Selkirk College

SGRC

GIS 492 Report

Forest Health Project with the

Ministry of Forests and Range

Kootenay Lake Forest District

Prepared for

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Introduction

During my 3 years with the Ministry of Forests and Range (MOFR) at the Kootenay Lake Forest District, I have been involved in assisting the Forest Health section with data manipulation, analysis and map creation. With the mass invasion of the mountain pine beetle (*dendroctonus ponderosae*) in our province, the MOFR has been actively monitoring and working with licensees on the best management practices to combat the spread and to best utilize the stands of infested trees.

The monitoring and activities done by the MOFR consists of 2 types of data collection procedures and follow-up actions. One is a detailed collection method. This method is a more rigorous method that is done only on a part of the district that can still be successful in eradicating the beetle and saving some mature trees.

The second method, and one this project describes, is the overview collection method. This is done on the entire forest district/region. The aerial flights are organized by the regional staff. In the summer, the regional staff has the infested areas mapped into points and polygons using low elevation aircraft flights. The aerial flights collect infestations from such pests as the mountain pine beetle, douglas fir beetle and spruce bark beetle, to name a few. These are the three pests that are closely monitored by the Kootenay Lake Forest District. This map is then digitized by a contractor and two layers are provided to the district.

Once this data is made available, it is my responsibility to create maps for review, analysis, discussions and planning purposes. Using these maps as the basis for discussions, the Forest Health Officer meets with the licensees to determine what actions they will be doing to address the current mountain pine beetle infested areas. Once it is determined which infestations are <u>not</u> being addressed by the licensees, these areas of

interest (AOI's) are circled on the maps and the action that needs to be done for them is determined.

The project I am about to describe is the detailed analysis work done with these AOI's. The output from this project was to analyze the AOI's as to their hazard classes, operability, actions required and calculate how much area is infested within each licensee's operating area.

Project Description

Inputs:

Several layers the Ministry of Forests already had created were used in this analysis. The following is a brief description of these layers.

Hazard rating – this identifies which stands that can expect to have mountain pine beetle activity.

Operability – this identifies the stands that are accessible for harvesting.

Operating areas – this identifies the licensee operating areas within the district.

Landscape Units – this identifies the landscape units within the district.

Infestation overview polygons – these are areas that have infestations with attributes such as severity code collected by the MOFR regional office.

Infestation overview points – areas where there are 10 or fewer trees infested.

Methodology:

The initial maps used by the licensees and the Forest Health Officer were created for the entire district at a scale of 1:50,000. An example of such a map can be seen in Appendix 1. All the input layers are shown on the map. On the map, Provincial and National Parks are the base layer. MPB hazard ratings were placed with the darkest purple showing the most hazard and varying lighter shades of purple with less hazard. All overview points and polygons were then added as red, and lastly the base layer features (water, contours, etc) were added. Landscape Units and Licensee Operating Areas are shown for reference as hollow polygons, with labels. Areas where the operability is classed as inaccessible are shown with hatched hollow lines. Coordinating the layers in the right order with the right shade of color or hatching is very important so that the all features are visible and not one is overpowering in the map.

With these maps the Forest Health Officer met with each Licensee. They discussed which areas the Licensee was going to harvest in the near future. The remaining areas of concern were circled on the map. These areas either had infestations in them or were very high hazard, or both. The maps were then taken to the Copy Shop in Kamloops where they scanned the maps (34" X 44") and produced a CD with all the maps in jpg format. (Biznet in Castlegar now also offers this service).

All the layers in the jpg map were loaded into an ArcMap session along with the jpg map. Having all the layers present made it easier to find the point in the ArcMap session that corresponded to the jpg map. Using the *Georeferencing toolbar - Fit to Display* brought the picture into the space where the ArcMap session was. Using a point in each of the four corners of the jpg map, each point is snapped to the same point in the ArcMap

session. *Georeferencing toolbar - Add Control Point* tool was used to does this. The point in the jpg is selected first, then the corresponding point in the ArcMap session is selected. This snaps the jpg point to the point in the ArcMap session. As each corner of the jpg is snapped into place the picture is stretched to its correct place, also. *Georeferencing toolbar - update georeferencing* saves the Georeferencing work. This creates a file with the same name as the jpg with the extension .aux which stores the georeferencing information.

ArcScan was then used to digitize the polygons that were drawn on the maps. First the color and thickness of the line was selected to match the color and thickness of the line work (circles) on the jpg map. Raster snapping was then used to snap to the AOI lines and digitize all the polygons. After the AOI polygon layer was created, attribute data was assigned to each polygon. On the jpg map the polygons were all numbered. This number was added as an attribute to identify each polygon. The Forest Health Officer provided a spreadsheet with the actions that were required for each polygon. A column was added called Action and populated from this spreadsheet. Such actions as one of the following were added: Proposed Development, Reconnaissance (Recce), Monitor, Development Optimized, Insignificant Hazard, or Abandon.

Using this AOI layer, the Hazard Class Rating polygons and Overview polygons and points were selected if they fell within these areas. They were then exported into a separate layer. In order to better analyze the selected Overview Points with the selected Overview Polygon information, the Overview Points needed to be converted into a polygon layer. The way this was done was to buffer the Overview points. It is assumed (as a standard practice) that each point covers 0.25 of a hectare. Therefore the equation to determine the size of the buffer to use was determined by figuring out for radius in the

following formula: 0.25 hectare = *Pi* * radius. The result for radius is 28.2 meters. This is the distance to be used to buffer the Overview points.

To complete the analysis, all the layers that were created from the selected AOI's area were joined together into one layer. First the new polygons layer, from the buffered Overview points, was joined with the Overview Polygons using the *Union tool*. This new layer was then combined with the extracted Hazard Class Rating layer using the *Identity tool*. The Landscape Units, Operability and the Operating Areas were also added using the *Identity tool*, one at a time.

The result of combining all the layers together created slivers with areas that were too small for detailed analysis. The *Eliminate tool* was then used to merge these slivers into the polygon with the largest edge adjacent to it. The method to use the *Eliminate tool* is to select the polygons that are to be eliminated and then run the process. From the data manipulation the area fields were incorrect. The *XTools toolbar- calculate table – area* process was used to populate the correct area into the attribute table. With this tool you can select to update the area, perimeter, hectares and area fields all at once or individually in the units of your choice (meters).

To identify whether a feature was infested, another column called "Infested" was added to the attribute table. We know that if there were any overview polygons or points attribute information within a feature then the feature is infested. If the unique identifier for the Overview Points or Overview Polygons was present in the attribute table, (not null) then the feature was infested. These features were selected and the Infested column was populated with Y. By doing a reverse selection the remaining Infested column was populated with N. This completed the ArcMap portion of the analysis.

In order to create charts and tables MS Access was used. The shapefile was saved as a personal geodatabase (in MS Access). The geodatabase created an MS Access table with the shapefile information as one of the tables. MS Access has great functionality for creating reports, pivot tables and charts. There is a wizard that creates nice looking reports; however there are limitations to how many fields can be put into the horizontal and vertical columns. The pivot table does not have these limitations. The pivot table is fairly simple to create. Simply drag and drop each field into the space that is needed (i.e. column, heading, row). Once the pivot table or chart was completed, it was exported to an MS Excel spreadsheet for the Forest Health Officer to use.

Outputs:

There were many ways that the data was output into different tables to be further analyzed by the Forest Health Officer. Two of these ways can be found in Appendix 2 and Appendix 3. Appendix 2 shows a chart of infestation broken down by Licensee within each Landscape Unit in Hectares. From the chart it is very clear where the most infestations are and which Licensee is most affected. BCTS has over 1500 hectares of infested timber within K10 Landscape Unit, and Wynndel Box & Lumber has over 1500 hectares of infested timber within K25 Landscape Unit. From here we would need to look into these areas to see how much of this infested timber is within an operable area. This was done in another pivot table.

Appendix 3 shows another table that was exported from MS Access. This table shows the infested and not infested areas within the AOI by Licensee and by the action that is required to be taken. In the bottom portion of the infested areas you can see that, of the 1845 hectares of infested timber that BCTS has, 659 hectares will not have any action. This is because it is already optimized or needs to be abandoned due to inoperability. The remainder of the 1186 hectares will have actions such as monitor, recce, or development into a cut block. Wynndel Box's 2117 hectares of infested timber has 1,244 hectares that will have action. There will be no action on 873 hectares.

In the year after this analysis the created AOI layer was used to see how many new infestations were within these areas. One map created using this AOI layer in the following year can be found at Appendix 4. This map identifies the AOI's with a yellow outline.

Conclusion

The information this analysis provided for the Forest Health Officer was very valuable for planning purposes. By creating the AOI layer, it enabled closer analysis on the areas that needed targeting. By grouping the information by the Licensee and by what actions that needed to done in each area it was easy to see the extent of the problem. Also knowing what the Licensee was going to target made it clear as to what critical areas were left. These areas were then analyzed as to what was accessible and how to allocate the available resources. With this information the Forest Health Officer was able to develop a strategy for the coming year and determine funding. In the following year, the AOI layer (now known as the "pine priority polygons") was used to further analyze the current mountain pine beetle infestations.

It is interesting to note that in the Sitkum Creek drainage, which is very steep, there was a severe Balsam bark beetle infestation. In the summer of 2007 this area received a lightning strike and started a large forest fire. It burned so hot that it severely damaged the soil of the drainage. Now there is another infestation on the Spruce trees that were not burned in the fire. Since this drainage is very close to a residential area it is monitored very closely.

Appendix 1 - Initial Map created with AOI's identified

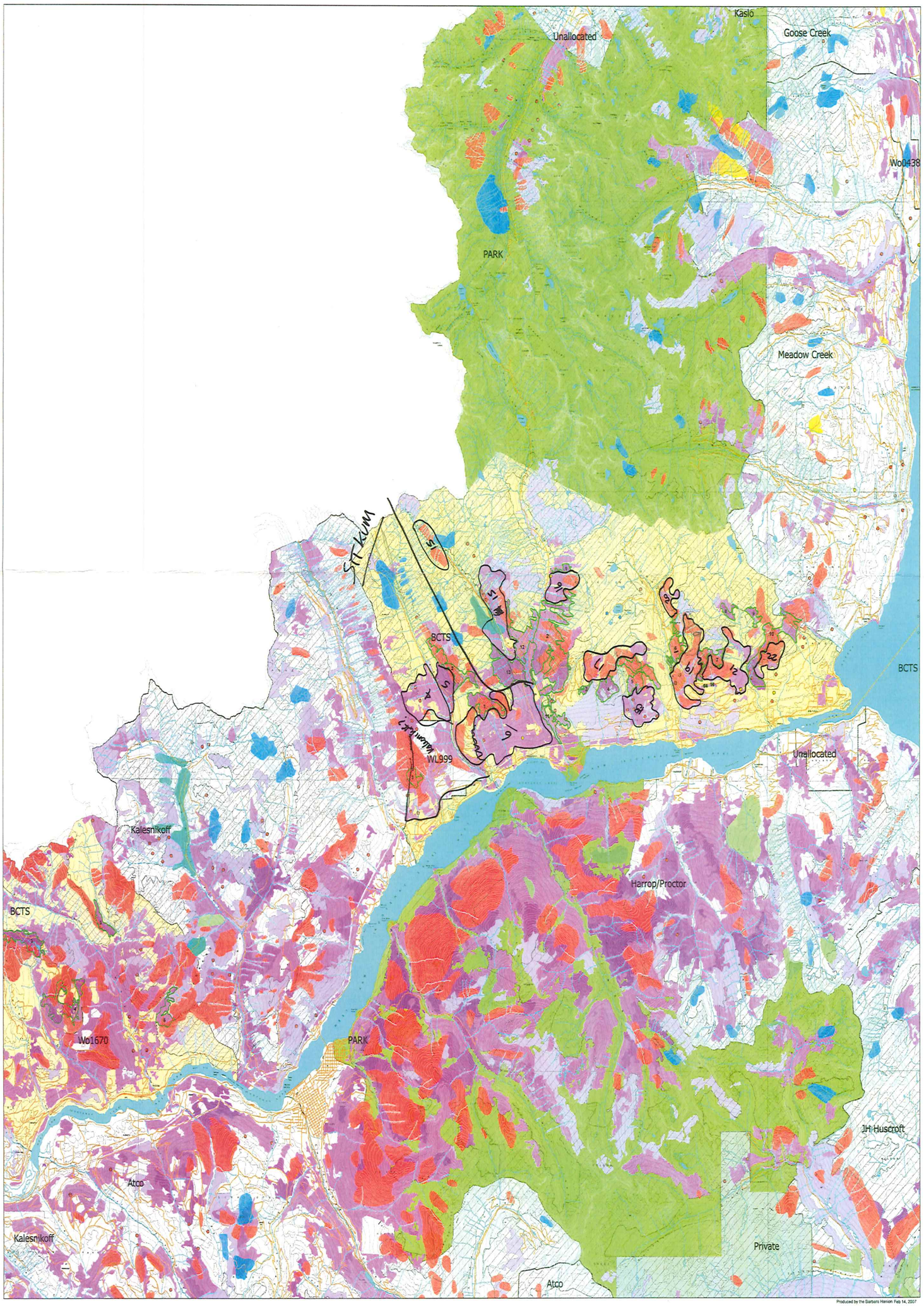
Ministry of Forests and Range
Kootenay Lake District Office

Forest Health Polygons - 2006: DFM, IBB, IBD, IBM, IBS, IDL, IDF, IDH, IDN, NB, NW
Forest Health Points - 2006: IBB, IBD, IBM
Hazard Class: High, Low, Moderate, NTL, Very Low
Operability: Inaccessible

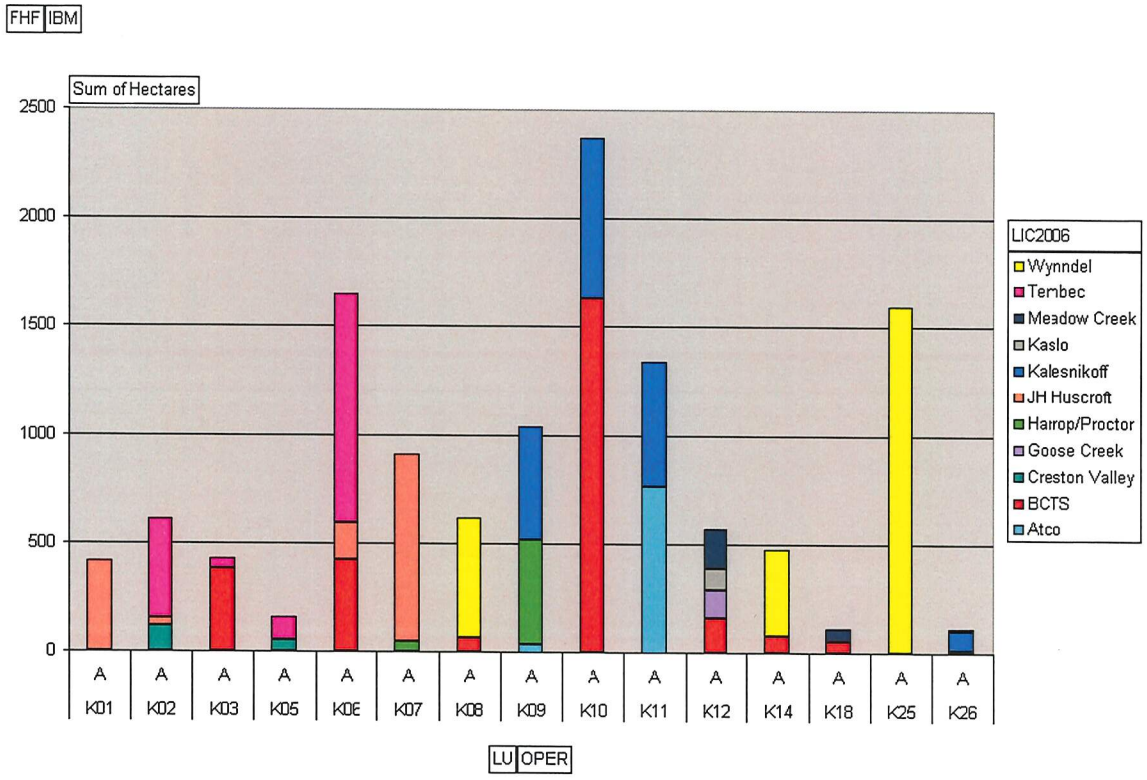
Projection: UTM 11N
Datum: NAD 83
Scale: 1:50,000

N

2006 Forest Health Overview and IBM Hazard Ratings for Sitkum West



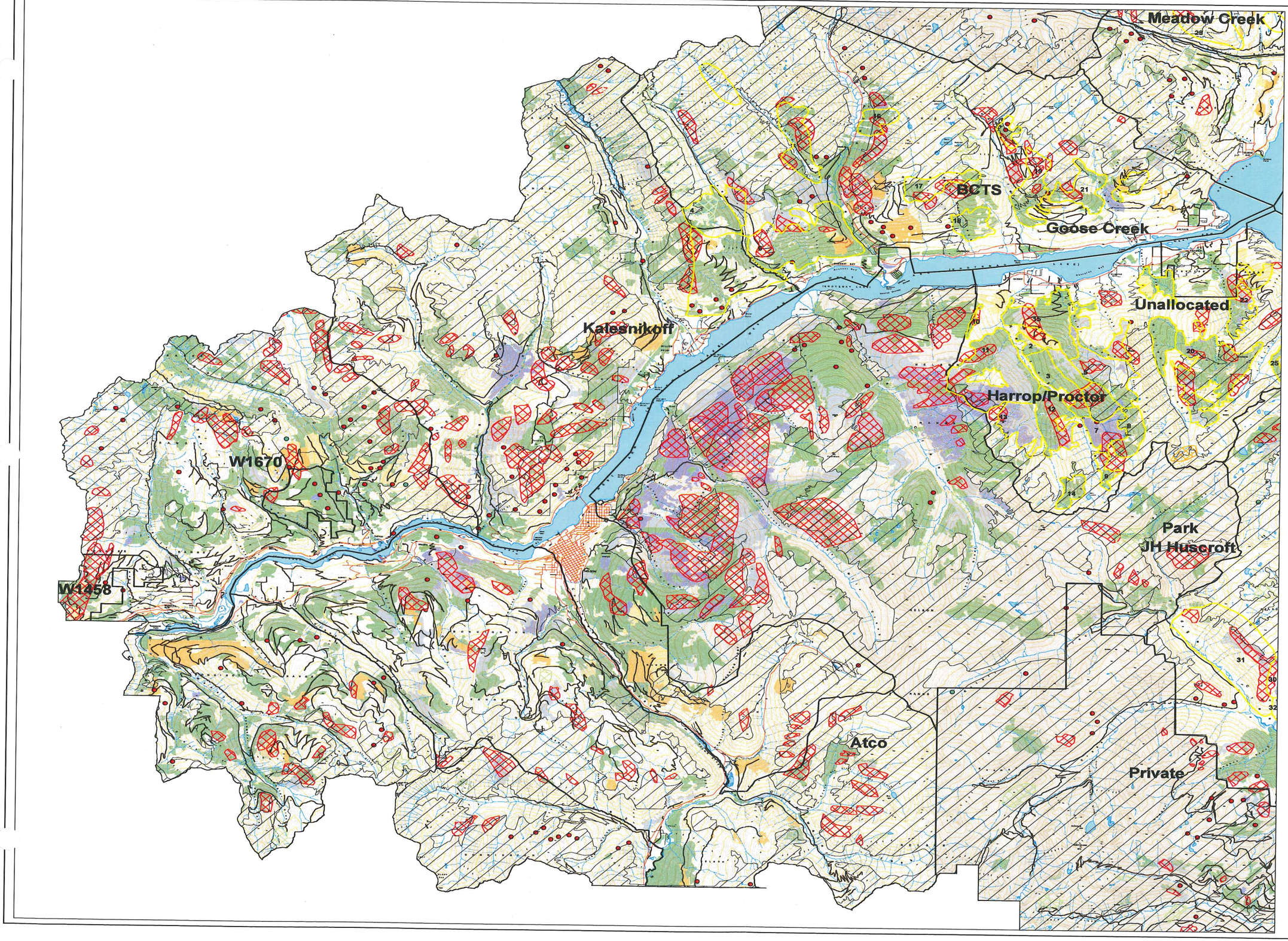
Appendix 2 – Chart of Infestation in Hectares by Licensee within Landscape Units



Appendix 3 – Infested and Not Infested Areas within AOI by Licensee and Action Required

NOT INFESTED								
HECTARES	LICENCEE							
ACTION	BCTS	Creston Valley	Harrop/Proctor	JH Huscroft	Meadow Creek	Tembec	Wynndel	Grand Total
Abandon	5767.07	498.86	1352.53	3169.36	1598.46	1124.43	3350.99	16861.70
Development Optimized	2607.88						2087.84	4695.72
Insignificant Hazard-No action-Low PL% in type			840.34	31.86				872.20
Monitor	9514.19		63.51	1025.55		12956.47	2386.51	25946.24
Proposed Development	9552.13	38.06	298.61	5330.82		7313.29	4029.24	26562.16
Proposed Development/Monitor	1371.48					2867.62		4239.09
Recce	3010.52	1435.43	1943.93	745.49	3762.12	5867.77		16765.27
Recce/Monitor	1823.46	1242.05				962.19	1242.55	5270.26
Grand Total	33646.73	3214.41	4498.92	10303.09	5360.58	31091.77	13097.14	101212.64
INFESTED								
HECTARES	LICENCEE							
ACTION	BCTS	Creston Valley	Harrop/Proctor	JH Huscroft	Meadow Creek	Tembec	Wynndel	Grand Total
Abandon	494.43	14.26	167.17	858.00	12.00	173.03	712.70	2431.60
Development Optimized	164.75						161.29	326.04
Insignificant Hazard-No action-Low PL% in type			4.15	17.39				21.54
Monitor	550.07		9.41	231.36		3602.67	361.88	4755.38
Proposed Development	321.42		47.89	674.46		865.78	576.03	2485.58
Proposed Development/Monitor	109.98					979.45		1089.42
Recce	167.16	13.63	244.48	126.22	279.92	1081.31		1912.71
Recce/Monitor	37.08	18.07				249.25	304.69	609.09
Grand Total	1844.88	45.96	473.09	1907.42	291.92	6951.49	2116.59	13631.36

Appendix 4 - Map with AOI's identified (outlined in yellow)



2007 Overview
Forest Health Factors
West Arm

- Pine Priority Polygons
- Boundary DKL
- Licensee
- Inaccessible

Overview Points

FHF

- DFM
- IBB
- IBD
- IBM
- IBS

Overview Polygons

FHF

- DFM
- IBB
- IBD
- IBM
- IBS
- IDL
- IDN
- NB
- NF
- NW
- SLIDE
- Main
- Operational
- Spur
- Trail
- Contour - Intermediate
- Contour - Index
- Water
- Lakes
- Current Harvest
- 2004 - 2008 Harvest

2006 MPB Hazard Rating

Hazard Classes

- Low (5-33)
- Med (34-66)
- High (67-100)
- Park; Private

N W E S

Projection: UTM 11N
Datum: NAD 83
Scale: 1:50,000

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