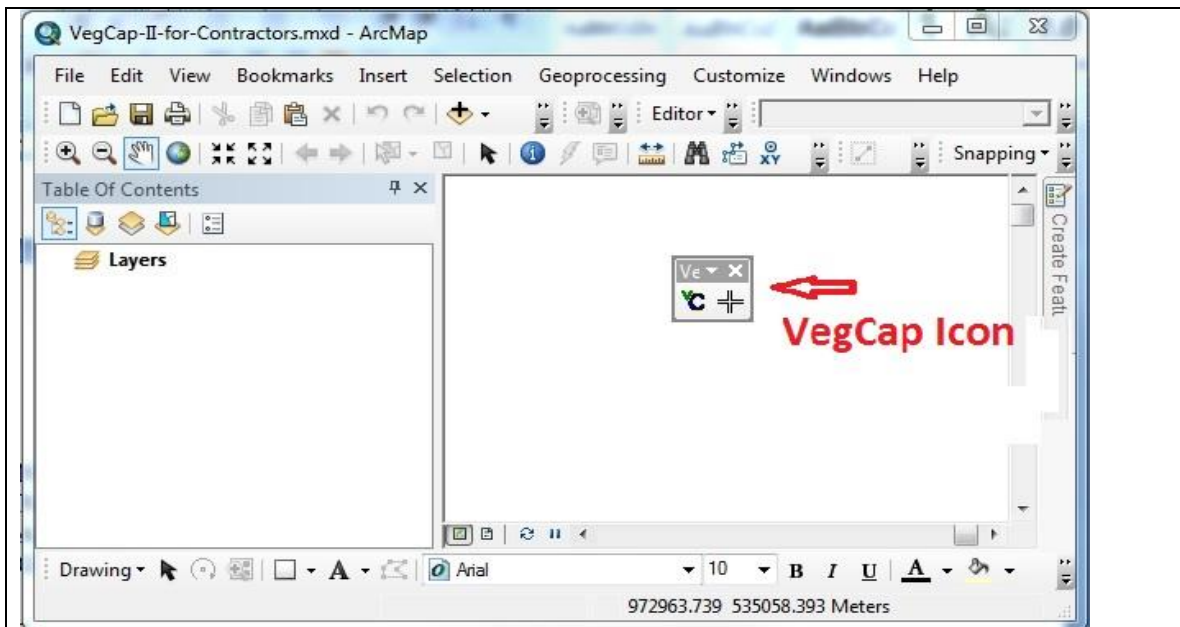


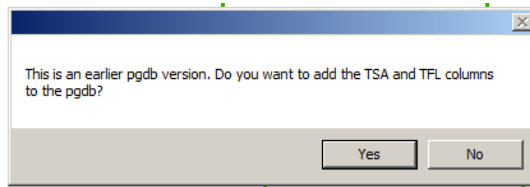
Figure 18. VegCap mxd

- 2) From Arc_Catalogue add in the TRANSACTION table and update the Entry_Timestamp the Checked_OUT_BY attributes. The Transaction_ID will always be “-2”, the PGDB version will always equal “1.0” and the VRIMS_Transaction_Type_Code will always equal “NNR”. Then export the table to the FME output table and delete from the VegCap mxd.

TRANSACTION					
OBJECTID	TRANSACTION_ID	CHECKED_OUT_BY	PGDB_VERSION	ENTRY_TIMESTAMP	VRIMS_TRANSACTION_TYPE_CODE
1	-2	CTQ	1.0	2014-11-21	NNR

Figure 19. Deliverable personal geodatabase transaction table.

- 3) From Arc_Catalog add in the FOREST_COVER_OBJECT feature class layer that was created by FME to the VegCap mxd in Arcmap.
- 4) Select "Yes" when prompted to add the TSA and TFL columns to the PGDB.



- 5) Select all the polygons in the FOREST_COVER_OBJECT layer and launch VegCap. The VegCap software imports all the rows of data from the FOREST_COVER_OBJECT. Validate all the polygons in the FOREST_COVER_OBJECT table. Create a Report from VegCap. For Backlog Free Growing projects, all “Errors” identified in the VegCAP report must be addressed prior to delivery to the FAIB Update Team. Re-inventory projects may have some errors allowed as per sections 3.0 and 3.1. Only edit attributes based on “Warnings” that are applicable to the forest inventory project (e.g. the ratio of Age to Height is greater than 30 should be fixed).

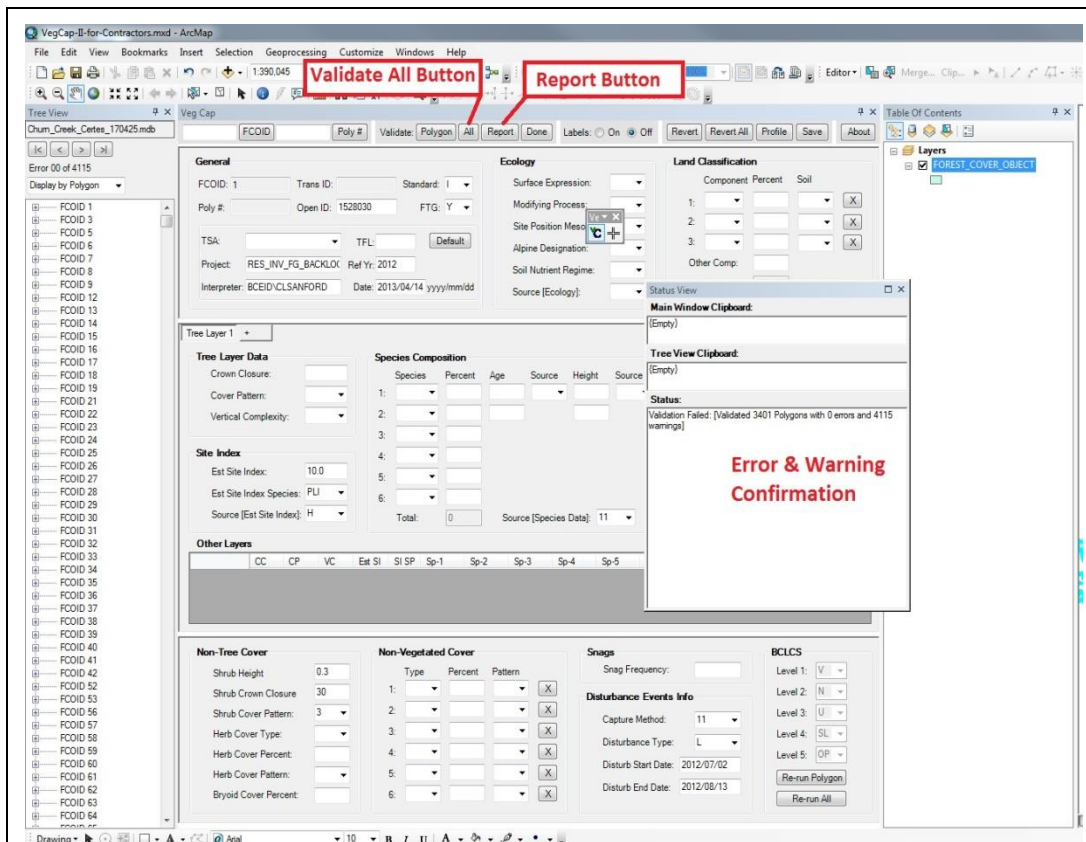


Figure 20. VegCap Attribute Validation Tool

6) The following table lists some of the most common errors and solutions.

Table 4. VegCAP error messages and service provider solutions.

Error Code	Solution
BCLCS Level 1 and 2: Consistency Check	Using the ArcMap select tool, select all the openings of interest and in VegCAP select Edit>>>Calculate All BCLCS
BCLCS 4 or 5: Consistency Check	This is most likely caused by: <ul style="list-style-type: none"> - A single layer stand incorrectly added to a RESULTS layer 1, 2 or 3 with a crown closure less than 11%. - A single layer stand with a crown closure of less than 3% - A multi-layer stand with a crown closure = 1% in all layers. In each case update the crown closure using the Appendix A lookup table to a sum of at least 11%.
Crown Closure Percent Sum Consistency	Follow the steps outlined in Section 3.0. Where the sum of the crown closure % in multi-layer RESULTS polygons is > 100%, prorate the crown closure percent to 100%.
Crown Closure Percent Format Range Check	This is most likely caused by a crown closure = 0%. Update the crown closure using the Appendix A lookup table to a sum of at least 11%.
Site Index Range Check & Tree Cover Layer Null Check	Follow the steps outlined in Section 3.0
Interpretation Date Check	This is likely caused if the reference year was updated because VRI attributes were used and the FOREST_COVER_WHEN_UPDATED was not changed.
Tree Species Percent Sum	The conversion from RESULTS to the FAIB RESULTS Extract format restricts the number of species to 5. Add the missing percentage to species 1.
Height Null Check & Tree Cover Layer Height Consistency	Follow the steps outlined in Section 3.0
Age Null Check	Follow the steps outlined in Section 3.0
Age Range Check	Follow the steps outlined in Section 3.0
Age-Height Check	Follow the steps outlined in Section 3.0
Missing Site Index	Follow the steps outlined in Section 3.0
Missing Crown Closure	Follow the steps outlined in Section 3.0
Missing Total Stems	Follow the steps outlined in Section 3.0

3.4 VegCap Validation

Full validation is required for backlog free growing projects. Validation errors are permissible in re-inventory preparation project polygons, ONLY where attributes are missing from the available data sources as per section 3.0, points 3 through 10 above

3.5 Deliverable Packaging

FINAL DELIVERABLE CREATION

- As the last step in polygon processing, create a points feature class from VRIMS Deliverable, joining all tables into the final .mdb, using the template provided.
- Add the holes feature class to the final .mdb. (Section 0)
- Use the “DELIVERY_BATCH” and “DELIVERY_DATE” attributes to track the openings provided. The naming convention for each of the deliverables will be Local_Name_Company_YYYYMMMDD
e.g.Churn_Creek_Certes_2017MAY01.mdb.
- For a detailed description of the personal geodatabase data structure, see the VRIMS Personal Geodatabase Structure and Use document.⁶ This data structure must be followed. One feature class (TRANSACTION) and six tables as well as a feature class containing the “holes” (see Section 0) and “points” included in the personal geodatabase. The most recent tracking spreadsheet will also be added to the deliverable.

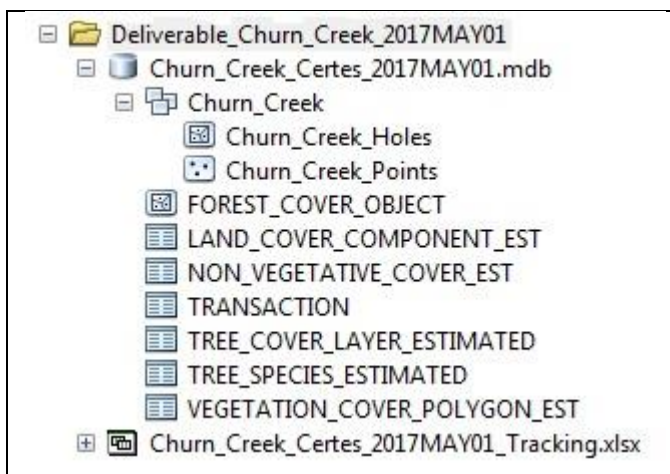


Figure 21. Deliverable List

TRANSFERRING DELIVERABLES TO THE FAIB UPDATE TEAM

All deliverables will be compacted in ArcCatalog and delivered as per the Schedule A of the contract.

⁶Ministry of Forests and Range. 2009. VRIMS Personal Geodatabase – Structure and Use. Version 1.2. April, 2009. 72 pp.

4 Standards

All of the procedures follow the guidelines in the “VRI Photo Interpretation Procedures” focusing mainly on Appendix A “Photo Interpretation Guidelines for Integrating RESULTS Information.”³

The procedures in the previous section outline the recommended steps to complete the work. The spatial editing (the majority of the work) can be completed using a variety of different tools in ArcGIS or even altogether different software packages.

Any deliverables not meeting the standards outlined below will be returned for corrections. A sample of openings identified in the tracking spreadsheet as “Removed from the deliverable” will also be reviewed.

Table 5. Standards.

Description	Standard
Spatial	
Positional Accuracy	No more than 20m off the best available imagery Described in Section 2.0.
Spatial Gaps	Roads and Landings = No less than 40m Not Roads and Landings = No less than 1.0ha or 20m Described in Section 2.2 and Section 2.3
Spatial Overlaps	None Described in Section 2.2
Spikes	Maximum spike width = 10m Maximum spike width/length ratio = 5
Gores	Maximum gore width = 1m Maximum gore width/length ratio = 5
Polygon Size	Not less than 1.0ha unless it is: a) Greater than 0.5ha harvested standalone polygon; or b) Greater than 0.5ha harvested polygon in a patch cut.; or c) Greater than 0.3ha single stand alone harvested polygon Described in Section 2.5
Multi-part Geometry	None
Topology (upon request)	Include a deliverable PGDB with topology that shows no errors. Described in Section 0
Other	
VegCAP	No errors. Warnings are acceptable. Described in Section 3.2
Deliverable Personal Geodatabase Format and Content	Described in Section 3.5
Tracking Spreadsheet	Described in Section 3.5

5 Software/Hardware Requirements and Source Data

5.0 Hardware and Software Requirements

The following are required:

Hardware / Software	Comment
ArcGIS - ArcEditor 10x or ArcGIS - ArcInfo 10x	Spatial data will be delivered and returned in ESRI ArcGIS v10x personal geodatabase format. To run topology either: a) ArcInfo with a ArcEditor license ; or b) Arcmap with Spatial Analyst Extension
VegCAP for Contractors	ArcGIS tool used to validate VRI attribute data. VegCAP can be downloaded at: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/forest-cover-inventories/photo-interpretation/standards/ VEGCAP Software Download VEGCAP Software Download for Contractors Update
High speed Internet connection	Contractors will routinely transfer large datasets to and from the FAIB Update Team
Microsoft Excel	Tracking spreadsheet
FME	An FME workspace will be provided by the FAIB Update Team. This FME workspace is needed to convert the RES_FC_Extract to the deliverable personal geodatabase format.

5.1 Source Data

The following datasets, worksheets and documents are required:

Name	Source	Comment
FAIB RESULTS Extract	FAIB Update Team	Personal geodatabase containing the RESULTS openings of interest.
BCGS 1:20,000 Grid	BCGW	
Satellite Imagery	BlackBridge Geomatics	Streaming Image Content
Tracking	FAIB Update Team	Tracking spreadsheet template
Topology_Template.mdb	FAIB Update Team	MDB template used to check topology
VRIMS Personal Geodatabase Structure and Use. Version 2.0.	FAIB Website	This document describes the structure of the deliverable personal geodatabase ⁷
VRIMS Veg. Cover Polygon Validation Rules. Version 2.0.0.	FAIB Website	This document specifies the validation rules for Vegetation Cover Polygons defined in the VRI data model ⁸

⁷https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/forest-cover-inventories/photo-interpretation/standards/VRIMS_Personal_Geodatabase_Structure_and_Use_V2.0.pdf

⁸https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/forest-cover-inventories/photo-interpretation/standards/VRIMS_Vegetation_Cover_Polygon_Validation_Rules_V2.0.0.pdf

BCGW Standard Base Layers clipped to project extent	FAIB Update Team	Standard Base Layers used to replace TRIM base data
---	------------------	--

Appendix A – Crown Closure Lookup Table

The following crown closure lookup table is from page 267 of the 2013 Silviculture Survey Procedures Manual.⁹, and has been modified by FAIB for VRI RESULTS Preparation contracts.

Height	Density (sph)												
	0- 49	50- 99	100- 199	200- 499	500- 999	1000- 1499	1500- 1999	2000- 2999	3000- 3999	4000- 4999	5000- 5999	6000- 7999	8000- 9999+
0.0-0.4	1	1	1	1	2	3	5	5	7	10	12	15	20
0.5-0.9	1	2	2	2	4	8	10	15	18	20	25	30	35
1.0-1.4	1	2	3	3	6	10	13	20	25	30	35	40	50
1.5-1.9	1	2	4	4	8	15	18	25	30	35	40	50	60
2.0-2.9	1	3	5	10	15	20	25	35	40	45	50	60	70
3.0-3.9	1	4	7	15	20	25	30	40	45	50	55	65	75
4.0-4.9	1	5	9	20	25	30	35	45	50	55	60	70	80
5.0-5.9	2	6	11	25	30	35	40	50	55	60	65	75	85
6.0-6.9	2	7	13	30	35	40	45	55	60	65	70	80	90
7.0-7.9	2	8	15	35	40	45	50	60	65	70	75	85	95
8.0-8.9	2	9	17	40	45	50	55	65	70	75	80	90	95
9.0-11.9	3	10	20	50	55	60	65	75	80	85	90	100	100
12.0-14.9	3	10	25	55	60	65	70	80	85	90	95	100	100
15.0+	3	10	25	60	65	70	75	85	90	95	100	100	100

Percent crown closure calculated are only to be used as a guideline. Actual Crown Closure may vary by +/- 20% depending upon species composition and variability in height and distribution of stems. This table often over estimates crown closure on young trees in the interior of BC.

⁹Ministry of Forests, Lands and Natural Resource operations. 2013. Silviculture Survey Procedures Manual - Regen Delay, Stocking and Free Growing Surveys - plus Alternative Survey Methodologies. April 1, 2013. Available at: http://www.for.gov.bc.ca/hfp/silviculture/Surveys/SilvicultureSurveyProceduresManual-April_1_2013.pdf

Appendix B – VegCAP Non-productive Codes

NC-FOR

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 19615

Inventory Standard:

Interpreter: DAN_TURNER Interpretation Date: 2013/10/17
Project: MERRITT_TSA_FG_BA Year of Photo: 1989

General / Ecology

Surface Expression: Modifying Process: Site Position Meso:

Alpine Designation: Soil Nutrient Regime: Data Source [Ecology]:

Land Classification

Land Cover Component: 1 ST Percent Coverage: 100 Soil Moisture Regime: 3

2

3

Other Percent Coverage:

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 24129

Site Index

Layer Level	Est Site Index	Est Site Index Species	Est Site Index Src	Crown Closure	Cover Pattern
*					

Species Composition

Species	Pct
*	

Total %: 0.0

Data Source:

Leading Species

Age: Data Source [Age]:

Height: Data Source [Height]:

Second Species

Age: Height:

Vertical Complexity:

Mensurational Data

Basal Area: Data Source [Basal Area]:

Density: Data Source [Density]:

14 of 49 Go To VCID Details Validate Save Revert Close

Validation failed. Validation errors on polygons with errors and no warnings.

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 19615

Non Tree Cover

Shrub Height: 2.5 Shrub Crown Closure: 60 Shrub Cover Pattern: 8

Herb Cover Type: Herb Cover Percent: Herb Cover Pattern:

Bioid Cover Percent:

Non Veg

Cover Type	Cover Pattern	Cover Percent
*		

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 19615

BCLCS Level 1: V

BCLCS Level 2: N

BCLCS Level 3: U

BCLCS Level 4: ST

BCLCS Level 5: OP

ROCK

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 10547

Interpreter: DAN_TURNER Interpretation Date: 2013/10/17
YYYY/MM/DD

Inventory Standard: I Project: MERRITT_TSA_FG_BA Year of Photo: 2001

Manage Defaults

General / Ecology

Surface Expression: Modifying Process: Site Position Meso:

Alpine Designation: Soil Nutrient Regime: Data Source [Ecology]:

Land Classification

Land Cover Component: 1 RO Percent Coverage: 100 Soil Moisture Regime: 1 Delete

2 Delete

3 Delete

Other Percent Coverage:

Snag Frequency: Opening ID: -276130000

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 24129

Site Index

Layer Level	Est Site Index	Est Site Index Species	Est Site Index Src	Crown Closure	Cover Pattern
*					

Species Composition

Species	Pct
*	

Total %: 0.0

Data Source:

Leading Species

Age: Data Source [Age]:

Height: Data Source [Height]:

Second Species

Age: Data Source [Age]:

Height: Data Source [Height]:

Mensurational Data

Basal Area: Data Source [Basal Area]:

Density: Data Source [Density]:

Vertical Complexity:

14 of 49 Go To VCID Details Validate Save Revert Close

Validation failed: Validated 43 polygons with 2 errors and 40 warnings.

WAT

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 10545

Non Tree Cover

Shrub Height: Shrub Crown Closure: Shrub Cover Pattern:

Herb Cover Type: Herb Cover Percent: Herb Cover Pattern:

Bryoid Cover Percent:

Non Veg

Cover Type	Cover Pattern	Cover Percent
BR	8	100
*		

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 38208

BCLCS Level 1: N

BCLCS Level 2: L

BCLCS Level 3: U

BCLCS Level 4: RO

BCLCS Level 5: BR

Generate BCLCS

SWAMP

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 3459

Inventory Standard:

NP-NAT

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 5338

Inventory Standard:

Interpreter: DAN_TURNER Interpretation Date: 2013/10/18
Year of Photo: 1993

Project: MERRITT_TSA_FG_BA

Manage Defaults

General / Ecology

Surface Expression: Modifying Process: Site Position Meso:

Alpine Designation: Soil Nutrient Regime: Data Source [Ecology]:

Land Classification

Land Cover Component: 1 SL Percent Coverage: 100 Soil Moisture Regime: 3 Delete

2 Delete

3 Delete

Other Percent Coverage:

Snag Frequency: Opening ID: 22095

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 24129

Site Index

Layer Level	Est Site Index	Est Site Index Species	Est Site Index Src	Crown Closure	Cover Pattern
*					

Species Composition

Species	Pct
*	

Total %: 0.0

Data Source:

Leading Species

Age: Data Source [Age]:

Height: Data Source [Height]:

Second Species

Age: Basal Area:

Height: Data Source [Basal Area]:

Vertical Complexity: Density: Data Source [Density]:

Mensurational Data

Basal Area: Data Source [Basal Area]:

Density: Data Source [Density]:

Go To VCID: Details Validate Save Revert Close

Validation failed. Validation for polygons with errors and no warnings.

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 5338

Non Tree Cover

Shrub Height: 0.5 Shrub Crown Closure: 40 Shrub Cover Pattern: 8

Herb Cover Type: Herb Cover Percent: Herb Cover Pattern:

Bryoid Cover Percent:

Non Veg

Cover Type	Cover Pattern	Cover Percent
*		

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 5338

BCLCS Level 1: V

BCLCS Level 2: N

BCLCS Level 3: U

BCLCS Level 4: SL

BCLCS Level 5: DP

Generate BCLCS

LAKE and RIVER [Land Cover and Non-Veg Cover Type = 'LA' or 'RI']

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 3331

Inventory Standard: I

Interpreter: DAN_TURNER Interpretation Date: 2013/10/17

Project: MERRITT_TSA_FG_BA Year of Photo: 1991

Manage Defaults

General / Ecology

Surface Expression: Modifying Process: Site Position Meso:

Alpine Designation: Soil Nutrient Regime: Data Source [Ecology]:

Land Classification

Land Cover Component: 1 LA Percent Coverage: 100 Soil Moisture Regime: 8 Delete

2 Delete

3 Delete

Other Percent Coverage:

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 24129

Site Index

Layer Level	Est Site Index	Est Site Index Species	Est Site Index Src	Crown Closure	Cover Pattern
*					

Species Composition

Species	Pct
*	

Total %: 0.0

Data Source:

Leading Species

Age: Data Source [Age]:

Height: Data Source [Height]:

Second Species

Age: Height:

Mensurational Data

Basal Area: Data Source [Basal Area]:

Density: Data Source [Density]:

Vertical Complexity:

Go To VCID Details Validate Save Revert Close

Validation failed. Validated 43 polygons with 2 errors and 40 warnings.

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 3331

Non Tree Cover

Shrub Height: Shrub Crown Closure: Shrub Cover Pattern:

Herb Cover Type: Herb Cover Percent: Herb Cover Pattern:

Bryoid Cover Percent:

Non Veg

Cover Type	Cover Pattern	Cover Percent
LA	8	100
*		

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 3331

BCLCS Level 1: N

BCLCS Level 2: W

BCLCS Level 3: W

BCLCS Level 4:

BCLCS Level 5: LA

Generate BCLCS

NSR

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 31121 Interpreter: CTQ Interpretation Date: 2013/11/18
Inventory Standard: [dropdown] Project: MERRITT_TSA_FG_BA Year of Photo: 2001

General / Ecology
Surface Expression: [dropdown] Modifying Process: [dropdown] Site Position Meso: [dropdown]
Alpine Designation: [dropdown] Soil Nutrient Regime: [dropdown] Data Source [Ecology]: [dropdown]

Land Classification
Land Cover Component: 1 [dropdown] Percent Coverage: [input] Soil Moisture Regime: [dropdown] [Delete]
2 [dropdown] [input] [dropdown] [Delete]
3 [dropdown] [input] [dropdown] [Delete]
Other Percent Coverage: [input]

Snag Frequency: [input] Opening ID: 97721

K < > > 162 of 198 Go To VCID Details Validate Save Revert Close

Validation failed. Validated 130 polygons with 2 errors and 204 Warnings.

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 30716

Site Index

Layer Level	Est Site Index	Est Site Index Species	Est Site Index Src	Crown Closure	Cover Pattern
1	15.0	PL	H		

Species Composition

Species	Pct
*	

Total %: 0.0
Data Source: 0

Leading Species
Age: [input] Data Source [Age]: [dropdown]
Height: [input] Data Source [Height]: [dropdown]

Second Species
Age: [input]
Height: [input]

Mensurational Data
Basal Area: [input]
Data Source [Basal Area]: [dropdown]
Density: [input] Data Source [Density]: [dropdown]

Vertical Complexity: [dropdown]

K < > > 28 of 209 Go To VCID Validate Save Revert Close

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 30716

Non Tree Cover
Shrub Height: 0.3 Shrub Crown Closure: 30 Shrub Cover Pattern: 3
Herb Cover Type: [dropdown] Herb Cover Percent: [input] Herb Cover Pattern: [dropdown]
Bryoid Cover Percent: [input]

Non Veg

Cover Type	Cover Pattern	Cover Percent
*		

VRIMS - VegCap II

File Edit Help

Polygon Layer Non Tree Disturbance BCLCS

Vegetation Cover Id: 30716

BCLCS Level 1: [dropdown]
BCLCS Level 2: [dropdown]
BCLCS Level 3: [dropdown]
BCLCS Level 4: [dropdown]
BCLCS Level 5: [dropdown]

Generate BCLCS

