APPENDIX P

TERRESTRIAL RESOURCES TECHNICAL SUPPORT DOCUMENTS

P-1 Baseline Terrestrial Report

P-2.1 GHD Category 2 and Category 3 Updated Modelling Report (Ferrit 2024)

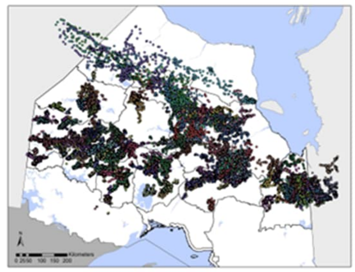
P-2.2 Resource Selection Probability Modelling of Calving Areas using Recent Satellite Telemetry Data (Minnow 2024)

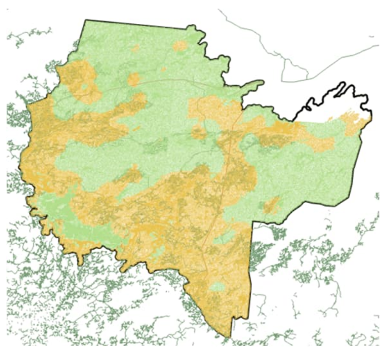
P-2.3 Resource Selection Probability Modelling of Calving Areas Using GHD Spring & Summer and MECP Category 1 Areas (Ferrit 2024)

P-2.4 Report on Caribou Sustainability Metrics for the Springpole Project Current and Future Condition Scenarios with Assessments at LSA and RSA Scales (Ferrit 2024)

Phase 1 Report on Updates to Mapping Caribou Category 2 and Category 3 Habitat for the Churchill Caribou Range

Jan 20th, 2024





Rob Rempel, FERIT Environmental Consulting

https://www.ferit.ca

northernbio@gmail.com

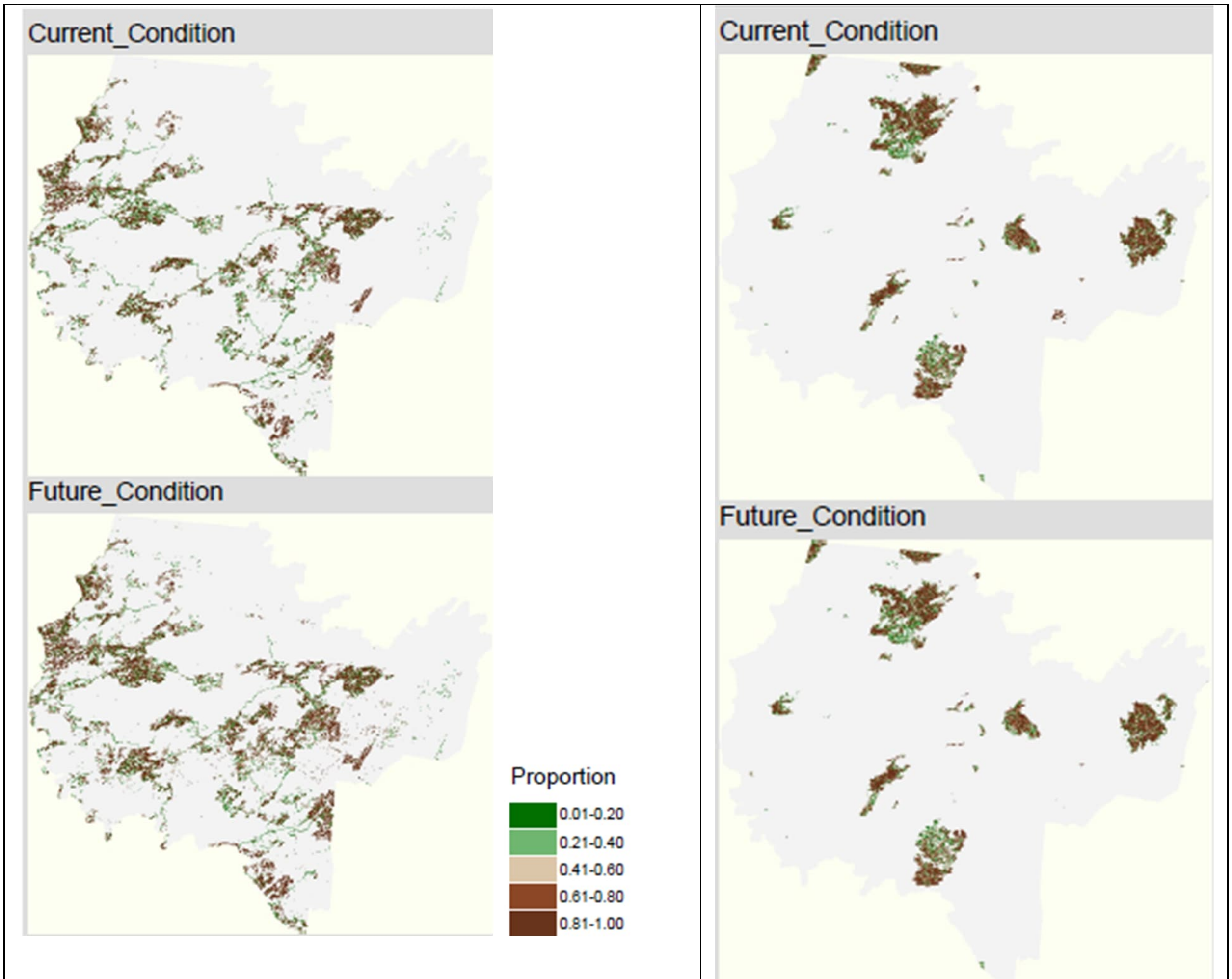
Under the General Habitat Description, Category 2 habitat represents seasonal ranges for caribou, while category 3 is the remaining habitat that may still be used, but has lower value to caribou (General habitat description for the Forest-dwelling Woodland Caribou | ontario.ca). MECP has taken an RSPF approach to mapping category 2 habitat by mapping each of the 4 seasonal ranges, and is briefly described in methods for State of the Woodland Caribou Resource reports (State of the Woodland Caribou Resource Report: Part 3 | ontario.ca). More detail is available in Hornseth and Rempel (2016) and Rempel and Hornseth (2017). This method maps potential habitat value based on modelling associations of observed caribou use with land cover, linear features, and other environmental variables.

Methods

The Category 2 (RSPF) model was based on 7 classes from the Landsat based Provincial Forest Classification (PLC) plus esker lines, mapped forest fires, and anthropogenic linear features (Table 1). Maps of the variables are provided in Appendix 1 (Table A1), along with PLC class definitions. Calculations are conducted in the specialized GIS program, Landscape Scripting Language (LSL) (Kushneriuk and Rempel 2011), which allows for multiple scale modeling using spatial averaging of hexagons. For caribou Category 2 maps, an intersection of 3-ha hexagons with landscape variables is conducted first, and then spatial averages generated at the 5,000-ha scale are used for the RSPF analysis. This scale was used because it resulted in the highest performance relative to all other scales that were assessed (Hornseth and Rempel 2016).

Table 1. Variables used in the Category 2 RSPF model.

Variable	Source	Calculation
Dense Deciduous	PLC	Proportion within hexagon
Dense Mixed Forest	PLC	Proportion within hexagon
Dense Conifer	PLC	Proportion within hexagon
Sparse Treed	PLC	Proportion within hexagon
Treed Peatland	PLC	Proportion within hexagon
Open Peatland	PLC	Proportion within hexagon
Water	PLC	Proportion within hexagon
Natural Disturbance	Disturbance mapping	Majority with hexagon
Eskers lines	Topographic map	Density (m/ha)
Linear features – roads, railways, and transmission lines	Anthropogenic disturbance mapping	Density (m/ha)



A. FRI Harvest	B. Burns

Figure 1. Disturbance. FRI Harvest (A) and Wildfire Burns (B). There is no difference between current condition and future condition. Future condition is where the Springpole Project Development Area (PDA) preferred option has been applied to the landscape.

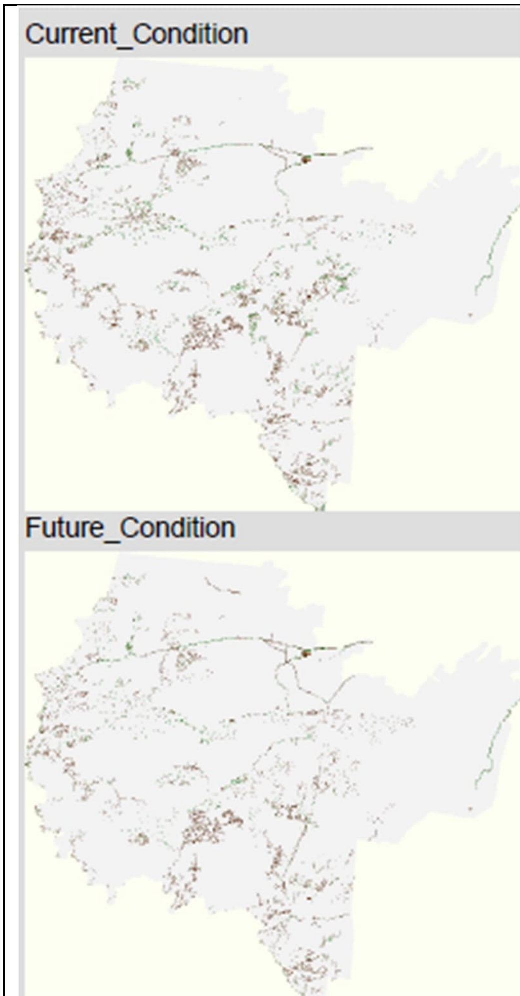
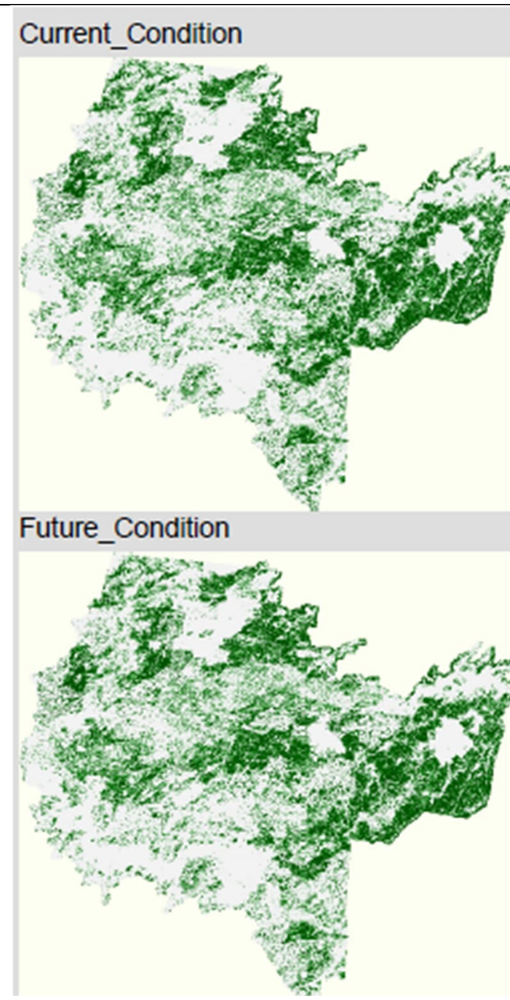
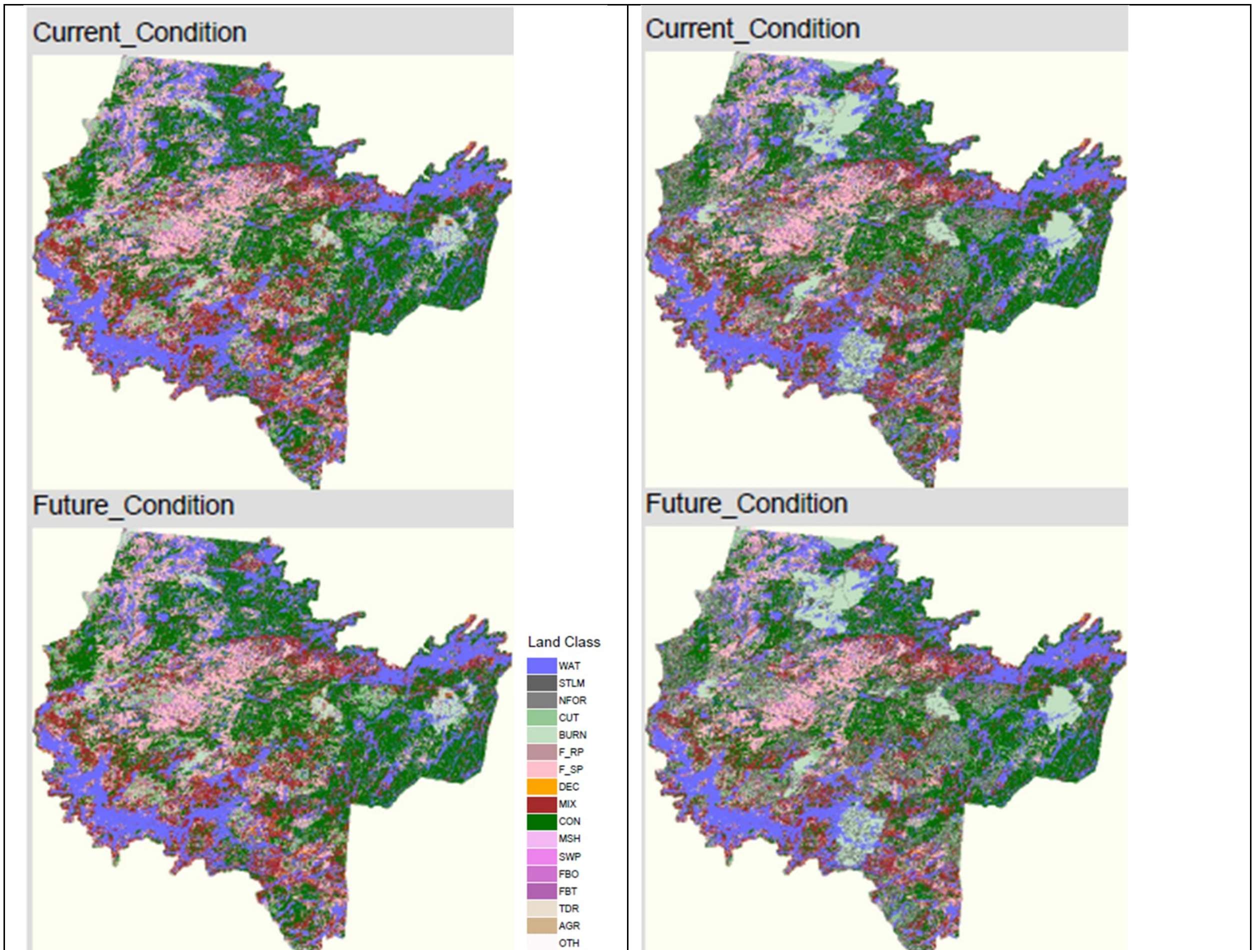
	
A. Distribution of settlements and infrastructure	B. Distribution of conifer forest

Figure 2. Distribution of settlements and infrastructure (A), and conifer forest (B), between current and future conditions. Future condition is where the Springpole Project Development Area (PDA) preferred option has been applied to the landscape.



A. PLC (before updates)	B. PLC (after updates)

Figure 3. Provincial Landcover 2000, Before disturbance updates (A), and after disturbance (B) updates. Disturbance updates are when the Springpole Project Development Area (PDA) preferred option has been applied to the landscape. Note that updated PLC with the Springpole Project preferred option PDA has been applied (bottom right-hand image) has very little change from the updated current condition (top right-hand image).

Forest harvest, aging, and succession change the landcover over time, especially forest cover. Wetlands and other variables remain stable. Of the original PLC model variables, deciduous, mixed forest, and conifer in the PLC were updated in LSL by overlaying disturbance layers and reassigning existing PLC classes to the appropriate disturbance classes. The Churchill caribou range intersects with 7 FMUs (Caribou Forest, Cat Lake Forest, English River Forest, Lac Seul Forest, Trout Lake Forest, Wabigoon Forest, and Whiskey Jack Forest), and these were merged into a single GIS layer where LFGU, Polytype, YRORG, and DevType were retained as common variables (Fig. 1B).

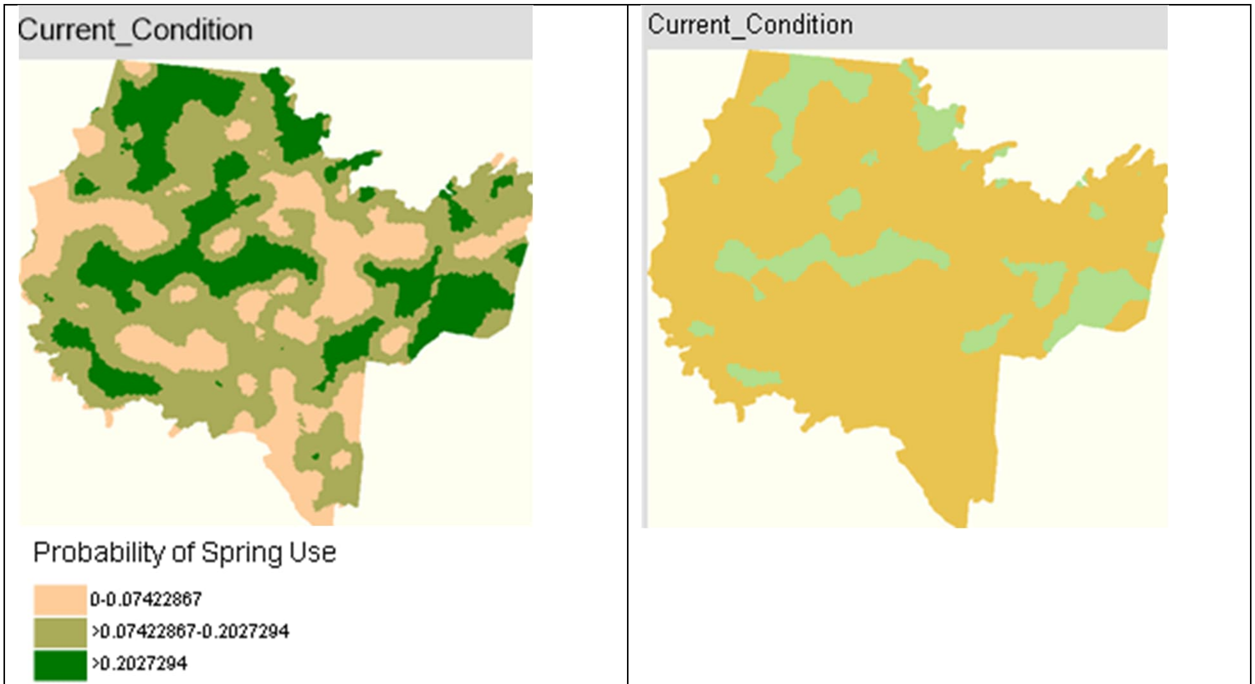
Specifically, three groups of disturbance under current condition were processed in LSL to update the PLC 2000 map: harvest, burns, and infrastructure (Fig. 2A). The harvest layer (Fig. 1A) was derived from the merged FRI coverage, and disturbance age calculated as current year (2024) – year of stand origin. The burn layer was from LIO (Fig. 1B), and disturbance age calculated as current year – burn year. A settlement layer was created from the LIO settlements layer and MNDM mines layer by creating a 1 km buffer around existing mines and settlements. If a 3-ha hexagon intersected a burn or harvest disturbance <= 40 years or a settlement, and proportion was > 10% of the hexagon, then mature forest in the hexagon was reclassed to either PLC classes 7 (Burn), 8 (Harvest), or 3 (Settlement). In addition, construction of roads also removes mature forest. To model this the PLC landcover was updated in LSL to change any mature forest classes in the 3.1 ha hexagon cell (100 m radius) that intersected an anthropogenic linear feature to the Settlement class (which includes road disturbance). The collective effect of this disturbance (Fig. 2A) on the PLC 2000 landcover is shown in Fig. 3, where original PLC is in Fig 3A, and the updated version in Fig. 3B. For future condition, proposed mine infrastructure, including mine sites, roads, and transmission lines, were added to the appropriate layers, and processed in LSL as a separate scenario. The updated PLC versions used for modelling current and future condition are shown in Fig. 3B.

Linear features have an additional effect on caribou in that they facilitate movement and effectiveness of predators. Vector lines from LIO for roads, railways, and hydro-lines were imported into LSL, and density of these features calculated.

Category 2 regional range caribou habitat is based on the selective use of landscape features across all 4 seasons. The RSPF models habitat selection for each season, and a threshold value for the continuous probability of use is determined above which the habitat is considered high use, and therefore contributes to category 2 habitat (Figs. 4).

With two of the models (spring and winter RSPFs) there was a small, but positive coefficient associated with linear features (Appendix 2, Fig. A2). This resulted not only in the model failing to respond to linear feature density in a negative manner, but in many instances Category 2 habitat increased in areas of high linear feature density (Appendix Fig. A3-B). I searched for all previous version of the model that I could find, and all had negative coefficients for linear features, but could not find the model that is currently used in the LSL script. I found two alternative models for spring and winter that used the same habitat variables and had high performance statistics (70% accuracy for spring model and 80% accuracy for winter model, based on area under ROC curve) (see Appendix, Table A2, for the alternative LSL code). These models were explored, and the result was a Category 2 classification that performed as expected, with the model responding negatively to high linear feature density (Fig. A3 – C). A possible explanation is that the negative sign for linear features was accidentally removed during the LSL coding, but I could not find the original model to confirm this. Consequently, I believe it is more appropriate to use the alternative models for spring and winter. Note that for the other seasons, linear feature density has a strong, negative effect (Fig. A2), as would be expected (Fig. A2).

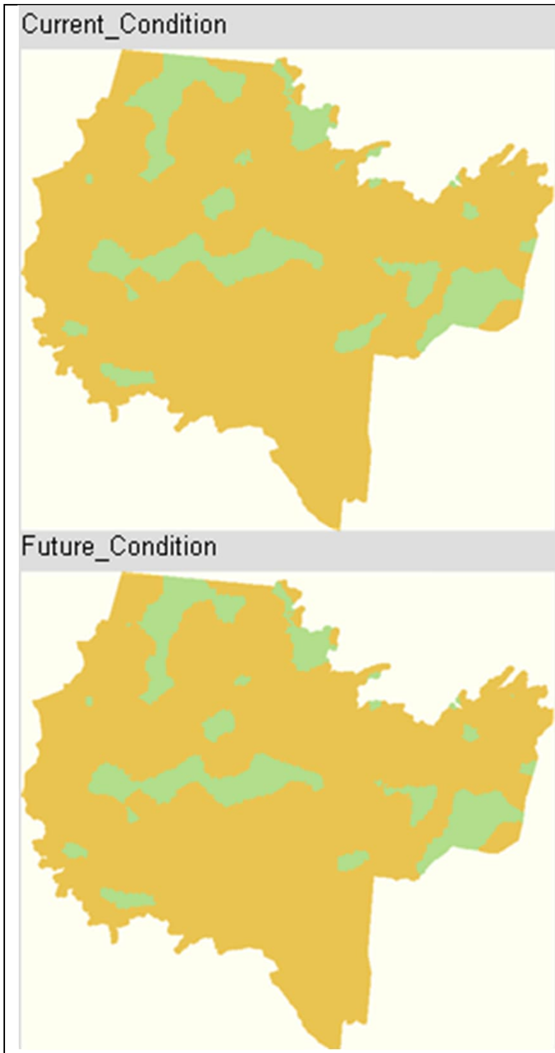
Once the seasonal RSPFs and thresholds are calculated (Figs. 5-6), then these are added together, and any place that is categorized as high use in any season is classed as category 2; if not used in any season, then classed as category 3 (Fig. 7; Fig 8). Once the RSPF map is generated for the hexagons, a .dbf attribute file that links the FRI to the PolyID attribute is optionally created to map the RSPF and category 2 values using a standard FRI layer (Fig. 9). Shapefile attribute definitions are given in Appendix 3.



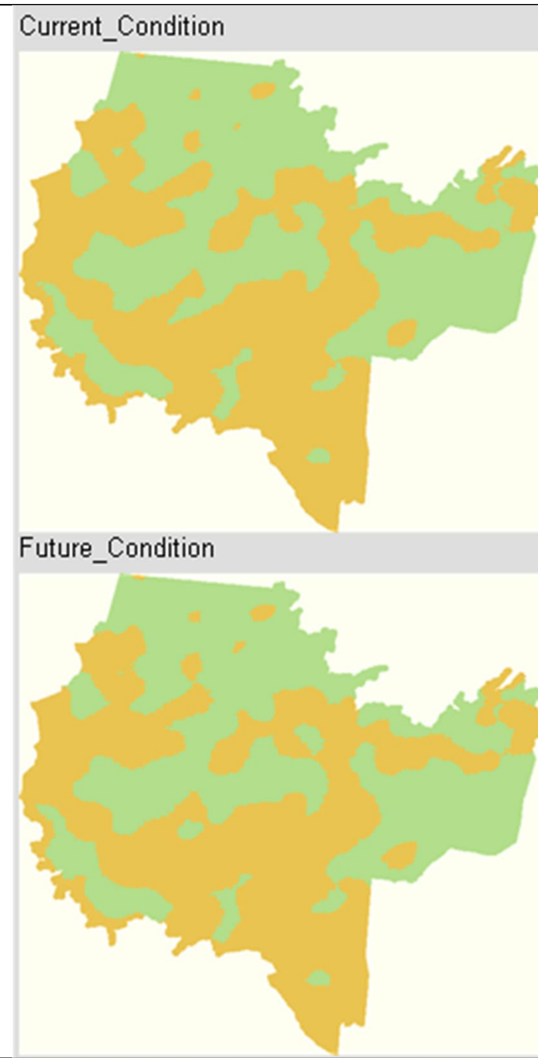
A. Probability of use

B. Predicted high and low use areas.

Figure 4. Translation of modelled probability of use into areas of predicted high use and low use, where high use represents those 3-ha hexagon areas where predicted probability of use exceeds a defined threshold that balances false and negative error. For the Spring model, the threshold was 0.2386. Green is predicted high use, and yellow is predicted low use.

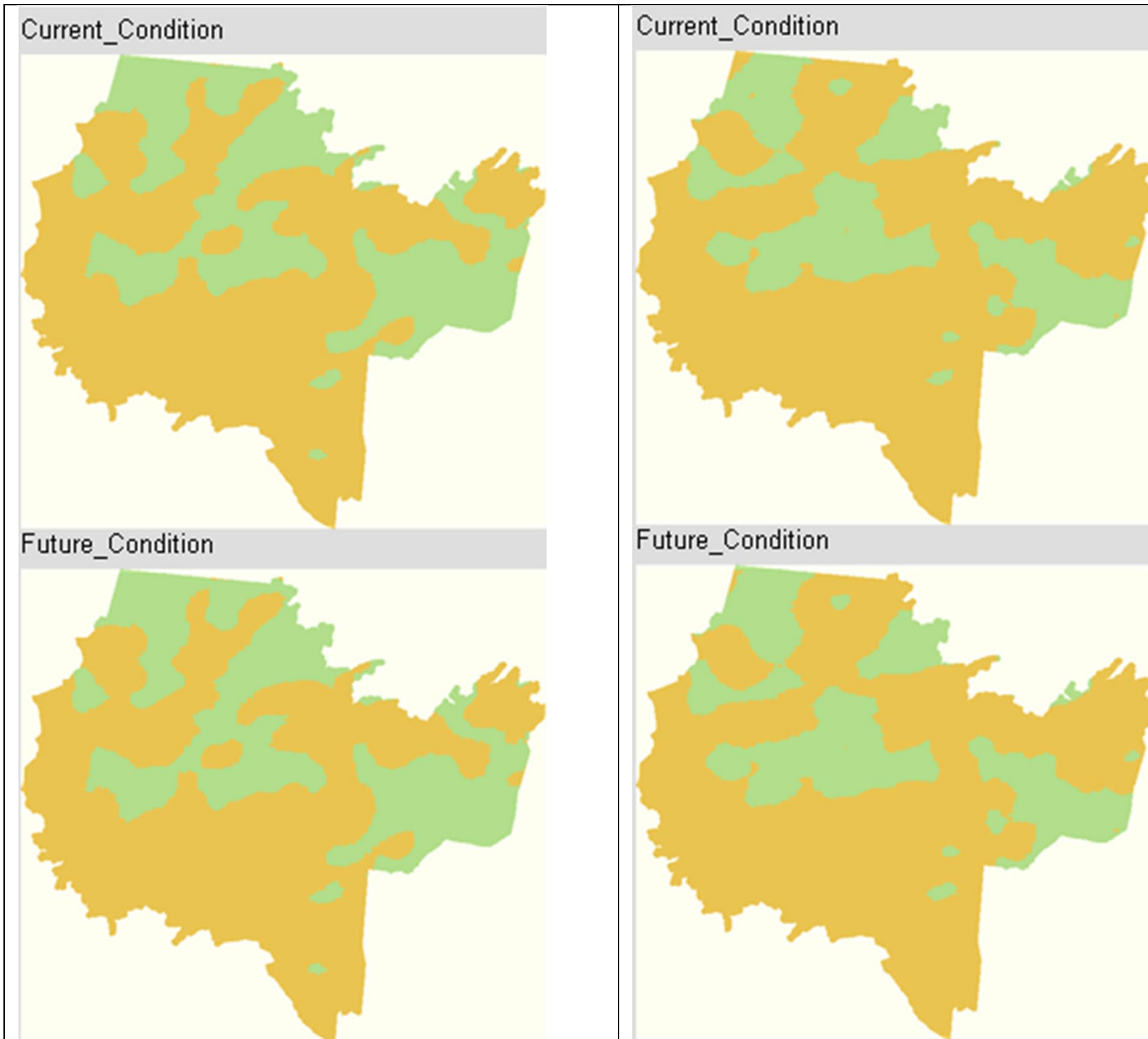


A. Spring Use



B. Summer Use

Figure 5. Spring (A) and summer (B) use categories for current and future conditions. Green is predicted season specific high use, and yellow is predicted low use.



Fall Use	Winter Use

Figure 6. Fall (A) and Winter (B) use categories for current and future conditions. Green is predicted season specific high use, and yellow is predicted low use.

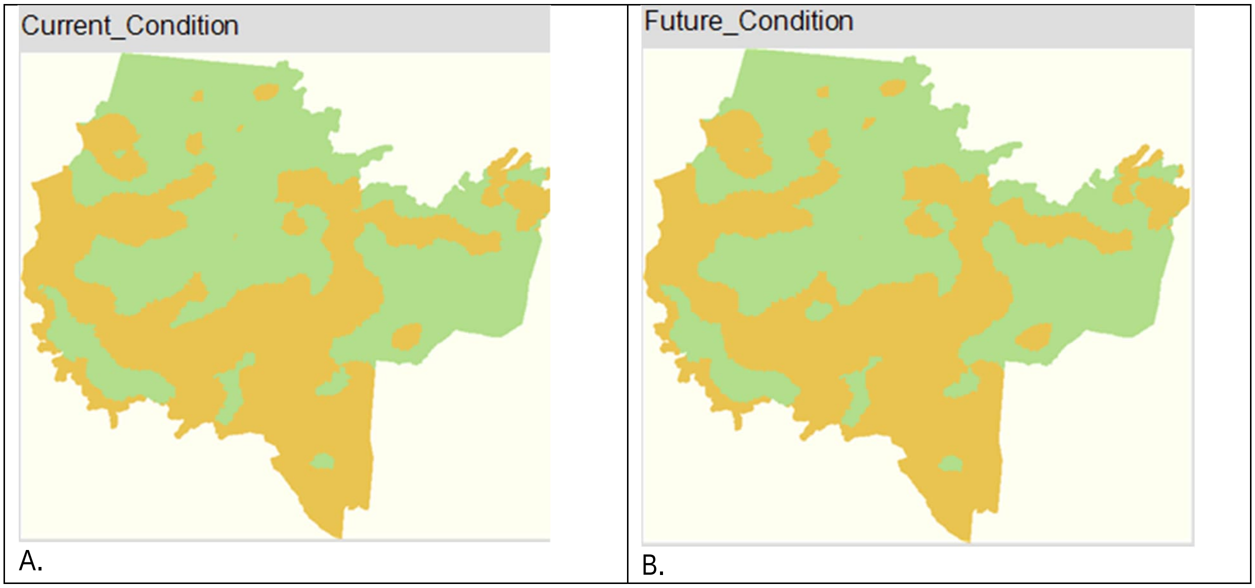


Figure 7. Map of GHD Caribou Category 2, for current (A), and future (B) conditions. Category 2 represents 3-ha hexagon areas where for at least 1 season that hexagon had predicted high use. Green is category 2 (high use), and yellow is category 3 (low use).

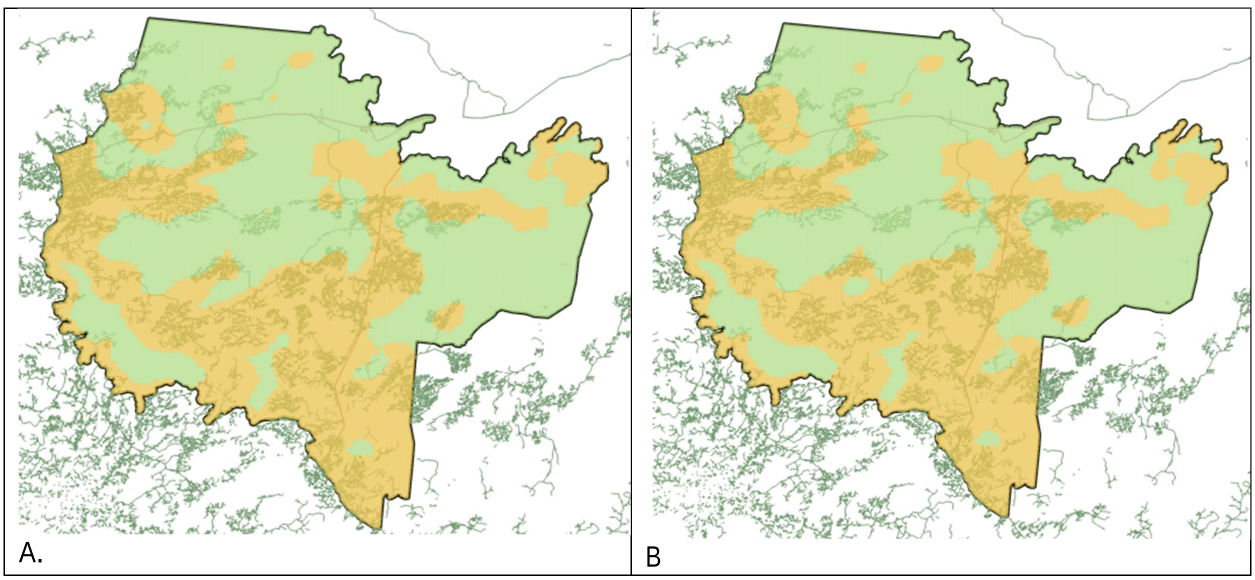


Figure 8. LSL Hexagon (3 ha) level output of Category 2 and Category 3 map with overlay of linear features for current condition (A), and future condition after proposed development included in analysis (B). Note that the proposed addition of linear features from the Springpole Project caused virtually no change in Category 2 and Category 3 habitat.

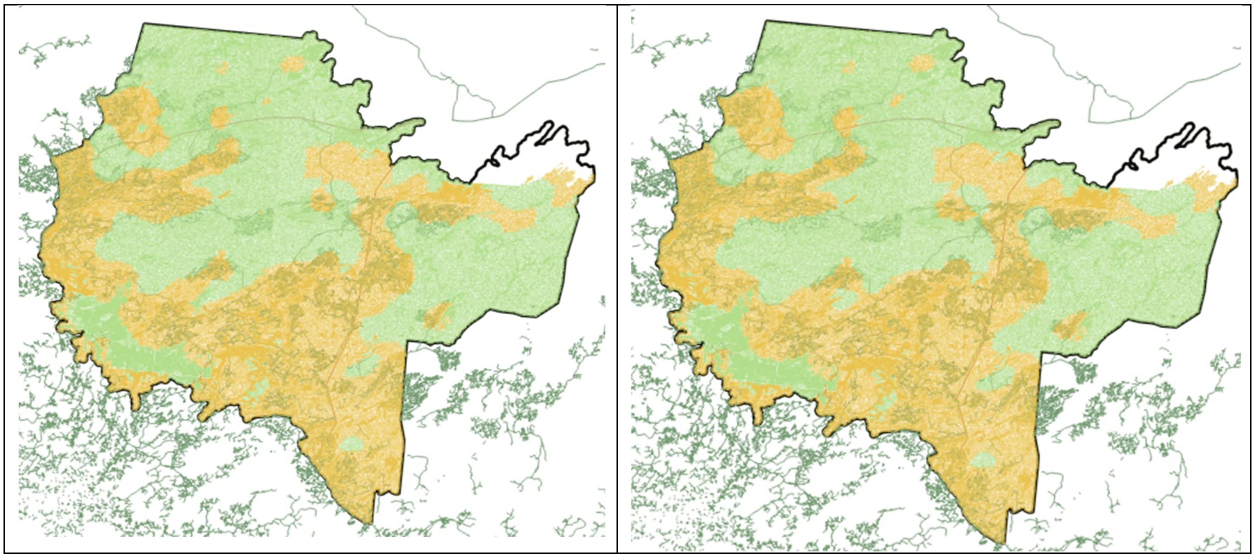


Figure 9. FRI Polygon level output of Category 2 and Category 3 map with overlay of linear features for current condition (A), and future condition after proposed development included in analysis (B). Green is Category 2 (high use), and yellow is Category 3 (low use).

Results and Discussion

The net effect of the proposed footprint on Category 2 and Category 3 habitat showed little change in the distribution of Categories, as at the broad scale of the model these were relatively minor changes to the landscape (Fig. 9; Table 2). The average Category 2 and 3 values changed from 0.519 to 0.514 between current and future conditions, with less than 1% change (Table 2). The averages represent the percent area within the two categories. It appears that several linear features must occur in close proximity to generate a strong negative effect on Category 2 habitat. Note that Category 2 is an aggregation of the individual seasonal effects, and that the project appears to have the biggest impact on Spring habitat, with a 9% decrease in the predicted Spring High-Use category (Table 2). There was a slight increase in the predicted Winter High-Use category under the proposed project, perhaps because of a slight change in Deciduous or Mixed Forest classes resulting from the disturbance updates to the PLC.

In conclusion, the proposed Springpole Project had only a minor negative influence (-0.96%) on the prevalence of Category 2 (high use) habitat in the Churchill Range.

Table 2. Comparison of mean Category 2 and 3 habitat, season categories, and seasonal probabilities of use, between current condition and future condition with proposed Springpole Project.

Variable	Range	Season	Current Condition	Future Condition	% Change
Category 2/3	Churchill	All Seasons	0.519	0.514	-0.96%
Prob High Use	Churchill	Spring	0.155	0.141	-9.03%
Prob High Use	Churchill	Summer	0.486	0.477	-1.85%
Prob High Use	Churchill	Fall	0.344	0.340	-1.16%
Prob High Use	Churchill	Winter	0.263	0.269	2.28%
Prob of Use	Churchill	Spring	0.143	0.138	-3.50%
Prob of Use	Churchill	Summer	0.123	0.120	-2.44%
Prob of Use	Churchill	Fall	0.126	0.125	-0.79%
Prob of Use	Churchill	Winter	0.108	0.111	2.78%

References

Hornseth, M. L., and R. S. Rempel. 2016. Seasonal resource selection of woodland caribou (*Rangifer tarandus caribou*) across a gradient of anthropogenic disturbance. Canadian Journal of Zoology 94:79-93.

Kushneriuk, R. S., and R. S. Rempel. 2011. LSL- Landscape Scripting Language Ontario Ministry of Natural Resources, Centre for Northern Forest Ecosystem Research, Thunder Bay, Ontario.

Rempel, R. S., and M. L. Hornseth. 2017. Binational climate change vulnerability assessment of migratory birds in the Great Lakes Basins: Tools and impediments. PLoS ONE:1 - 17.

Appendix 1. PLC class description, and variables used in the RSPF category 2 habitat model.

Table A1 . A Summary List of the Land Cover Classes of the Second-Edition Provincial Land Cover Data Base

Code	Class	Description
1	Water - Deep or Clear	Deep or clear waterbodies.
2	Water - Shallow or Sedimented	Shallow waterbodies and waterbodies with a high concentration of suspended sediment.
3	Settlement/Infrastructure	Clearings for human settlement and economic activity; major transportation routes.
4	Sand/Gravel/Mine Tailings	Beach deposits, aggregate quarries and sand dunes; mines and mine tailings.
5	Bedrock	Exposed bedrock, lacking vegetation cover.
6	Mudflats	Unvegetated coastal areas of the Hudson Bay-James Bay Lowlands, partly submerged at high tide.
7	Cutovers	Forest clearcuts estimated to be less than 10 years of age.
8	Burns	Forest burns estimated to be less than 10 years of age.
9	Regenerating Depletion	Old burns supporting very sparse vegetation.
10	Sparse Forest	A patchy or sparse forest canopy composed of coniferous or deciduous species or a combination of the two.
11	Deciduous Forest	Largely continuous forest canopy composed primarily of deciduous species.
12	Mixed Forest	Largely continuous forest canopy composed of both deciduous and coniferous species. In more northerly areas, a greater component of coniferous species can be expected; in more southerly areas, a greater component of deciduous species can be expected.
13	Coniferous Forest	Largely continuous forest canopy composed primarily of coniferous species
15	Intertidal Marsh	Coastal marshes of the Hudson Bay-James Bay Lowlands lying between the coastal mudflats and the supertidal zone.
16	Supertidal Marsh	Coastal marshes of the Hudson Bay-James Bay Lowlands lying inland of both the coastal mudflats and intertidal marshes, and subject to only exceptionally high tides.
17	Inland Marsh	Lakeshore and inland marshes of Southern Ontario.

18	Deciduous Swamp	Hardwood swamps of Southern Ontario occurring along rivers and in old lakebeds and other low-lying areas.
19	Coniferous Swamp	Swamps with dense conifer tree or shrub cover occurring in Southern Ontario.
20	Open Fen	Fens generally lacking tree cover that may support some shrub cover and tamarack. Open fens include fens with an open water surface, graminoid fens, pattern fens, and shrub-rich fens.
21	Treed Fen	Fens supporting a sparse to dense cover of trees or shrubs.
22	Open Bog	Bogs generally lacking tree cover.
23	Treed Bog	Bogs supporting a sparse to dense cover of trees.
24	Tundra Heath	Low tundra vegetation growing on slightly raised beach deposits and strand lines along the Hudson Bay coast.
25	Pasture	Open grassland with sparse shrubs in rural land.
27	Cropland	Areas of row crops and fallow fields.
28	Other	transitional areas between classes, such as some wetland boundaries.
29	Cloud and Shadow	Areas of cloud or shadow on the satellite images.

Appendix 2. Modification to existing RSPF equation for Churchill Falls.

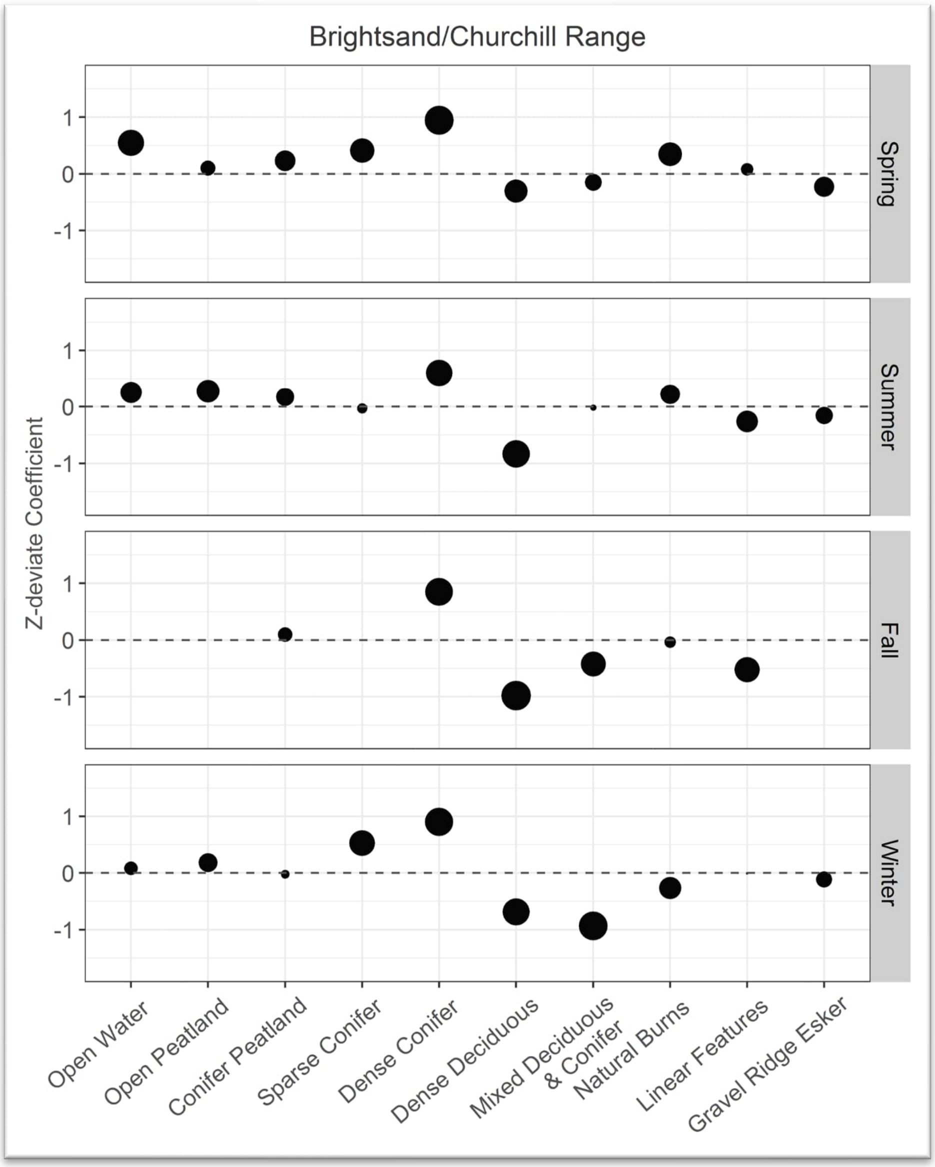


Figure A1. Comparison of standardized seasonal model coefficients for the combined Brightsand and Churchill caribou range.

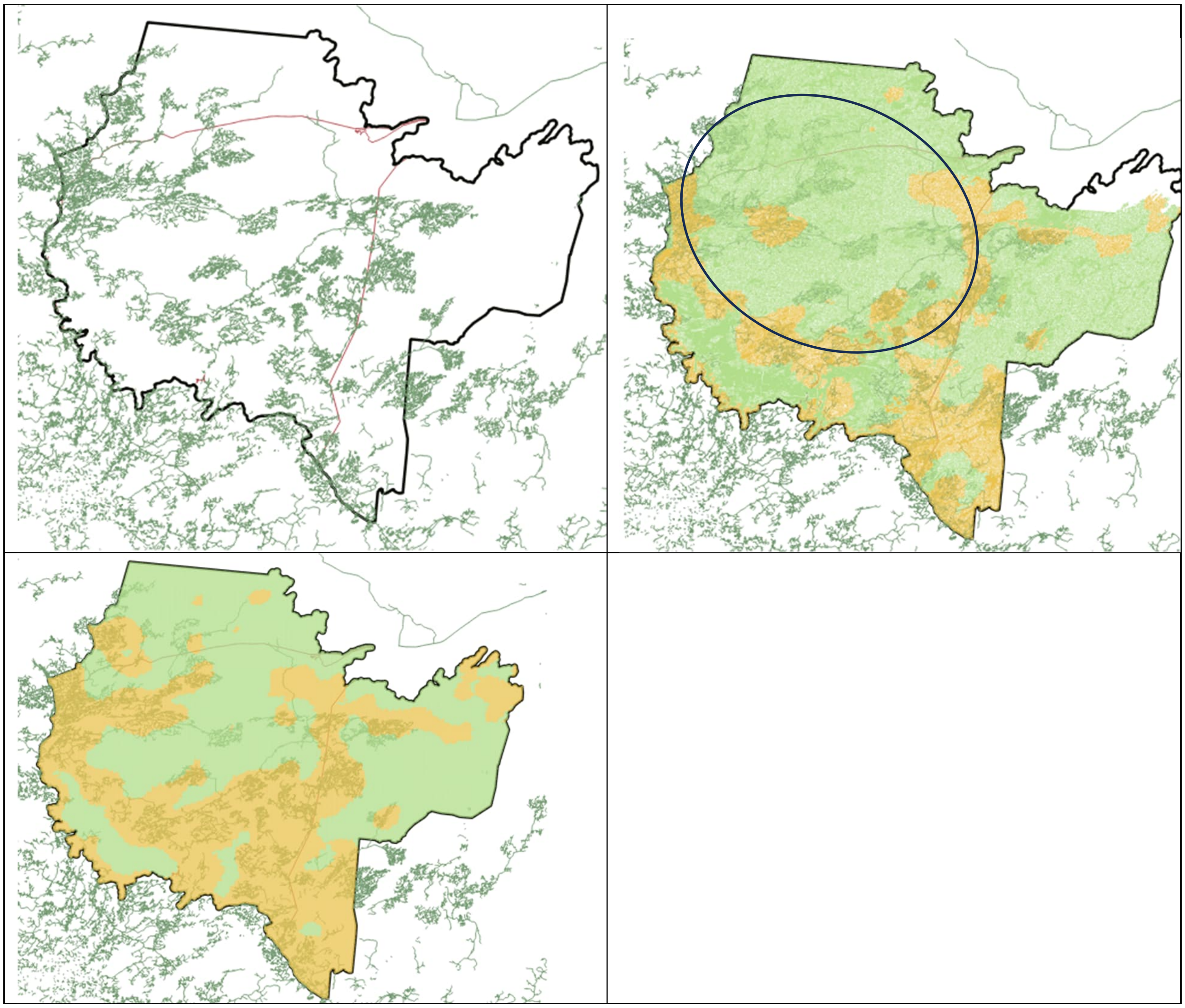


Figure A3. Current roads (A); Category 2/3 distribution using original RSPF equations for Spring and Winter, with outline showing areas where roads have little to no influence (B). Note how roads have little negative influence in parts of the range; Category 2/3 distribution using alternative spring and winter models (C). Influence of linear features is more consistent across the range, and as expected, with the alternative model. Green is category 2 (high-use), and yellow is category 3 (low-use).

Table A2. Original and alternative RSPF code for Churchill

```
If gs.S_area(j) >= Threshold Then

            If rname = "Churchill" Then

                #region Code for Spring Use Model

                  If RunModifiedScript = "1" Then
                              logitSP_Use = _
                              (-7.18367 * gs.DEC_S5(j)) + _
                              (-1.0788 * gs.ESK_S5(j)) + _
                              (-0.0206942 * gs.TDENLF_S5(j)) + _
                              (2.63288 * gs.MIX_S5(j)) + _
                              (3.18057 * gs.DTN_S5(j)) + _
                              (4.16792 * gs.ST_S5(j)) + _
                              (4.50488 * gs.LGW_S5(j)) + _
                              (4.53496 * gs.LGTP_S5(j)) + _
                              (5.33077 * gs.CON_S5(j)) + _
                              (15.2785 * gs.LGOP_S5(j)) + _
                              (-5.42841)
                  Else
                              logitSP_Use = _
                              (-13.8214 * gs.DEC_S5(j)) + _
                              (-1.78556 * gs.MIX_S5(j)) + _
                              (-0.55255 * gs.ESK_S5(j)) + _
                              (0.0160082 * gs.TDENLF_S5(j)) + _
                              (2.32037 * gs.DTN_S5(j)) + _
                              (4.02012 * gs.ST_S5(j)) + _
                              (4.42165 * gs.LGW_S5(j)) + _
                              (5.34232 * gs.CON_S5(j)) + _
                              (7.17763 * gs.LGTP_S5(j)) + _
                              (16.1389 * gs.LGOP_S5(j)) + _
                              (-5.01081)
                  End If
                              odds_SP = 2.718281828 ^ logitSP_Use
                              gs.pSP_Use(j) = odds_SP / (1.0 + odds_SP)
                              gs.cf_SP_Use(j) = 0


                              If RunModifiedScript = "1" Then
                                    cpSpr = 0.238576444
                              Else
                                    cpSpr = 0.08235
                              End If                                 #endregion

                  #region Code for Summer Use Model
                              logitSU_Use = _
                              (-41.8592 * gs.DEC_S5(j)) + _
                              (-0.454738 * gs.ESK_S5(j)) + _
                              (-0.0350838 * gs.TDENLF_S5(j)) + _
                              (0.530534 * gs.ST_S5(j)) + _
                              (0.802784 * gs.MIX_S5(j)) + _
                              (2.15437 * gs.DTN_S5(j)) + _
                              (2.77072 * gs.LGW_S5(j)) + _
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```
                (4.08734 * gs.CON_S5(j)) + _
                (5.32027 * gs.LGTP_S5(j)) + _
                (44.061 * gs.LGOP_S5(j)) + (-3.95866)

                odds_SU = 2.718281828 ^ logitSU_Use
                gs.pSU_Use(j) = odds_SU / (1.0 + odds_SU)
                gs.cf_SU_Use(j) = 0

                If gs.pSU_Use (j) > 0.10336 Then
                      gs.cf_SU_Use(j) = 1
                End If
                #endregion

        #region Code for Fall Use Model
                logitFA_Use = _
                (-56.4116 * gs.DEC_S5(j)) + _
                (-5.23716 * gs.MIX_S5(j)) + _
                (-0.356225 * gs.DTN_S5(j)) + _
                (-0.128353 * gs.TDENLF_S5(j)) + _
                (2.86515 * gs.LGTP_S5(j)) + _
                (4.40582 * gs.CON_S5(j)) + (-2.15043)


                odds_FA = 2.718281828 ^ logitFA_Use
                gs.pFA_Use(j) = odds_FA / (1.0 + odds_FA)
                gs.cf_FA_Use(j) = 0

                If gs.pFA_Use (j) > 0.12616 Then
                      gs.cf_FA_Use(j) = 1
                End If
                #endregion

        #region Code for Winter Use Model

            If RunModifiedScript = "1" Then
                logitWI_Use = _
                (-11.9115 * gs.DEC_S5(j)) + _
                (-11.0689 * gs.MIX_S5(j)) + _
                (-9.78934 * gs.DTN_S5(j)) + _
                (-0.339649 * gs.ESK_S5(j)) + _
                (-0.0702411 * gs.TDENLF_S5(j)) + _
                (3.65479 * gs.LGTP_S5(j)) + _
                (-2.48184 * gs.LGW_S5(j)) + _
                (2.11835 * gs.CON_S5(j)) + _
                (0.703459 * gs.ST_S5(j)) + _
                (28.1923 * gs.LGOP_S5(j)) + (-0.868801)
            Else
                logitWI_Use = _
                (-31.845 * gs.DEC_S5(j)) + _
                (-10.6597 * gs.MIX_S5(j)) + _
                (-0.708967 * gs.DTN_S5(j)) + _
                (-0.275126 * gs.ESK_S5(j)) + _
                (0.0332388 * gs.TDENLF_S5(j)) + _
                (0.346165 * gs.LGTP_S5(j)) + _
                (1.80009 * gs.LGW_S5(j)) + _
                (6.18843 * gs.CON_S5(j)) + _
                (6.26025 * gs.ST_S5(j)) + _
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                (32.0258 * gs.LGOP_S5(j)) + (-3.99216)
          End If

                odds_WI = 2.718281828 ^ logitWI_Use
                gs.pWI_Use(j) = odds_WI / (1.0 + odds_WI)
                gs.cf_WI_Use(j) = 0

                If RunModifiedScript = "1" Then
                      cp = 0.15192
                Else
                      cp = 0.14090
                End If

                If gs.pWI_Use (j) > cp Then
                      gs.cf_WI_Use(j) = 1
                End If                                    End If
                #endregion

    End If
```

Appendix 3. Variable definitions in FRI-Cat2 shapefile

Variable	Definition
POLYTYPE	FRI Polygon Type
DEVSTAGE	Forest Stand Development Stage (includes value for harvest depletion)
YRORG	Year of Stand Origin
LgFU	Landscape Guide Forest Unit
CurrentAge	Age based on YRORG - 2023
Harvest	Flag to indicate Harvested Stand (=HARV)
MuNum	Management Unit Number
PolyID	Unique Polygon ID
CF_SP_USE	Spring – Predicted High/Low Caribou Use (Current Condition)
CF_SU_USE	Summer – Predicted High/Low Caribou Use (Current Condition)
CF_FA_USE	Fall – Predicted High/Low Caribou Use (Current Condition)
CF_WI_USE	Winter – Predicted High/Low Caribou Use (Current Condition)
CAT2	Category 2/3 Habitat (Current Condition). 1 = Category 2; 0 = Category 3
PolyID_2	Duplicate of PolyID
FC_CF_SP_U	Spring – Predicted High/Low Caribou Use (Future Condition)
FC_CF_SU_U	Summer – Predicted High/Low Caribou Use (Future Condition)
FC_CF_FA_U	Fall – Predicted High/Low Caribou Use (Future Condition)
FC_CF_WI_U	Winter – Predicted High/Low Caribou Use (Future Condition)
FC_CAT2	Category 2/3 Habitat (Future Condition). 1 = Category 2; 0 = Category 3

Phase 2: Update Report on Mapping Caribou Category 2 and 3 Habitat: - May 6th, 2024

Updates for Berens, Kinloch, and Churchill Ranges

Mapping for Time periods pre-project (0); 0-20; 20-40; 40-60; and 60-80 (post-project).

In Support of Springpole Project Assessment

Rob Rempel, FERIT Environmental Consulting

https://www.ferit.ca

northernbio@gmail.com

Methods

Disturbance data:

The general methods describing the category 2 and 3 mapping using the GMap tool are described in the document "Report on Mapping Caribou Category 2 and 3 Habitat for the Churchill Caribou Range". However, a new source of FRI inventory became available through MNRF that was recently developed. This data is big update and improvement on data available on through LIO, and is called PIAMM (Provincial Impact Assessment Model). Two versions of the geodatabase were available, and one called caribou2024.gdb was appropriate for this work. Inventory data covered all of the Berens and Churchill ranges and about half of the Kinloch range (Fig. 1). PIAMM also included eFRI inventories for Parks and more recent inventories in northern management units. Although these data were relatively clean, additional pre-processing was required to make data suitable for GMap. An R script was written to process geometry and attributes.

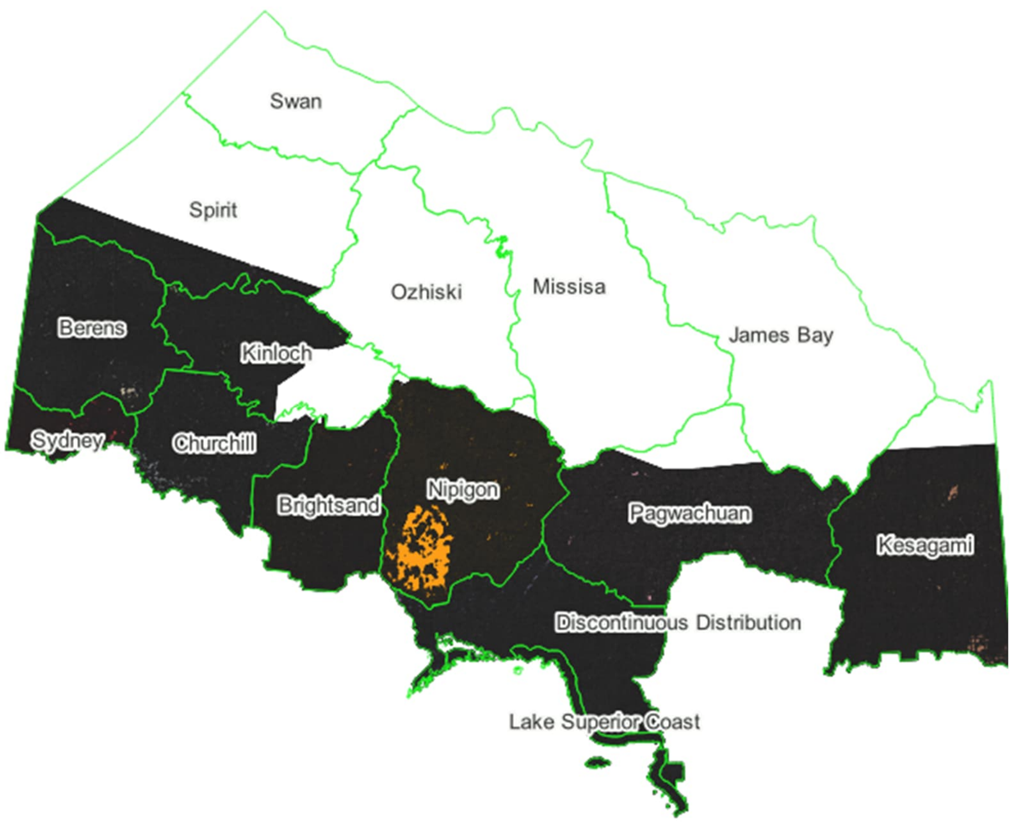


Figure. 1. Areas where PIAMM FRI data is available.

Reference and Alternative Scenarios:

Scenarios were created to represent reference conditions and all proposed combinations of Mine Access Road (MAR) and Transmission Line (TL) options (Table 1). These MAR and TL options were mapped in the GIS (Fig. 2 and 3), and then scenarios were created for the GHD Mapping Tool. Scenario MAR_0_TL_0_T20 represents the preproject reference condition at project start. The Project Development Area (PDA) was used rather than the Direct Impact Footprint (Fig. 3) for permanent disturbance in the GHD mapping tool because it better represented the extent of disturbance on caribou.

For each scenario, the model was run for 4 time periods. During this time the forest aged, and at year 60 all mapped disturbance (MAR, TL, and PDA) was removed. Maps were generated for each scenario and range and the average Category 2 values was calculated for each range, for each time period. Time T20 represents the effect over the first 20 years, with the full project footprint present. T40 represents years 20 to 40, and T60 years 40 to 60. The final time period, T80, represents the post-project condition for years 60 to 80 and onward where the footprint has been fully removed. Category 2 values are binary (0,1), and the average values represent the percent area across the range belonging to category 2.

Table 1. Scenario definitions based on mine access road (MAR) and transmission line (TL) combinations.

Scenarios	MAR	TL	Name	Comment
Mar_0_TL_0	None	None	Mar_0_TL_0	Pre-project reference
MAR_1_TL_1	MAR_1	TL_1	MAR_1_TL_1	Current preferred
MAR_1_TL_2	MAR_1	TL_2	MAR_1_TL_2	
MAR_1_TL_3	MAR_1	TL_3	MAR_1_TL_3	Previous preferred
MAR_1_TL_4	MAR_1	TL_4	MAR_1_TL_4	
MAR_3_TL_1	MAR_3	TL_1	MAR_3_TL_1	
MAR_4_TL_1	MAR_4	TL_1	MAR_4_TL_1	
MAR_5_TL_1	MAR_5	TL_1	MAR_5_TL_1	

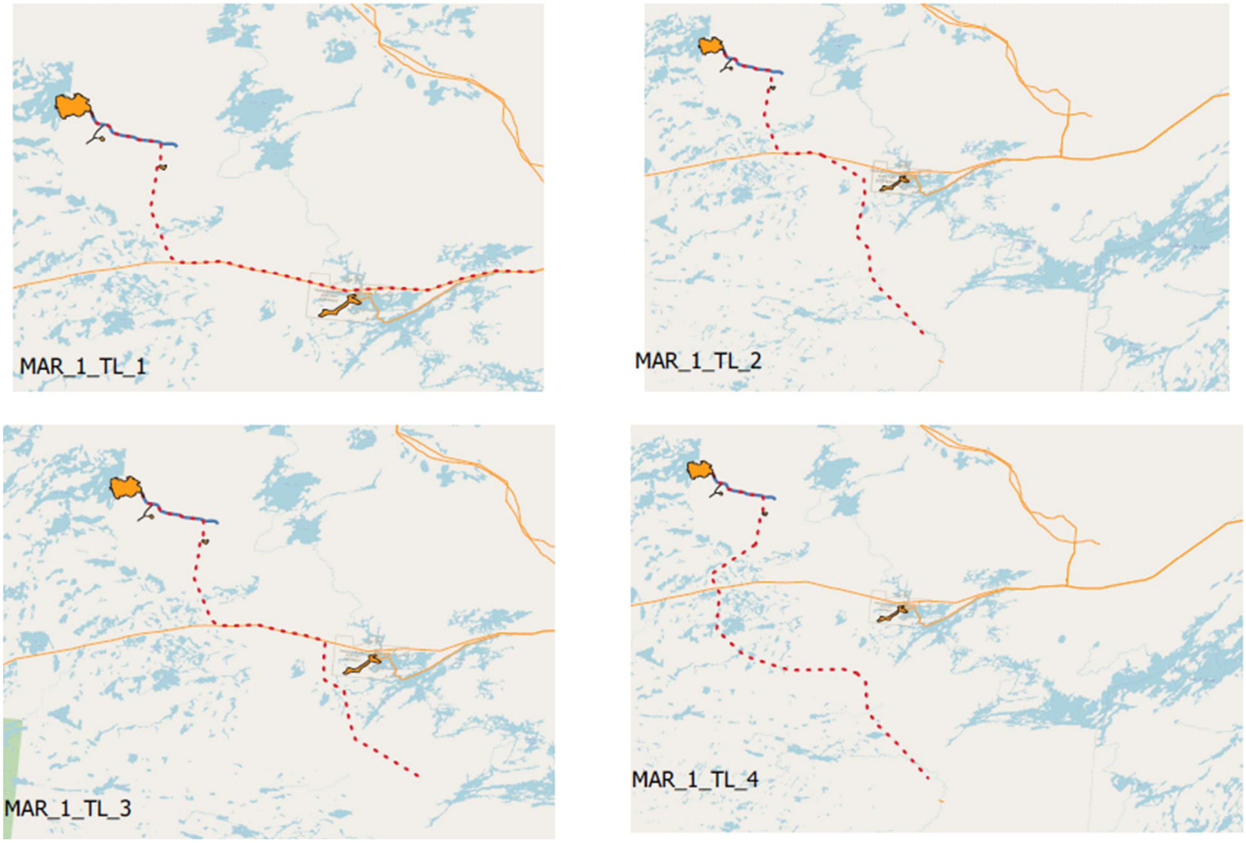


Figure 2. Mapped Scenarios MAR_1_TL1 (preferred), MAR_1_TL_3, MAR_3_TL1, and MAR_4_TL1.

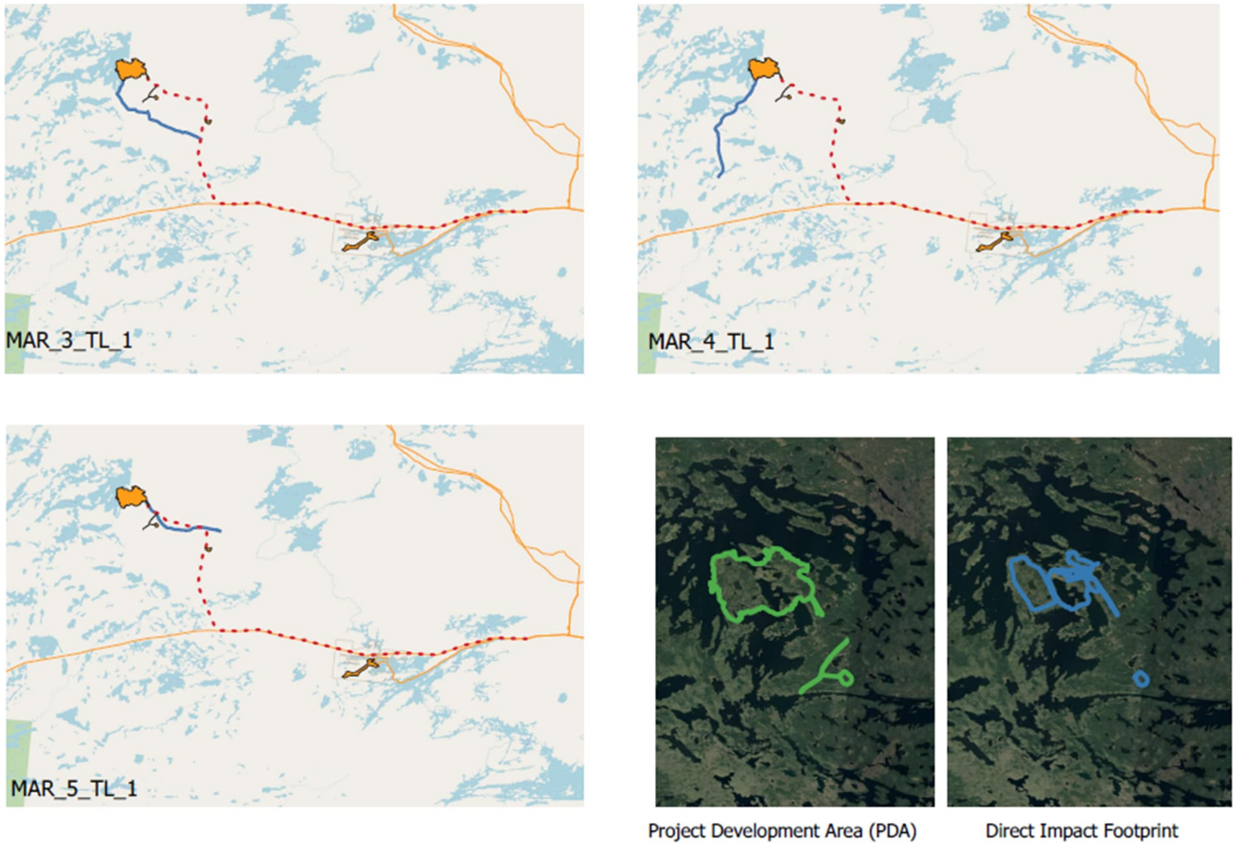


Figure 3. Mapped Scenarios MAR_5_TL1, MAR_1_TL_2, MAR_1_TL4, and MAR_1_TL4. Project Development area polygon used for Permanent Disturbance map (0-60 years).

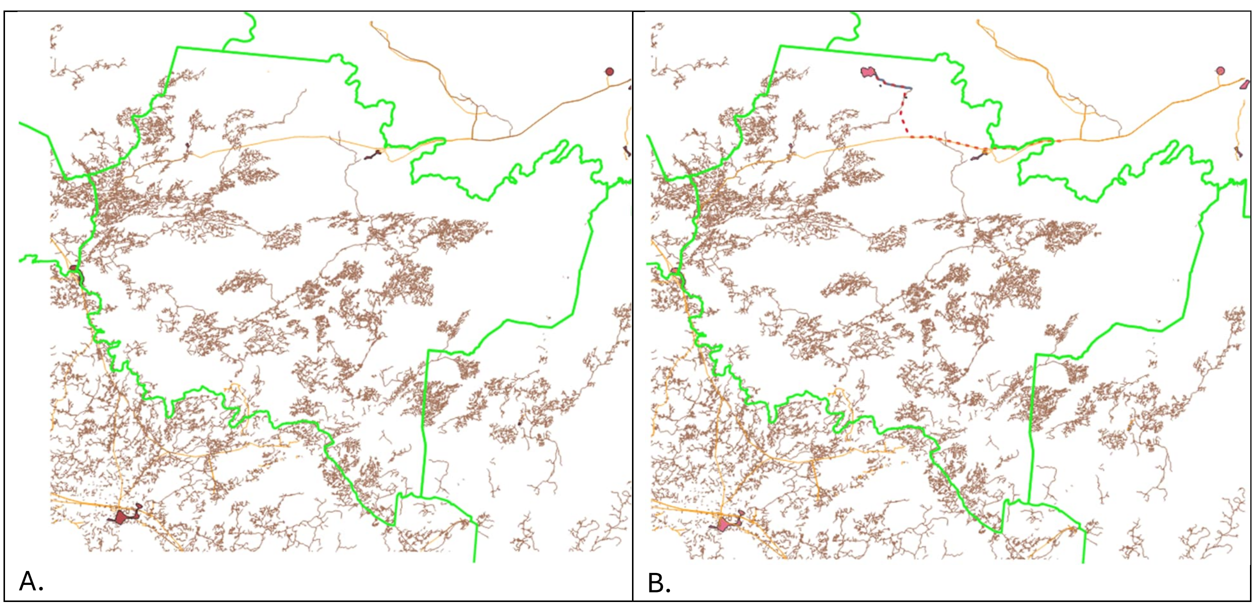
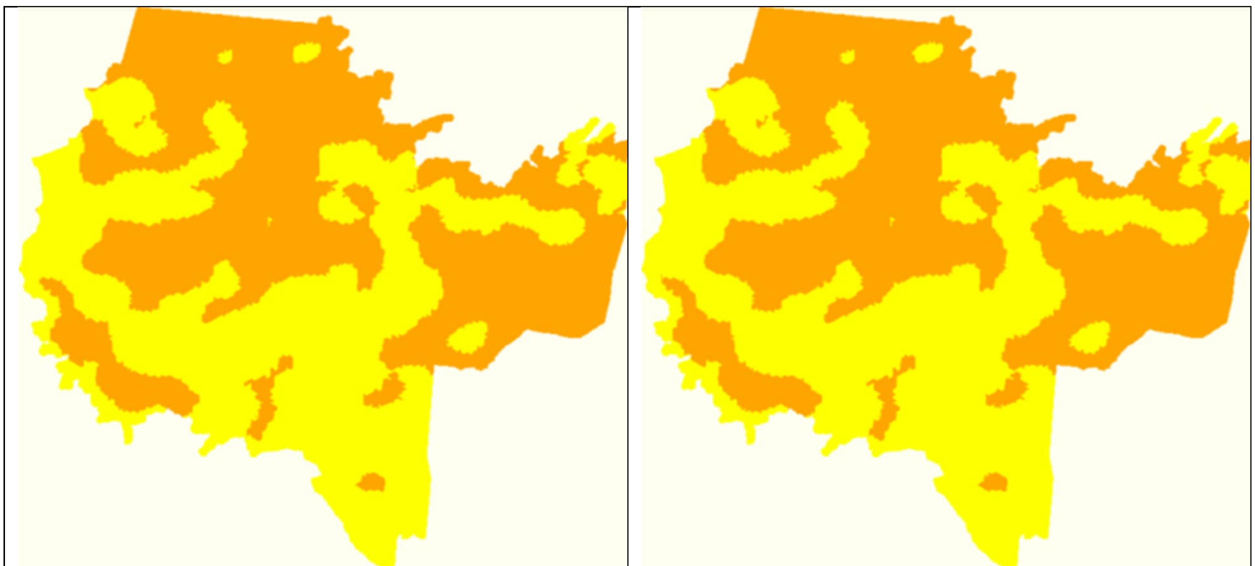


Figure 4. Visual comparison of linear features (roads and transmission lines) and permanent disturbance (including PDA) between A. pre-project, and B. preferred scenario MAR_1_TL_1.

Results

A comparsion of pre-project condition with the preferred scenario (MAR_1_TL_1_T20) for the Churchill range reveals almost no difference on the map (Fig. 5), and very little difference in average category 2 level for the average of the 3 ranges, or for Churchill specifically (Table 2). This is likely because the addition of the MAR, TL, and PDA add proportionally little additional disturbance to the exisitng condition (Fig. 4), and the increase in linear feature density wasn't sufficient to result in a large change in probability of use. Note that only Churchill has a project footprint, so only for this range do category 2 values change from T20 to T40.

A comparison across the 4 time periods from project start (0- 20) to the end of the analysis period (60-80) shows a trend of initially decreasing up until T40, then subsequently increasing as the forest gets older and recent disturbance becomes 40 years plus (Fig. 6; Table 2). At T80 there is another jump upward, as scenario anthropogenic disturbance is removed at this time, and category 2 average once again matches the reference condition.

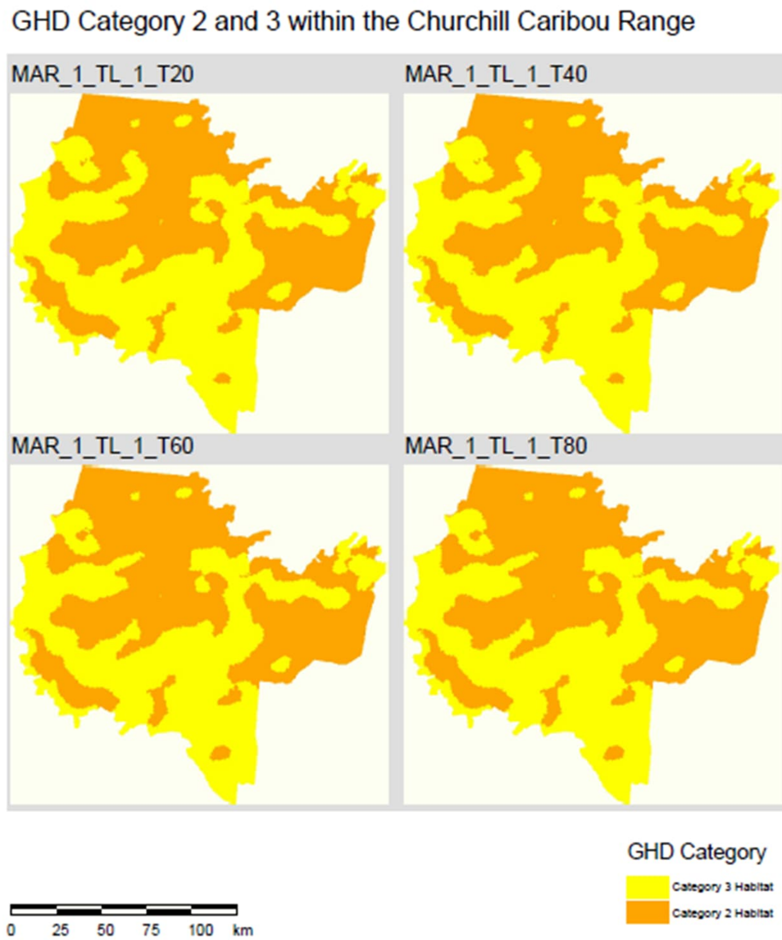


A. MAR_0_TL_0_T20

B. MAR_1_TL_1_T20

Figure 5. Change in category 2 and 3 habitat from pre-project condition to conditions under preferred scena

Figure 6. Change in category 2 and 3 habitat for scenario MAR_1_TL_1 over 4 time periods (80 years), for Churchill range. Note that Category 2 comprises approximately 50% of the Churchill



range.

In comparison of alternative scenarios, scenario MAR_1_TL_1 shows the lowest negative effect (decrease) on Category 2 habitat. Overall, there is little decrease in Category 2 a result of adding disturbance across either the 3 ranges, or for just the Churchill range (Table 2)

Table 2. Mean Category 2 (% area) among scenarios and time periods.

Scenario	Berens	Churchill	Kinloch	Average
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_0_TL_0_T40	0.7183786	0.5042574	0.8045791	0.675738367
MAR_0_TL_0_T60	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_1_TL_1_T20	0.7167448	0.5096395	0.781991	0.669458433
MAR_1_TL_1_T40	0.7183786	0.5043536	0.8045791	0.675770433
MAR_1_TL_1_T60	0.8609813	0.533894	0.8313523	0.742075867
MAR_1_TL_1_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_1_TL_2_T20	0.7167448	0.509262	0.781991	0.6693326
MAR_1_TL_2_T40	0.7183786	0.5039673	0.8045791	0.675641667
MAR_1_TL_2_T60	0.8609813	0.5330324	0.8313523	0.741788667
MAR_1_TL_2_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_1_TL_3_T20	0.7167448	0.5094719	0.781991	0.669402567
MAR_1_TL_3_T40	0.7183786	0.504186	0.8045791	0.675714567
MAR_1_TL_3_T60	0.8609813	0.5335266	0.8313523	0.7419534
MAR_1_TL_3_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_1_TL_4_T20	0.7167448	0.5084106	0.781991	0.6690488
MAR_1_TL_4_T40	0.7183786	0.503116	0.8045791	0.6753579
MAR_1_TL_4_T60	0.8609813	0.5322569	0.8313523	0.741530167
MAR_1_TL_4_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_3_TL_1_T20	0.7167448	0.5088159	0.781991	0.6691839
MAR_3_TL_1_T40	0.7183786	0.5034906	0.8045791	0.675482767
MAR_3_TL_1_T60	0.8609813	0.5330383	0.8313523	0.741790633
MAR_3_TL_1_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_4_TL_1_T20	0.7167448	0.5084864	0.781991	0.669074067
MAR_4_TL_1_T40	0.7183786	0.502976	0.8045791	0.675311233
MAR_4_TL_1_T60	0.8609813	0.5330193	0.8313523	0.7417843
MAR_4_TL_1_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167
MAR_0_TL_0_T20 (Reference)	0.7167448	0.5095579	0.781991	0.669431233
MAR_5_TL_1_T20	0.7167448	0.5095783	0.781991	0.669438033
MAR_5_TL_1_T40	0.7183786	0.5042924	0.8045791	0.675750033
MAR_5_TL_1_T60	0.8609813	0.5338328	0.8313523	0.742055467
MAR_5_TL_1_T80 (Reference)	0.8609813	0.5336549	0.8313523	0.741996167