LARGE AND REMNANT LANDSCAPE LEVEL FORESTS

HIGH CONSERVATION VALUES 2 & 3, QUESTIONS 7 & 10

Does the forest constitute or form part of a globally, nationally or regionally significant forest landscape that includes populations of most native species and sufficient habitat such that there is a high likelihood of long-term species persistence?
Are large landscape level forests (i.e. large unfragmented forests) rare or absent in the forest or ecoregion?

BACKGROUND

The intent of Question 7 is to identify intact or relatively intact contiguous forest landscapes of a size such that there is a likelihood of longer-term persistence of native species (*i.e.* 10s to 100s of years). There are two main areas of investigation for which guidance is provided in the national HCVF framework: size of unfragmented forest landscapes and habitat condition. Thresholds for these two indicators will likely differ for broad forest ecosystem types. Furthermore, the investigation of forested landscapes should consider more than just the forest stands. That is, all natural, non-forest habitat (*e.g.* wetlands), water bodies and naturally disturbed areas (burns, insect damage, windthrow areas) can be part of a large landscape level forest.

In highly fragmented forest regions where large functioning landscape level forests are rare or do not exist, many of the remnant forest patches require consideration as potential HCVs under Question 10. These are the "best of the rest" areas – remnant patches that may:

- Provide the only remaining habitat for some forest species on a local or regional scale
- Serve as important source areas for recolonization of species
- Serve as representative areas informally within a landscape or formally with a protected areas network.

Similar analyses can be used to address both Questions 7 and 10, hence these are dealt with together in this document. The main issues pertaining to functional intactness, including type and density of human infrastructure, adjacency and linkages, and forest quality also apply to both investigations. Additional issues to consider under Question 10 include the size and scale of the remnant patches, the distribution of these patches in the landscape, and quality of forest in these patches.

DATA SOURCES

In general, we recommend that this analysis consider permanent infrastructure (*e.g.* road and rail lines, power transmission corridors), non-permanent human disturbances (*e.g.* harvest areas, logging roads, seismic cut lines), and indicators of forest condition (*e.g.* seral stage distribution, focal species habitat availability).

The HCVF Framework for Canada lists the following possible data sources:

- Global Forest Watch (GFW) Large Remaining Unfragmented Forest Areas dataset (http://www.globalforestwatch.ca/)
- Forest cover, infrastructure, and disturbance data provided by industry or government

Additional data sources which could inform analyses of forest quality might include:

- Data from forest cruises on stand structure
- Significant species and habitat distribution (see suggested significant species list under HCV 1, Question 4 in this document)
- Community and seral stage distribution data from Forest Resource Inventory data.

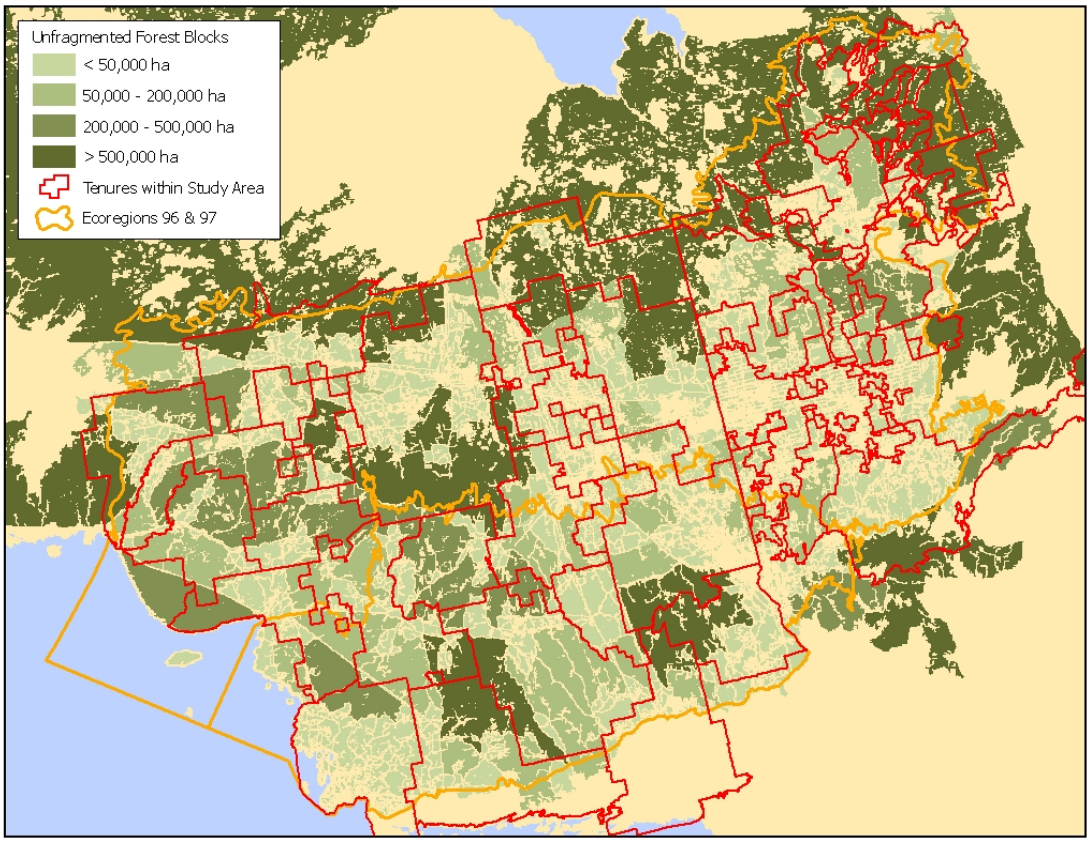
The methods laid out below utilize permanent infrastructure as delimiters of forest blocks, and non-permanent, anthropogenic disturbances (e.g. non-permanent roads, cutovers) as indicators of forest quality. The newest data from GFW (2005) utilize all disturbances, both permanent and non-permanent, to define intact forest landscapes, resulting in a very restricted set of areas. For this reason, the analyses below have used the 2001 version of the GFW Large Remaining Unfragmented Forest Areas, which is based only on permanent infrastructure, allowing non-permanent disturbance to be considered independently.

INTERPRETING GLOBAL, NATIONAL AND REGIONAL SIGNIFICANCE

The national HCVF framework has suggested thresholds for globally (greater than 500,000 ha), nationally (200,000 to 500,000 ha) and regionally (50,000 to 200,000 ha) significant large landscape level forests for boreal ecosystems. These thresholds are generally based on fire disturbance dynamics and habitat requirements for wide-ranging species. For other broad forest ecosystems, such as Pacific maritime, montane Cordilleran and Acadian forests, the thresholds will need to be modified to reflect the spatial and temporal scales of disturbance-recovery events and wildlife movements. One source of information to determine the size thresholds for other forest ecosystems is the WWF documentation related to the Assessment of Representation GIS tool (ftp://forests:gc678yy@ftp.wwf.ca/).

Thresholds for forest condition attributes also change for broad forest ecosystems. Frequency distributions of fire sizes and other analyses suggest that more that 30% late seral stands comprise more natural forests in

Figure 7.1 Large landscape level forests intersecting the study area.



eastern boreal landscapes (Bergeron *et al.* 1998). In drier western boreal forest landscapes, 10% late seral stand composition is more common (Lee *et al.* 2000; Johnson *et al.* 1995). We would also suggest that the need to consider indicators of habitat condition diminishes as the size of unfragmented forest landscape approaches thresholds that are considered globally significant. For example, a natural forest landscape in excess of 500,000 ha in size with appropriately low levels of human disturbance should be identified as an HCVF even though it may contain less than an appropriate amount of late seral, potentially as a result of recent large fires burns.

In landscapes where large landscape level forests are rare or absent, it is recommended to examine intact forest remnants at a broad regional scale such as the ecoprovince or North American ecoregion to assess the relative significance of forest patches.

ADDITIONAL GUIDANCE

We suggest two approaches to identifying large or remnant landscape level forests. One approach uses all permanent infrastructure to map intact forest blocks, and to then consider non-permanent human disturbances and forest condition measures. A complementary approach uses watersheds as the geographic unit to compile permanent infrastructure and non-permanent disturbance data as well as other measures of forest condition.

Map unfragmented forest landscapes and consider the level of non-permanent human disturbances

This analysis should first be conducted at the regional scale, as shown in Figure 7.1, using information that is of a consistent level of detail across forest tenures. This will emphasize areas of particular significance in the broader region that includes the forest tenure under investigation. In Figure 7.1, seven general areas of globally or nationally significant large landscape level forests are evident: two in Quebec and five in Ontario. However, this assessment does not necessarily confirm the presence of large landscape level forests. Consideration needs to be given to measures of forest condition within these blocks.

Analysis of forest condition is addressed through analyses scaled down to the level of the tenure, in this case Iroquois Falls Forest (Figure 7.2). Intact forest blocks are further refined using the best quality permanent infrastructure data available, and the degree of anthropogenic, non-permanent disturbance can be tabulated for each block (Table 7.1). While four forest blocks meet the minimum 50,000 ha threshold for a large landscape level forest (LLLFs 9, 10, 21 and 26), none of these forests meet the 5% disturbance threshold suggested in the HCVF framework. This

Figure 7.2 Distribution of unfragmented forest blocks within Iroquois Falls Forest (ID numbers relate to Table 7.1)

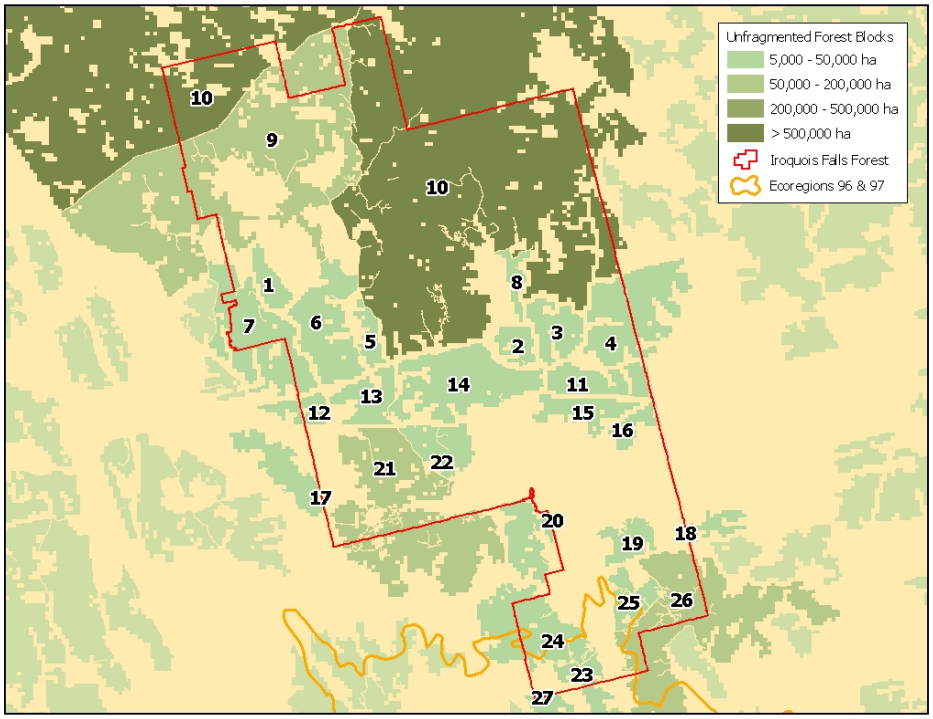
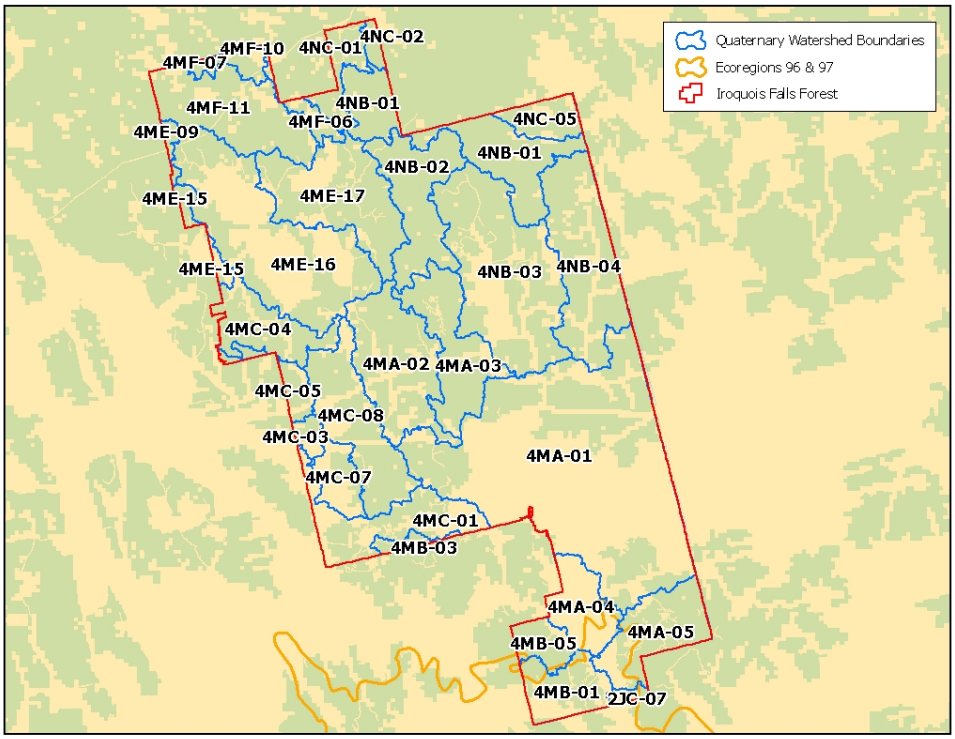


Figure 7.3 Quaternary watersheds within Iroquois Falls Forest (Watershed IDs relate to Table 7.1)



straight comparison should be tempered with an understanding of the limitations of the analyses. In this case, only disturbance within the tenure in question has been analyzed. Forest block 10, while containing disturbance well in excess of the recommended threshold, is connected to a much vaster tract of forest outside the tenure, and is in all likelihood connected to unallocated forest further to the north. This forest block should be considered a HCVF despite the nominal violation of the disturbance threshold.

It is common that the result of a regional scan of large forest blocks will differ from the finer grained investigation at the level of the individual tenure. Regional investigations suggest that the Gordon Cosens Forest (GCF) includes parts of two globally significant large landscape level forests while a nationally significant large landscape level forest comprises much of the Pineland-Martel Forest (PMF). However, in separate HCVF assessments using more detailed roads data and non-permanent human disturbances, the large landscape level forests are reduced in the GCF to smaller, regionally significant large landscape level forests and are non-existent in the PMF. This results from a consideration of non-permanent disturbances which exceed the suggested 5% threshold. Cases such as this, where a regional scan indicates the presence of large landscape level forests but a tenure level analysis diminishes or eliminates forest blocks, can potentially reveal the best opportunities to select remnant intact forest blocks under Question 10.

Investigate the density and/or proportion of disturbances and forest condition attributes for watersheds

A complementary analysis considers comparing statistics for permanent infrastructure, non-permanent human disturbances and select forest quality indicators within watersheds. Figure 7.2 and Figure 7.3 illustrate the distribution of unfragmented forest landscapes and watersheds, respectively, for the Iroquois Falls tenure.

In Table 7.1, we used the following thresholds to identify potential large landscape level forest HCVs for watersheds intersecting the Iroquois Falls forest tenure:

- density of permanent infrastructure <0.05 km/km^2 (Noss 1995)
- proportion of non-permanent disturbances <5%. This threshold is provided in the national HCVF framework. McIntyre and Hobbs (1999) defined intact landscapes as retaining 90% of natural or near-natural habitat (*i.e.* with a low degree of modification).
- proportion of late seral forests >30% (Bergeron *et al*. 1998).

This assessment identifies six highly likely watersheds as large landscape level forests (4ME-09, 4MF-07, 4MF-10, 4MF-11, 4NB-02, 4NC-02) and four additional watersheds (4MF-06, 4NB-01, 4NB-04, 4NC-05) as possible HCVs.

There are several observations that we can make and we have thematically depicted the selected watersheds in Figure 7.4 to illustrate some points:

- The selected watersheds in this case are contiguous. Using all watersheds results in one regionally significant (77,000 ha) and one nearly nationally significant (193,000 ha) large landscape level forest. Note that we have data for only parts of some watersheds and it would be ideal to have the results for all parts of all intersecting watersheds. In fact, these watersheds may be contiguous with the intact, unallocated forest and, hence, would be considered globally significant.
- If the marginal watersheds (4NC-05 and 4NB-04) are removed, then this drops the nationally significant forest to a regionally significant large landscape level forest.
- Considering only the six most likely intact watersheds listed above still results in two regionally significant large landscape level forests. Note that the human disturbance and habitat condition indicators for most of the watersheds are very close, but not all within *a priori* thresholds set out above. Given the nature of deriving HCV thresholds, we feel that this type of subjective judgment is credible with an appropriate rationale.

Comparison of analyses of unfragmented forest blocks to forested watersheds

The analysis of unfragmented forest blocks will, by definition, capture large blocks of contiguous forested landscapes. These relatively intact expanses are of importance in maintaining large-scale natural disturbance regimes and as habitat for wide-ranging species and species that are sensitive to the barriers to migration which permanent infrastructure often represents (Noss & Csuti, 1997). An analysis of watersheds is based on ecological units within the landscape and is appropriate because the level of intactness of forest cover plays a role in the ecological functiona of watersheds (Bosch & Hewlett 1982; Hornbeck *et al*. 1993).

While in the case of Iroquois Falls Forest, the two methods identify largely complimentary results (Figure 7.5), some key differences are seen which illustrate the strengths and weaknesses of both approaches.

The analysis of unfragmented forest block is highly sensitive to any permanent infrastructure, and can result in the subdivision of otherwise large intact, forested landscapes into less substantial blocks due to the dissection of a single road or hydro corridor. This can be seen in Figure 7.2, where LLLF 9 and 10 are separated in the northwest corner of the tenure by a single corridor. The watershed-based analysis does not reveal this division, rather it identifies a watershed with very low levels of disturbance and high indicators of quality.

The watershed-based approach is susceptible to diminishing the area identified as intense, localized disturbance in one portion of a large watershed can remove the entire watershed from the analysis. This results in the "buffered" appearance of Figure 7.5,

HCV2/3 Q7/10 – Large and Remnant Landscape Level Forests

Table 7.1 Summary of forest block and watershed size and condition in Iroquois Falls Forest

	Block ID	Area of Block within Tenure (ha)	Total Block Size (ha)	Density of Permanent Disturbance within Tenure (km/km^2)	Prop. of Non-Permanent Disturbance within Tenure	Prop. of Late Seral Stands
Large Landscape Level Forests	LLLF 1	7,710	7,710		0.1%	17.5%
	LLLF 2	6,755	6,755		30.4%	12.6%
	LLLF 3	13,717	13,717		28.3%	10.0%
	LLLF 4	19,032	40,180		0.7%	5.2%
	LLLF 5	5,851	5,851		20.0%	4.4%
	LLLF 6	30,253	30,253		12.3%	12.1%
	LLLF 7	22,402	42,215		11.4%	10.8%
	LLLF 8	5,314	5,314		57.6%	10.9%
	LLLF 9	86,968	170,091		18.6%	34.2%
	LLLF 10	320,157	2,561,259		12.9%	25.5%
	LLLF 11	15,069	15,362	*N/A*	2.5%	1.1%
	LLLF 12	3,937	7,166		1.4%	8.6%
	LLLF 13	12,720	12,720		10.5%	15.0%
	LLLF 14	40,723	40,723		2.1%	9.2%
	LLLF 15	12,160	12,160		13.7%	3.6%
	LLLF 16	5,860	5,989		6.1%	2.2%
	LLLF 19	9,356	9,356		6.3%	5.2%
	LLLF 20	546	15,908		28.5%	32.0%
	LLLF 21	43,254	85,246		15.3%	12.3%
	LLLF 22	14,590	14,590		11.9%	15.7%
	LLLF 23	5,060	11,789		11.1%	0.7%
	LLLF 24	20,159	36,452		28.5%	6.9%
	LLLF 25	9,996	9,996		22.1%	5.3%
	LLLF 26	25,767	83,490		16.5%	5.0%
	LLLF 27	491	8,034		7.0%	14.3%
Quaternary Watersheds	4MA-01	244,219		0.28	11.1%	4.5%
	4MA-02	59,034		0.34	12.2%	6.3%
	4MA-03	44,873		0.19	5.7%	10.1%
	4MA-04	26,292		1.02	15.6%	3.0%
	4MA-05	37,950		0.54	21.8%	4.8%
	4MB-01	25,842		0.61	24.2%	4.3%
	4MB-03	4,248		0.53	33.0%	0.0%
	4MB-05	13,236		0.46	22.4%	7.1%
	4MC-01	41,757		0.64	29.0%	5.4%
	4MC-03	6,576		0.44	9.1%	13.8%
	4MC-04	31,436		0.29	10.8%	11.7%
	4MC-05	10,080		0.37	3.1%	11.0%
	4MC-07	16,314	*N/A*	0.46	27.8%	16.0%
	4MC-08	51,905		0.25	13.6%	13.2%
	4ME-09	3,795		0.10	5.3%	40.3%
	4ME-15	6,917		0.20	38.9%	22.5%
	4ME-16	109,186		0.28	36.8%	17.9%
	4ME-17	63,953		0.24	32.3%	17.4%
	4MF-06	7,345		0.08	8.2%	20.3%
	4MF-07	2,786		0.00	0.0%	37.0%
	4MF-09	161		0.00	0.0%	28.9%
	4MF-10	6,308		0.12	0.0%	33.7%
	4MF-11	56,820		0.06	3.0%	37.4%
	4NB-01	59,828		0.03	12.1%	38.0%
	4NB-02	46,728		0.04	6.0%	30.8%
	4NB-03	101,997		0.30	34.4%	17.9%
	4NB-04	66,941		0.11	8.4%	16.3%
	4NC-01	16,083		0.27	25.9%	17.2%
	4NC-02	4,185		0.08	5.8%	25.3%
	4NC-05	15,347		0.00	13.2%	17.9%

where the areas identified by the watershed approach are withdrawn from the margins of the areas identified by looking at large forest blocks.

Using the summed areas of both lines of investigation gives a more comprehensive view of large landscape level forests, and those areas identified by both approaches are highlighted as being of prime importance.

Size and scale of remnant large landscape level forests

The HCVF Framework refers to remnant patches that are "thousands of hectares" in size, but does not provide further guidance on determining how large a remnant should be to qualify as a HCVF under Question 10. The significance of a remnant is scale dependent – that is, relative to the size of the landscape and to other forest patches. Within smaller block sizes, other factors including forest condition and quality and proximity to other landscape features (see below) increase in importance for determining HCVF status. As with Question 7, thresholds for the two primary indicators - remnant patch size and forest condition – will likely differ for different forest ecosystem types.

Quality of forest remnants

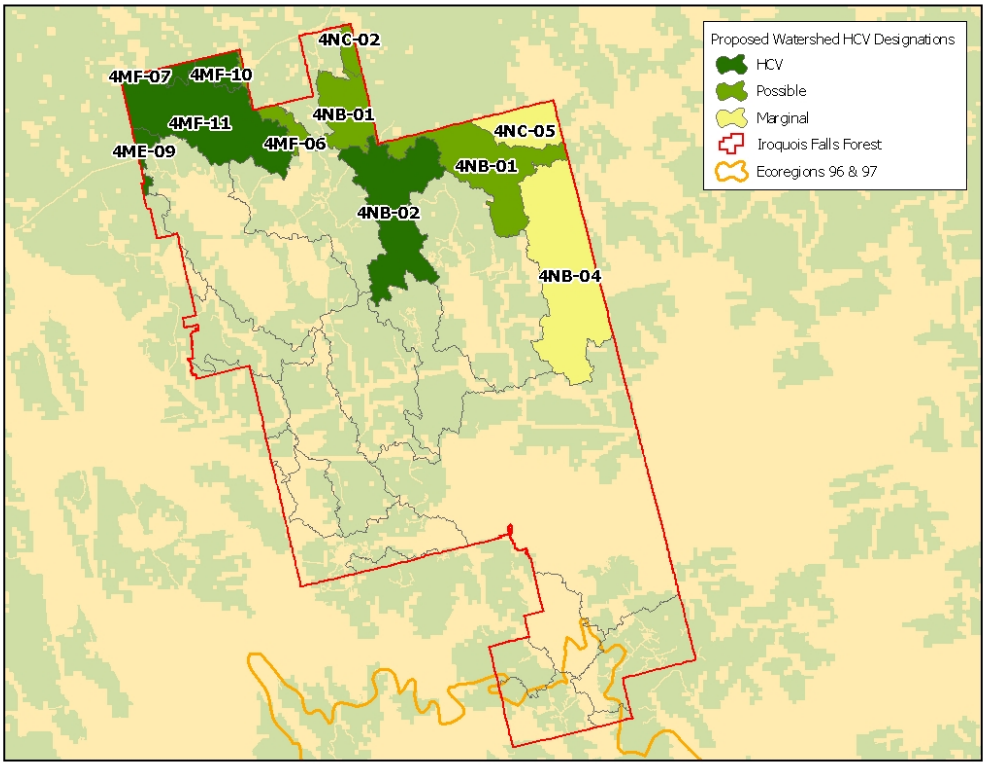
The guidance questions in the HCVF Framework recognize the importance of several forest quality parameters in determining HCVF status on forest remnants. One factor that is sometimes overlooked is that natural disturbance cycles are an important part of intact forest landscapes; forests affected by wild fire, insects or windthrow may still be intact, even if the canopy layer is removed or compromised. In addition to levels of anthropogenic disturbance, we recommend investigation of the following indicators of forest quality during the HCV assessment process:

- Percent of climax species vs pioneer species Thresholds for forest condition attributes depend on the characteristics of the broad forest ecosystem. Frequency distributions of fire sizes and other analyses suggest that natural eastern boreal forests are composed of approximately 30% late seral stands (Bergeron *et al*. 1998). In drier western boreal forests landscapes, a 10% late seral stand composition is common (Lee *et al*. 2000; Johnson *et al*. 1995).
- Habitat for focal species – a cumulative effects study conducted for the Deh Cho Land Use Planning Committee (2004) provides well-researched thresholds for habitat availability, minimum core area, minimum patch size, and specialized habitat features. We recommend this type of approach for evaluating habitat quality for focal species.
- Structural indicators
    - Number of snags/hectare
    - Amount of coarse woody debris
    - Forest cruise data on canopy structure

Distribution of forest remnants on the landscape

How and if relatively large remnant patches are

Figure 7.4 Proposed HCV status of quaternary watersheds based on levels of disturbance.



connected to natural corridors (*e.g.*, rivers with buffers) is significant for wildlife and the functioning of natural disturbance regimes. An analysis of the distribution of relatively large remnant forest patches relative to other landscape features should help in determining local and regional significance.

The question of distribution on the landscape can be also be addressed by taking the previously discussed alternative approach of looking at high quality watersheds as the base unit of "forest blocks" and looking at connectivity of these high quality watersheds in the landscape (Figure 7.3; Table 7.1).

If we look at the analysis for Iroquois Falls Forest and work under the assumption that no Large Landscape Level Forests were identified (*i.e.* assume that LLLFs 9 & 10, and watersheds 4ME-09, 4MF-6, -7, -10, and -11 are omitted; see Figures 7.2 and 7.3), then we can use this data as an illustrative example for discussion of forest remnants using the same thresholds:

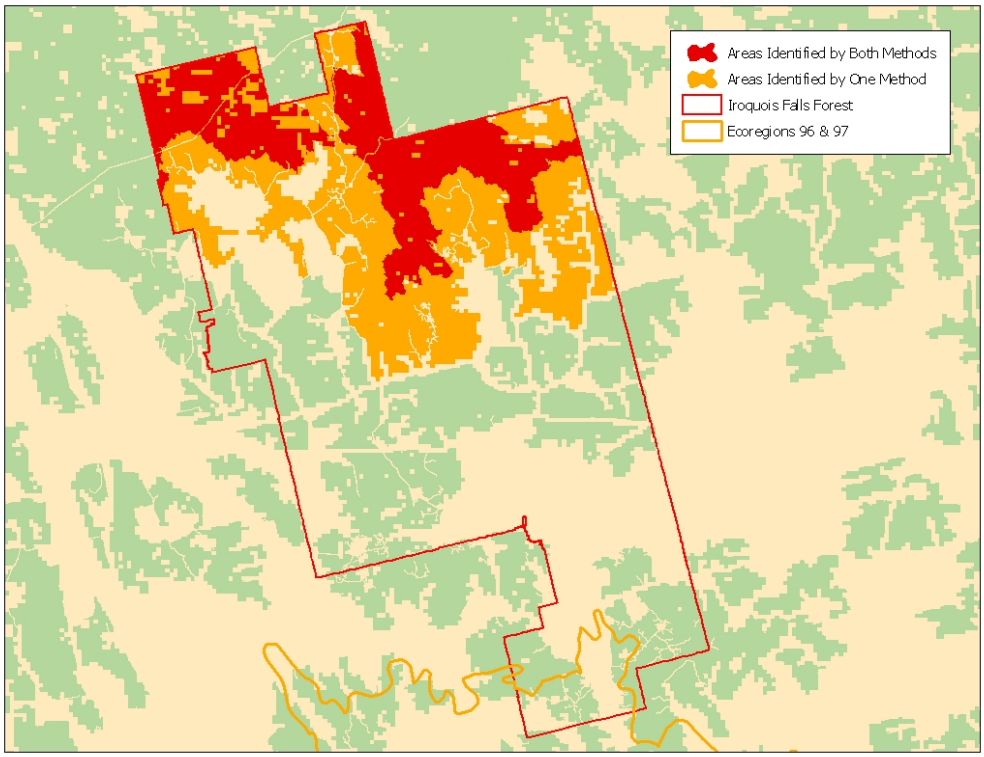
- density of permanent infrastructure <0.05 km/km^2 (Noss 1995)
- proportion of non-permanent disturbances <5%. This threshold is provided in the national HCVF framework. McIntyre and Hobbs (1999) defined intact landscapes as retaining 90% of natural or near-natural habitat (*i.e.* with a low degree of modification).
- proportion of late seral forests >30% (Bergeron *et al.* 1998)

Given that no forest blocks or watersheds meet these thresholds, the "best of the rest" approach leads those closest to the thresholds to be selected. For the Iroquois Falls example, if the thresholds are relaxed to consider watersheds with 0.3 to 0.5 km/km2 road density, less than 10% non-permanent disturbance and greater 10% late seral stands, five watersheds are selected: 4MC-05, 4MA-03, 4MC-03, 4MC-04 and 4MC-08. Using the same thresholds for remnant forest blocks, we would select LLLF 13 and 22.

Watershed 4MF-09 and LLLF 27 would also techinically qualify under these thresholds, but only a very small portion of these blocks intersects Iroquois Falls Forest. Levels of disturbance outside the tenure boundaries are unknown. If these small blocks were connected to much larger, high quality areas outside the tenure, then these blocks could be additionally selected.

A survey of the spatial arrangement of the watersheds, and their levels of disturbance suggests that the contiguous unit formed by watersheds 4MC-04, 4MC-05 and 4MC-08 captures a contiguous area with moderate levels of permanent and non-permanent disturbance, proportions of late seral forest which are on par with the surrounding forest blocks, and which encompasses several sizable forest remnants.

Figure 7.5 Comparison of results from the forest block and watershed approaches to identifying large landscape level forets in Iroquois Falls Forest.



We recommend the following questions as additional guidance in determining remnant forest blocks

- If remnant patches are dominated by pioneer species, did this condition result from a natural or anthropogenic disturbance events? (See discussion of forest quality above.)
- Are intact remnants connected to or in close proximity to other important habitat features on the landscape (*e.g.*, river corridors)?

SUMMARY OF RECOMMENDATIONS

- Examine large landscape level forests and remnants at multiple scales to reveal their relative significance.
- Investigations should consider the size and condition of forest blocks, as per the HCVF framework, but should also utilize the watershed-based approach. The combined results of these two analyses will address a broader definition of intact forest landscapes.
- To determine HCVF status under Question 10 weigh and balance stand quality with patch size and proximity. Higher quality remnants that are well positioned on the landscape relative to other HCVs are usually good candidates for HCV status.
- Percent of climax vs pioneer species, habitat for focal species, and structural habitat indicators should all be used as indicators of forest quality.

LITERATURE CITED

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METHODOLOGY

Figures 7.1, 7.2, and 7.3

Sources

- Global Forest Watch Canada. Large Remaining Unfragmented Forest Areas (revised). (1 km resolution raster). 2001. (While newer versions of GFWC data are available, they include impacts of all disturbance, including non-permanent; this study utilized the 2001 data which defined forest blocks using 1:250,000 transportation data only. This allowed non-permanent disturbance to be treated as an indicator of forest quality, not a delimiter of forest blocks)
- DMTI Can-Map Streetfiles. 1:50,000 to 1:200,000. 2002.
- Power Lines in the "Lands for Life" area. OMNR. 1:600,000. 1997.
- Digital Chart of the World. Utility lines & corridors. 1:1,000,000.
- National Atlas Information Service. Railroads within Canada. 1:7,500,000.
- Quaternary Watersheds. OMNR. 1:20,000. 2002.
- Global Forest Watch Canada. Forest Tenures in Canada.
- Environment Canada & Agriculture Canada. Terrestrial Ecoregions of Canada.

Methodology

- The GFW grid was converted to a polygon theme to facilitate manipulation and areal calculations
- DMTI roads ("CARTO" classes 1 through 5; excludes trails, ferry routes, *etc.*), power lines, utilities and railroads themes were merged to create a Permanent Linear Infrastructure theme in the hopes of capturing infrastructure that may have been missed in the GFW analysis.
- The Permanent Linear Infrastructure theme was used to further dissect the GFW polygon theme
- All intact forest blocks that intersected the Study area (Terrestrial Ecoregions of Canada, Ecoregions 96 and 97) were then symbolized by their total area to produce Figure 7.1
- The forest blocks were intersected with the boundary of Iroquois Falls Forest, and each intersected block falling within Iroquois Falls

Forest and with an area >5,000 ha was assigned a unique identifier, creating Figure 7.2
- The forest blocks were further intersected with the Quaternary watershed boundaries falling within Iroquois Falls Forest, creating Figure 7.3

Figures 7.4 and Table 7.1

Sources
- Forest Blocks >5,000 ha Intersected by Iroquois Falls Forest and Quaternary Watershed Boundaries. Generated in Figures 7.2 and 7.3
- Roads in Iroquois Falls Forest. Abitibi Consolidated.
- Seismic lines for Canada. Compilation of seismic lines from Canada's NTS maps for Canadian Boreal Initiative (CBI).
- Quaternary Watersheds. OMNR. 1:20,000. 2002.
- Depletions in Iroquois Falls Forest. Abitibi Consolidated.
- Forest Resource Inventory for Iroquois Falls Forest. Abitibi Consolidated.

Methodology
- Within each Forest Block identified in Figure 7.1, the level of non-permanent, anthropogenic disturbance was derived by calculating the proportion of the block impacted by harvesting and forest roads
- All Abitibi roads categorized as non-gravelled tertiary or winter roads (Classes 4 and 5) and seismic lines were buffered 50m and this area was unioned with the area of depletions due to harvesting activity. Depletions due to fire were excluded.
- This layer of non-permanent disturbance was then intersected with the Large Forest Blocks and the level of disturbance was expressed as a proportion of the total block covered by the disturbance layer as per Table 7.1
- Late seral stands within Iroquois Falls Forest were identified by performing the following attribute query on the Forest Resource Inventory data to select qualified stands based on their age and Standard Forest Unit designation (Query based on Uhlig *et al.* 2001):

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(("FU" = 'PR1') and ("AGE" >= 130)) or
(("FU" = 'PRW') and ("AGE" >= 130)) or
(("FU" = 'PW1') and ("AGE" >= 130)) or
(("FU" = 'BOG') and ("AGE" >= 150)) or
(("FU" = 'SB1') and ("AGE" >= 120)) or
(("FU" = 'SP1') and ("AGE" >= 100)) or
(("FU" = 'PJ1') and ("AGE" >= 110)) or
(("FU" = 'PJ2') and ("AGE" >= 100)) or
(("FU" = 'LC1') and ("AGE" >= 120)) or
(("FU" = 'SF1') and ("AGE" >= 90)) or
(("FU" = 'PO1') and ("AGE" >= 90)) or
(("FU" = 'BW1') and ("AGE" >= 90)) or
(("FU" = 'MW1') and ("AGE" >= 95)) or
(("FU" = 'MW2') and ("AGE" >= 100)) or
(("FU" = 'LH1') and ("AGE" >= 90)) or
(("FU" = 'TH1') and ("AGE" >= 145))
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- The proportion of late seral forest within each forest block was derived by intersecting the late seral stands with the Forest Blocks identified in Figure 7.1 and summing their areas by forest block, as per Table 7.1
- All watershed-based analyses were performed on all data within Iroquois Falls Forest (*i.e.* data were not restricted to falling within the large forest blocks)
- The layer of non-permanent disturbance was intersected with the Quaternary Watershed boundaries and the level of disturbance was expressed as a proportion of the watershed covered by the disturbance layer as per Table 7.1
- The level of permanent disturbance was calculated as the kilometres of Permanent Linear Infrastructure (as defined in Figure 7.1) per square kilometre for each watershed as per Table 7.1
- The proportion of late seral forest within each watershed was derived by intersecting the late seral stands with the Quaternary Watershed boundaries and summing their areas, as per Table 7.1