A Spatial Analysis and Literature Review of Timber Potential in the Deh Cho Territory, NWT

2003

Prepared for
The Deh Cho Land Use Planning Committee

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Summary

The Deh Cho Land Use Planning Committee is responsible for developing a land use plan for the Deh Cho territory, pursuant to the Deh Cho Interim Measures Agreement. To assist in the completion of this effort, the Committee commissioned PACTeam Canada and associates to prepare of a "Spatial Analysis and Literature Review of Timber Potential of the Deh Cho Territory" that will contribute to the information base to be used in the development of a land use plan for the area. In the context of this project, timber refers to trees of sawlog size only.

The best source for information about sawlog stands, and hence potential, is the existing forest management inventories from the Territorial Government. All available inventory sources were used in this study. However, since detailed forest management inventories are not available for the whole of the Deh Cho Territory, other available vegetation inventories and/or classifications were also utilised. In order of preference, this project utilised larger scale, aerial photograph based inventories over smaller scale, satellite based vegetation inventories.

Grid cells measuring 1km by 1km were assigned a rating based on species, site, access, fire history and information source. Cells impacted by fire were excluded from the analysis. A combination of distance to a linear feature and species type were used to classify the cells with the inventoried areas. Areas outside the inventory areas were classified directly.

As the Deh Cho Land Use Planning Committee requested timber potential polygons with a minimum size of 100 km^2 and a maximum size of 10000km^2 it was necessary to aggregate the rated 1km^2 grid cells into polygons of suitable size. The following summary map describes the results of this process: areas with the potential to supply timber (sawlogs) in the Deh Cho Territory.

Some of the recommendations and comments arising from the study include:

- Logging potential, not forest productivity, is the focus of this study. Issues surrounding forest productivity and long term sustainability should be explored by the Deh Cho Land Use Planning at some point in their planning cycle.
- The forest inventory data available for the Deh Cho Territory does not cover the entire productive forest. Therefore less detailed vegetation inventory was utilized in this project. Future inventory efforts should be directed at areas without detailed management inventories but with higher timber potential.
- The minimum polygon size of 100km^2 specified by the Deh Cho Land Use Planning Committee is inconsistent with the characteristics of the forest stands found in the area. Commercially viable stands in the area are small and non-contiguous. A smaller polygon size would be more reflective of the resource base and operational considerations.
- The saw timber focus of this study does not evaluate other forest products and values such as fuel wood, non-timber products, and the environmental and habitat benefits of forests. Given the limited nature of the timber harvest in the Deh Cho, these other values may provide greater economic benefit then otherwise expected.
- A detailed economic analysis of commercial forestry operations in the study area was unavailable. Additional information such as operation considerations, harvest and reforestation costs, potential markets and market conditions will affect saw timber harvest in the territory. Such factors were beyond the scope of this study.

Summary Map: Areas with the potential to supply timber (sawlogs) in the Deh Cho Territory

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Acknowledgements
This project was fortunate to have direct access to the spatial and non-spatial inventory files held by the Forest Management Division of the Government of the Northwest Territories. The assistance of RWED inventory and management staff is appreciated.

Project team members included Barry W. Hunter RPF, Alan Udell, Janice Traynor RPF, Martin Haefele and Sara Geirholm. Numerous colleagues provided useful comment on earlier drafts and methodologies.

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1.0 Introduction

The Deh Cho Land Use Planning Committee is responsible for developing a land use plan for the Deh Cho territory, pursuant to the Deh Cho Interim Measures Agreement. To assist in the completion of this effort, the Committee commissioned PACTeam Canada and associates to prepare of a "Spatial Analysis and Literature Review of Timber Potential of the Deh Cho Territory" that will contribute to the information base to be used in the development of a land use plan for the area.

1.1 Objectives

The objectives of this work, as identified in the project terms of reference (see Appendix A), were to:

- identify, collect, and summarize existing information,
- review and analyze the existing literature in order to document the current state of scientific knowledge relating to timber potential in the Deh Cho, including current status, data gaps, and research priorities,
- consult with officials with research and management responsibilities for timber and timber harvesting in the Deh Cho territory, and/ or those who are involved either currently or are planning timber related research in the Deh Cho,
- prepare maps illustrating the location of stands with economic potential, and,
- prepare reports documenting the above tasks and results.

The purpose of this document is to present the results of the project, to describe the methods employed, to compare the results to the literature, and, to identify data and other gaps.

1.2 The Study Area

The Deh Cho Territory encompasses over 200 000 km^2 in the south-western portion of the Northwest Territories.

The NWT has an abundance of forest resources. Approximately 614,000km2, or 18% of the NWT is classified as forest. Of this 137,000 km2, or 22%, is considered non-reserved timber productive land and available for timber management (Bohning et al. 1997). It is likely that the much of the timber productive land is located in the Deh Cho Territory

The forests in the Deh Cho area are contained within the northern portion of the boreal forest region (Figure 1). They are comprised of four major tree species: white spruce (*Picea glauca* [Moench] Voss), black spruce (*P. mariana* [Mill.] B.S.P.), trembling aspen (*Populus tremuloides* Michx.), and balsam poplar (*P. balsamifera* L.). Jack pine (*Pinus banksiana* Lamb.) and lodgepole pine (*P. contorta* var. *latifolia* Engelm.) are also present but they are to some extent restricted to the southern portion of the territory. Tamarack (*Larix laricina* [Du Roi] K. Koch) is an abundant species in the NWT but is often a less dominant component of a black spruce stand. White birch (*Betula papyrifera* Marsh.) is also present and its abundance increases with increased latitude.

Figure 1. Forest Regions of the Deh Cho Territory.

It should be noted that timber in the Deh Cho area is on the fringe of the economic timber zone in Canada (Forestry Corp 2002). In the past saw timber was harvested only when lumber prices were high and the stands easily accessible.

The Northwest Territories forest industry consists of a number of small family run logging and sawmill businesses and larger, joint venture partnerships between local First Nation development corporations and established logging and sawmilling companies. In the past, there were five sawmills in the Deh Cho area: three in Hay River and two in Fort Simpson. Recently saw log production has been greatly reduced. Community and individual fuel wood production was also present and still is, to some extent (Bohning 1986).

The Forest Management Division of the Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories is currently responsible for forest management in the NWT. Prior to the GNWT assuming this responsibility, the authority for forest management rested with the Federal government. RWED and its predecessors have completed forest cover inventory and vegetation/land classification within much of the productive land within the Deh Cho region. These inventories and classifications have been completed under different standards and have varying levels of usefulness in current forestry and land use planning.

2.0 Methods and Results

2.1 Overview

The general research process followed that outlined in the proposal, and consisted of the following steps:

- Consultation with the Deh Cho Land Use Planning Committee, appropriate forestry research officials, forest industry and regulatory agencies to identify possible sources of information, to discuss operational, stand, economic considerations and methodology and to ensure that any concerns about data confidentiality are addressed.
- Gather information (literature, maps and data) from government, academia, and other sources including forest resource inventories, timber supply plans, and forest management plans.
- Summarise the information collected.
- Compile maps describing the forest resource, including tree species and distribution, and update these maps to reflect disturbances to the land base such as forest fires and development activities.
- Define logging limits by delineating operational, stand and economic considerations and analyze various logging limit scenarios and develop potential rating criteria and develop composite map(s).
- Prepare draft and final reports.

2.2 Literature Search and Data Collection

The following library and other institutional reference databases were explored: Government of NWT, Department of Resources, Wildlife and Economic Development; University of Alberta Library system; Aurora Research Institute Compendium;

Government of Canada, Natural Resources Canada, Canadian Forest Service. In addition "ingenta" (www.ingenta.com), a commercial reference database and search system was utilised.

Very few relevant references were found. The bibliography section of this report contains a listing of the more useful materials. More pertinent documents are referenced throughout this document. In addition Appendix B contains a brief annotated bibliography of potentially useful items.

Inventory and other data were sourced from RWED, various federal departments and the Deh Cho Atlas. Often government or other personnel often indicated potentially useful data or publications during discussions with project team members.

2.3. Base Layers

A base layer was created which covers the entire Deh Cho Territory and includes forest cover, fire history, and access. All available information, from identified sources, was brought together to create one common base, a polygon grid with cells 1 km^2. All information used was assigned to these grid cells.

2.3.1 Forest Cover

Detailed forest management inventories cover only a portion of the Deh Cho Territory. Although this is likely some of the most productive area in the region it was necessary to identify other sources that categorized the forest throughout the Deh Cho rather that just where spatial forest inventories were available.

The best source for information about sawlog stands, and hence potential, is the existing forest management inventories from the Government of NWT. All available inventory sources were included. However, since detailed forest management inventories are not available for the whole of the Deh Cho Territory, other available vegetation inventories and/or classifications were utilised. In order of preference, this project utilised:

a. Any spatial forest management inventories, provided by the Forest Management Department of RWED.
b. Any non-spatial inventory, provided by the Forest Management Department of RWED.
c. The "Digital Compilation of Vegetation Types of the Mackenzie Valley Transportation Corridor" by Wright *et al*. (2003).
d. NWT (RWED) Vegetation Classification Project and the National Forest Inventory (Productive Forest Classification) were used in the remainder of the study area.

Additional detail about these inventories/vegetation classifications can be found in upcoming sections.

Delineation of stands containing saw logs requires detailed measurements of species, height and site quality. Only management inventories provide such information. Thus

for areas not covered by spatial and non-spatial forest management inventories, only a less accurate categorization of sawlog stands and hence potential is possible.

Figure 2 depicts the spatial and non-spatial forest management inventory areas and the area covered by the "Vegetation Types of the Mackenzie Valley Transportation Corridor" project within the Deh Cho Territory.

2.3.1.1 Forest Inventory

Eight forest inventories were made available by the Forest Management Division (FMD) of RWED.

These inventories have been completed under differing standards and have varying levels of usefulness in current forest planning. Significant efforts were required to make the data from the various inventories useable and comparable for the purposes of this project. Although some spatial and attribute information was available there was no common location, format, projection, attribute information or history attached to the files. Before these data could be used there was a need to:

- Import existing data to ArcInfo formats from varying platforms including SPANS, dxf, dgn and ArcInfo
- Identify data projections and project to a single documented projection
- Link tabular data of forest cover polygon attributes with associated spatial data

This detailed management information was critical to developing a saw log potential as existing data sources were too general. During a previous project The Forestry Corp had identified the existing spatial data sets and therefore contacted RWED Forest Management Division regarding their use on this project. FMD was unable to allocate staff immediately to complete the required tasks however, recognizing the important need to compile and document these data and benefit of timely completion of this task to provide information to the Deh Cho Land Use Planning Committee, FMD contracted The Forestry Corp to complete these tasks and prepare shape files in geographic projection for distribution to the Deh Cho Land Use Planning Committee and for use in this project.

Completion of these tasks took considerable time. However this was a critical task to be completed before the selection of potential saw log stands could be completed.

The older inventory data is used "as is" recognizing that quality of the data is uncertain. All these spatial data have been shared with Deh Cho Land Use Planning Committee by FMD as they represent the best available data however FMD staff are still completing quality control.

Details about each inventory follow:

Buffalo River

This inventory was created in 1961 and only recently digitized to support the determination of a sustainable harvest level for Buffalo River Area. It is constructed from 1:40,000 and 1:63,630 photography, however, the age of this inventory and the lack of

Figure 2. Forest Inventory Areas in the Deh Cho Territory.

site productivity and age information are limiting. Where no additional information was available this was used to identify potential sites.

Liard Valley 1970s
Mapped in the late 1970s, this inventory is dated. Not all parts of the inventory are available spatially. While a good range of attribute data is available, there was little information to describe the source, formats and projections of the spatial data. While these questions are still being evaluated the draft forms of this inventory was used in this project.

Fort Liard 1991
These spatial files were developed and processed by the Canadian Wildlife Service from existing SPANS spatial data. The date of this information is uncertain, likely in the late 1980s. A seamless forest cover has been created that joins closely with the surrounding Liard 1970s data. It contains species and percentages information for forested polygons.

Cameron Hills (1985 – 1997)
The spatial data for the Cameron Hills was cleaned and processed into a single coverage to be used as part of the Timber Supply Analysis in 2000. The early portions of the inventory were updated to match with a 1997 inventory and merged with another piece completed in 1994. The single coverage creates a useful dataset for timber analysis over the inventory area.

Fort Providence (1984)
This inventory is generated from 1994 photography although some parts in the centre of the study area are still under review. All sheets (including those under review) were useful in selecting saw log stands within this project.

Fort Simpson (1994)
This inventory was compiled from 1994 photography and dissolved into a single seamless coverage of the inventory area. This dataset as well as the next two datasets required no processing for use in the forest planning.

Hay River Corridor (1994)
This inventory is available from 1994 photography and covers a portion of the historical Buffalo River Inventory.

Wrigley, Camsell Bend, Ebbutt Hills (1994)
This inventory was completed in 2003 from 1994 photography.

Additional detail about each inventory was provided to the Deh Cho Land Use Planning Committee by the FMD along with the spatial data.

The species codes and percentages in each species were used to define 8 forest types for the sawlog potential in spatially inventoried stands. These types were:

SW_1 -- white spruce forest on Good Sites

SW_3 -- White spruce forests on Fair sites (Class 3)
C -- Mixed pine and spruce forest
MX Mixed pine, spruce and aspen forests
MX-C Mixed pine-aspen forests
MX-A Aspen Mixed woods
PL -- Jack pine and Lodgepole pine forests
AW – Aspen forests – only forests in the Liard and the Cameron Hills areas are believed to have any potential for aspen sawlogs.

Site class was included in the above categorisation as it has been found that while stands classed as Site 1and Site 2 are capable of producing saw timber stands, stands classed as Site 3 are marginal for saw timber production. Operational experience in NWT demonstrated that about 50% of site class 3 stands are actually operable (Golder Associates, 2000 and The Forestry Corp., 2002).

Stands with the above attributes were included in the analysis.

2.3.1.2 Non-Spatial Forest Inventory

In the Liard and Fort Simpson areas some additional areas outside the spatial inventoried areas were used to assign ratings. These were areas within the 1970s Liard Valley inventory that had digital attribute files but no spatial stand files. The database files for each map sheet were summarized and the potential sawlog stands extracted using the same procedure as for the spatial inventory files. The area of potential sawlog stands (as a percentage cover) was then applied as a rating for the full map sheet area (approximately 300km2). This known inventory data generated at a scale of 1:25,000 was felt to be more useful than any of the satellite inventories because of the scale and the field measurements which support it.

2.3.1.3 Vegetation Types of the Mackenzie Valley Transportation Corridor

An additional inventory was provided by the client in August. The vegetation types of the Mackenzie Valley Transportation Corridor were interpreted from photography flown between 1970 and 1972 to paper maps by the Canadian Forest Service at a scale of 1:125,000. The original paper maps were recently digitized by the Geologic Survey of Canada to allow use with GIS (Wright *et al.* 2003).

The inventory provides broad information on species composition, canopy height and density of forest cover and included some field checking in the early 1970s. This inventory was used to provide information in any areas not covered by the larger scale GNWT forest cover inventories.

While this inventory did not identify specific species or heights however it did classify the productive, mature forest. The 4 productive forest types, which were believed to have some sawlog potential, were the Riparian and Upland mature mixed wood (Spruce/Hardwood) and Conifer (Spruce/Feather Moss) forest types. These forest types (RS, RSH, US, USH) were used in the analysis to identify potential sawlog stands.

2.3.1.4 NWT Vegetation Classification

In 1997 a project was initiated to use Landsat TM images (30 m resolution) to classify vegetation types across the NWT for use in developing a fuel type database (Croft 2001). Although not designed for forest inventory, the vegetation classification has been used to detect areas of potential mature spruce timber where forest cover information is unavailable. This data is limited by the absence of a site classification or stand height.

In this analysis, areas classified as mature conifer forest were used to indicate the potential for sawlogs in areas outside existing, aerial photograph based, forest cover or vegetation inventories.

2.3.1.5 National Forest Inventory

The NWT portion of the National Forest Inventory (Lowe *et al*. 1996) was used for areas outside the previously discussed inventories or in conjunction with the NWT Vegetation classification. These data are part of the 1991 national inventory developed by the Canadian Forest Service in association with the responsible Territorial agencies.

Forest lands within 10km by 10km cells on fair or better sites were classified to softwood, hardwood or mixed wood. This classification is derived from three data sources, representing varying levels of detail, including management inventory, reconnaissance inventory or satellite inventory as available. Areas with a timber productivity rating of 80 to 100% on productive forest land were identified as a possible location of saw timber.

Figure 3 shows the timber productive forest within the Deh Cho Territory as determined during the national forest inventory.

2.4 Saw Timber Definition

To meet the RWED sawlog utilization standards (17.5 cm dbh, 10 cm top, 5.0 m log length) stands must have, at a minimum, the following attributes:

- White spruce stands on Class 3 (medium) sites that are 15 m tall and 80 years old.
- Lodgepole or Jack Pine stands on Class 3 (medium) sites that are 19 m in height.
- Aspen stands on Medium sites, in the Liard Valley and Cameron Hills only, that are 15m in height (Pers. Comm. RWED-FMD).

Attribute definitions vary among the available inventory sets. The goal was to identify stands which currently meet the species, height, age and stand specifications within each inventory then later identify the area of saw timber within each base grid cell. Specific criteria were developed which reflected the attribute standards, date of inventory and species groups used in the various inventories (Appendix C).

These criteria identify stands most likely to contain trees large enough for saw timber. These selection criteria were used to develop 3 separate shape files, one showing white spruce stands, one with aspen stands and one with pine stands which may contain saw timber. Each of these shape files was joined with the base grid and then summarized by species and total hectares within each 1 km^2 cell.

Figure 3. Timber Productive Forest from National Forest Inventory within the Deh Cho Territory

Depending on the age and source of the inventory, the stand selection criteria were adjusted to account for stand growth since the time of the original stand interpretation.

Figures 4, 5, and 6 describe possible white spruce, pine or aspen sawlog stands within portions of the study area covered by detailed forest management inventories.

In areas without detailed forest inventories then the Mackenzie Valley Transportation Corridor Vegetation Mapping Project, the RWED non-spatial inventories, or the GNWT Vegetation Classification data were used to identify possible sawlog areas by grid cell. These data are less reliable since they lack one or more of the desired attributes of species, height or site class and represent inventories at a smaller, less detailed scale.

2.5 Economic Measures

For each of the grid cells the distance from the centre of the cell to the nearest cut line, seasonal road and all-weather road was calculated. The roads and seismic coverages used were those supplied by Deh Cho Land Use Planning Committee and were extracted from National Topographic and National Energy Board data.

This distance was calculated by extracting the label point for each grid polygon to point coverage and using the ArcInfo NEAR command to calculate distances from the polygon centre-point to the nearest line of each type of linear feature (seismic, seasonal and all-weather roads). Distances were calculated on coverages stored in Lambert Conformal Conic projection. These distances are not exact and were only used to group cells based on their proximity to existing roads. This distance was used as an indication of the cost of accessing this timber.

Figure 7 shows the roads and seismic lines in the Deh Cho Territory.

This distance to linear features (roads or cut lines) was ranted as outlined in Table 1.

Table 1. Linear Features Rating.

Linear Feature	Distance to feature	Rating
All weather road	< 1 km	A (High)
All weather road	1-2 km	B (Moderate)
All weather road	2-5 km	C (Low)
All weather road	> 5	X (None/Excluded)
Seasonal road	< 1 km	A
Seasonal road	1-2 km	B
Seasonal road	2-5 km	C
Seasonal road	> 5	X
Seismic line	< 0.5 km	A
Seismic line	0.5 – 1.0 km	B
Seismic line	1-2 km	C
Seismic line	> 2 km	X

Figure 4. Possible White Spruce Saw Log Stands in portions of the Deh Cho Territory covered by detailed forest management inventories.

Figure 5. Possible Pine Saw Log Stands in portions of the Deh Cho Territory covered by detailed forest management inventories.

Figure 6. Possible Aspen Saw Log Stands in the Liard Valley and the Cameron Hills areas of the Deh Cho Territory covered by detailed forest management inventories.

Figure 7. Roads and Seismic Lines in the Deh Cho Territory.

2.6 Fire History

Fire history coverage prepared by GNWT, Fire Management Division identifies areas burned from 1970 to 2001 (Figure 8). These burnt areas are unlikely to contain saw timber potential stands. Base grid cells that were burnt were excluded from analysis and assumed to have no sawlog potential.

2.7 Timber Potential Rating for Grid Cells

All 1km by 1km grid cells were assigned a rating.

- Cells impacted by fire were excluded from potential
- Where possible forest cover interpreted from photos was used (GNWT spatial and non-spatial inventories, Mackenzie River Inventory).
- For cells classified based on photo-interpreted inventory an area code which represented the coverage percent was calculated (area under potential sawlog stands divided by total grid cell area). For the non-spatial inventories the percentage coverage inside the map sheet was applied to all cells in that map sheet area. This percentage, representing area of sawlog stands within the grid cell, was multiplied by 30 and added to the species rating in Table 2. This was used to assign an additional rating to inventoried stands recognizing the increased known potential of sawlogs in these selected areas.
- The combination of distance to a linear feature and type of species were used to classify the cell with each of the inventoried areas.
- Areas outside the inventory areas were classified directly using the NWT vegetation classification data supplemented by the timber productive forest potential coverage.
- In terms of species, white spruce stands are most likely to produce commercially viable saw logs. Hence white spruce stands were assigned a higher rating than other species. Pine and aspen stands were rated slightly lower. Stands and/or vegetation classification types were assigned a rating based on the professional judgement of the authors (see Table 2).
- Similarly, distance to linear features (access) was incorporated into the rating. Stands closest to better quality roads were rated higher than those stands further away.

The area of potential saw timber within each cell was used to provide a rating which reflects both availability and economic potential as large areas of saw timber will be more economically viable than isolated stands.

The saw timber area is cumulative and includes spruce, aspen and pine stands.

The code used to assign a rating to each grid cell is listed in Appendix C.

Figure 8. Forest Fires within the Deh Cho Territory 1970 to 2001

Table 2 outlines a classification based on vegetation, proximity to linear features and the assigned rating.

Table 2. Rating of Vegetation Type and Access

Classification representing Vegetation Type and distance to linear features	Brief Description of Classification Groupings	Assigned Species rating.
S1,C1,M1,P1	Mature conifer and mixed-wood sawlog sized timber on very good sites, close to linear features	70
S2, S1F,C2,M2,A1,P2	Sawlog sized timber, all species on good sites close to linear features	65
S3, S2F,C3,M3,A2,P3	Sawlog sized timber on medium sites, moderately accessible	60
S4, S3F,C4,M4,A3(55),A4,P4	Sawlog sized timber – site or access limitations	50
S5, S4F,C5,M5,A5,P5	Mature forest site and access limitations	45
S6, S5F,C6,M6,A6,P6	Mature forest not rated for access	40
S7,S6F	Potential forest or young forest with access	35
S8	Potential forest – moderate access	30
S9	Potential forest – limited access	25
S10	Potential forest – no access	20
B1, B2	Non-productive forest	5
B (Barren lands and water)	Non-forest	0

2.7.1 Final Rating

The Deh Cho Land Use Planning Committee requested timber potential polygons with a minimum size of 100 km^2 and a maximum size of 10000km^2. Hence it was necessary to aggregate the rated 1km^2 grid cells described above to meet the needs of the Committee. The following steps were undertaken to create polygons of the desired size:

1) The 1km^2 grid cell ratings described above were assigned to a more generalized rating system with 10 equal classes (1-10) based on the cell ratings from 0 to 99. The breakpoints were established based on a visual evaluation of the ratings distribution. Ratings from 80 to 100 were grouped and 60 to 80 were combined to create the more general codes.

2) These groupings of cells, (ArcInfo regions) were then extracted to polygon coverage. This coverage was imported to ARCInfo GRID for raster analysis. Intermediate groupings of 1km^2, 4 km^2 and 9km^2 were developed using grid analysis. The final rating was developed from a base grid cell size of 9km2 (3000m per side). A single rating that represents the dominant rating within the cell was developed. This dominant rating reflected both largest area within the cell and the use of a slight increased weighting for high potential stands within the grid analysis to ensure they were reflected in the final output. An applied example of the cell amalgamation procedure can be found in Appendix C.

3) A polygon coverage created from this grid (merging adjacent cells with equivalent ratings) came close to meeting the requested area and spatial distribution. Merging the few remaining small polygons (< 90km2) into the surrounding polygon eliminated the last remaining small polygons, less that 100 km2. The few polygons larger than 10000km^2 were split to generate polygons < 10000km2. Most of these large polygons reflected low potential areas.

4) Analysis took place in the Lambert Conformal projection. The areas discussed were those calculated in this projection. As requested the final spatial files were converted to a geographic projection.

Figure 9 describes areas with the potential to supply timber (sawlogs) in the Deh Cho Territory.

Figure 9. Areas with Potential to Supply Timber (Sawlogs) in the Deh Cho Territory.

3.0 Discussion

The available literature about the forest resources, and hence timber potential, of the Deh Cho region is imperfect. Given this limitation, this section will compare the results of this project with the literature, briefly discuss some of the economic, operational, and industrial aspects of forest management and harvesting in the Deh Cho Territory, as well as identify data gaps and offer some general recommendations.

The timber potential[1] of a given stand is a function of stand parameters such as species and volume, operational considerations, and economic considerations such as access. These parameters are further discussed herein.

3.1 Site and Stand Parameters

3.1.1 Stand Size and Location

The size, type and location of timber potential stands have been discussed by a number of researchers. The results of this study, in terms of spruce, pine and aspen saw timber potential stands, are consistent with the literature. In short, it has been stated that the best timber is found in scattered stands generally along rivers within the study area (Hirvonen 1968a, b, 1975; Wallace and Peaker 1969; Gilmour 1982 a, b; Bohning 1986; Bohning et al. 1997). The more northerly the location the more accentuated this phenomenon becomes.

The GNWT has noted that that commercially significant forests in the NWT are concentrated in the southwest corner of the NWT: along the Slave River, Hay River & Cameron Hills, upper Mackenzie River and Liard River valley (Anon. RWED 1997).

Hirvonen (1975) mentioned that large concentrations of saw log sized stands occur in the Liard River region south of the South Nahanni River.

Within the lower Liard inventory area, one of the most productive forests in the Territory, the following areas were identified as the major areas containing white spruce saw timber:

- West side of the Liard River, south of Kotaneelee River;
- North along the Liard River from Fort Liard to Big Island, including the Petitot and Muskeg Rivers;
- North along the Liard River from Big Island to Blue Bill Creek, including Flett and Blue Bill Creeks;
- Alluvial floodplains of the Liard north to Nahanni Butte and east to Blackstone River;
- North along the Nahanni River from Nahanni Butte to Nahanni National Park Reserve (DIAND 1982).

[1] Timber potential , as defined by the Deh Cho Land Use Planning Committee, is generally referred to as logging potential.

The forested area of the NWT is classified as Boreal Forest. The Boreal Forest in the NWT includes parts of seven forest sections: however, only three sections – Upper Liard, Hay River, and Upper Mackenzie – support forests of commercial significance (Bohning 1986).

The results of this study match the trends and locations identified above. However the average saw log stands identified by this study within the inventoried areas varied in size from 17 to 30 hectares depending on species. Such a small stand size presented a challenge in meeting the Deh Cho Land Use Planning Committee's request for a minimum timber potential polygon size of 100 km^2. This study attempted to address this problem by using a base grid of 1km^2 and aggregating upwards to the polygon size specified by the Committee.

Further, the available forest management inventory data used in this project is concentrated in the ecological regions and areas identified above. This helps to ensure that potential timber stands are captured.

3.1.2 Species

Spruce is the premier sawlog species in the study area. Jack Pine and Lodgepole Pine may also be utilised. Harvester interest has been shown for Aspen in select areas of the Deh Cho Territory.

While all three species may be utilised, white spruce is the species of choice. The 2000 Timber Supply Analysis for the Cameron Hills indicated that conifer volume is so much more valued that it recommends that stands with a conifer understory might be better left to develop a spruce overstory (via natural succession) for later harvesting rather than harvesting the deciduous species now.

Given comments from operators that aspen was not generally merchantable in the NWT except for a few stands in the Liard and possibly the Cameron Hills (as reflected in the Buffalo River Inventory Report and the Cameron Hills Timber Supply Analysis), aspen was designated a commercial sawlog species only in the Liard and Cameron Hills inventory areas for the purposes of this study.

3.1.3 Insect, Disease, Fire and Industrial Disturbance

Spruce budworm is fast becoming an issue in the Deh Cho Territory and the impacts of the continuing spruce budworm infestation must be considered in the development of forest management plans (Pers. Comm. Bob Decker). Recent surveys have indicated a lot of tree mortality and evidence of stands under extreme stress caused by the budworm.

From a timber availability point of view this means that one may be able to capture mature stand volumes in the near term but leaving these stands will likely mean a loss of all sawlog potential. Given that the white spruce stands in the Lower Liard are over mature (DIAND 1982) this poses an even greater risk.

More complete details about the extent of the spruce budworm infestation are expected in December 2003 and hence have not been incorporated into this study.

Fire is the greatest danger to NWT forests and important influence on forest succession and wildlife habitat distribution. The number, distribution and size of forest fires varies considerably in any given year. Over a ten year period prior to 1997, the annual number of fires ranged from 137 to 627 and the area burned annually varied from 37,000 ha to more than 3 million hectares. The long term average number of fires is about 300 and the average area burned is about 600,000 ha, or about 1% of the forested area, per year (Bohning et al. 1997). Within the Buffalo River area, the Forestry Corp (2002) reported that 38% of the productive forest land base was burnt over the last 20 years. While this study accounted for fires prior to 2001, the possibility of future fires impacting the availability of potential sawlog stands is great.

Industrial activities such as roads, commercial scale forest harvesting and oil and gas exploration and development will also affect the availability and accessibility of potential sawlog stands. For instance the Buffalo River Sustainable Harvest determination determined that approximately 6,000 ha of the gross land base could be attributed to road and anthropomorphic features. Within the Cameron Hills Timber Supply analysis area it was found that trail and cut line area comprised about 550 ha of the total land base. While the forest inventories, and their updates, used in this study captured some of this industrial change, such landscape alterations are ongoing.

While it is arguably true that the trees will not be growing that much over the 20 year planning cycle of the Deh Cho Land Use Planning Committee, influences such as insects and disease, fire, and industrial development will be actively changing the landscape and its ability to provide and/or access saw log sized trees. As predicting such change is very difficult, timely reassessment can ensure that decisions are made on the most up-to-date information.

3.2 Operational Considerations

Operability is a function of cover type (forest or non-forest), highway and watercourse buffers, site productivity, fire history and site specific factors such as slope, terrain stability and others. Some of these factors have been examined above. Others will be discussed here.

Harvesting equipment operations are curtailed on steep slopes due to safety concerns. Generally slopes over 25 – 30% necessitate the use of specialised harvesting equipment. For example the 2000 Cameron Hills Timber Supply Analysis utilised a maximum slope of 25% when “netting down” the land base, consistent with the draft GNWT timber harvesting and operating ground rules (GNWT 2000).

Regulatory requirements such as riparian buffers can also affect the availability of saw timber. The Cameron Hills Timber Supply Analysis and the Buffalo River Timber Supply Determination, identified approximately 1,600 ha and 8,000 ha of unavailable area due to watercourse buffering. Given that many of the sawlog stands identified in this project are

small and generally situated along watercourses such buffering can significantly reduce the available potential sawlog stands.

Within the Cameron Hills area, slumping (slope failures) has been identified as a concern (Golder Associates 2000). Forest harvesting operations and the road building associated with such activities can contribute to the problem.

In all forests there are trees that will never attain a size that is economical to harvest. Therefore "merchantability" issues are also a concern when identifying areas for future forest harvesting.

When the above factors are considered, the cumulative reduction to the gross land base can be significant. For example, within the Buffalo River Timber Supply Analysis Area less than 2% of the gross area is operable (The Forestry Corp. 2002). In the Cameron Hills, approximately 30% of the gross area is operable.

While this project was able to address some of these issues, for instance merchantability through the stand selection procedure, many of the concerns were not identifiable due to the available data or to the scale of the work or were beyond the scope of the project.

3.2.1 Forest Inventories

The availability of current, quality, and detailed forest management inventories has been cited by a number of authors as an impediment to proper forest management (RWED 1997, Forestry Corp 2002, Borque 1997, Mactavish et al. 1986, others)

To date (1996), approximately 25% of the productive forests have timber inventories (Bohning et al. 1997). With the completion of the more recent inventories, this figure has improved slightly.

At the onset of this project only one of eight inventories was publicly available. This study was fortunate to have access to all eight digital inventories for analysis, including those currently under review by the Territorial government. These detailed inventories cover approximately 38, 600 km of the most important forested areas in the Deh Cho Territory. These inventories have been completed under differing standards and have varying levels of usefulness in current forest planning. Significant efforts were required to make the data from the various inventories useable and comparable for the purposes of this project. Although some spatial and attribute information was available there was no common location, format, projection, attribute information or history attached to the files.

The older inventory data is used "as is" recognizing that quality of the data is uncertain. The dated inventories (i.e. those from the 1970s) were modernized to include stands which are likely to have grown to saw log size since the time of inventory.

Additionally, non-spatial inventory data was provided by RWED and incorporated into this study.

To accurately assess stands as saw log quality based on GNWT standards requires knowing at least three parameters: species, site class and tree height. Only forest management inventories provide such detailed stand parameters within the study area. Accordingly the first stage of analysis focused on these inventories.

The identification of saw log stands and potential in areas without detailed forest inventories is much more difficult. This project utilised a photo-interpreted vegetation classification project recently digitised by the Geologic Survey of Canada and the LANDSAT imagery based vegetation classification work completed by RWED (Wright *et al.* 2003; Croft 2001). In general neither of these sources provides all of the required stand details (i.e. species, height, site class) to accurately identify suitable saw log stands. While these information sources were used in identifying sawlog potential, their incomplete nature must be recognised.

A few very old (40 – 60 years) reconnaissance level inventories were found for portions of the Deh Cho Territory. There are very significant quality, relevancy and methodological concerns surrounding this information and as such this study opted to use the more recent satellite based vegetation classification and the national forest inventory for the areas in question. For reference, forest inventories in the south are generally updated on a 10 to 15 year cycle. The out datedness of these reconnaissance level inventories is put into perspective by looking at the rotation age for trees in the study area varies between 100 and 120 years for conifers and about 70 years for deciduous species.

3.3 Industrial Forest Harvesting

Timber harvesting in the NWT is marginal at best and extremely sensitive to market conditions presumably due to high access and transportation costs. This section describes past and future forest harvest.

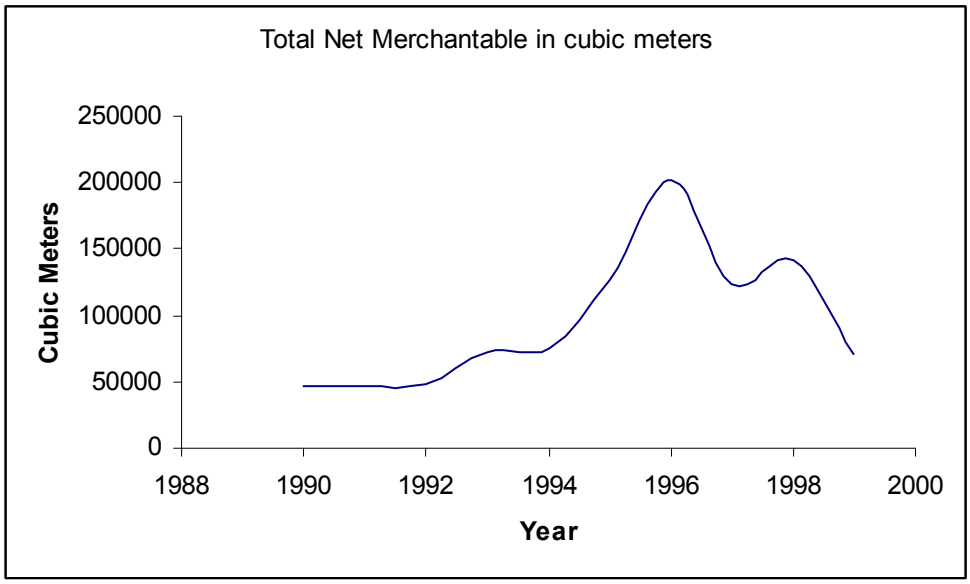
To relate harvest volumes to economic opportunity it may be useful to know that:

- 15000-25000 m^3 of high quality spruce will supply a small mill with a labour force of 25 people for about a year (Borque et al. 1997);
- one direct job and 1.3 indirect jobs in harvesting, milling and basic silviculture are added to the economy for each 1000m^3 of spruce harvested (GNWT 1997);

3.3.1 Past Harvest Levels

Past harvest levels within the NWT have greatly fluctuated. Details from Canada's Forestry Database Program show the annual merchantable round wood harvest for the 1990s (Figure 10). Harvest levels have varied from about 46,000 to over 200,000 m^3. When reviewing these figures it is important to note that the round wood includes sawlogs as well as other product categories such as pulpwood.

Figure 10. Net Merchantable Round Wood Harvest in the NWT for the period 1990 – 1999



The NWT Economic Framework Sector Profile for Forestry indicated that up to 1992/93 the commercial harvest of forest products 40,000 m^3 per year of which 25,000 m^3 was for sawlogs. By 1995/96 the commercial harvest was 130,000 m^3 of which 113,000 m^3 was intended for lumber or plywood production. In other words, approximately 65 to 85% of the harvest consisted of saw timber.

Prior to 1990 the NWT reported no round wood harvest in the national forestry database program (National Forest Inventory Database www.nfdp.ccfm.org).

The harvest level pattern noted above is reflective of the marginal economics of timber harvest in area and a commercial forest industry under development.

3.3.2 Future Harvest Levels

The GNWT has stated that "forest inventories for the NWT's forests, when completed, could indicate a sustainable annual harvest level of more than 500, 000 cubic meters of spruce and pine saw logs, and an equivalent volume of aspen/poplar and birch" (RWED 1997). Some authors have ventured the opinion that at least some of the earlier saw timber allowable cut estimates within the Deh Cho Territory are too high (DIAND 1979). While the authors of this report are not commenting on the validity of this projection, there are a number of studies that look at sustainable annual harvest levels in portions of the Deh Cho Territory.

Harvest level determinations, under various utilisation standards, have been made for the Cameron Hills, the Lower Liard and the Buffalo River Area (Golder 2000, Borques' Consulting Ltd.1997, Forestry Corp 2002). A summary of these harvest levels appears in

Table 3.

Table 3. Summary of Harvest Levels in the Deh Cho Territory

Location	Gross Area[2] (ha)	Net Operable Area[3] (ha)	Inventory Date	Analysis Date	Recommended[4] Sustainable Annual Harvest (m^3)	Source & Comments
Cameron Hills	91,512	27,138	1985, 1996	2000	8,000 – 10,000	Golder Associates 2000. The volume presented here best represents the current practice in the area.
Lower Liard	n/a	n/a	1991	1997	88,000	Borques' Consulting 1997. All piece sizes conifer and deciduous.
Buffalo River	731,588	33,034	1961, 1994, 2002	2002	11,000	Forestry Corp 2002. Conifer Sawlogs Only Most of the area was inventoried in 1961.

It is important to note that agencies conducting the above analyses caution that even flow timber supply analysis may not be the most suitable method for determining harvest allocations for the area given the general absence of higher level management plans, other resource values in the study area and the overall age of the forest (DIAND 1979, Golder 2000, Borques' Consulting Ltd.1997, Forestry Corp 2002).

Earlier timber supply analyses also exist for the Lower Liard and portions of the Slave and Hay management units. However portions of these areas have been included in the more recent analyses described above and hence are not be discussed herein.

4.0 Conclusions and Data Gaps

The following recommendations and comments arose from the study:

- Logging potential, not forest productivity, is the focus of this study. Issues surrounding forest productivity and long term sustainability should be explored by the Deh Cho Land Use Planning at some point in their planning cycle.

- The forest inventory data available for the Deh Cho Territory does not cover the entire productive forest. Therefore less detailed vegetation inventory was utilized

[2] Gross area is the total area inclusive of all forest and non-forest land cover types
[3] Net operable is the area of merchantable forest based on the standards of the analysis
[4] Recommended by the group conducting the timber supply analysis using varying standards

in this project. Future inventory efforts should be directed at areas without detailed management inventories but with higher timber potential.

- Some of the inventory utilized in this project is dated, is of questionable quality and was collected under suspect methods. Old inventories should be updated using recognized methods and with adequate quality control.

- Spruce, pine and aspen (in select locations) were considered commercial sawlog species for the purposes of this study. However, spruce is clearly the most sought after species and planning decisions pertaining to timber provisions should be cognoscente of this fact.

- Spruce budworm is of concern but details about the severity and extent of the infestation are not yet known. As this pest will affect timber potential, especially in older, over mature stands, the situation should be monitored and incorporated into any future estimates of timber potential.

- Natural forest pests and industrial activities such as forest harvesting and oil and gas exploration and development will affect the accessibility and availability of potential timber stands. Periodic reassessment of timber potential can ensure that decisions are made with the most up to date information.

- The minimum polygon size of 100km^2 specified by the Deh Cho Land Use Planning Committee is inconsistent with the characteristics of the forest stands found in the area. Commercially viable stands in the area are small and non-contiguous. A smaller polygon size would be more reflective of the resource base and operational considerations.

- Operational considerations including regulatory requirements such as watercourse buffers, terrain and slope failures will affect the harvest of potential sawlog stands. Such factors are site specific and difficult to incorporate into larger regional studies but will need to be considered when designating sawlog harvest areas.

- The saw timber focus of this study does not evaluate other forest products and values such as fuel wood, non-timber products, and the environmental and habitat benefits of forests. Given the limited nature of the timber harvest in the Deh Cho, these other values may provide greater economic benefit then otherwise expected.

- A detailed economic analysis of commercial forestry operations in the study area was unavailable. Additional information such as operation considerations, harvest and reforestation costs, potential markets and market conditions will affect saw timber harvest in the territory. Such factors were beyond the scope of this study.

- Past harvest levels have been extremely variable indicating the marginal economics of timber harvest in the study area and a commercial forest industry under development. Forest planning scenarios and assumptions must consider this.

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1988c: Cameron Hills forest management plan volume 3: Appendices to forest management plan; Denron Resource Surveys Ltd.

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2002: Buffalo River Area: Sustainable Harvest Level Determination (2 volumes). Prepared for Resources, Wildlife and Economic Development, Government of the Northwest Territories.

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Appendix A
Project Terms of Reference

(From request for proposals) **Part 2: Terms of Reference**

Introduction

The Deh Cho Land Use Planning Committee ("Committee") has been established pursuant to the Deh Cho Interim Measures Agreement (IMA), signed by the Deh Cho First Nations and the Governments of Canada and the Northwest Territories. The Committee is responsible for the preparation of a land use plan for the Deh Cho territory (outside of existing municipal boundaries and the Nahanni National Park Reserve) within the Northwest Territories (see Appendix A). The Committee is currently in the information collection and analysis phase of plan preparation that involves the collection and analysis of biophysical, cultural and socio-economic information for the Deh Cho territory. To assist with this phase, the Committee requires the services of a contractor to conduct a review of available data relating to **timber potential** in the Deh Cho territory.

Timber is defined here as, saw logs, NOT including cones, seeds, seedlings, saplings, fence posts, fuel wood, Christmas trees and trees intended for transplanting.

The contractor will be required to prepare a report which identifies timber present in the Deh Cho territory and harvest potential based upon available information, literature, and maps. The results of work performed will contribute to the information base that the Committee will consider in the preparation of a land use plan for the Deh Cho territory.

Scope of Work

The Committee requires the **preparation of a literature review and accompanying maps** that will contribute to the information base to be utilized in the development of the land use plan. As such, the contractor should be familiar with the various information sources: literature, maps, surveys, and professional contacts, and any related initiatives currently underway in the Deh Cho territory. The project will require the contractor to:

- identify, collect, and summarize existing information,
- review and analyze the existing literature in order to document the current state of scientific knowledge relating to timber potential in the Deh Cho, including current status, data gaps, and research priorities,
- consult with officials with research and management responsibilities for timber and timber harvesting in the Deh Cho territory, and/ or those who are involved either currently or are planning timber related research in the Deh Cho,
- prepare maps illustrating the location of stands with economic potential, and,
- prepare reports documenting the above tasks and results.

Specific Tasks

The following specific tasks must be completed by the contractor:

- attend a Project Initiation Meeting in Fort Providence,

- collect, review, and summarize available documentation, data, and research in progress (including, as available, forest resource inventories, timber supply plans, and forest management plans),
- consult with officials with responsibility for, and/or involvement in, forestry and related research in the Deh Cho territory,
- prepare draft and final reports that address the following for timber and timber potential:
    i. a summary of existing literature/data and research in progress including, as available, forest resource inventories, timber supply plans, and forest management plans, and,
    ii. timber present in the Deh Cho Territory including, as available, timber species, quantity, and distribution.
- provide a description of the analytical methods used, and,
- maintain on-going consultation with the Project Manager.

Deliverables

The Contractor shall submit the following to the Project Manager:

- six hard copies of the draft report,
- six hard copies of the final report, addressing comments provided on the draft report,
- one electronic copy of the final report,
- maps identifying, as available, species and their quantities, economic potential, and distribution,
- one composite map identifying areas of very high, high, medium, and low timber potential based on a minimum polygon size of 100 km^2 and a maximum polygon size of 10,000 $km^{2,}$

All reports shall follow the Geological Survey of Canada "Guide to Authors" (http://www.nrcan-rncan.gc.ca/ess/pubs/guide/index_e.html) and shall be delivered in Word format and Acrobat Reader format.

Digital map data shall be delivered in Arcview Shapefiles - geographic projection, NAD83).

All maps shall use a standard cartographic template (to be provided) with the following parameters:

Dimension	11”x17”(landscape)
Scale	1 : 3,000,000
Datum	NAD83
Central Meridian	122W
Reference Latitude	60N
Standard Parallel 1	60N
Standard Parallel 2	65N

Project Schedule

The following project schedule is anticipated:

Issuance of Request for Proposals	September 23, 2002
Proposal Closing	October 16, 2002
Contract Award (tentative)	October 18, 2002
Draft Report	February 14, 2003
Final Report	March 31, 2003

A final schedule will be confirmed at the Project Initiation Meeting.

Ownership and Use of Documents

The reports and material collected, compiled, or in any way produced pursuant to this contract will be, and shall remain, the exclusive property of the Committee and may not be lent, copied, used, sold, published, or distributed without the written consent of the Committee.

Project Manager

Questions concerning the direction and administration of the contract should be directed to the Project Manager:
Colin Beddoes
Deh Cho Land Use Planning Committee
General Delivery
Fort Providence, NT. X0E 0L0

Telephone: (867) 699-3162
Fax: (867) 699-3166
E-mail:cbdehcholandplan@ssimicro.com

Invoicing

The contractor will be paid monthly on submission and approval of invoices. Payment will be made based on the effort expended during the invoice period, and upon compliance with a budget included in the contractor's proposal that has received subsequent Committee approval. All invoices must be accompanied by a brief status report that clearly outlines the details of tasks that have been completed during the invoice period. Receipts must be provided for those expenses that are charged to the project budget

Appendix B
Annotated Bibliography

Author: Anonymous - RWED
Title: Northwest Territories economic framework sector profile:
Date: 1997
Publisher: Northwest Territories Resources, Wildlife and Economics Development
Place:
Volume/Series:
Summary: Profile of resources, human resources, investments, infrastructure, market, and taxation aspects of the NWT Forestry Sector. Part of the NWT Economic Framework Series.

Author: Anonymous - RWED
Title: Northwest Territories forest vegetation inventory, photo interpretation, transfer and database standards
Date: August 1999
Publisher:
Place:
Volume/Series:
Summary: Details procedures relating to forest vegetation inventory, photo interpretation, transfer and database standards.

Author: Beckley, T.M., and Hirsch, B.H.
Title: Subsistence and non-industrial forest use in the Lower Liard Valley
Date: 1997
Publisher: Northern Forest Service, Canadian Forest Service
Place: Edmonton, Alberta
Volume/Series:
Summary: Subsistence and non-industrial forest uses are important in many northern communities. In some communities, these forest uses may provide more economic value than commercial forest activities. This study uses the replacement value method to estimate the value of some subsistence and non-industrial forest activities to two communities in the lower Liard valley, Fort Liard and Nahanni Butte. Results show that these forest uses provide between $950 000 and $1 700 00 of income and in-kind income to valley residents. In addition, forest resources are widely shared throughout these communities. Over half the harvest of meat, fuel, berries, and other subsistence goods are given to persons outside the harvesters household. Comparison of contemporary harvest data to the historical data that exists suggests that subsistence and non-industrial forest activities are equal to or greater that historical harvests over the past thirty years.

Author: Bohning, R.A.

Title: The forest industry in the economy of the Northwest Territories, 1980-81

Date: 1986
Publisher: Northern Forestry Centre, Canadian Forestry Service

Place: Edmonton, Alberta
Volume/Series:

Summary: The forest industry and consumers of the forest products in the northwest territories were assessed in 1981. The results are analyzed in terms of forest resources, employment, production, consumption characteristics, and socio-economic impact, and information on commercial forest industry producers is provided in a directory. Numerous tables and figures provide detailed information.

Author: Bohning, R.A., Camplbell, D., and Grave, J.
Title: Forests of the Northwest Territories

Date: 1997
Publisher: Department of Resources, Wildlife and Economic Development, Canadian Forest Service

Place:
Volume/Series:

Summary: The northern boreal forests of the Northwest Territories cover a vast area with a number of different ecosystems. The terrain varies from large mountains in the west to wide meandering river valleys crisscrossing huge area of muskeg in the central region and the rugged topography of the Precambrian Shield in the east, which gradually gives way to the tundra.

The forests have been home to the aboriginal Dene for more than 11 000 years. Most Dene still live in small communities surrounded by vast forests. Like many Northerners they rely on forests for much of their livelihood and maintain a strong cultural and spiritual bond with the forests. Northwest Territories forests provide habitat for a great variety of plant and wildlife species. They also provide watershed protection, erosion control and ecosystem stability and contribute significantly to the NWT economy.

Author: Borques' Consulting Ltd.
Title: Summary Lower Liard Valley integrated resources management plan

Date: January 1997
Publisher: Dendron Resources Survey Inc.

Place: Ottawa, Canada
Volume/Series:

Summary: This report summarizes the result of a two year project by Borque's Consulting Ltd.

and Associates. The project has enabled the formulation of an integrated resource management plan for the forests of the Lower Liard Valley. The location of the project area is shown in Figure 1. A much longer, detailed report has also been prepared on the project. It contains a lot of additional technical information and is available to the communities.

Author: Clark, A.C.
Title: Management implications of integrating value-at-risk and community consultation with the Northwest Territories' forest fire policy
Date: Fall 1993
Publisher: University of Alberta
Place: Edmonton, Alberta
Volume/Series:
Summary: In 1979, extensive forest fires burned in the Northwest Territories causing residents to call for re-evaluation of the priority zone basis of the forest fire control policy. A new policy was developed through public consultation and implemented in 1990. It required that communities be consulted to define priorities for value-at-risk. This study was developed to: 1) define social and environmental resource values (values-at-risk) endangered by forest fires, and rank them in relative priority, and 2) describe how to more effectively involve the communities and recognize their values while implementing forest fire management policy. The target population was Dene people, 19 years of age and older, living primarily in small communities of the forested portion of the NWT. Data were to be collected through personal interviews based on a questionnaire. Community leaders in Hay River Reserve, Fort Liard, Snowdrift and Fort Good Hope helped identify the individuals to be included.

Author: Croft, B.
Title: Progress Status: NWT Preliminary Vegetation Classification (Poster 6 of 6).
Date: Fall 2001
Publisher: Forest Management Division HQ
Place: Fort Smith
Volume/Series: Poster 6 of 6
Summary: It was not until 1994 and 1995 that serious discussions began taking place about the feasibility of mapping the northern forest to develop a fuel database.

The ability to predict forest fire behaviour based on the knowledge of what forest cover types are present is a very important planning and decision making tool for forest fire managers.

For example, the summers of 1994 and 1995 produced 2 of the worst fire seasons on record in the NWT. It became obvious that better tools had to be developed in order to determine the potential impact of forest fire on the landscape.

Author: Dendron Resource Survey
Title: Cameron Hills forest management plan: Executive Summary
Date: 1988
Publisher: Dendron Resource Survey Ltd.
Place:
Volume/Series: V.1, V.2, and V.3
Summary: Forest management plan.

Author: DIAND Forest Resources
Title: An analysis of forest resources of the Northwest Territories (prepared for the Inquiry Board 1979)
Date: December 1979
Publisher: DIAND Forest Resources, Forest Inventory Section
Place: Fort Smith, Northwest Territories
Volume/Series:
Summary: N/A

Author: Ferguson, K.
Title: Overlap issues in wildlife, habitat, forestry, protected areas and tourism management
Date: December 6, 2001
Publisher: Government of Northwest Territories, Department of Resources, Wildlife, and Economic Development
Place: Yellowknife, Northwest Territories
Volume/Series:
Summary: The GNWT is currently reviewing many pieces of legislation relation to wildlife, species at risk, biodiversity, forests, parks and tourism,. Questions have arisen concerning the overlap between these issues. Overlap can occur at many different levels, such as departmental organization, legislation, policy, licensing and administration. For example: What should the organization and mandate of RWED divisions be to facilitate integrated resource management across the NWT? What forms of inter-disciplinary bodies could be established to coordinate legislation, policy and administration at both the headquarters and regional level?

How should habitat, biodiversity and species at risk be protected> For example, should habitat be protected separately under wildlife, species at risk, parks, forestry and tourism legislation or uniformly under some form of habitat or biodiversity act? Further, should it be protected under a general prohibition on damage or destructions, and/or by land designations for

area-specific protection>

How should timber harvesting be regulated to take account of wildlife and habitat needs and how should the desires of ecotourism operators for pristine wilderness be taken into account?

How should the licensing of commercial activities, such as outfitting, guiding and ecotourism be administered so as to address potential conflicts such as wildlife and habitat disturbance from cumulative impacts, while at the same time avoiding duplicate application procedures for operators?

What department and under what legislation should non-timber forest products (such as mushroom harvesting) be regulated?

Reviewing government organization, legislation and policies in other Canadian jurisdictions is one way to help answer some of these questions. With this in mind, this report describes in some detail the relevant approaches taken in British Columbia, Manitoba and the Yukon, and some additional approaches ofinterest in other jurisdictions.

Author: The Forestry Corp.
Title: Buffalo River Area: Sustainable harvest level determination
Date: October 31,2002
Publisher:
Place:
Volume/Series:
Summary: The Government of the Northwest Territories required the determination of a sustainable harvest level for the Buffalo River Area. The project area is situated east of Hay River, west of Little Buffalo River and south of Great Slave Lake. The Forestry Corp., a forestry consulting firm with extensive expertise in timber supply, was retained to determine the sustainable harvest level.

Author: The Forestry Corp.
Title: Supplemental Documentation for the Buffalo River Area: Sustainable harvest level determination
Date: October 31,2002
Publisher:
Place:
Volume/Series: V.2 of supplemental documentation
Summary: This is the second documentation in a series of two documents describing the process used to determine a sustainable harvest level for the Buffalo River Area. The first documentation in the series: Buffalo River Area: Sustainable Harvest Level Determination, describes the outcome and the process used to arrive at the sustainable harvest level. This supplemental documentation describes datasets and the processes

used to develop the background information. The spatial and attribute datasets developed and described in this documentation (including the inventory update) were provided in digital format to RWED.

Author: Gerylo, G., Hall, R.J, and Franklin, S.E.
Title: Remote sensing and its applications to forest management in the Liard Valley, Northwest Territories

Date: 1998
Publisher: Northern Forestry Centre, Canadian Forest Service

Place: Calgary, Alberta
Volume/Series:

Summary: A review of remote sensing in forestry commissioned by the GNWT under a Collaborative Research Agreement with the Canadian Forest Service (CFS) and involving scientists from the University of Calgary and the CFS, has been completed based on: (a) an intensive literature search; (b) a series of field visits; (c) personal communication with people in the north; and (d) a preliminary image analysis exercise. This review has been organized into sections that describe the information needs of resource managers including a summary of community concerns. Remote sensing technology and analysis methods have been summarized , and several applications of remote sensing for forest surveys are described with details and examples from the literature.

The major findings of this review include a set of recommendations for operational remote sensing applications, near-operational remote sensing initiatives, and some research opportunities. These ideas are set out in the form of 9 themes that are recommended for developing an approach to using remote sensing for forest surveys in the NWT (Sections 9.0 to 11.0). Further, two research proposals designed to meet the information needs of the NWT are presented in the final section of this report (Section 12.0)

Author: Gerylo, G., Hall, R.J., Franklin, S.E., and Smith L.
Title: Empirical relations between Landsat TM spectral response and forest stands near Fort Simpson, Northwest Territories, Canada

Date: 2002
Publisher: Canadian Journal of Remote Sensing

Place: Northwest Territories
Volume/Series: V.28, No.1.

Summary: Empirical relationships between forest stand variables, such age and crown closure, and spectral response measured by the Landsat Thermatic Mapper (TM) satellite sensor have long been suggested as an information source to support forest inventories in many regions of the world. Using regression and correlation techniques, the authors have identified the form and strength of these relationships for a sample of forest stands near Fort Simpson.

Northwest Territories. Models were strongest for pioneer forest species such as jack pine, and trembling aspen as these relationships were characterized by reasonably consistent changes in stand structure and composition. White spruce, a secondary successional species, produced by statistically weakest models from Landsat TM spectral response patterns for all stand variables with the exception of crown closure. The authors attribute the difference in model strength to variable trends in stem growth and stand structure changes caused by differing successional pathways for white spruce.

Author: Gilmour, J.G,
Title: Coniferous and deciduous volume estimates with proposed requirements for the harvest of white spruce sawtimber in the lower Liard Timber District, Northwest Territories

Date: 1982
Publisher: Department of Indian and Northern Affairs Canada

Place:
Volume/Series:
Summary: N/A

Author: Gilmour J.G.
Title: Lower Liard River Timber Inventory

Date: August 1982
Publisher: Indian and Northern Affairs, Forest Resources

Place: Fort Smith, N.W.T.
Volume/Series: Book One: Regional Forestry and Book Three: Map Folio Forest Resources
Summary: The Lower Liard Timber District occupies an area of 2 173 742 ha, of which 1 770 481 ha are classed as stocked productive forest land. The land area occupied by stands containing merchantable sized timber is 2 15 606 ha; the remaining 1 554 875 ha is immature stock (stands having a mean height of less than 15 m).

A survey area (706 563 ha) containing the bulk of white spruce sawtimber was established within the productive land base. The removal of stands that are unsuitable for harvest operations because of isolation or environmental concerns as well as immature area and pure hardwood stands, from the survey area, results in a harvest area of 73 099 ha of accessible stands containing white spruce sawtimber.

The reliable minimum estimate of white spruce sawtimber on the harvest area, calculated to a utilization level of 25.4 cm dbh, 0.3 m stump and 15.0 cm top dib, is 10 519 000 m^3. The corresponding white spruce pulpwood volume using utilization limits of 15.0 cm dbh., 0.3 m stump and 8.0 cm top dib is 16 078 000 m^3.

The accessible hardwood volume within the harvest zone, to pulpwood utilization standards totals 24 739 000 m^3, of which 21 644 000 m^3 is aspen and poplar. Birch pulpwood volume is 3 095 000 m^3, but this is accumulated on very small diameters and may be overestimated.

Management of this area on a 120 year rotation results in an annual cut of white

spruce sawtimber of 87 600 m^3 over an area of 609 ha. Because of the extremely large proportion of mature and overmature timber stands in this area, an initial annual cut could be set as high as 100 000 m^3.

Author: Golder Associates Ltd.
Title: Timber supply analysis for Cameron Hills forest management area, Northwest Territories
Date: January 13, 2000
Publisher:
Place:
Volume/Series:

Summary: This documentation describes the methods and results of the timber supply analysis (TSA) process that was preformed cooperatively between RWED and Golder Associates. The TSA process was undertaken to estimate a sustainable harvest level for the Cameron Hills. The results of the TSA will be used by RWED to help determine an annual allowable cut (AAC) for the FMA. An AAC that has been set through an exhaustive TSA process will not only promote sustainable use of the timber resource such as hunting and trapping. The climate and physiography of the Cameron Hills area has been described in a previous report (Terrain Hazard Assessment, RWED 1999) and will not be repeated here.

Author: Hirvonen, R.P.
Title: Forest resources of the Mackenzie River Valley, Northwest Territories
Date: May 1976
Publisher: Canadian Forest Service, Forest Management Institute
Place: Ottawa, Canada
Volume/Series:

Summary: The forests along the Mackenzie River are described in the context of forest regions, species distribution and site. Estimates of forest areas and of timber volumes are presented. Only sketch maps, showing the approximate distribution of productive forest lands in the Mackenzie valley, are attached; reference to the availability of more detailed mapping included. The suitability of the forests as a source of raw materials is briefly discussed.

Author: Hirvonen, R.P.
Title: Report on the Forest Conditions in the Lower Liard River Basin Yukon/ Northwest Territories
Date: January 1973
Publisher: Department of Forestry and Rural Development, Forest Management Institute

Place: Ottawa, Canada
Volume/Series:

Summary: Interest in the forest resources of the Yukon and the Northwest Territories increased rapidly after the Second World War, but available pertinent information appeared very limited. To promote such information one of several investigations was reconnaissance survey of the timber along the Lower Liard river north of the 60th parallel, in 1955. The Beaver and the La Biche rivers in the Yukon and the lower portion of the South Nahanni river were incorporated in this survey by means of air photo interpretation.

The total area of approximately 5,700 square miles is outlines on the key map,and covered by map series S 93 (1- 20). About 1,500 square miles are in the Yukon and the remainder in the Northwest Territories. The estimated merchantable timber contained in trees with a minimum height of 30 feet, is 21.9 million cunits, or an average volume per acre of 16.3 cunits with respectively 9.3 cunits and 7.0 cunits of softwoods and hardwoods on a potentially productive forest area of approximately 1,340,00 acres or 2,100 square miles. This is approximately 37 per cent of the total area covered by the survey. Detailed tables for area and volume, and forest inventory maps are appended.

The volumetric estimates were largely obtained by interpolation and extrapolation of limited field data and represent gross merchantable volumes without deductions for defects. The estimates are therefore subject to

Author: Hirvonen, R.P.
Title: Report on the Forest Conditions in the Buffalo River Area, Northwest Territories

Date: October 1968
Publisher: Department of Fisheries and Forestry, Forest Management

Place: Ottawa, Canada
Volume/Series:

Summary: The Pine Point mining development required an assessment of the timber in the area to supply local needs. Which particular sections would be accessible, and therefore the most important, depended largely on the route chosen for the railway needed to service Pine Point. At the time it was not certain whether the railroad would come through Wood Buffalo Park from the Waterways, Alberta, or follow the Mackenzie Highway route as it eventually did; in either case it was apparent that the timber in the general area of Pine Point might be on demand. Thus, the mile-to-the -inch forest cover mapping was continued north, beyond the coverage already available in Wood Buffalo Park, to Great Slave lake. There was no field sampling done in the area; instead data obtained from previous surveys in adjacent Wood Buffalo Park were used to make volume estimates. Also, the air photographs were at small scale (1: 40,000 and 1: 63.630), so that the forest classification is very general indeed. However, it does provide useful information on

the amount, location and distribution of the timber resource in the area.

Author: Lowe, J.J., Power, K., Gray, S.L.
Title: Canada's forest inventory 1991: the 1994 version. An addendum to Canada's forest inventory 1991.

Date: 1996
Publisher: Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre,

Place: Victoria, B.C.
Volume/Series: Information Report BC-X-362E
Summary: Canada's Forest Inventory 1991 was created without any new information from Quebec. The Quebec data became available in 1994, at which time the 1991 database (CanFI91) was amended to become the 1994 version (CanFI91-V94).

This document, an addendum to the main report Canada's forest inventory 1991 (Lowe et al. 1994), updates certain key numbers and maps.

Summaries from the inventory could previously be reported by province and territory or by forest region and forest section. Now reports can also be summarized by ecozone and ecoregion. All three of these important systems of administrative and natural regionalisation are quantified in some of the tables.

Author: MacTavish, J.S.
Title: Development of a Northwest Territories forest policy
Date: March 27, 1986
Publisher: Dendron Resources Surveys Ltd.

Place:
Volume/Series:
Summary: The government of the Northwest Territories (GNWT) and the Federal Government have agreed that responsibilities for forest management will be transferred to the Territorial Government in 1986. Aboriginal land claim settlements will yield large area of essentially private land. It is timely for the Northwest Territories to examine the policies and programs that are to be transferred and to modify them to reflect more closely its own needs and priorities. New territorial legislation will be required for timber management and present Forest Fire Ordinance requires amendment to bring it up to date. The objectives of this paper is to define the elements of policy needed as a basis for new legislation and to guide the assumption of responsibilities by the Territorial Government.

Author: MacTavish, J.S.
Title: Timber management strategy for the Northwest Territories
Date: 1985
Publisher: Denron Resource Surveys Ltd.

Place:
Volume/Series:
Summary: N/A

Author: Olsen, R.
Title: 1998 Year in review: Forest management, South Slave Region, Department of Resources, Wildlife and Economic Development, Northwest Territories
Date: 1998
Publisher: Department of Resources, Wildlife and Economic Development
Place:
Volume/Series:
Summary: Annual regional reporting - concerned primarily with forest fire fighting.

Author: Resources Initiatives Ltd.
Title: A planning framework for renewable resource development in Northwest Territories. Appendix A: agriculture overview. Appendix B: forestry overview
Date: 1985
Publisher: Resources Initiatives Ltd.
Place:
Volume/Series:
Summary: N/A

Author: Wallace, W.L., and Peaker, J.P.
Title: Forest inventory Lower Liard River area Yukon and Northwest Territories
Date: January 1973
Publisher: Department of Fisheries and Forestry, Forest Management
Place: Ottawa, Canada
Volume/Series:
Summary: This survey was undertaken by the Forest Management Institute of the Department of Fisheries and Forestry for the Water, Forest and Land Division of the Northern Economic Development Branch, Department of Indian Affairs and Northern Development. It is intended to update and improve the volume estimates and forest cover maps for the most important part of an area inventoried in 1955 and described in "Report on the Forest Conditions in the Lower Liard River Basin, Yukon/ Northwest Territories" (Northern Survey report No. 3, Forest Management Institute, Department of Forestry and Rural Development). Background information on climate, topography

and access to the area may be found in this earlier report. The survey area covers 860 square miles and extends approximately 50 miles down the Liard River from latitude 60 degrees north; it straddles the Yukon- Northwest Territories border. The area contains perhaps the largest
continuous block of merchantable timber found in either the Northern Territories. It is relatively inaccessible area and timber cut to date has been largely for local construction and firewood. However, a proposed road from Fort Nelson, B.C. to Fort Simpson, NWT has created interest in establishing large-scale forest operations in the area.

Author: Wright, J.F., Duchesne, C., and Cote, M.M.
Title: Digital compilation of vegetation types of the Mackenzie Valley transportation corridor.

Date: 2003
Publisher: Geological Survey of Canada

Place: Ottawa, Canada
Volume/Series: Open file 1614, 1 CD-ROM
Summary: The vegetation maps were originally prepared by the Forest Management Institute of the Canadian Forestry Service for the Environmental-Social Program of the task Force on Northern Oil Development. They were subsequently digitized by Natural Resources Canada (geological Survey of Canada) for use in a ground thermal modeling project. Secondary benefit of digitizing the 1974 paper maps was data preservation to digital format easily accessible in a geographic Information System. The data represented a broad classification of the vegetation in the Mackenzie Valley Transportation Corridor, which stretches along the Mackenzie River, Northwest Territories, from the Alberta border to the Beaufort Sea (10° of latitude). Included in the dataset are information on species composition, and canopy height and density of forest cover. Landform modifiers are also included for areas of tundra vegetation. The vegetation was interpreted from black and white panchromatic aerial photographs taken between 1970 and 1972. Additional infrared colour photography was taken in 1971 and 1972 to cover a small portion of the area. Field checks of the maps took place at 314 sites in 1971 and 1972.

Appendix C
Criteria for Stand Selection,
Code to apply timber potential ratings &
An Applied Example of the Cell Amalgamation Procedure

The specific selection criteria used within each of the inventories are identified below:

- Fort Providence and Fort Simpson
  [Sp1 = 'SW' Sp1per >= 50 or Sp2 = 'SW' and sp2per >= 40] with a height >= 14 meters and a site class <= 3
  [sp1 = PL or PJ] Height >= 18m on site class 3

- Wrigley
  [Sp1 = SW or sp2 = SW and sp2per >4]. Height > 14 and site class <= 3
  Pine stands (sp1 = PL or PJ) Height >= 18m on site class 3

- Liard91
  Sp1 = SW or sp2 = SW and sp2per >4. Height > 10 and site class <= 3
  Pine stands (sp1 = PL or PJ) >= 18m on site class 3 Aspen stands sp1 = 'A" and height > 15

- Liard1970s
  White spruce - Sp1 = 1 or Sp2 = 1 and Sp2per >= 40. Height >10 and site class <= 3
  Pine - Sp1 = 3,4,11 Height >= 15 and site class <= 3
  Aspen - Sp1 = 7 and Height > 15

- Hay River and Cameron Hills
  Sp1 = Sw or Sp2 = Sw and Sp2per >= 40 – and Height >= 14 and site class <= 3
  Pine stands (sp1 = PL or PJ) >= 18m on site class

- Buffalo River
  Potential stands identified by The Forestry Corp in the document "Buffalo River Area: Sustainable Harvest Level Determination" were used to extract stands selected under the following criteria
  Domtyp = 'FO', Typeclas = 'SO', 'SH' and htclas >= 3

The following code was used to assign timber potential ratings to each 1km^2 grid cell.

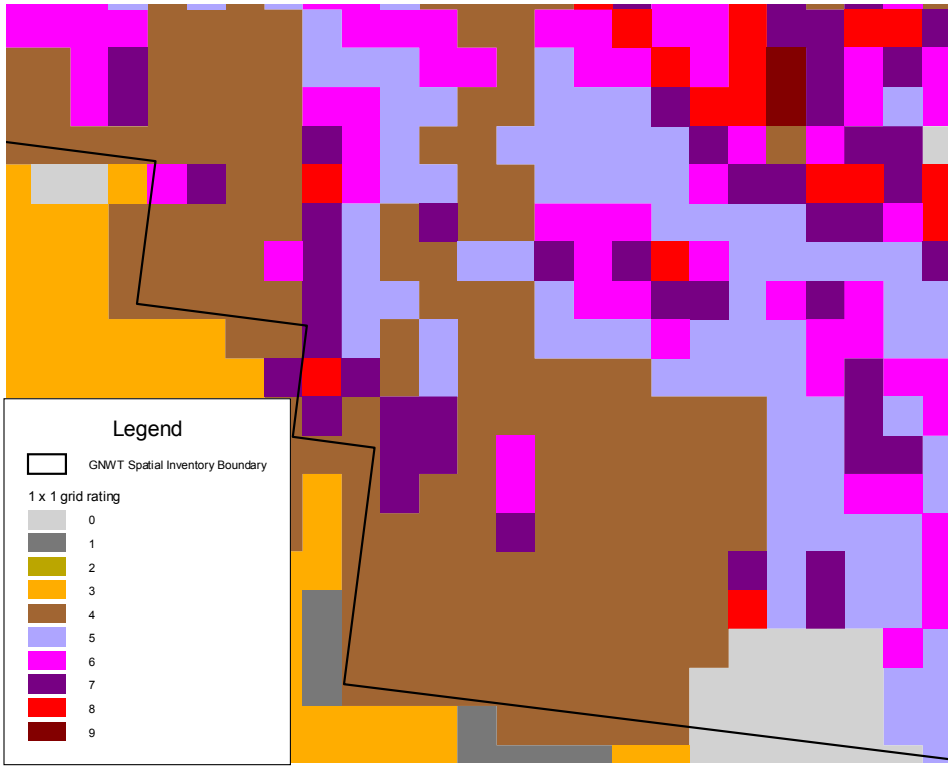
```
REM  Code used to assign timber potential values to grid cells
REM  Additional detail provided in Section 2

REM -- By default all cells assigned a values of 'B' (Barren)
update sawlog set cell_code = 'B';

REM -- Cells burned during recent fire history (1970 to 2001) are excluded
update sawlog set cell_code = 'F' where fire_year > 0;

REM -- Assign code based on inventory class where available (section 2.3.1.1)
update sawlog set cell_code = inv_cd where inventory = 'YES' and cell_code = 'B';

REM -- Use non-spatial, Mackenzie Corridor, NWT Vegetation Cover or NFI inventory
if available (section 2.4)
update sawlog set cell_code = 'S' where non_spatia = 'YES' and inventory <> 'YES'
and cell_code = 'B';
update sawlog set cell_code = riv_codes where mack_riv = 'YES' and riv_codes is not
null and cell_code = 'B';
update sawlog set cell_code = nt_veg where nt_veg is not null and avg_tpr > 40 and
cell_code = 'B';
update sawlog set cell_code = tpr_code where cell_code = 'B';

REM -- Assign rating based on distance to closest linear features (section 2.5)
update sawlog set all_dist = 'X' where dist_all = 0;
update sawlog set all_dist = 'C' where dist_all >= 2000;
update sawlog set all_dist = 'B' where dist_all >= 1000 and dist_all < 2000;
update sawlog set all_dist = 'A' where dist_all > 0 and dist_all < 1000;

update sawlog set seas_dist = 'X' where dist_seas = 0 ;
update sawlog set seas_dist = 'C' where dist_seas >= 2000 ;
update sawlog set seas_dist = 'B' where dist_seas >= 1000 and dist_seas < 2000 ;
update sawlog set seas_dist = 'A' where dist_seas > 0 and dist_seas < 1000 ;

update sawlog set seis_dist = 'X' where dist_seis = 0 or dist_seis > 2000 ;
update sawlog set seis_dist = 'C' where dist_seis >= 1000 and dist_seis <= 2000 ;
update sawlog set seis_dist = 'B' where dist_seis >= 500 and dist_seis < 1000 ;
update sawlog set seis_dist = 'A' where dist_seis > 0 and dist_seis < 500 ;

REM -- adjust rating based on area covered by sawlog for inventoried stands (to a
maximum of 80% coverage)
update sawlog set area_code = 0;
update sawlog set area_code = decode(inv_cd,'SW_1',sw_km2,'SW_3',sw_km2,'C',(sw_km2
+ pl_km2),'MX',(sw_km2 + aw_km2 - sw_in_aw_k),'MX-P',(pl_km2+aw_km2),'MX-
C',aw_km2,'AW',aw_km2,'X',(sw_km2+pl_km2+aw_km2-sw_in_aw_k),sw_km2) where inventory
= 'YES' ;

update sawlog set area_code = (m07_pct/100 + m04_swpct) where non_spatia = 'YES'
and (area_code = 0 OR area_code is null ) ;
update sawlog set area_code = m_riv_pct/5 where m_riv_pct > 0 and (area_code = 0 or
area_code is null ) ;
update sawlog set area_code = 0.8 where area_code >= 1;
```

```
REM -- Assign a rating based on species (or forest type), site (if available), and
distance for each grid cell.
update sawlog set sp_code = decode(cell_code,'F','F','B');

REM -- for GNWT inventory areas
update sawlog set sp_code= decode(cell_code,'SW_1','S1','C','C1','MX','M1','MX-
C','M1','MX-P','M1','AW','A1','PL','P1','SW_3','S1F','X','S7',sp_code) where
(all_dist = 'A' or seas_dist = 'A');

update sawlog set sp_code= decode(cell_code,'SW_1','S2','C','C2','MX','M2','MX-
C','M2','MX-P','M2','AW','A2','PL','P2','SW_3','S2F','X','S7',sp_code) where
seis_dist = 'A' and sp_code = 'B';

update sawlog set sp_code= decode(cell_code,'SW_1','S3','C','C3','MX','M3','MX-
C','M3','MX-P','M3','AW','A3','PL','P3','SW_3','S3F','X','S7',sp_code) where (
all_dist = 'B' or seas_dist = 'B' or seis_dist = 'B' ) and sp_code = 'B';

update sawlog set sp_code= decode(cell_code,'SW_1','S4','C','C4','MX','M4','MX-
C','M4','MX-P','M4','AW','A4','PL','P4','SW_3','S4F','X','S7',sp_code) where (
all_dist = 'C' or seas_dist = 'C' or seis_dist = 'C') and sp_code = 'B';

update sawlog set sp_code= decode(cell_code,'SW_1','S5','C','C5','MX','M5','MX-
C','M5','MX-P','M5','AW','A5','PL','P5','SW_3','S5F','X','S7',sp_code) where
(all_dist <> 'X' or seas_dist <> 'X' or seis_dist <> 'X' ) and sp_code = 'B';

update sawlog set sp_code= decode(cell_code,'SW_1','S6','C','C6','MX','M6','MX-
C','M6','MX-P','M6','AW','A6','PL','P6','SW_3','S6F','X','S8',sp_code) where
(all_dist = 'X' and seas_dist = 'X' and seis_dist = 'X' ) and sp_code = 'B';

update sawlog set sp_code= decode(cell_code,'SW_1','S6','C','C6','MX','M6','MX-
C','M6','MX-P','M6','AW','A6','PL','P6','SW_3','S6F','X','S8',sp_code) where
(all_dist = 'X' and seas_dist = 'X' and seis_dist = 'X' ) and sp_code = 'B';

REM -- for non-spatial and other inventories
update sawlog set sp_code = decode(cell_code,'S','S3','80 - 100%','S5','60 -
79%','S6','40 - 59%','S7',sp_code) where ( all_dist = 'A' or seas_dist = 'A' ) and
sp_code = 'B';
update sawlog set sp_code = decode(cell_code,'S','S4','80 - 100%','S6','60 -
79%','S7','40 - 59%','S8',sp_code) where ( all_dist = 'B' or seas_dist = 'B' or
seis_dist = 'A') and sp_code = 'B';

update sawlog set sp_code = decode(cell_code,'S','S5','80 - 100%','S7','60 -
79%','S8','40 - 59%','S9',sp_code) where ( all_dist = 'C' or seas_dist = 'C' or
seis_dist = 'B' or seis_dist = 'C') and sp_code = 'B';

update sawlog set sp_code = decode(cell_code,'S','S6','80 - 100%','S8','60 -
79%','S9','40 - 59%','S10',sp_code) where sp_code = 'B';

update sawlog set sp_code = 'S7' where cell_code in ('RS','RSH','US','USH') and (
all_dist = 'A' or seas_dist = 'A') and sp_code = 'B';
update sawlog set sp_code = 'S8' where cell_code in ('RS','RSH','US','USH') and (
all_dist = 'B' or seas_dist = 'B') and sp_code = 'B';
update sawlog set sp_code = 'S9' where cell_code in ('RS','RSH','US','USH') and (
all_dist = 'C' or seas_dist = 'C') and sp_code = 'B';
update sawlog set sp_code = 'S10' where cell_code in ('RS','RSH','US','USH') and
sp_code = 'B';
```

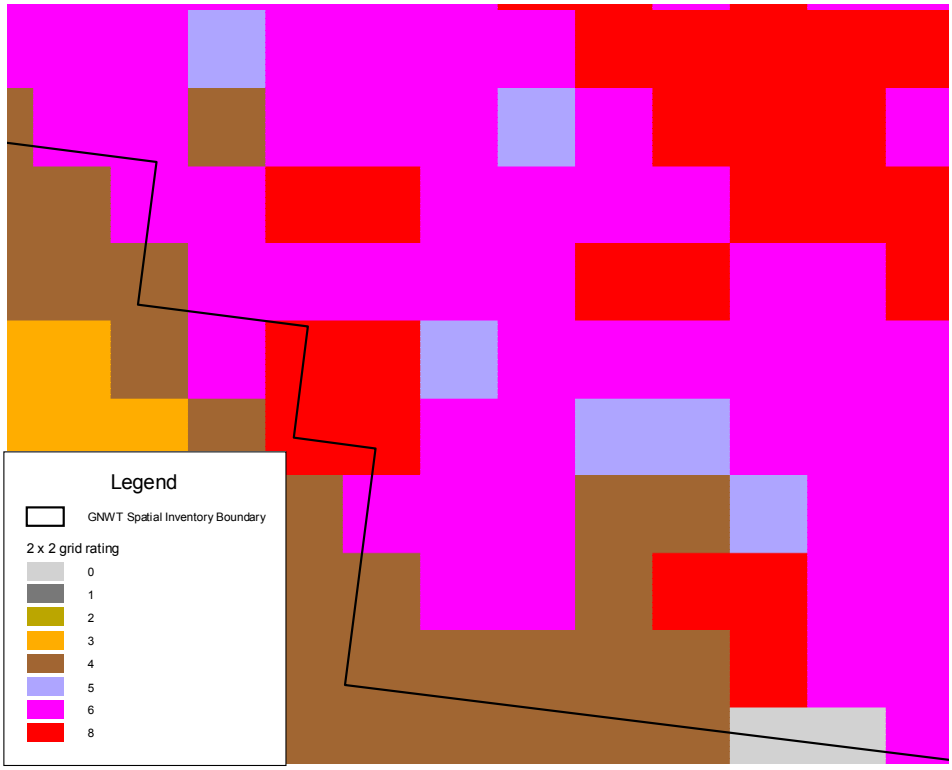
```
update sawlog set sp_code = decode(cell_code,'20 - 39%','B1','1 -
19%','B2','0%','B', 'DecFor','S9','MX_For','S8','PJ_For','S8', 'SW_For',
'S6','X','S6',sp_code) where sp_code = 'B';

REM -- Assign the ratings as outlined in Table 2
update sawlog set sp_rating = decode(sp_code,'S1',70,'S2',65,'S3',60,'S4',50,
'S5',45,'S6',40,'S7',35,'S8',30,'S9',25,'S10',20,
'S1F',65,'S2F',60,'S3F',55,'S4F',45,'S5F',40,'S6F',35,
'C1',70,'C2',65,'C3',60,'C4',50,'C5',45,'C6',40,
'M1',70,'M2',65,'M3',60,'M4',50,'M5',45,'M6',40,
'A1',65,'A2',60,'A3',55,'A4',50,'A5',45,'A6',40,
'P1',70,'P2',65,'P3',60,'P4',50,'P5',45,'P6',40,
'B',0,'B1',5,'B2',5,sp_rating );

REM -- Adjust for coverage percentage within inventoried stands
update sawlog set rating = sp_rating;
update sawlog set rating = sp_rating + floor(area_code * 30) where area_code > 0
and sp_rating > 0 ;
commit;
```

An applied example of the cell amalgamation procedure

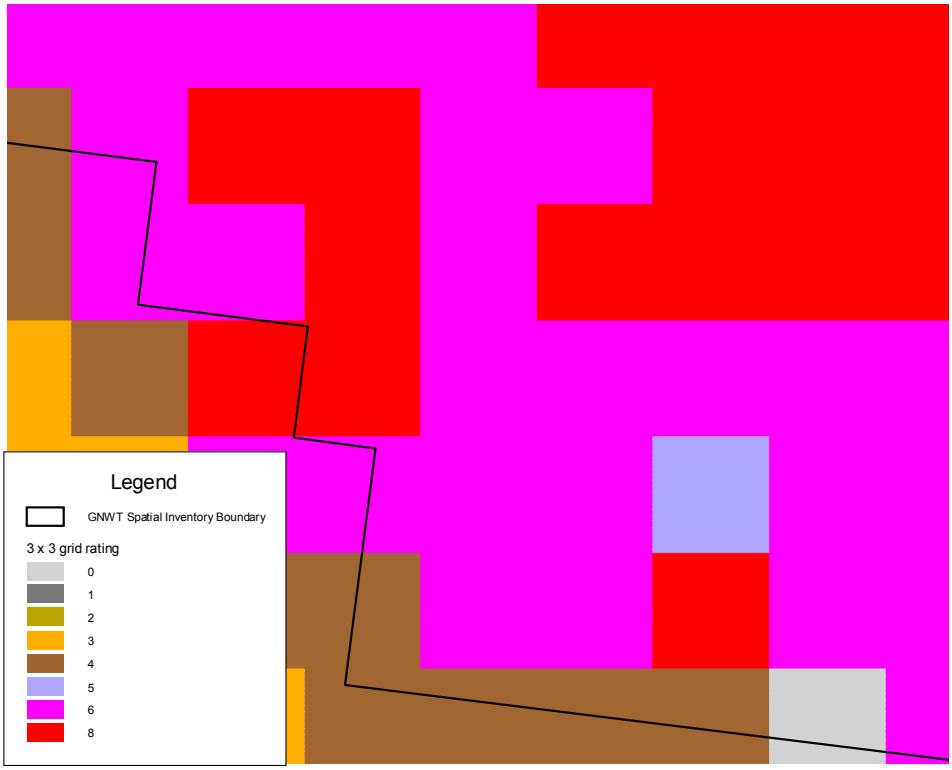
The following graphics indicate the process for merging the 1 km^2 grid cells to polygons which meet the size requirements of 100 to 10000 km^2.



Grid Cells 1 x 1 km in size. The rating is a classification of the actual codes of 1 to 100 applied through the attribute analysis described previously.

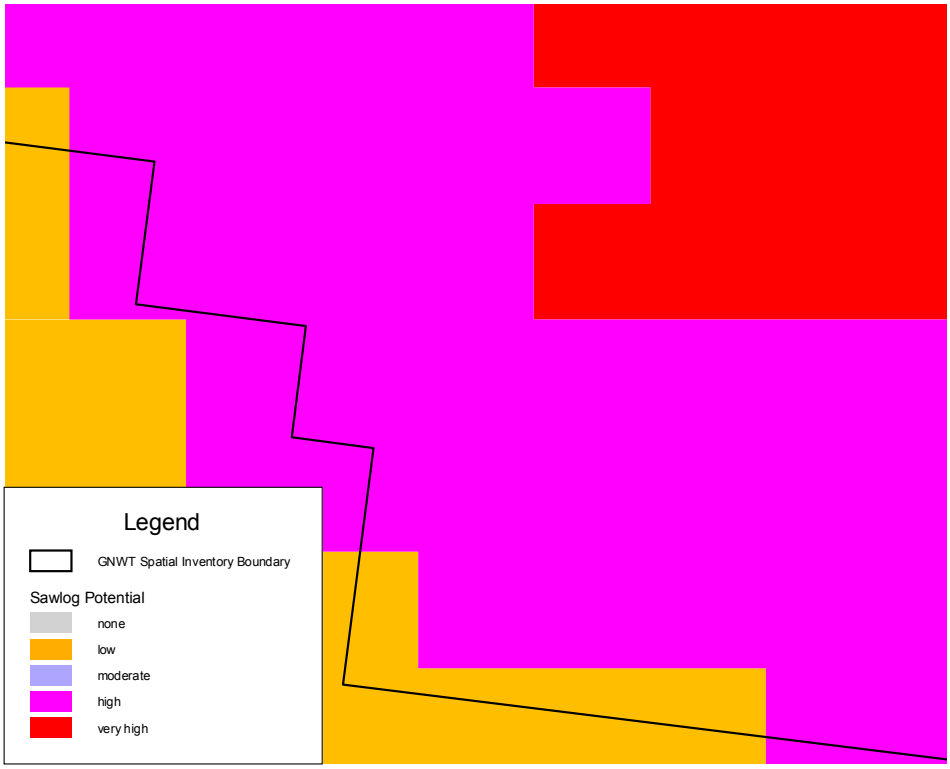


This grid was simplified slightly to a 2 x 2 km grid cell. The rating of the 4 cells which comprise the largest area in the re-sampled grid was used to assign the rating. To ensure that high and very high potential values continued to be represented in the combined cells a slightly higher weighting was applied to the higher potential areas. This meant that if the areas in low and high potential within a cell were close to the same value the cell would be rated as a higher potential. This helps to ensure that the location of these smaller pockets of high potential sawlog stands distributed across the landscape are not lost as the larger planning polygons of at least 100 km2 are generated.



A second resampling created the planning polygons where most polygons fell within the 100 to 10000 km^2 size range.

Within this coverage those small polygons (< 90 km^2) were merged in to the largest adjacent polygon. This created the final sawlog potential coverage. The ratings of 0 to 2 were classified as no potential. 3 and 4 indicated low potential. 5 indicated some or moderate potential and, for this area 6 indicated relatively high potential and 8 indicated the highest potential for sawlog on the landscape. Please note that these are relative ratings for the stands within this region and do not reflect overall forest potential.


Legend
GNWT Spatial Inventory Boundary
Sawlog Potential
none
low
moderate
high
very high