Residential Development Threats in the Land Between

Summary Report

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A critical but often overlooked aspect of land and ecological preservation is an acknowledgement of future threats. Understanding future threats can help land preservationist and planers move from a reactive to proactive position. These threats frequently represent residential intensification or conversion. In The Land Between (TLB), residential development is primarily occurring in the form of exurban development. Exurban development is defined as low density housing within a landscape dominated by native vegetation. The proximity to major urban centers and access to natural amenities are the two major factors driving exurban development in North America. TLB's lakes and forest, proximity to key protected areas in Central Ontario, and relatively close distance to two major urban centers (the Greater Toronto Area to the south and Ottawa to the east) make it an ideal setting for exurban growth. In TLB, a potential threat map could be used to inform land planning in the region, while contributing to a broader understanding of land use dynamics in exurban landscapes.

The objectives of this project were:

(1) Calculate accessibility to population centres, major transportation corridors, and natural amenity features.
(2) Determine the relationship between accessibility variables, socioeconomic conditions, biophysical characteristics (geomorphology, soil conditions, etc.), and recent residential expansion.
(3) Identify protected open space and other constraints on residential development.
(4) Map potential future development threat levels based on recent changes and constraints.

In the first step of the project, data from a variety of sources was collected for TLB (Table 1). The variables fall into three categories (biophysical characteristics, socioeconomic accessibility, and natural amenity accessibility) and were identified as potentially relevant characteristics associated with exurban development location, based on a review of the literature. Each dataset was clipped to the TLB boundaries and projected into Lambert Conformal Conic Canada. Two road density variables were derived from the Ontario road datasets, based on the length of roads within a 0.5 km and 1.5 km neighborhood respectively. Other variables look at the density of neighborhood forest cover and existing urban development, using similar neighborhood sizes. Several variables were created that are based on the distance of each cell to the nearest feature of interest. These variables are based on either a simple Euclidean distance calculation or functional distance, defined as the distance following the road network.

The next step compared the variables described above with existing exurban development to determine what factors were correlated with such development. A major step in this works was developing an accurate map of exurban development. Several approaches were tried, using Peterborough County as a test site. In the end, applying NDVI

thresholding and contextual post-processing to SPOT 5 MS satellite data provided a map that meet standard accuracy levels.

The relationship between exurban development and locating factors was then investigated using stepwise logistic regression, given that the dependant variable was binary (exurban development or undeveloped). Different sets of potential locating variables were included in separate runs, to determine which variables best explain the location of existing exurban development (Table 2). The northern and southern sections of TLB were analyzed separately to account for the differences in basic geography and exurban development pattern.

Table 3 details the results of the logistic analysis for each set of variables across the two regions. It was determined that variable set 5 best explained exurban development location in the North, while variable set 6 worked best in the South. Although several other variable sets performed equally well, these variable sets were not chosen because many more variables were retained in the final equation without significantly improving the correlation. Thus, the most parsimonious solution was chosen. Table 4 shows the variables that were retained in the final equations for both regions.

The final step of the project was to create a map showing the potential of future exurban development. This was done by first eliminating areas that were deemed not available for exurban development (i.e. protected as open space, urban centers, and locations that were already developed). The two equations derived from the logistic analysis were then applied to all available land. Figure 1 shows the results of the analysis. Numbers closer to one indicate a higher probability of converting to exurban development based on characteristics similar to locations that have already been converted to exurban uses. In general, the southern region and eastern section tend to have higher development potential. Most high potential areas are also located adjacent to lakes, with the exception of the southeast.

Table 1. Potential locating factors.

Variable	Description
	Biophysical
Dem	Elevation
Slope	Slope
Stoness	Stoniness
	Socioeconomic Accessibility
Uwrd_5	Road density within 0.5 km
Uwrd_15	Road density within 1.5 km
ED_rd	Euclidean distance to nearest road
ED_rails	Euclidean distance to nearest railway
ED_ua	Euclidean distance to nearest urban area
ED_air	Euclidean distance to nearest airfield
ED_hsp	Euclidean distance to nearest health center
ED_sch	Euclidean distance to nearest schools
FD_tor	Functional distance to Toronto
FD_rmp	Functional distance to nearest highway entrance ramp
Dev_1km	Percent developed within 1 km
Exden5	Density of parcels less than 8 ha within 0.5 km
	Natural Amenity Accessibility
ED_wtr	Euclidean distance to nearest water body
WD_capa	Euclidean distance to nearest conservation or protection area
For_1km	Percent forest cover within 1 km

Table 2. Variable sets included in logistic regression

Variable Set	Variables Included
All	All potential locating factors included
1	All variables but FD_tor and Uwrd_15
2	3 biophysical variables; road density variables; Dev_ 1km, Exden5; For_1km
3	3 biophysical variables; ED_rds, ED_ua; ED_air, ED_sch, ED_rails; FD_rmp; ED_wtr, ED_capa, For_1km
4	Set 3 plus exden5
5	Set 4 plus Uwrd_15
6	Set 4 plus Uwrd_5
7	Only 3 biophysical

Table 3. Logistic regression goodness of fit results.

Var. Set	AIC	Concordance	ROC	Tau-a	P. Rsq (L&f)
		North			
All	7053	92.7	0.928	0.428	0.485
1	7097	92.7	0.928	0.428	0.482
2	11196	80.0	0.801	0.301	0.181
3	9300	86.2	0.862	0.362	0.320
4	7239	92.6	0.926	0.426	0.471
5	7174	92.6	0.927	0.427	0.476
6	7164	92.7	0.927	0.427	0.477
7	7448	92.6	0.927	0.427	0.455
		South			
All	14168	88.8	0.888	0.388	0.379
1	14177	88.7	0.888	0.388	0.379
2	18209	80.9	0.810	0.310	0.201
3	17162	82.2	0.823	0.323	0.247
4	14324	88.5	0.886	0.386	0.372
5	14309	88.5	0.886	0.386	0.373
6	14205	88.7	0.887	0.387	0.377
7	14775	88.4	0.885	0.386	0.352

Table 4. Equations used for future predictions

Northern Region		Southern Region	
Variable	Beta Coefficient	Variable	Beta Coefficient
Intercept	3.9587	Intercept	4.6242
FD_rmp	-0.00025	FD_rmp	-0.000069
ED_ua	0.0683	ED_ua	0.0775
ED_rd	-0.8062	ED_rd	-2.1230
For_1km	-0.00046	ED_air	0.0251
Dem	-0.0153	ED_wtr	-0.2492
Stoness	-0.0338	For_1km	-0.00044
Exden	0.0987	Dem	-0.0185
Uwrd5	-0.3806	Stoness	-0.0240
		Exden	0.0494
		Uwrd5	-0.2783

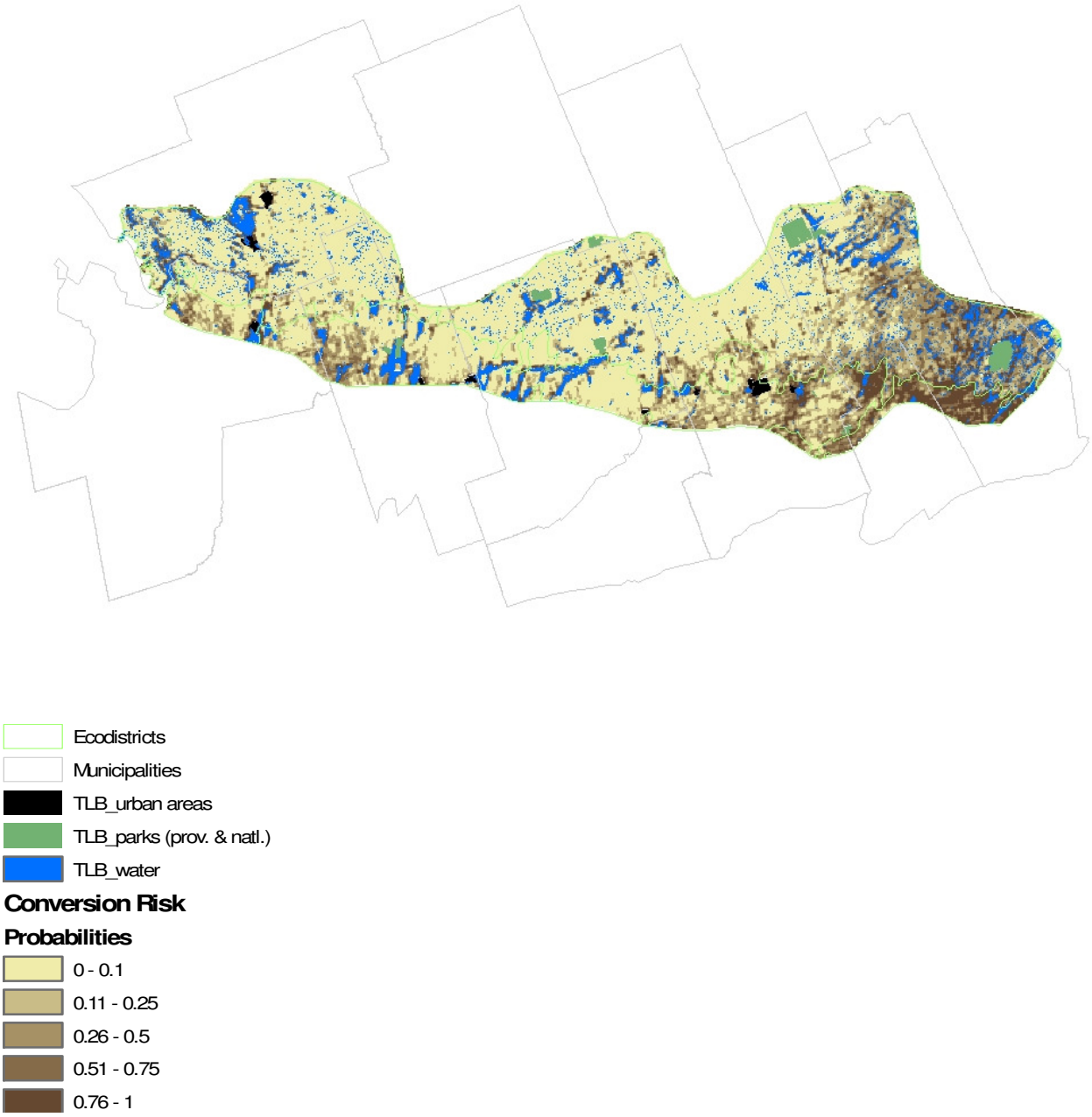

Figure 1. Probability of exurban development for Land Between.