WUSKWATIM GENERATION PROJECT

Report # 11-01

MAMMAL MONITORING INVESTIGATIONS FOR THE WUSKWATIM GENERATION PROJECT

PRE-CONSTRUCTION AND CONSTRUCTION REPORT (2004-2009)

WUSKWATIM
Power Limited Partnership

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A report prepared for

Wuskwatim Power Limited Partnership

by

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and

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This study was conducted under the auspices of the Wuskwatim Power Limited Partnership to meet the requirements of Environment Act Licence No. 2699 to complete monitoring as described in the Wuskwatim Generation Project Terrestrial Effects Monitoring Program.

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TECHNICAL SUMMARY

The Wuskwatim Power Limited Partnership is participating in a long-term monitoring program for mammals, and in particular, for the Wapisu woodland caribou population in northern Manitoba. Effects monitoring required that baseline data be collected prior to project development. Baseline surveys were conducted prior to construction of the access road and the generating station from 2004 to 2006. Surveys were also conducted during the construction period in summer and fall, 2007 to 2009.

Summer and fall tracking transect surveys provided data on the presence, absence and relative abundance of mammals near the Wuskwatim Generating Station and access road. Transects were placed perpendicular to the proposed access road location during both the pre-construction phase and construction phase of the project. A control area was also established well outside the area expected to be affected by construction activity (2005-2009) to compare and contrast the data. Each transect was up to four kilometers in length. Sign of woodland caribou, moose, black bear and gray wolf were of primary interest, however other mammal data were also recorded along segments of the survey transects. Hip chain thread was deployed along the length of the transects and sign and thread breaks were used to assess recent mammal activity. With the exception of 2006, which was sampled once, transects were sampled twice seasonally.

For the purposes of analysis, an activity level based on the number of sign and estimated number of individuals recorded at each point for woodland caribou, moose, black bear, and gray wolf was used to standardize the data collected by several technicians over the six-year period. For statistical analysis, the activity level per segment was modeled using negative binomial regression methods. The activity level was modeled as a function of distance to the (future) road, year, and an interaction between distance and year. Lengths of the segments and dominant landcover classification were included as additional covariates to account for differing segment lengths and habitat compositions. Distance to the road was an effect of primary interest. The interaction between distance to the road and year was also of interest to test for changes over the years in habitat use relative to the proposed road. Tests of statistical interactions between study year and an effect of interest are commonly used in the analysis of BACI (before-after control-impact) study designs.

Statistical contrasts were used to test for yearly differences in activity level within 2 km of the road verses 2 km or further from the road, and for the activity level located within

1 km of the road verses 1 km or further from the road. Contrasts were also performed to test if the distance to road effects during construction (2007-2009) were greater than these same effects pre-construction. Analyses were conducted by site visits and by species. Transects were analyzed using 200 m segments. Statistical analysis also used habitat and predators as covariates to assess their potential influences on wildlife activity.

Analyses indicated that woodland caribou activity was influenced by habitat and black bear activity. Wolves and moose did not appear to be significant explanatory factors that influenced the activity of caribou. Gray wolf presence did not appear to affect woodland caribou or moose activity; however, the lack of a relationship may be explained in part by the low detectability of gray wolf signs, and the paucity of data. Finally, moose and black bear were not influenced by habitat in the study area.

In general, woodland caribou activity levels were influenced by the construction of the access road and generating station. Overall, there was a decline in woodland caribou activity in areas nearer the access road and generating station from 2004 to 2009, at a rate ranging between 3% and 26% per year. This decline is most apparent when before construction years (2004-2006) and during construction (2007-2009) years were compared, and there were limited changes in woodland caribou activity levels in the control area. Declines were greater near the generating station compared to locations near the access road. Declines were greater in all construction areas, including near the road and generating station, compared to the control area.

With few exceptions, a loss of habitat effectiveness was observed up to 2 km from the access road and generating station. There was significantly less woodland caribou activity nearer the access road (within 1 km versus more than 1 km) and generally less activity within 2 km versus more than 2 km of the access road during each construction year. Woodland caribou activity also declined from the pre-construction to construction periods near the access road and in some cases increased, but not significantly, farther from it. While woodland caribou activity levels were higher near the generating station than further away in each study year, there was an overall decline in activity levels less than 2 km from the generating station during the construction years.

In most cases, moose activity declined during construction of the generating station and access road. Moose activity declined 36% per year from 2006 to 2009 during thread lay, but increased between 2% and 5% during subsequent visits. A general decline in moose activity occurred in the region with greater declines reported on control transects than those near active construction zones. Moose activity did not decline near active

construction zones. Despite the decline in activity levels from the pre-construction to construction periods, moose continued to use areas near the disturbances, and in some cases, activity levels actually increased nearer the access road. These results suggest that moose might be less susceptible to disturbances compared to woodland caribou.

Black bear activity was highly variable between years. While overall black bear activity declined at a rate ranging up to 46% per year from 2006 to 2009 in the study area, the location of activity tended to increase within 1 km of the road during construction. There are often more encounters with black bears in areas with increased human activity, as bears can be attracted to the smells and food sources humans produce. They may also be attracted to potential new food sources such as sedges and berries that can grow in roadside ditches and clearings associated with development.

Wildlife-human encounters occurred along the road, camp and at the generating station during the construction period. Encounters included black bear, red fox, gray wolf, American marten, mink, wolverine, striped skunk, river otter, cougar, lynx, woodland caribou and moose. Control measures were used only when required to address safety concerns for both humans and wildlife. Management activities included signage, relocation and an education program. A total of six animals were dispatched for safety reasons. Two wildlife-vehicle collisions were also reported along the access road. The road was also used to access areas for domestic harvesting purposes. The lessons learned from animal control measures and road accidents at Wuskwatim should be applied to future generation projects.

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1.0 INTRODUCTION

Environment Act Licence No. 2699 for the Wuskwatim Generation Project required the development of a monitoring program to address potential effects of the project on the terrestrial environment, in particular woodland caribou. A monitoring program to address woodland caribou and other large mammals was developed and is described in detail in the "Wuskwatim Generation Project Terrestrial Effects Monitoring Program" (TerEMP).

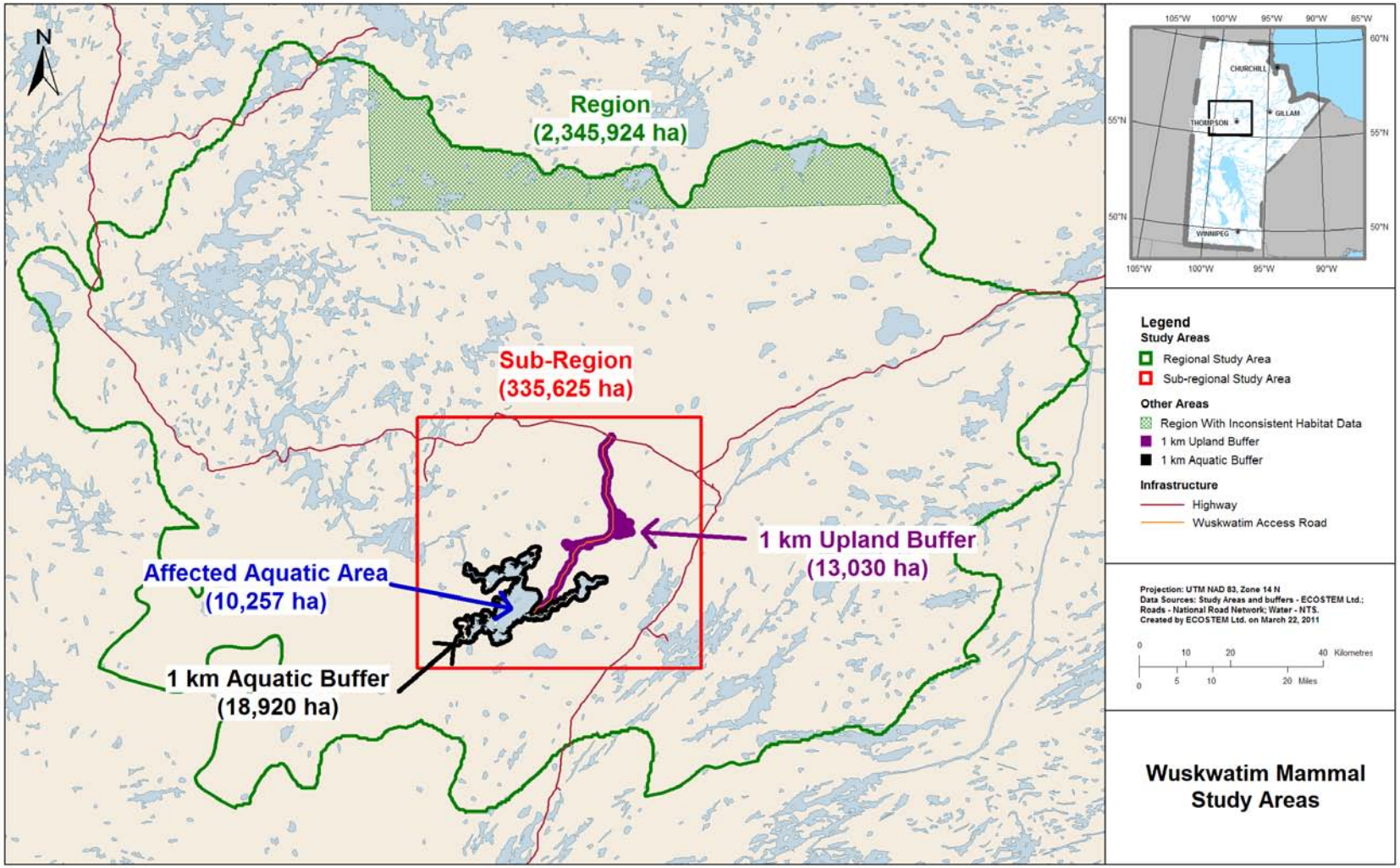
As described in the TerEMP, a ground-based tracking program was developed to determine whether there are Project effects on woodland caribou and/or caribou behavior by quantifying distribution, relative abundance, and movement, and assessing the loss of effective habitat resulting from construction of the access road and generating station. In addition to woodland caribou, large mammals such as moose, black bear and wolf were to be assessed for potential loss of effective habitat near construction zones. It was unclear when the TerEMP was developed whether these techniques would provide sufficient data to evaluate avoidance by large predators. Results of two years of pre-construction monitoring were previously reported in Blouw and Berger (2007) and one year of construction monitoring was previously reported in Ambrose *et al*. (2008).

This report presents the results of monitoring conducted before construction of the access road (i.e., 2004, 2005, and 2006), during construction of the access road and generating station (2007 and 2008), and during construction of the generating station but after the completion of the access road (2009). Camps were also monitored for wildlife encounters.

Region and Sub-region scale mammal studies have been on-going in the Wuskwatim Generation Project Area since 2000 (Map 1.0-1). Construction of the Wuskwatim access road began August 2006, including centreline clearing and the initiation of a temporary work camp. Early road construction coincided with the final round of the pre-construction ground-based mammal thread monitoring program (Blouw and Berger 2007). The geographic location of road construction at this stage would have been limited to approximately the first 15 km of the access road.

During 2007, road construction progressed over the entire length of the access road, extending south from Provincial Road (PR) 391 to the future generating station (GS) site. Activities such as clearing, grubbing, laying gravel, and packing and installing culverts had progressed along the road, and the majority of these activities were near completion.

Borrow areas were actively operating. In 2008, the temporary road work construction camp had been decommissioned and the second road construction camp was operating. Cofferdam construction was initiated at the future generating station site. Rock blasting activities were occurring periodically at the GS site. Relatively high levels of traffic, equipment and people were distributed throughout the construction area. The access road was completed in summer 2008 along with the main camp. Concrete slabs were poured for the bottom of the spillway in spring 2009, and the spillway gates were installed and were to be operational in summer 2010. After this phase of construction the mammal construction monitoring program was concluded.



Map 1.0-1. Mammal study areas (Manitoba Hydro 2003).

2.0 METHODS

Transect surveys were completed from 2004 to 2009 along the east and west sides of the proposed access road (Map 2.0-1). In 2004, 30 paired transects were surveyed on either side of the proposed access road and in 2005, 43 paired transects were sampled. Six additional transects were included in 2005, east and west of the proposed access road, identified with the suffix "A" (Appendix A). At the southern portion of the proposed access road on the south side of the Burntwood River, four transects were added to sample potential habitats near the future generating station, identified with the suffix "S" and referred to as generating station (GS) transects.

As recommended by Environment Canada, four transects were added in 2005 to control for potential woodland caribou activity changes at a regional level, and was expected to be well outside the influence of future infrastructure and construction activity. One major habitat group (i.e., sparsely treed black spruce peat bog complex) was selected for these purposes. Control sites were positioned about 20 kilometres (km) north of the junction of Mile 17 and Highway 39, well beyond the expected influence of any linear disturbances. In 2006, 20 paired transects were surveyed, plus the four paired control transects. Although the number of transects was selectively decreased in 2006 due to the paucity of woodland caribou data at certain sample sites in 2004 and 2005, other transects were added where woodland caribou demonstrated higher levels of activity. The 2006 survey was replicated in 2007, 2008, and 2009.

During each survey year, observations of mammal sign were recorded according to survey segments perpendicular to the access road. Recorded information associated with each mammal sign observation included species, approximate age of the sign (i.e., fresh versus old), number of sign and any additional relevant comments respecting habitat or animal activity. Mammal sightings were also recorded. All transects were initially visited at the beginning of the tracking season each year which corresponded to the early summer caribou calf-rearing period. Hip chain thread was strung along the length of the transect at this time. Animal signs were recorded up to one metre (m) on either side of the centreline. Sites were re-visited twice more (i.e., visits 2 and 3 or first check and second check) about one month apart, and the hip chain thread was assessed for breaks (Table2.0-1). Wherever thread breaks occurred, the surrounding area was surveyed for tracks or sign of the responsible animal. Global Positioning System (GPS) units were used to record the precise location of all large mammal activity. The second site visit

generally corresponded to the mid-summer caribou calf-rearing period, and the third site visit generally corresponded with the early fall caribou calf-rearing period.

Table 2.0-1. Dates of three visits to transects

Year	Thread Lay	First Check	Second Check
2004	July 6 to Aug. 11	Aug. 11 to 29	Sep. 14 to Oct. 5
2005	June 22 to July 19	July 24 to Aug. 23	Sep. 20 to 28
2006	Aug. 15 to 28	Sep. 14 to 24	
2007	June 26 to July 7	July 18 to Aug. 14	Aug. 14 to 24
2008	June 26 to July 7	July 17 to Aug. 14	Aug. 14 to 24
2009	June 23 to July 4	July 14 to 22	Aug 5. to 11

For statistical analysis, the estimated activity of animals at 200 m intervals (segments) from the access road was modeled using negative binomial regression methods (Cameron and Trivedi 1998). Negative binomial regression falls under the general class of generalized linear models and is appropriate when the response data represent counts (i.e., strictly non-negative) and it is necessary to account for dependence in the data (here, due primarily to spatial covariance). This method is common in the analysis of counts representing the amount of use of a resource (Manly *et al*. 2002).

Two sets of analyses were conducted: one conditioned on locations where activity was observed and the second analysis also incorporating the 200 m segments where no activity was observed. Incorporation of combined habitat broad classification (Appendix B) as a covariate was only possible in the conditional analysis. Estimated activity was aggregated to 200 m distance categories in order to ensure model convergence. Cases where habitat broad classification changed within a distance category were eliminated from the conditional analysis. Habitat broad categories with less than ten species-specific observations were also excluded.

Map 2.0-1. Map of the Wuskwatim Generation Project access road and the mammal transects sampled from 2004 to 2009.

The estimated activity of animals was modeled as a function of distance to the road (or to a fixed intercept line representing a theoretical road in the case of GS and control transects), year, and an interaction between distance and year.. The theoretical road is referred to as the **control road** for transects in the control area. For GS transects, effects are said to be measured from the generating station for simplicity. Presence of gray wolves and combined habitat broad landcover classification were included as additional covariates. For woodland caribou, presence of black bear and moose also served as covariates. Distance to the road was an effect of primary interest and was treated as a categorical predictor variable (0 – 1000 m, 1001 – 2000 m, 2001 – 3000 m, > 3000 m) as a smooth trend in the activity of animals was not expected as the distance from the road increased. The interaction between distance to the road and year was also of interest to test for changes over the years in habitat use relative to the access road. Tests of statistical interactions between study year and an effect of interest are commonly used in the analysis of BACI (before-after control-impact) study designs (Stewart-Oaten and Bence 2001).

The estimated activity of animals was modeled as a function of distance to the road, year, and an interaction between distance and year. Statistical contrasts were used to test for yearly differences in the activity of animals within 2 km of the road vs. 2 km or further from the road and for the activity of animals within 1 km of the road vs. 1 km or further from the road. Contrasts were also performed to test if the distance to road effects in 2007 through 2009 were greater than these same effects in earlier years. Analyses were conducted by visit and species.

One set of analyses was conducted for GS and control transects, also incorporating the 200 m segments where no activity was observed. Limited variation in classifications and sparse classes precluded inclusion of habitat broad as a covariate. Limited gray wolf observations on these segments also precluded inclusion of gray wolf presence as a covariate or as a response.

3.0 RESULTS

For the purposes of analysis, an activity level based on the number of sign and estimated number of individuals recorded at each point for woodland caribou, moose, gray wolf, and black bear was estimated (Appendix C) to standardize the data collected by several technicians over the six-year period. In 2006, data were collected during an initial thread lay and one check, whereas in 2004, 2005 and 2007 to 2009 data were collected during thread lay, and over the course of two additional site visits. Sign of smaller mammals was recorded incidentally where observed (Appendix D).

Activity levels varied from year to year and among species. From 2004 to 2009, a decline in woodland caribou activity was observed, at a rate of 22% per year during thread lay, 26% during the first check, and 3% during the second check. Moose activity declined 36% per year from 2006 to 2009 during thread lay, and increased 2% during the first check and 5% during the second check. Black bear activity declined 46% per year during the first check from 2006 to 2009, increased 1% from 2003 to 2005 during the first check, and declined 38% from 2007 to 2009 during the second check. Gray wolf activity declined 3% per year from 2004 to 2009.

3.1 WOODLAND CARIBOU

Across all three visits, there were 375 of 2790 (13.4%) 200 m segments for which habitat broad classifications were heterogeneous within a distance category. These were excluded from the conditional analyses. Woodland caribou activity during all visits before and during construction is depicted in Map 3.0-1a to 3.0-1d.

Map 3.0-1a. Woodland caribou activity on control transects before (2004 to 2006) and during (2007 to 2009) construction.

Map 3.0-1b. Woodland caribou activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, northern portion.

Map 3.0-1c. Woodland caribou activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, central portion.

Map 3.0-1d. Woodland caribou activity on GS transects before (2004 to 2006) and during (2007 to 2009) construction.

3.1.1 Thread Lay

3.1.1.1 Access Road Transects

Six habitat broad classifications (representing categories 011, 031, 042, 046, 211, 321 and comprising 17 observations) were excluded from the analysis of the transects east and west of the access road. The effects of habitat broad (χ^2 = 23.41, with 9 degrees of freedom and p = 0.0053), moose presence (more woodland caribou when moose not present; χ^2 = 27.10, with 1 degree of freedom and p < 0.0001), year (χ^2 = 412.32, with 5 degrees of freedom and p < 0.0001), and the interaction between distance to the road and year (χ^2 = 29.55, with 15 degrees of freedom and p = 0.0137) were all statistically significant.

The effects of gray wolf presence (χ^2 = 0.46, with 1 degree of freedom and p = 0.4975), black bear presence (χ^2 = 2.62, with 1 degree of freedom and p = 0.1057), and distance to the road (χ^2 = 7.30, with 3 degrees of freedom and p = 0.0629) were not significant.

In 2004 and 2007, there was evidence of less activity observed within 1 km and 2 km of the road while in 2005 there was evidence of more activity observed within 2 km of the road (Figure 3.0-1). In comparing 2007 to 2009 vs. the pre-construction years, there was a larger distance to road effect, characterized by less activity within 1 km of the road (Table 3.0-1).

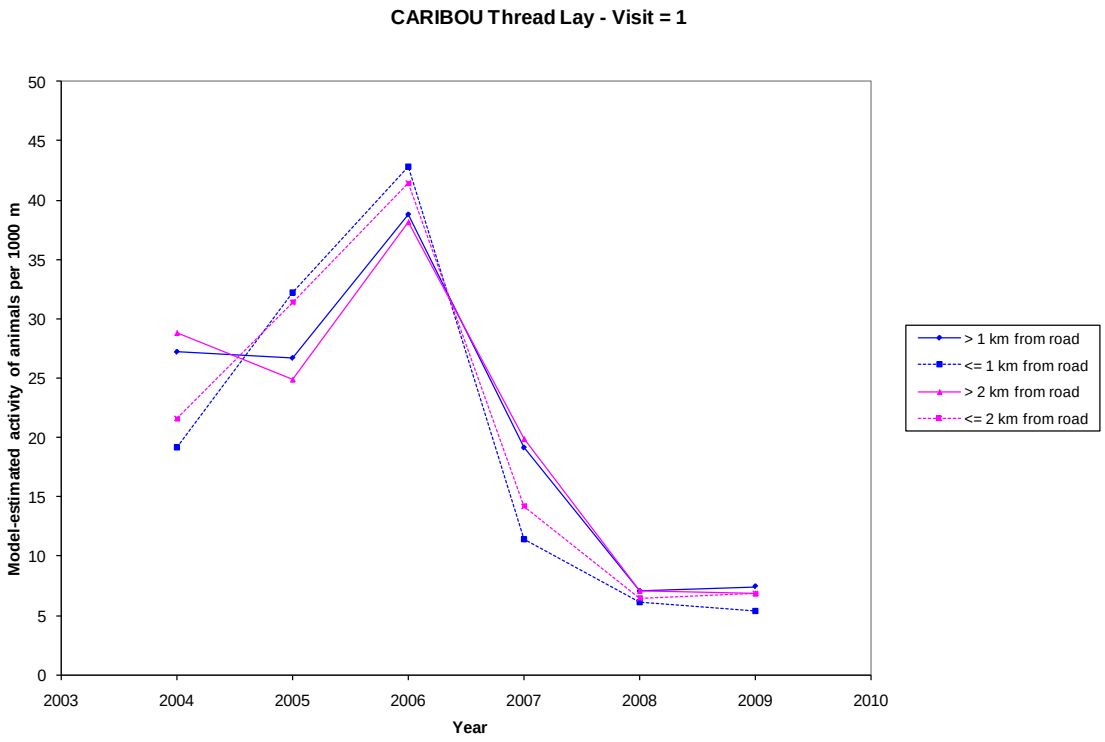


Figure 3.0-1. Woodland caribou activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009.

Table 3.0-1. Analysis of woodland caribou activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	4.94 (less activity within 2 km of road)	**0.0262**
	Activity of animals≤ 1 km vs. > 1 km of road	9.51 (less activity within 1 km of road)	**0.0020**
2005	Activity of animals≤ 2 km vs. > 2 km of road	4.34 (more activity within 1 km of road)	**0.0373**
	Activity of animals≤ 1 km vs. > 1 km of road	2.37	0.1234
2006	Activity of animals≤ 2km vs. > 2 km of road	0.82	0.3653
	Activity of animals≤ 1 km vs. > 1 km of road	1.03	0.3096

Year	Contrast	χ^2 value	p-value*
2007	Activity of animals≤ 2 km vs. > 2 km of road	9.20 (less activity within 2 km of road)	**0.0024**
	Activity of animals≤ 1 km vs. > 1 km of road	14.44 (less activity within 1 km of road)	**0.0001**
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.22	0.6401
	Activity of animals≤ 1 km vs. > 1 km of road	0.28	0.5959
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9649
	Activity of animals≤ 1 km vs. > 1 km of road	1.03	0.3092
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	1.52	0.2170
	Activity of animals≤ 1 km vs. > 1 km of road	3.70 (larger distance to road effect in later years)	0.0544

*Bold indicates significance.

Estimated woodland caribou activity significantly declined by at least 67% within each distance from the road category from the pre-construction through construction periods (Table 3.0-2).

Table 3.0-2. Comparison of woodland caribou activity during thread lay on transects along the Wuskwatim access road before and during construction.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	189.19	< **0.0001**	**72% decline**
	More than 2 km	158.65	< **0.0001**	**67% decline**
	Within 1 km	98.32	< **0.0001**	**76% decline**
	More than 1 km	248.37	< **0.0001**	**67% decline**

*Bold indicates significance.

When zero values were included for 200 m segments where woodland caribou activity was not observed, the effects of distance to the road (χ^2 = 56.71, with 3 degrees of freedom and $p < 0.0001$), year (χ^2 = 564.96, with 5 degrees of freedom and $p < 0.0001$), and the interaction between distance to the road and year (χ^2 = 94.44, with 15 degrees of freedom and $p < 0.0001$) were all statistically significant. The effects of gray wolf presence (χ^2 = 0.36, with 1 degree of freedom and $p = 0.5503$), moose presence (χ^2 =

1.20, with 1 degree of freedom and p = 0.2741), and black bear presence (χ^2 = 0.30, with 1 degree of freedom and p = 0.5810) were not significant.

In 2004 and 2005, there was evidence of more activity observed within 1 km and 2 km of the road (Figure 3.0-2). In 2006, there was evidence of more activity observed within 2 km of the access road. In 2008 through 2009, there was evidence of less activity observed within 1 km of the road. In comparing 2007 to 2009 vs. the other years, there were greater distance effects in 2004 to 2006 vs. the later years – characterized by more activity within 1 km and 2 km the road (Table 3.0-3).

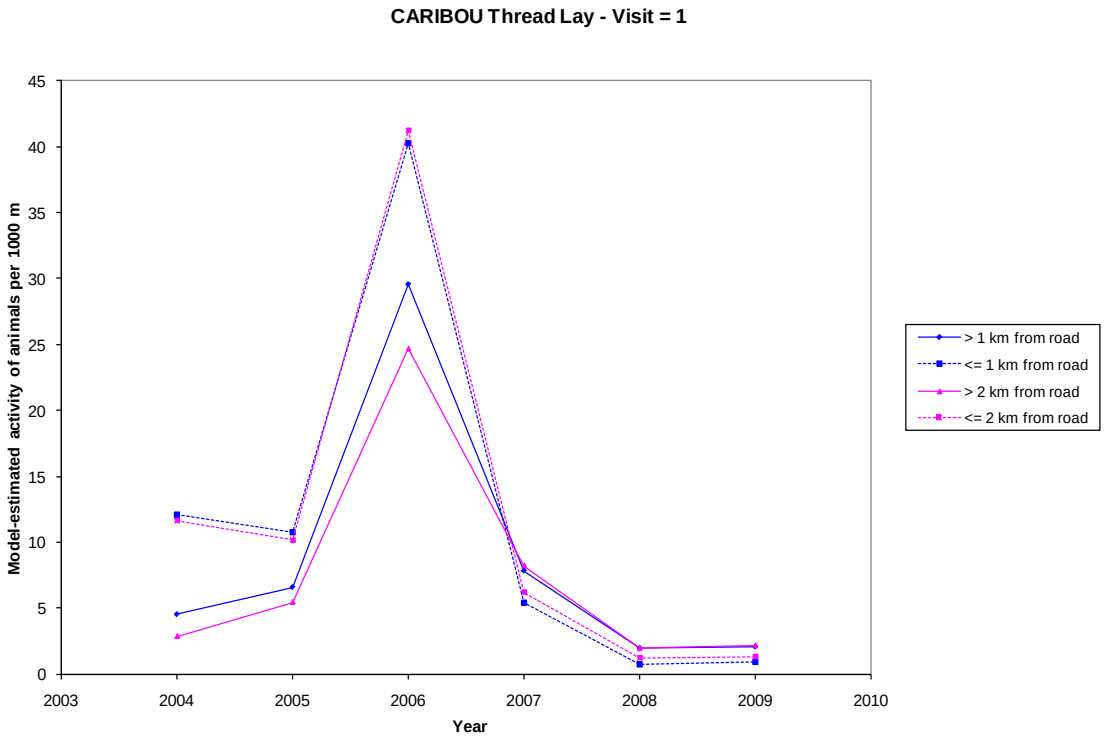


Figure 3.0-2. Woodland caribou activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009, with zero values.

Table 3.0-3. Analysis of the number of woodland caribou activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction, with zero values.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	89.95 (more activity within 2 km of road)	< **0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	36.31 (more activity within 1 km of road)	< **0.0001**
2005	Activity of animals≤ 2 km vs. > 2 km of road	16.49 (more activity within 2 km of road)	< **0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	8.12 (more activity within 1 km of road)	**0.0044**
2006	Activity of animals≤ 2 km vs. > 2 km of road	8.05 (more activity within 2 km of road)	**0.0045**
	Activity of animals≤ 1 km vs. > 1 km of road	2.24	0.1345
2007	Activity of animals≤ 2 km vs. > 2 km of road	2.36	0.1241
	Activity of animals≤ 1 km vs. > 1 km of road	2.88 (marginally less activity within 1 km of	0.0898
2008	Activity of animals≤ 2 km vs. > 2 km of road	3.72 (marginally less activity within 2 km of	0.0537
	Activity of animals≤ 1 km vs. > 1 km of road	10.15 (less activity within 1 km of road)	**0.0014**
2009	Activity of animals≤ 2 km vs. > 2 km of road	3.26 (marginally less activity within 2 km of	0.0709
	Activity of animals≤ 1 km vs. > 1 km of road	5.66 (less activity within 1 km of road)	**0.0173**
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	59.37 (smaller distance effect in 2007 to 2009)	< **0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	44.38 (smaller distance effect in 2007 to 2009)	< **0.0001**

*Bold indicates significance.

Estimated woodland caribou activity significantly declined by at least 55% within each distance from the road category from the pre-construction through construction periods (Table 3.0-4).

Table 3.0-4. Comparison of woodland caribou activity during thread lay on transects along the Wuskwatim access road before and during construction, with zero values.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	285.52	< **0.0001**	**87% decline**
	More than 2 km	48.64	< **0.0001**	**55% decline**
	Within 1 km	189.62	< **0.0001**	**91% decline**
	More than 1 km	132.10	< **0.0001**	**67% decline**

*Bold indicates significance.

3.1.1.2 Generating Station Transects

No woodland caribou activity was observed on GS transects in 2004 or 2009. The effects of year ($\chi^2 = 116.21$, with 3 degrees of freedom and $p < 0.0001$) and distance to the GS ($\chi^2 = 72.73$, with 3 degrees of freedom and $p < 0.0001$) were statistically significant. The interaction between distance to the GS and year ($\chi^2 = 10.04$, with 9 degrees of freedom and $p = 0.3476$) was not significant.

In all years, there was evidence of more activity observed within 1 km and 2 km of the road (Figure 3.0-3). Distance to GS effects did not differ appreciably between pre-construction and construction periods (Table 3.0-5).

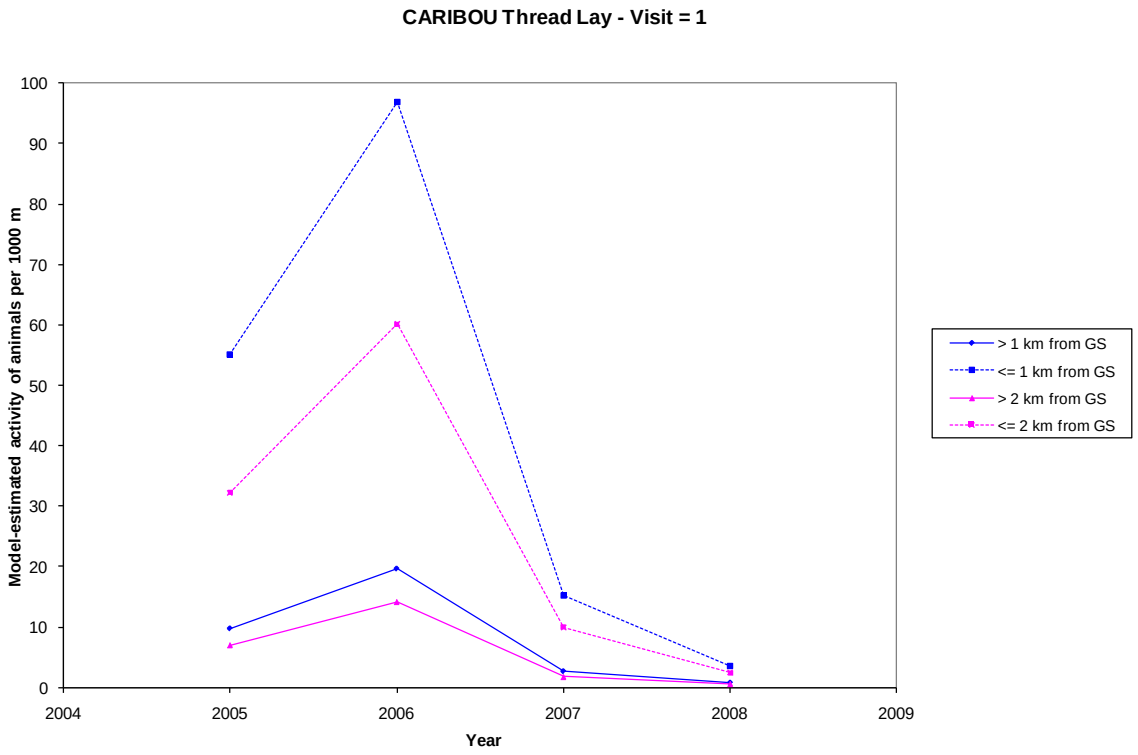


Figure 3.0-3. Woodland caribou activity during thread lay on GS transects at varying distances to the generating station from 2004 to 2009, with zero values.

Table 3.0-5. Analysis of woodland caribou activity during thread lay on GS transects by distance from the generating station before (2005-2006) and during (2007-2008) construction, with zero values. No woodland caribou sign was observed in 2004 and 2009.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of GS	20.61 (more activity within 2 km of GS)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of GS	21.53 (more activity within 1 km of GS)	**< 0.0001**
2006	Activity of animals≤ 2 km vs. > 2 km of GS	19.66 (more activity within 2 km of GS)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of GS	18.94 (more activity within 1 km of GS)	**< 0.0001**
2007	Activity of animals≤ 2 km vs. > 2 km of GS	18.36 (more activity within 2 km of GS)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of GS	17.48 (more activity within 1 km of GS)	**< 0.0001**

Year	Contrast	χ^2 value	p-value*
2008	Activity of animals≤ 2 km vs. > 2 km of GS	6.22 (more activity within 2 km of GS)	**0.0126**
	Activity of animals≤ 1 km vs. > 1 km of GS	7.53 (more activity within 1 km of GS)	**0.0061**
2007 to 2008 vs. 2005 to 2006	Activity of animals≤ 2 km vs. > 2 km of GS	0.02	0.8952
	Activity of animals≤ 1 km vs. > 1 km of GS	0.07	0.7942

*Bold indicates significance.

Estimated woodland caribou activity significantly declined by at least 89% within each distance from the GS category from the pre-construction through construction periods (Table 3.0-6).

Table 3.0-6. Comparison of woodland caribou activity during thread lay on GS transects before and during construction, with zero values. No woodland caribou sign was observed in 2004 and 2009.

Contrast	Distance from GS	χ^2 value	p-value*	Estimated Effect
Average activity 2005 to 2006 vs. average activity 2007 to 2008	Within 2 km	78.84	< **0.0001**	**89% decline**
	More than 2 km	47.14	< **0.0001**	**89% decline**
	Within 1 km	47.06	< **0.0001**	**90% decline**
	More than 1 km	77.29	< **0.0001**	**89% decline**

*Bold indicates significance.

3.1.1.3 Control Area Transects

No woodland caribou activity was observed on control transects in 2004. The effects of year ($\chi^2 = 322.80$, with 4 degrees of freedom and $p < 0.0001$) and the interaction between distance to the road and year ($\chi^2 = 22.95$, with 12 degrees of freedom and $p = 0.0282$) were statistically significant. The effect of distance to the road ($\chi^2 = 5.69$, with 3 degrees of freedom and $p = 0.1280$) was not significant.

In 2005, there was evidence of less activity within 1 km and 2 km of the road, while in 2008 there was some evidence of more activity within 2 km of the road (Figure 3.0-4).

There were contradictory distance effects in 2005 and 2006, but more activity within 1 km and 2 km of the road in 2007-2009 (Table 3.0-7).

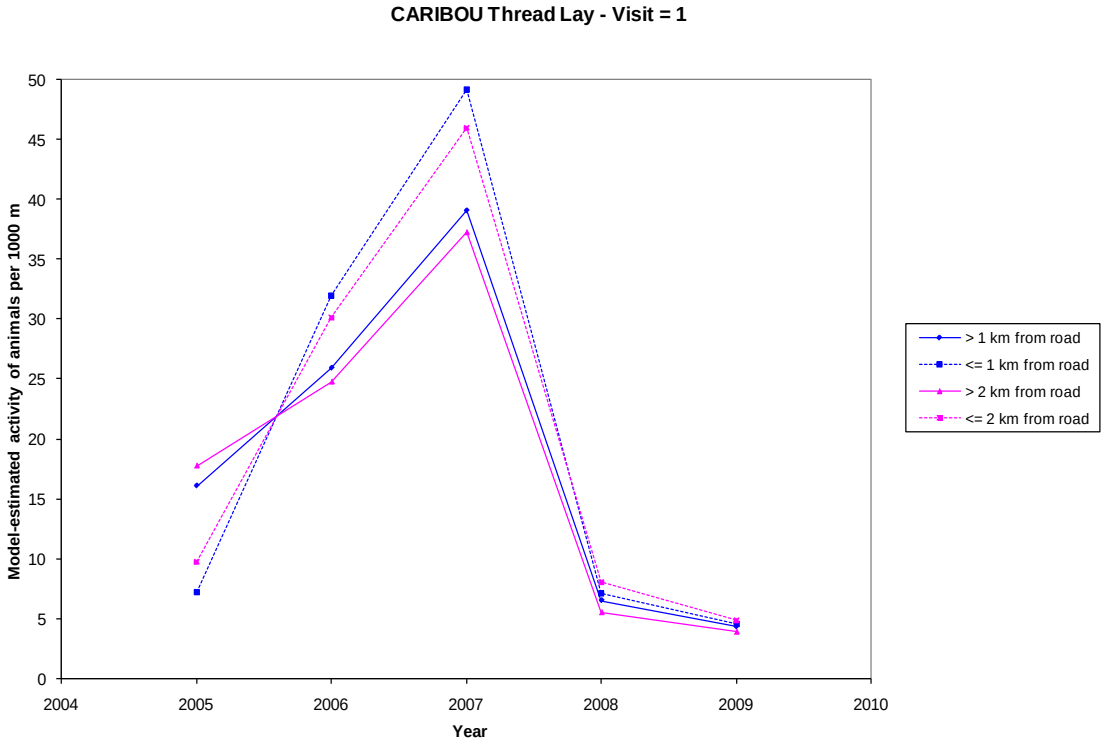


Figure 3.0-4. Woodland caribou activity during thread lay on control transects at varying distances to the control road from 2004 to 2009, with zero values.

Table 3.0-7. Analysis woodland caribou activity during thread lay on control transects by distance from the control road before (2005-2006) and during (2007-2009) construction, with zero values. No woodland caribou sign was observed in 2004.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of road	8.65 (less activity within 2 km of the road)	**0.0033**
	Activity of animals≤ 1 km vs. > 1 km of road	10.10 (less activity within 1 km of the road)	**0.0015**
2006	Activity of animals≤ 2 km vs. > 2 km of road	1.49	0.2223
	Activity of animals≤ 1km vs. > 1 km of road	1.31	0.2515

Year	Contrast	χ^2 value	p-value*
2007	Activity of animals≤ 2 km vs. > 2 km of road	1.82	0.1777
	Activity of animals≤ 1 km vs. > 1 km of road	1.64	0.2003
2008	Activity of animals≤ 2 km vs. > 2 km of road	3.47 (greater activity within 2 km of the road)	0.0626
	Activity of animals≤ 1 km vs. > 1 km of road	0.17	0.6805
2009	Activity of animals≤ 2 km vs. > 2 km of road	1.03	0.3112
	Activity of animals≤ 1 km vs. > 1 km of road	0.04	0.8497
2007 to 2009 vs. 2005 to 2006	Activity of animals≤ 2 km vs. > 2 km of road	7.55 (contradictory distance effects in 2005 and 2006 vs. more activity closer to the road in 2007-2009)	**0.0060**
	Activity of animals≤ 1 km vs. > 1 km of road	4.32 (contradictory distance effects in 2005 and 2006 vs. more activity closer to the road in 2007-2009)	**0.0377**

*Bold indicates significance.

Estimated woodland caribou activity significantly decreased more than 1 km and 2 km from the control road from the pre-construction through construction periods (Table 3.0-8). There was also a significant decline in activity within 2 km from the control road. See Appendix E for comparisons of woodland caribou activity on the three transect types.

Table 3.0-8. Comparison of woodland caribou activity on control transects during thread lay before and during construction, with zero values.

Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2005 to 2006 vs. average activity 2007 to 2009	Within 2 km	7.87	**0.0050**	**29% decline**
	More than 2 km	45.07	< **0.0001**	**56% decline**
	Within 1 km	2.20	0.1381	23% decline
	More than 1 km	48.35	< **0.0001**	**50% decline**

*Bold indicates significance.

3.1.2 First Check

3.1.2.1 Access Road Transects

Eight habitat broad classifications (representing categories 011, 031, 042, 044, 046, 101, 211, 321 and comprising 21 observations) were excluded from the analysis of transects east and west of the access road. No woodland caribou activity was observed within 1 km of the road in 2009. The effects of habitat broad (χ^2 = 17.09, with 7 degrees of freedom and p = 0.0168), and year (χ^2 = 149.25, with 5 degrees of freedom and p < 0.0001) were statistically significant. The effects of gray wolf presence (χ^2 = 2.26, with 1 degree of freedom and p = 0.1328), black bear presence (χ^2 = 3.50, with 1 degree of freedom and p = 0.0613), moose presence (χ^2 = 3.25, with 1 degree of freedom and p = 0.0716), distance to the road (χ^2 = 7.59, with 3 degrees of freedom and p = 0.0554), and the interaction between distance to the road and year (χ^2 = 17.99, with 14 degrees of freedom and p = 0.2072) were not significant.

In 2005 and 2009, there was some evidence of less activity observed within 2 km of the road, while in 2006 there was some evidence of more activity observed within 2 km (Figure 3.0-5). In comparing 2007 to 2009 vs. earlier years, there was a stronger distance to road effect, characterized by less activity within 2 km of the road (Table 3.0-9).

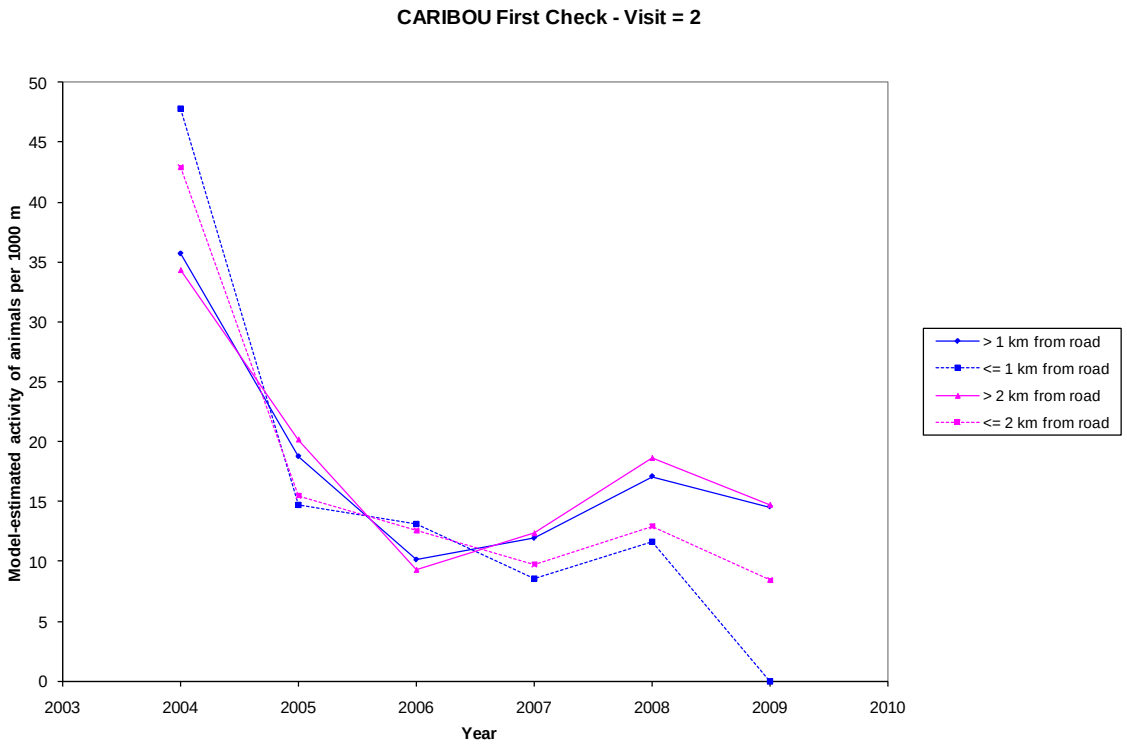


Figure 3.0-5. Woodland caribou activity during the first check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009.

Table 3.0-9. Analysis of woodland caribou activity during the first check on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	1.83	0.1760
	Activity of animals≤ 1 km vs. > 1 km of road	2.28	0.1309
2005	Activity of animals≤ 2 km vs. > 2 km of road	3.30 (marginally less activity within 2 km of road)	0.0691
	Activity of animals≤ 1 km vs. > 1 km of road	1.87	0.1709
2006	Activity of animals≤ 2 km vs. > 2 km of road	3.01 (marginally more activity within 2 km of road)	0.0829
	Activity of animals≤ 1 km vs. > 1 km of road	1.88	0.1700
2007	Activity of animals≤ 2 km vs. > 2 km of road	1.92	0.1660
	Activity of animals≤ 1 km vs. > 1 km of road	1.93	0.1652
2008	Activity of animals≤ 2 km vs. > 2 km of road	1.69	0.1934
	Activity of animals≤ 1 km vs. > 1 km of road	0.58	0.4457
2009	Activity of animals≤ 2 km vs. > 2 km of road	4.47 (less activity within 2 km of road)	**0.0346**
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	7.95 (stronger distance effects in 2007 to 2009 vs. earlier	**0.0048**
	Activity of animals≤ 1 km vs. > 1 km of road	2.50	0.1136

*Bold indicates significance.

Estimated woodland caribou activity significantly increased by 25% more than 1 km from the road from the pre-construction through construction periods (Table 3.0-10).

Table 3.0-10. Comparison of woodland caribou activity on transects along the Wuskwatim access road during the first check before and during construction.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	0.49	0.4847	10% increase
	More than 2 km	0.91	0.3402	11% increase
	Within 1 km	1.91	0.1672	25% decline
	More than 1 km	7.08	**0.0078**	**25% increase**

*Bold indicates significance.

When zero values were included for 200 m segments where woodland caribou activity was not observed, the effects of black bear presence (more woodland caribou when black bears not present; $\chi^2 = 10.09$, with 1 degree of freedom and $p = 0.0015$), distance to the road ($\chi^2 = 115.52$, with 3 degrees of freedom and $p < 0.0001$), year ($\chi^2 = 84.40$, with 5 degrees of freedom and $p < 0.0001$), and the interaction between distance to the road and year ($\chi^2 = 97.40$, with 15 degrees of freedom and $p < 0.0001$) were statistically significant. The effects of gray wolf presence ($\chi^2 = 2.45$, with 1 degree of freedom and $p = 0.1174$) and moose presence ($\chi^2 = 0.40$, with 1 degree of freedom and $p = 0.5268$) were not significant.

In 2006, there was evidence of more activity observed within 1 km and 2 km of the road (Figure 3.0-6). In 2004 and 2007 through 2009, there was evidence of less activity observed within 1 km and 2 km of the road. In comparing 2007 through 2009 vs. earlier years, there were stronger distance to the road effects, characterized by less activity observed within 1 km and 2 km of the road (Table 3.0-11).

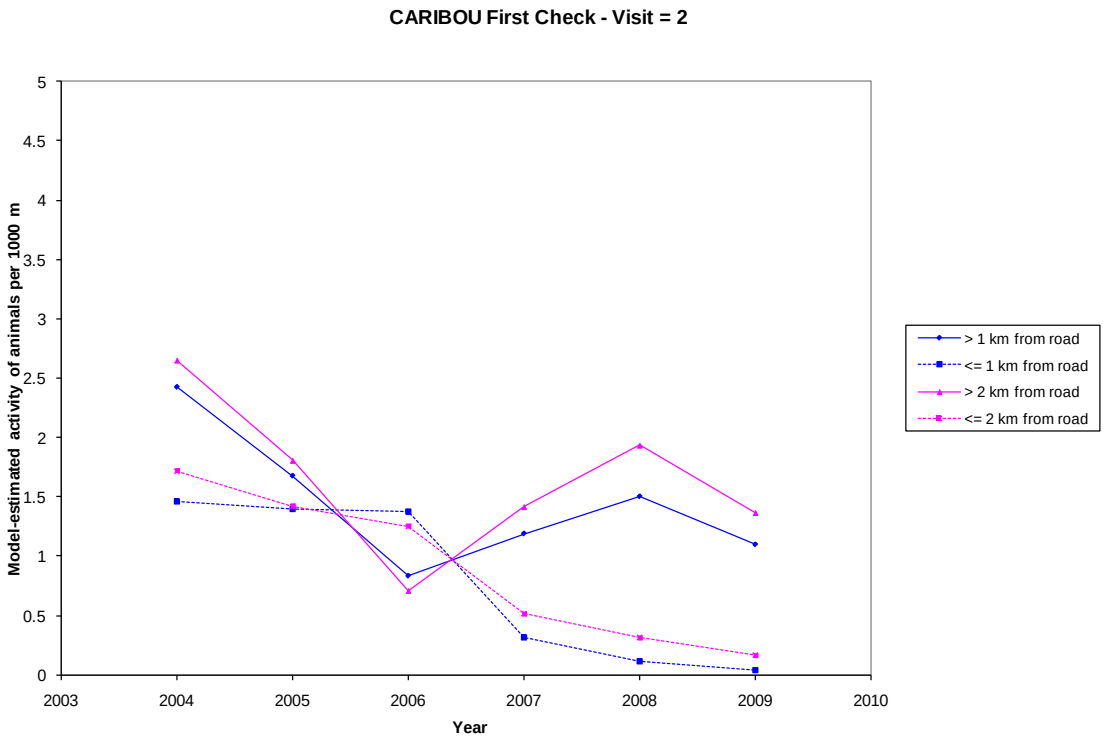


Figure 3.0-6. Woodland caribou activity during the first check on transects along the Wuskwatim access road at varying distances from the road from 2004 to 2009, with zero values.

Table 3.0-11. Analysis of woodland caribou activity during the first check on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction, with zero values.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	4.46 (less activity within 2 km of road)	**0.0347**
	Activity of animals≤ 1 km vs. > 1 km of road	5.19 (less activity within 1 km of road)	**0.0227**
2005	Activity of animals≤ 2 km vs. > 2 km of road	1.65	0.1995
	Activity of animals≤ 1 km vs. > 1 km of road	0.67	0.4125
2006	Activity of animals≤ 2 km vs. > 2 km of road	6.70 (more activity within 2 km of road)	**0.0096**
	Activity of animals≤ 1 km vs. > 1 km of road	4.22 (more activity within 1 km of road)	**0.0400**

Year	Contrast	χ^2 value	p-value*
2007	Activity of animals≤ 2 km vs. > 2 km of road	21.64 (less activity within 2 km of road)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	21.54 (less activity within 1 km of road)	**< 0.0001**
2008	Activity of animals≤ 2 km vs. > 2 km of road	45.26 (less activity within 2 km of road)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	39.25 (less activity within 1 km of road)	**< 0.0001**
2009	Activity of animals≤ 2 km vs. > 2 km of road	23.25 (less activity within 2 km of road)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	19.42 (less activity within 2 km of road)	**< 0.0001**
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	53.42 (larger distance effects in 2007 to 2009 vs. earlier	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	51.03 (larger distance effects in 2007 to 2009 vs. earlier	**< 0.0001**

*Bold indicates significance.

Estimated woodland caribou activity significantly decreased within 1 km and 2 km of the road from the pre-construction through construction periods (Table 3.0-12). There was also marginal evidence of a decline more than 1 km from the road.

Table 3.0-12. Comparison of woodland caribou activity on transects along the Wuskwatim access road during the first check before and during construction, with zero values.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	74.32	**< 0.0001**	**79% decline**
	More than 2 km	0.06	0.8026	3% increase
	Within 1 km	65.04	**< 0.0001**	**92% decline**
	More than 1 km	2.97	0.0851	17% decline

*Bold indicates significance.

3.1.2.2 Generating Station Transects

No woodland caribou activity was observed on GS transects in 2004 and only five signs were found in 2009 (all within 2 km of the GS). The effects of year (χ^2 = 26.22, with 3

degrees of freedom and $p < 0.0001$) and distance to the GS ($\chi^2 = 38.45$, with 3 degrees of freedom and $p < 0.0001$) were statistically significant. The interaction between distance to the GS and year ($\chi^2 = 7.96$, with 9 degrees of freedom and $p = 0.5378$) was not significant.

In 2005 through 2007, there was evidence of more activity observed within 1 km and 2 km of the GS (Figure 3.0-7). Distance to GS effects did not differ appreciably by year (Table 3.0-13).

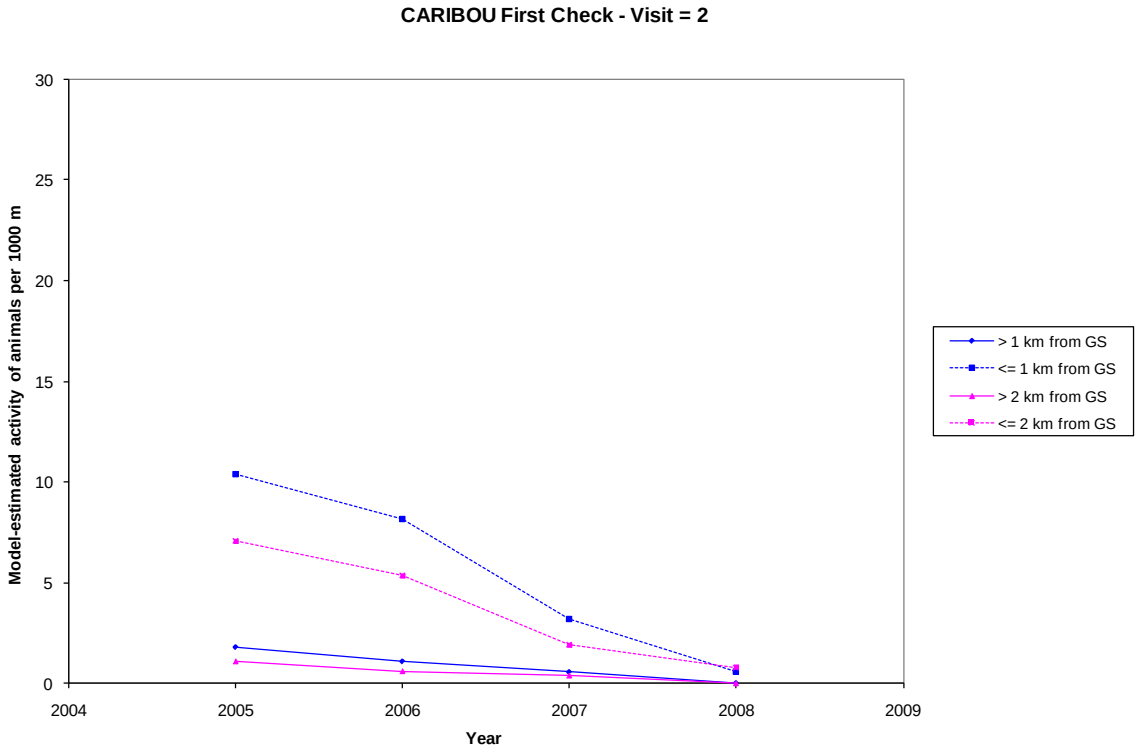


Figure 3.0-7. Woodland caribou activity during the first check on GS transects at varying distances to the generating station from 2004 to 2009, with zero values.

Table 3.0-13. Analysis of woodland caribou activity during the first check on GS transects by distance from the generating station before (2005-2006) and during (2007-2008) construction, with zero values. Little or no woodland caribou sign was observed in 2004 and 2009.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals ≤ 2 km vs. > 2 km of GS	17.71 (more activity within 2 km of GS)	**< 0.0001**

Year	Contrast	χ^2 value	p-value*
	Activity of animals ≤ 1 km vs. > 1 km of GS	17.46 (more activity within 1 km of GS)	**< 0.0001**
2006	Activity of animals ≤ 2 km vs. > 2 km of GS	18.86 (more activity within 2 km of GS)	**< 0.0001**
	Activity of animals ≤ 1 km vs. > 1 km of GS	21.39 (more activity within 1 km of GS)	**< 0.0001**
2007	Activity of animals ≤ 2 km vs. > 2 km of GS	5.48 (more activity within 2 km of GS)	**0.0192**
	Activity of animals ≤ 1 km vs. > 1 km of GS	9.12 (more activity within 1 km of GS)	**0.0025**
2008	Activity of animals ≤ 2 km vs. > 2 km of GS	0.00	0.9673
	Activity of animals ≤ 1 km vs. > 1 km of GS	0.00	0.9695
2007 to 2008 vs. 2005 to 2006	Activity of animals ≤ 2 km vs. > 2 km of GS	0.00	0.9785
	Activity of animals ≤ 1 km vs. > 1 km of GS	0.00	0.9835

*Bold indicates significance.

Estimated woodland caribou activity significantly decreased within 1 km and 2 km of the GS from the pre-construction through construction periods (Table 3.0-14).

Table 3.0-14. Comparison of woodland caribou activity during the first check on GS transects before and during construction, with zero values.

Contrast	Distance from GS	χ^2 value	p-value*	Estimated Effect
Average activity 2005 to 2006 vs. average activity 2007 to 2008	Within 2 km	26.17	**< 0.0001**	**80% decline**
	More than 2 km	0.00	0.9635	98% decline
	Within 1 km	18.81	**< 0.0001**	**85% decline**
	More than 1 km	0.00	0.9573	95% decline

*Bold indicates significance.

3.1.2.3 Control Area Transects

No woodland caribou activity was observed on control transects in 2004. The effects of year ($\chi^2 = 14.48$, with 4 degrees of freedom and $p = 0.0059$) and distance to the road ($\chi^2 = 12.95$, with 3 degrees of freedom and $p = 0.0048$) were statistically significant. The

interaction between distance to the road and year (χ^2 = 15.05, with 12 degrees of freedom and p = 0.2388) was not significant.

In 2005 and 2008, there was evidence of more activity within 2 km of the control road (Figure 3.0-8). Distance to control road effects did not differ appreciably by year (Table 3.0-15).

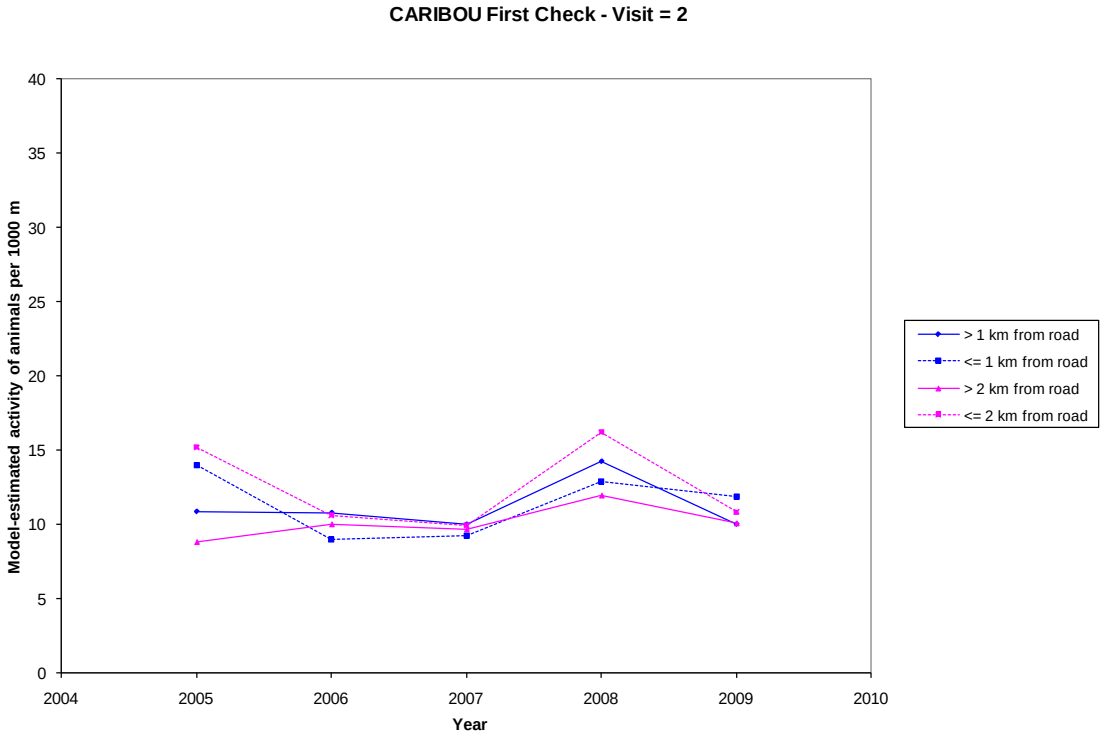


Figure 3.0-8. Woodland caribou activity during the first check on control transects at varying distances to the control road from 2004 to 2009, with zero values.

Table 3.0-15. Analysis of woodland caribou activity during the first check on control transects by distance from the control road before (2005-2006) and during (2007-2009) construction. No woodland caribou sign was observed in 2004.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of road	10.10 (greater activity within 2 km of the road)	**0.0015**
	Activity of animals≤ 1 km vs. > 1 km of road	1.77	0.1830

Year	Contrast	χ^2 value	p-value*
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.15	0.6977
	Activity of animals≤ 1 km vs. > 1 km of road	1.00	0.3167
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.03	0.8719
	Activity of animals ≤ 1 km vs. > 1 km of road	0.18	0.6721
2008	Activity of animals≤ 2 km vs. > 2 km of road	4.65 (greater activity within 2 km of the road)	**0.0311**
	Activity of animals≤ 1 km vs. > 1 km of road	0.39	0.5342
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.24	0.6272
	Activity of animals≤ 1 km vs. > 1 km of road	1.01	0.3139
2007 to 2009 vs. 2005 to 2006	Activity of animals≤ 2 km vs. > 2 km of road	1.37	0.2410
	Activity of animals≤ 1 km vs. > 1 km of road	0.06	0.8098

*Bold indicates significance.

Estimated woodland caribou activity did not change significantly from the pre-construction through construction periods (Table 3.0-16). See Appendix F for comparisons of woodland caribou activity on the three transect types.

Table 3.0-16. Comparison of woodland caribou activity on control transects during the first check before and during construction, with zero values.

Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2005 to 2006 vs. average activity 2007 to 2009	Within 2 km	0.31	0.5793	6% decline
	More than 2 km	1.18	0.2767	12% increase
	Within 1 km	0.00	0.9998	0% change
	More than 1 km	0.23	0.6339	4% increase

*Bold indicates significance.

3.1.3 Second Check

3.1.3.1 Access Road Transects

Eight habitat broad classifications (representing categories 011, 031, 042, 044, 046, 201, 211, 321 and comprising 16 observations) were excluded from the analysis of transects east and west of the access road. No woodland caribou activity was observed in 2006. The effects of habitat broad (χ^2 = 6.79, with 6 degrees of freedom and p = 0.0101), black bear presence (χ^2 = 13.13, with 1 degree of freedom and p = 0.0003), distance to the road (χ^2 = 8.76, with 3 degrees of freedom and p = 0.0326), and year (χ^2 = 10.48, with 4 degrees of freedom and p = 0.0330) were statistically significant. The effects of gray wolf presence (χ^2 = 1.17, with 1 degree of freedom and p = 0.2802), moose presence (χ^2 = 0.01, with 1 degree of freedom and p = 0.9271), and the interaction between distance to the road and year (χ^2 = 18.78, with 12 degrees of freedom and p = 0.0940) were not significant.

In 2004, there was evidence of less activity within 1 km the road while in 2005 there was some evidence of more activity within 2 km of the road (Figure 3.0-9). In comparing 2007 to 2009 vs. the other years, there was little evidence for either an increase or decrease in the activity of animals observed closer to the road (Table 3.0-17).

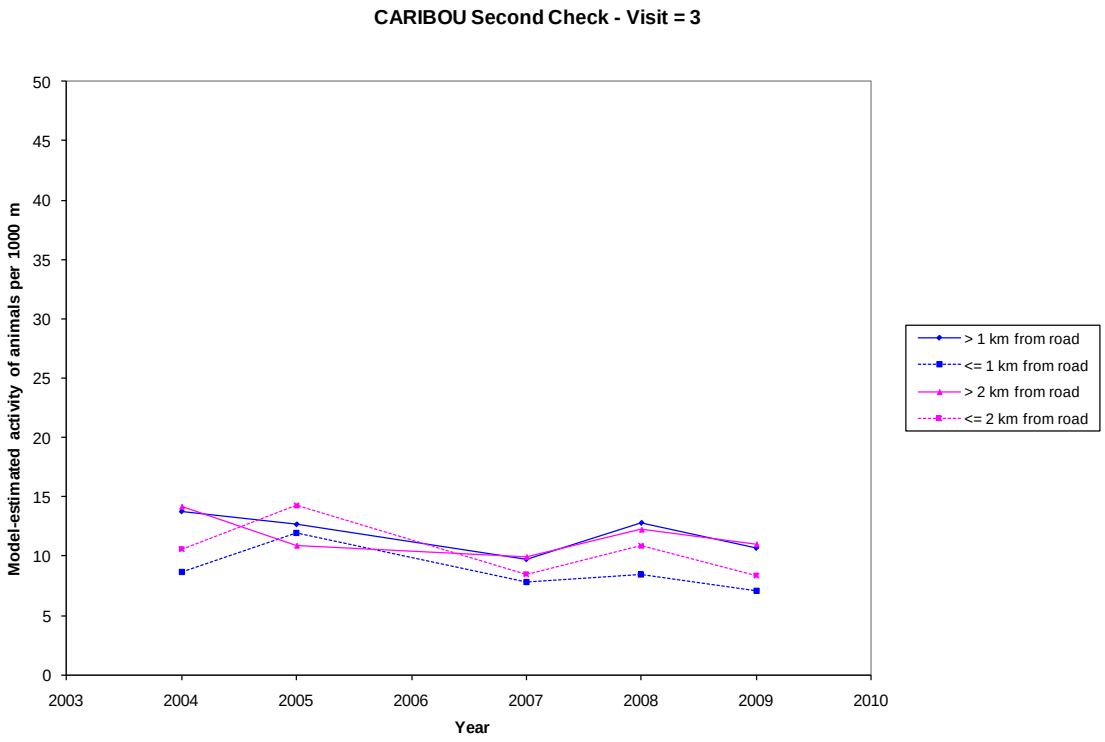


Figure 3.0-9. Woodland caribou activity during the second check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009. There was no second check in 2006.

Table 3.0-17. Analysis of woodland caribou activity during the second check on transects along the Wuskwatim access road by distance from the road before (2004, 2005) and during (2007-2009) construction. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals ≤ 2 km vs. > 2 km of road	2.60	0.1068
	Activity of animals ≤ 1 km vs. > 1 km of road	3.83 (less activity within 1 km of road)	**0.0503**
2005	Activity of animals ≤ 2 km vs. > 2 km of road	2.98 (marginally more activity within 2 km of road)	0.0841
	Activity of animals ≤ 1 km vs. > 1 km of road	0.85	0.3568
2007	Activity of animals ≤ 2 km vs. > 2 km of road	1.68	0.1943
	Activity of animals ≤ 1 km vs. > 1 km of road	1.31	0.2520

Year	Contrast	χ^2 value	p-value*
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.92	0.3376
	Activity of animals≤ 1 km vs. > 1 km of road	2.50	0.1136
2009	Activity of animals≤ 2 km vs. > 2 km of road	1.42	0.2327
	Activity of animals≤ 1 km vs. > 1km of road	0.69	0.4058
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	0.76	0.3847
	Activity of animals≤ 1 km vs. > 1 km of road	0.06	0.8043

*Bold indicates significance.

The greatest decline in estimated woodland caribou activity was within 2 km or 1 km of the road from the pre-construction through construction periods (Table 3.0-18). A smaller decline was observed more than 1 km and more than 2 km from the road. None of the estimated effects were statistically significant.

Table 3.0-18. Comparison of woodland caribou activity during the second check on transects along the Wuskwatim access road before and during construction. There was no second check in 2006.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 to 2005 vs. average activity 2007 to 2009	Within 2 km	2.79	0.0947	25% decline
	More than 2 km	2.43	0.1189	17% decline
	Within 1 km	0.89	0.3463	24% decline
	More than 1 km	3.52	0.0608	17% decline

When zero values were included for 200 m segments where woodland caribou activity was not observed, the effects of distance to the road (χ^2 = 82.69, with 3 degrees of freedom and $p < 0.0001$), year (χ^2 = 40.17, with 4 degrees of freedom and $p < 0.0001$), and the interaction between distance to the road and year (χ^2 = 62.33, with 12 degrees of freedom and $p < 0.0001$) were statistically significant. The effects of gray wolf presence (χ^2 = 0.43, with 1 degree of freedom and $p = 0.5123$), moose presence (χ^2 = 1.30, with 1 degree of freedom and $p = 0.2539$), and black bear presence (χ^2 = 1.06, with 1 degree of freedom and $p = 0.3030$) were not significant.

In 2004 there was evidence of less activity within 2 km of the road and in 2005, there was evidence of more activity observed within 2 km of the road (Figure 3.0-10). In all other years there was evidence of less activity observed within 1 km and 2 km of the road. In comparing 2007 through 2009 vs. earlier years, there were stronger distance to the road effects, characterized by less activity within 1 km and 2 km of the road (Table 3.0-19).

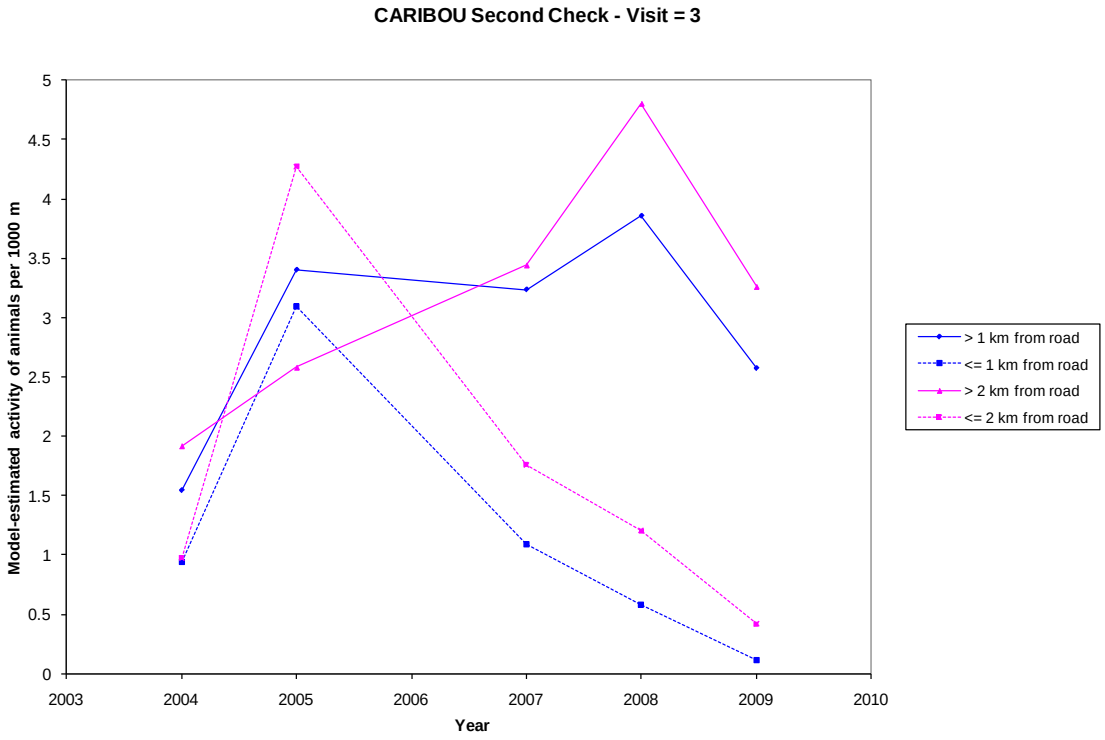


Figure 3.0-10. Woodland caribou activity during the second check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009, with zero values. There was no second check in 2006.

Table 3.0-19 Analysis of woodland caribou activity during the second check on transects along the Wuskwatim access road by distance from the road before (2004, 2005) and during (2007-2009) construction, with zero values. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	6.17 (less activity within 2 km of road)	**0.0130**
	Activity of animals≤ 1 km vs. > 1 km of road	2.77 (marginally less activity within 1 km of road)	0.0958
2005	Activity of animals≤ 2 km vs. > 2 km of road	5.48 (more activity within 2 km of road)	**0.0193**
	Activity of animals≤ 1 km vs. > 1 km of road	0.15	0.7034
2007	Activity of animals≤ 2 km vs. > 2 km of road	13.14 (less activity within 2 km of road)	**0.0003**
	Activity of animals≤ 1 km vs. > 1 km of road	20.64 (less activity within 1 km of road)	**< 0.0001**
2008	Activity of animals≤ 2 km vs. > 2 km of road	39.95 (less activity within 2 km of road)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	35.67 (less activity within 1 km of road)	**< 0.0001**
2009	Activity of animals≤ 2 km vs. > 2 km of road	23.29 (less activity within 2 km of road)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	17.76 (less activity within 1 km of road)	**< 0.0001**
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	27.81 (stronger distance effects in 2007 to 2009 vs.	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	25.93 (stronger distance effects in 2007 to 2009 vs.	**< 0.0001**

*Bold indicates significance.

Estimated woodland caribou activity significantly decreased within 1 km and 2 km of the road from the pre-construction through construction periods (Table 3.0-20). There was a significant increase in activity more than 1 km from the road.

Table 3.0-20. Comparison of woodland caribou activity during the second check on transects along the Wuskwatim access road before and during construction, with zero values. There was no second check in 2006.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 to 2005 vs. average activity 2007 to 2009	Within 2 km	15.12	**0.0001**	**53% decline**
	More than 2 km	2.29	0.1300	8% increase
	Within 1 km	19.46	**< 0.0001**	**76% decline**
	More than 1 km	6.56	**0.0104**	**39% increase**

*Bold indicates significance.

3.1.3.2 Generating Station Transects

No woodland caribou activity was observed in on GS transects 2004 or 2006 and only two signs were found in 2009. The effects of year (χ^2 = 19.42, with 2 degrees of freedom and $p < 0.0001$), distance to the GS (χ^2 = 17.65, with 3 degrees of freedom and $p = 0.0005$), and the interaction between distance to the GS and year (χ^2 = 18.29, with 6 degrees of freedom and $p = 0.0055$) were all statistically significant.

In 2005 and 2007, there was evidence of more activity observed within 1 km and 2 km of the GS (Figure 3.0-11). Distance to GS effects were larger in 2005 than in the latter years – there was a bigger difference in the activity of woodland caribou observed within 1 or 2 km versus more than 1 or 2 km from the GS in 2005 than was observed in later years (Table 3.0-21).

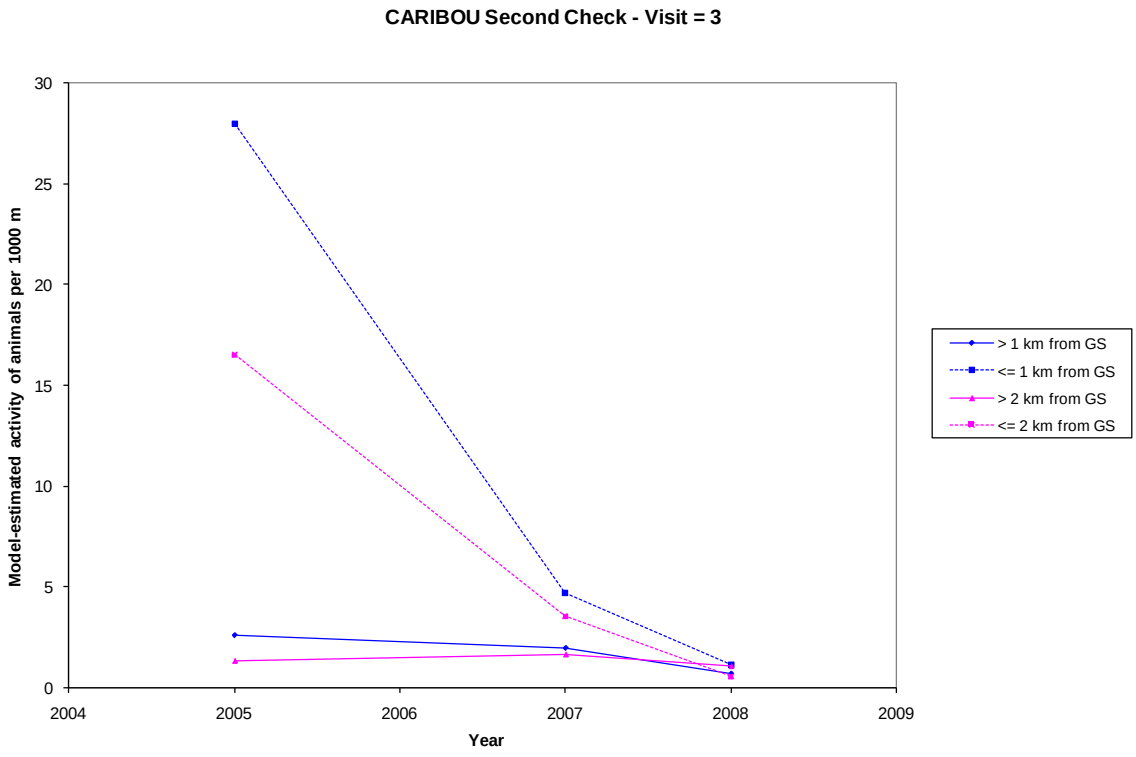


Figure 3.0-11. Woodland caribou activity during the second check on GS transects at varying distances to the generating station from 2004 to 2009, with zero values. There was no second check in 2006.

Table 3.0-21. Analysis of woodland caribou activity during the second check on GS transects by distance from the generating station before (2005) and during (2007, 2008) construction, with zero values. Little or no woodland caribou sign was observed in 2004 and 2009. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of GS	30.61 (more activity within 2 km of GS)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of GS	29.88 (more activity within 1 km of GS)	**< 0.0001**
2007	Activity of animals≤ 2 km vs. > 2 km of GS	3.96 (more activity within 2 km of GS)	**0.0465**
	Activity of animals≤ 1 km vs. > 1 km of GS	4.94 (more activity within 1 km of GS)	**0.0262**
2008	Activity of animals≤ 2 km vs. > 2 km of GS	0.76	0.3819

Year	Contrast	χ^2 value	p-value*
2007 to 2008 vs. 2005	Activity of animals ≤ 1 km vs. > 1 km of GS	0.58	0.4482
	Activity of animals ≤ 2 km vs. > 2 km of GS	15.91 (larger distance to the GS effect in 2005 than in later years)	**< 0.0001**
	Activity of animals ≤ 1 km vs. > 1 km of GS	7.88 (larger distance to the GS effect in 2005 than in later years)	**0.0050**

*Bold indicates significance.

Estimated woodland caribou activity significantly decreased within 1 km and 2 km of the GS from the pre-construction through construction periods (Table 3.0-22). There was also a significant decline in activity more than 1 km from the GS.

Table 3.0-22. Comparison of woodland caribou activity during the second check on GS transects before and during construction, with zero values. Little or no woodland caribou sign was observed in 2004 and 2009. There was no second check in 2006.

Contrast	Distance from GS	χ^2	p-value*	Estimated Effect
Average activity 2005 vs. average activity 2007 to 2008	Within 2 km	38.00	**< 0.0001**	**92% decline**
	More than 2 km	0.00	0.9916	< 1% decline
	Within 1 km	29.83	**< 0.0001**	**92% decline**
	More than 1 km	4.58	**0.0324**	**56% decline**

*Bold indicates significance.

3.1.3.3 Control Area Transects

No woodland caribou activity was observed on control transects in 2004 or 2006. The effect of year (χ^2 = 147.61, with 3 degrees of freedom and $p < 0.0001$) was statistically significant. The effects of distance to the road (χ^2 = 5.23, with 3 degrees of freedom and $p = 0.1559$) and the interaction between distance to the control road and year (χ^2 = 9.83, with 9 degrees of freedom and $p = 0.3648$) were not significant.

In 2009, there was evidence of more activity observed within 1 km and 2 km of the control road (Figure 3.0-12). Distance to road effects did not differ by year (Table 3.0-23).

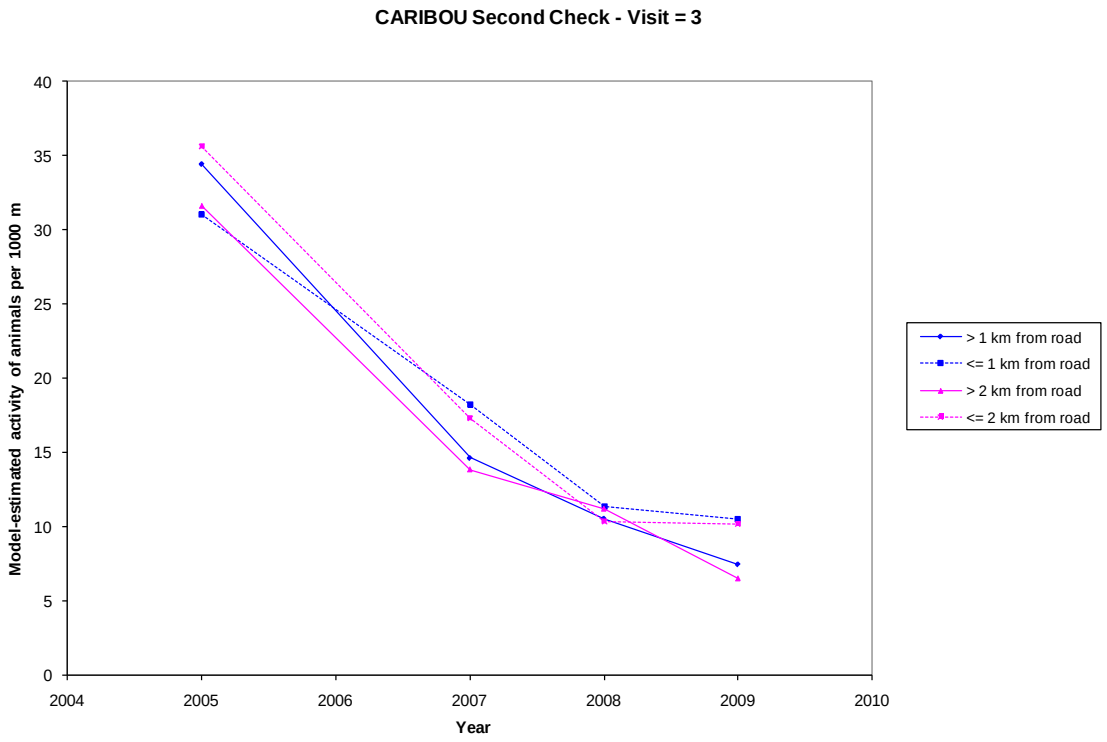


Figure 3.0-12. Woodland caribou activity during the second check on control transects at varying distances to the control road from 2004 to 2009, with zero values. There was no second check in 2006.

Table 3.0-23. Analysis of woodland caribou activity during the second check on control transects by distance from the control road before (2005) and during (2007-2009) construction, with zero values. No woodland caribou sign was observed in 2004. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of road	0.49	0.4851
	Activity of animals≤ 1km vs. > 1 km of road	0.27	0.6004
2007	Activity of animals≤ 2 km vs. > 2 km of road	2.58	0.1085
	Activity of animals≤ 1 km vs. > 1 km of road	1.98	0.1594
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.27	0.6062
	Activity of animals≤ 1 km vs. > 1 km of road	0.20	0.6577
2009	Activity of animals≤ 2 km vs. > 2 km of road	7.58 (greater activity within 2 km of the	**0.0059**
	Activity of animals≤ 1 km vs. > 1 km of road	3.60 (greater activity within 1 km of the	**0.0577**
2007 to 2009 vs. 2005	Activity of animals≤ 2 km vs. > 2 km of road	0.16	0.6862
	Activity of animals≤ 1 km vs. > 1 km of road	2.03	0.1546

*Bold indicates significance.

Estimated woodland caribou activity significantly declined by at least 58% within each distance from the control road category from the pre-construction through construction periods (Table 3.0-24). See Appendix G for comparisons of woodland caribou activity on the three transect types.

Table 3.0-24. Comparison of woodland caribou activity during the second check on control transects before and during construction, with zero values. No woodland caribou sign was observed in 2004. There was no second check in 2006.

Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2005 vs. average activity 2007 to 2009	Within 2 km	62.14	< **0.0001**	**66% decline**
	More than 2 km	68.38	< **0.0001**	**68% decline**
	Within 1 km	20.13	< **0.0001**	**58% decline**
	More than 1 km	112.35	< **0.0001**	**70% decline**

*Bold indicates significance.

3.2 MOOSE

Across all three visits, there were 175 of 1783 (9.8%) 200 m segments for which habitat broad classifications were heterogeneous within a distance category. These were excluded from the conditional analyses. Moose activity during all visits before and during construction is depicted in Map 3.0-2a to 3.0-2d.

Map 3.0-2a. Moose activity on control transects before (2004 to 2006) and during (2007 to 2009) construction.

Map 3.0-2b. Moose activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, northern portion.

Map 3.0-2c. Moose activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, central portion.

Map 3.0-2d. Moose activity on GS transects before (2004 to 2006) and during (2007 to 2009) construction.

3.2.1 Thread Lay

3.2.1.1 Access Road Transects

Six habitat broad classifications (representing categories 031, 044, 046, 101, 211, 321 and comprising 18 observations) were excluded from the analysis of transects east and west of the access road. No moose activity was observed in 2004 or 2005. The effects of distance to the road (χ^2 = 12.60, with 3 degrees of freedom and p = 0.0056) and year (χ^2 = 180.34, with 3 degrees of freedom and p < 0.0001) were statistically significant. The effects of habitat broad (χ^2 = 12.81, with 7 degrees of freedom and p = 0.0769), gray wolf presence (χ^2 = 0.76, with 1 degree of freedom and p = 0.3848), and the interaction between year and distance to the road (χ^2 = 7.11, with 9 degrees of freedom and p = 0.6256) were not significant.

No effects of distance to the road were evident in any of the years (Figure 3.0-13, Table 3.0-25).

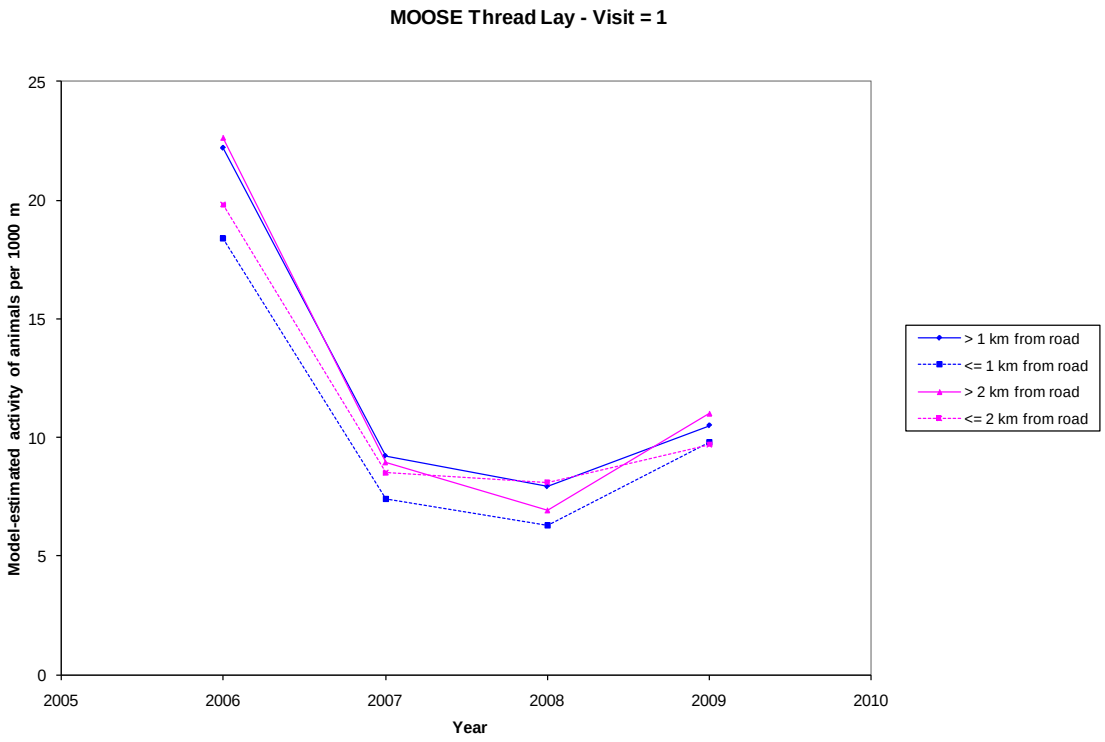


Figure 3.0-13. Moose activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2006 to 2009. No moose sign was observed in 2004 and 2005.

Table 3.0-25. Analysis of moose activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2006) and during (2007-2009) construction. No moose sign was observed in 2004 and 2005.

Year	Contrast	χ^2 value	p-value
2006	Activity of animals≤ 2 km vs. > 2 km of road	1.77	0.1835
	Activity of animals≤ 1 km vs. > 1 km of road	2.29	0.1306
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.19	0.6594
	Activity of animals≤ 1 km vs. > 1 km of road	2.48	0.1150
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.80	0.3726
	Activity of animals≤ 1 km vs. > 1 km of road	1.55	0.2127

Year	Contrast	χ^2 value	p-value
2009	Activity of animals ≤ 2 km vs. > 2 km of road	0.71	0.3983
	Activity of animals ≤ 1 km vs. > 1 km of road	0.19	0.6668
2007 to 2009 vs. 2006	Activity of animals ≤ 2 km vs. > 2 km of road	0.97	0.3237
	Activity of animals ≤ 1 km vs. > 1 km of road	0.01	0.9183

Estimated moose activity significantly declined by at least 56% within each distance from the road category from the pre-construction through construction periods (Table 3.0-26).

Table 3.0-26. Comparison of moose activity during thread lay on transects along the Wuskwatim access road before and during construction. No moose sign was observed in 2004 and 2005.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2009	Within 2 km	84.04	< **0.0001**	**56% decline**
	More than 2 km	101.53	< **0.0001**	**61% decline**
	Within 1 km	43.01	< **0.0001**	**58% decline**
	More than 1 km	144.20	< **0.0001**	**59% decline**

*Bold indicates significance.

When zero values were included for 200 m segments where moose activity was not observed, the effects of distance to the road (χ^2 = 63.81, with 3 degrees of freedom and $p < 0.0001$), and year (χ^2 = 223.02, with 3 degrees of freedom and $p < 0.0001$) were statistically significant. The effects of gray wolf presence (χ^2 = 2.20, with 1 degree of freedom and $p = 0.1380$), and the interaction between year and distance to the road (χ^2 = 16.54, with 9 degrees of freedom and $p = 0.0564$) were not significant.

In 2006 and 2007, there was some evidence of less activity observed within 1 km of the road (Figure 3.0-14). In 2008 and 2009, there was evidence of more activity observed within 1 km and 2 km of the road. In comparing 2007 through 2009 vs. earlier years, there were stronger distance to the road effects, characterized by more activity within 2 km of the road (Table 3.0-27).

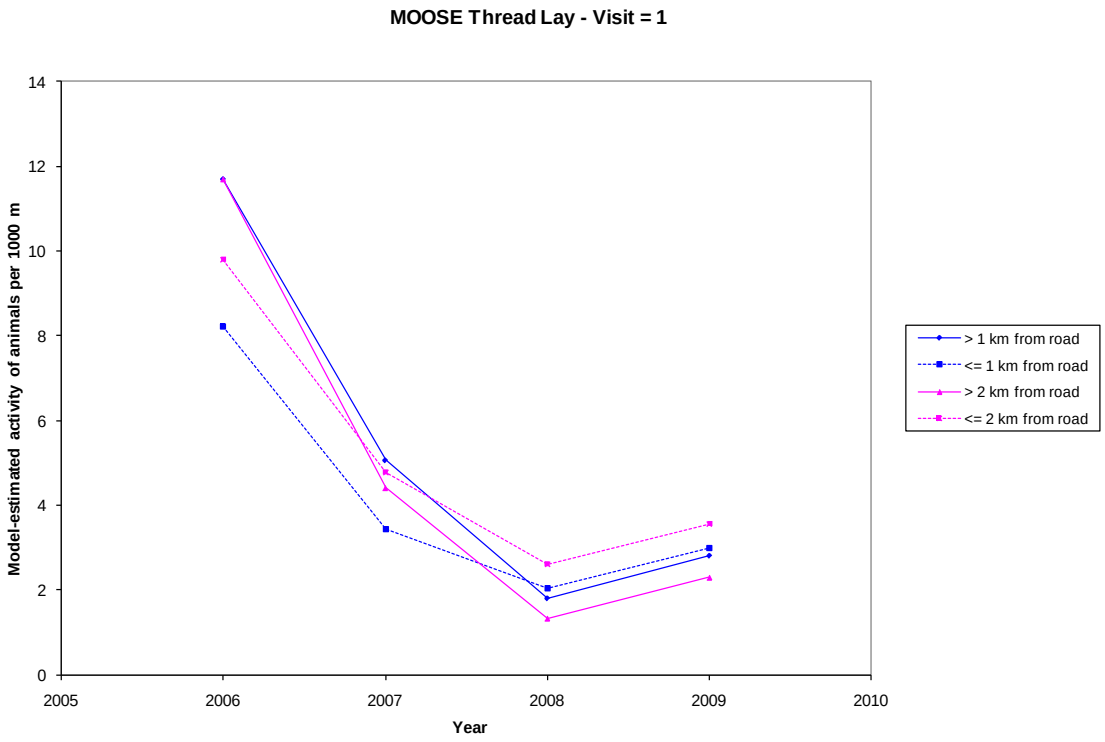


Figure 3.0-14. Moose activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2006 to 2009, with zero values. No moose sign was observed in 2004 and 2005.

Table 3.0-27. Analysis of moose activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2006) and during (2007-2009) construction, with zero values. No moose sign was observed in 2004 and 2005.

Year	Contrast	χ^2 value*	p-value
2006	Activity of animals≤ 2 km vs. > 2 km of road	1.22	0.2702
	Activity of animals≤ 1 km vs. > 1 km of road	3.54 (marginally less activity within 1 km of road)	0.0600
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.28	0.5979
	Activity of animals≤ 1 km vs. > 1 km of road	4.68 (less activity within 1 km of road)	**0.0304**
2008	Activity of animals≤ 2 km vs. > 2 km of road	11.65 (more activity within 2 km of road)	**0.0006**
	Activity of animals≤ 1 km vs. > 1 km of road	0.32	0.5746

Year	Contrast	χ^2 value*	p-value
2009	Activity of animals≤ 2 km vs. > 2 km of road	6.35 (more activity within 2 km of road)	**0.0118**
	Activity of animals≤ 1 km vs. > 1 km of road	0.09	0.7641
2007 to 2009 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	9.18 (stronger distance effects in 2007 to 2009 vs. earlier years)	**0.0024**
	Activity of animals≤ 1 km vs. > 1 km of road	1.66	0.1983

*Bold indicates significance.

Estimated moose activity significantly declined by at least 64% within each distance from the road category from the pre-construction through construction periods (Table 3.0-28).

Table 3.0-28. Comparison of moose activity during thread lay on transects along the Wuskwatim access road before and during construction, with zero values. No moose sign was observed in 2004 and 2005.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2009	Within 2 km	59.12	< **0.0001**	**64% decline**
	More than 2 km	136.17	< **0.0001**	**80% decline**
	Within 1 km	32.60	< **0.0001**	**66% decline**
	More than 1 km	157.77	< **0.0001**	**75% decline**

*Bold indicates significance.

3.2.1.2 Generating Station Transects

No moose activity was observed on GS transects in 2004 or 2005. The effects of year ($\chi^2 = 30.65$, with 3 degrees of freedom and $p < 0.0001$) and distance to the GS ($\chi^2 = 46.88$, with 3 degrees of freedom and $p < 0.0001$) were statistically significant. The interaction between distance to the GS and year ($\chi^2 = 5.73$, with 9 degrees of freedom and $p = 0.7668$) was not significant.

In 2007 through 2009, there was evidence of more activity observed within 1 km and 2 km of the GS (Figure 3.0-15). In 2006 there was evidence of more activity within 2 km of the GS. Distance to GS effects were larger in 2007 through 2009 than in 2006 – there was

a somewhat larger difference in the activity of moose observed within 2 km versus more than 2 km from the GS in 2007 through 2009 than was observed in 2006 (Table 3.0-29).

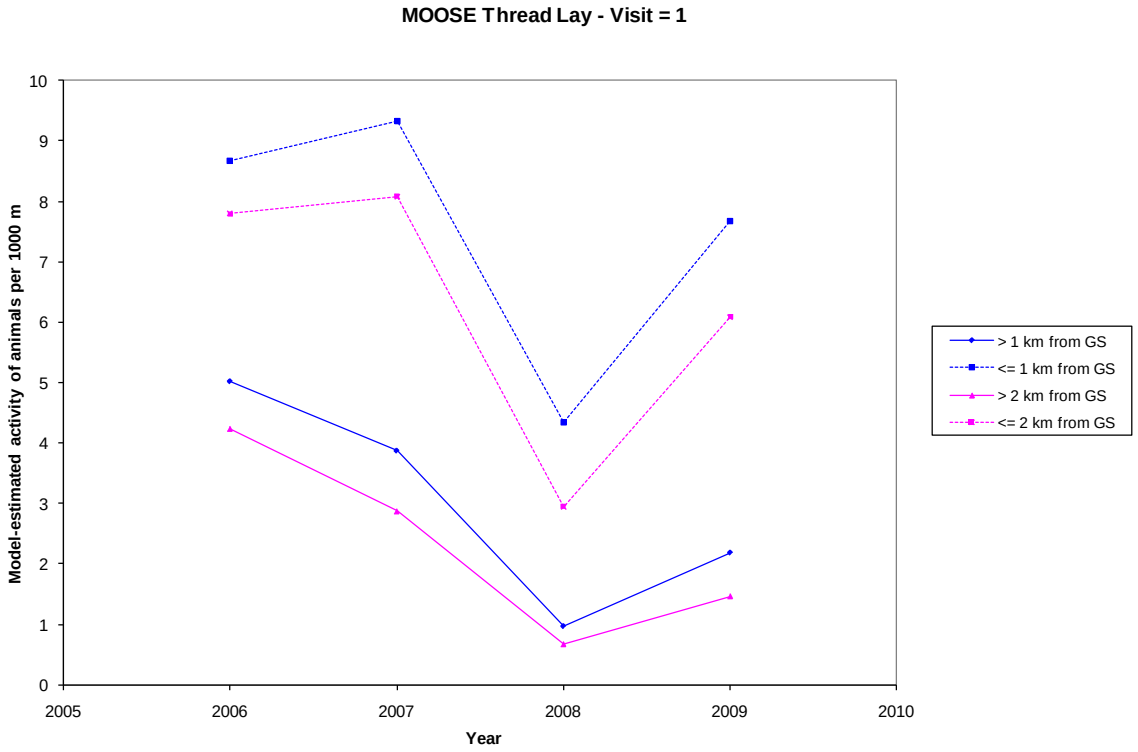


Figure 3.0-15. Moose activity during thread lay on GS transects at varying distances to the generating station from 2006 to 2009, with zero values. No moose sign was observed in 2004 or 2005.

Table 3.0-29. Analysis of moose activity during thread lay on GS transects by distance from the generating station before (2006) and during (2007-2009) construction, with zero values. No moose sign was observed in 2004 or 2005.

Year	Contrast	χ^2 value	p-value*
2006	Activity of animals≤ 2 km vs. > 2 km of GS	4.00 (more activity within 2 km of GS)	**0.0454**
	Activity of animals≤ 1 km vs. > 1 km of GS	2.68	0.1018
2007	Activity of animals≤ 2 km vs. > 2 km of GS	10.39 (more activity within 2 km of GS)	**0.0013**
	Activity of animals≤ 1 km vs. > 1 km of GS	6.73 (more activity within 1 km of GS)	**0.0095**

Year	Contrast	χ^2 value	p-value*
2008	Activity of animals ≤ 2 km vs. > 2 km of GS	8.92 (more activity within 2 km of GS)	**0.0028**
	Activity of animals ≤ 1 km vs. > 1 km of GS	11.45 (more activity within 1 km of GS)	**0.0007**
2009	Activity of animals ≤ 2 km vs. > 2 km of GS	15.28 (more activity within 2 km of GS)	**< 0.0001**
	Activity of animals ≤ 1 km vs. > 1 km of GS	11.96 (more activity within 1 km of GS)	**0.0005**
2007 to 2009 vs. 2006	Activity of animals ≤ 2 km vs. > 2 km of GS	3.43 (some evidence of a larger distance to GS effect in 2007-	0.0639
	Activity of animals ≤ 1 km vs. > 1 km of GS	2.76 (some evidence of a larger distance to GS effect in 2007-	0.0966

*Bold indicates significance.

Estimated moose activity significantly decreased more than 1 km and 2 km from the GS from the pre-construction through construction periods (Table 3.0-30). There was also a marginally significant decline in activity within 2 km of the GS.

Table 3.0-30. Comparison of moose activity during thread lay on GS transects before and during construction, with zero values. No moose sign was observed in 2004 or 2005.

Contrast	Distance from GS	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2009	Within 2 km	2.71	0.0996	32% decline
	More than 2 km	13.70	**0.0002**	**67% decline**
	Within 1 km	0.56	0.4534	22% decline
	More than 1 km	15.86	**< 0.0001**	**60% decline**

*Bold indicates significance.

3.2.1.3 Control Area Transects

No moose activity was observed on control transects in 2004 or 2005. The effects of year (χ^2 =103.37, with 3 degrees of freedom and $p < 0.0001$) and the interaction between distance to the road and year (χ^2 = 17.09, with 9 degrees of freedom and $p = 0.0473$) were statistically significant. The effect of distance to the road (χ^2 = 5.34, with 3 degrees of freedom and $p = 0.1485$) was not significant. There were no significant distance to road effects in any year (Figure 3.0-16, Table 3.0-31).

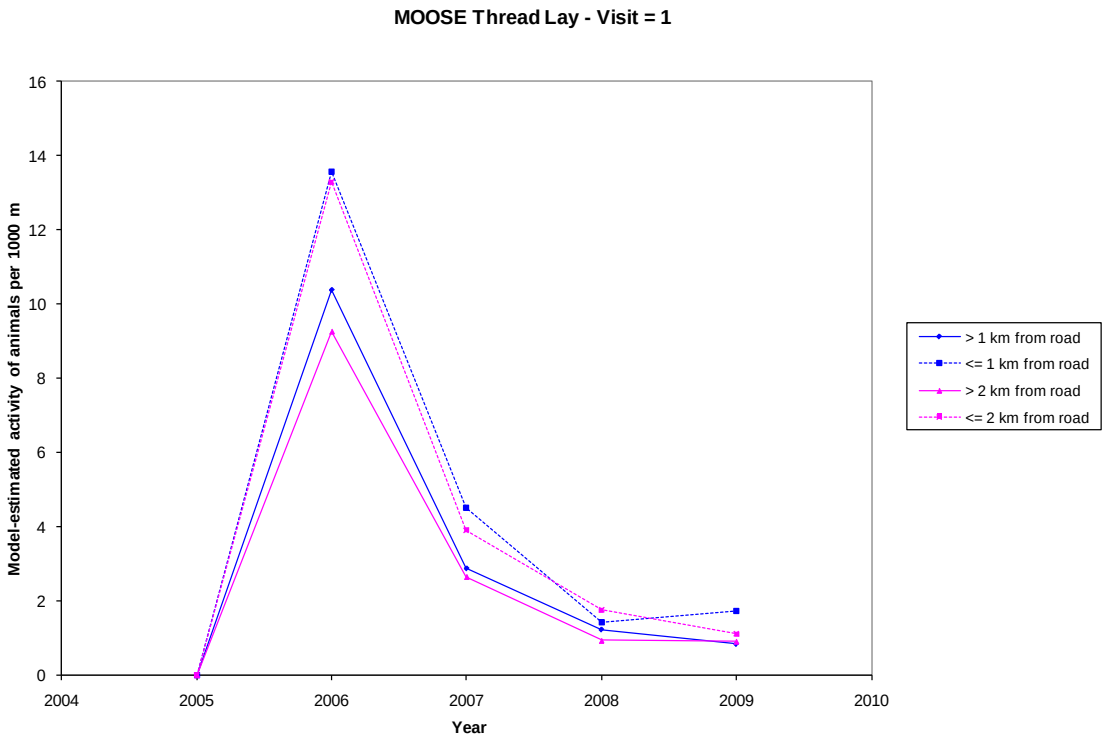


Figure 3.0-16. Moose activity during thread lay on control transects at varying distances to the control road from 2005 to 2009, with zero values. No moose sign was observed in 2004 and 2005.

Table 3.0-31. Analysis of moose activity during thread lay on control transects by distance from the control road before (2006) and during (2007-2009) construction, with zero values. No moose sign was observed in 2004 and 2005.

Year	Contrast	χ^2 value	p-value
2006	Activity of animals ≤ 2 km vs. > 2 km of road	1.56	0.2121
	Activity of animals≤ 1 km vs. > 1 km of road	0.66	0.4154
2007	Activity of animals≤ 2 km vs. > 2 km of road	1.44	0.2301
	Activity of animals≤ 1 km vs. > 1 km of road	1.60	0.2055
2008	Activity of animals≤ 2 km vs. > 2 km of road	1.62	0.2028
	Activity of animals≤ 1 km vs. > 1 km of road	0.09	0.7640

Year	Contrast	χ^2 value	p-value
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.18	0.6679
	Activity of animals≤ 1 km vs. > 1 km of road	2.18	0.1394
2007 to 2009 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9813
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9729

Estimated moose activity significantly declined by at least 84% within each distance from the control road category from the pre-construction through construction periods (Table 3.0-32). See Appendix H for comparisons of moose activity on the three transect types.

Table 3.0-32. Comparison of moose activity on control transects during thread lay before and during construction, with zero values. No moose sign was observed in 2004 and 2005.

Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2009	Within 2 km	54.92	**< 0.0001**	**85% decline**
	More than 2 km	46.94	**< 0.0001**	**86% decline**
	Within 1 km	25.57	**< 0.0001**	**84% decline**
	More than 1 km	75.66	**< 0.0001**	**86% decline**

*Bold indicates significance.

3.2.2 First Check

3.2.2.1 Access Road Transects

Eight habitat broad classifications (representing categories 011, 031, 042, 044, 046, 201, 211, 321 and comprising 35 observations) were excluded from the analysis of transects east and west of the access road. There were no statistically significant effects. The effects of habitat broad ($\chi^2 = 4.46$, with 7 degrees of freedom and p = 0.7253), gray wolf presence ($\chi^2 = 0.04$, with 1 degree of freedom and p = 0.8389), distance to the road ($\chi^2 = 2.08$, with 3 degrees of freedom and p = 0.5556), year ($\chi^2 = 5.52$, with 5 degrees of freedom and p = 0.3562), and the interaction between year and distance to road ($\chi^2 = 5.01$, with 15 degrees of freedom and p = 0.9920) were not significant.

No effects of distance to the road were evident in any of the years (Figure 3.0-17, Table 3.0-33).

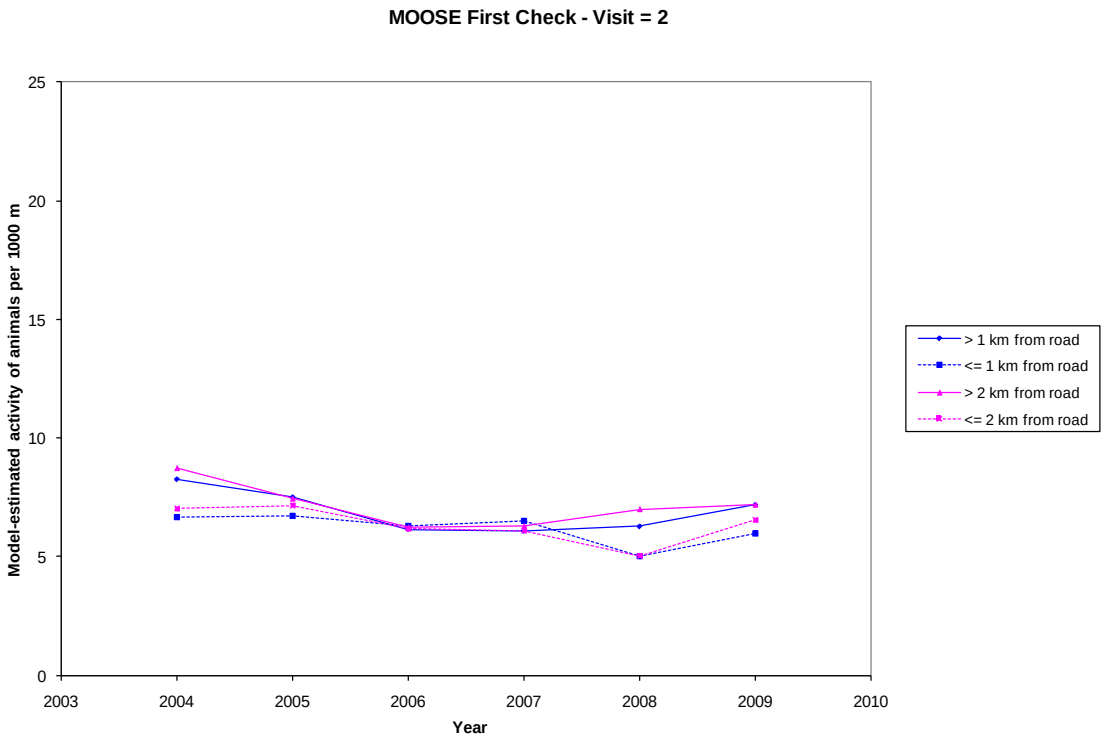


Figure 3.0-17. Moose activity during the first check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009.

Table 3.0-33. Analysis of moose activity during the first check on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction.

Year	Contrast	χ^2 value	p-value
2004	Activity of animals≤ 2 km vs. > 2 km of road	1.67	0.1967
	Activity of animals≤ 1 km vs. > 1 km of road	2.30	0.1292
2005	Activity of animals≤ 2 km vs. > 2 km of road	0.08	0.7760
	Activity of animals≤ 1 km vs. > 1 km of road	0.52	0.4693
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9611
	Activity of animals≤ 1 km vs. > 1 km of road	0.01	0.9157
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.01	0.9095
	Activity of animals≤ 1 km vs. > 1 km of road	0.05	0.8315
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.70	0.4012
	Activity of animals≤ 1 km vs. > 1 km of road	0.23	0.6318
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.24	0.6208
	Activity of animals≤ 1 km vs. > 1 km of road	0.77	0.3816
2007 to 2009 vs. others	Activity of animals≤ 2km vs. > 2km of road	0.10	0.7549
	Activity of animals≤ 1km vs. > 1 km of road	0.00	0.9557

Estimated moose activity did not change significantly from the pre-construction through construction periods (Table 3.0-34).

Table 3.0-34. Comparison of moose activity on transects along the Wuskwatim access road during the first check before and during construction.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	1.14	0.2847	14% decline
	More than 2 km	0.33	0.5684	8% decline
	Within 1 km	0.41	0.5239	12% decline
	More than 1 km	0.92	0.3364	11% decline

When zero values were included for 200 m segments where moose activity was not observed, the effects of distance to the road (χ^2 = 28.05, with 3 degrees of freedom and $p < 0.0001$), year (χ^2 = 80.12, with 5 degrees of freedom and $p < 0.0001$), and the interaction between distance to the road and year (χ^2 = 92.09, with 15 degrees of freedom and $p < 0.0001$) were statistically significant. The effect of gray wolf presence (χ^2 = 0.01, with 1 degree of freedom and $p = 0.9220$) was not significant.

In 2004, there was evidence of more activity observed within 1 km and 2 km of the road (Figure 3.0-18). In 2005, there was some evidence of more activity within 2 km of the road. In comparing 2007 through 2009 vs. earlier years, there were larger distance to the road effects in 2004 to 2006, characterized by more activity within 1 km and 2 km of the road (Table 3.0-35).

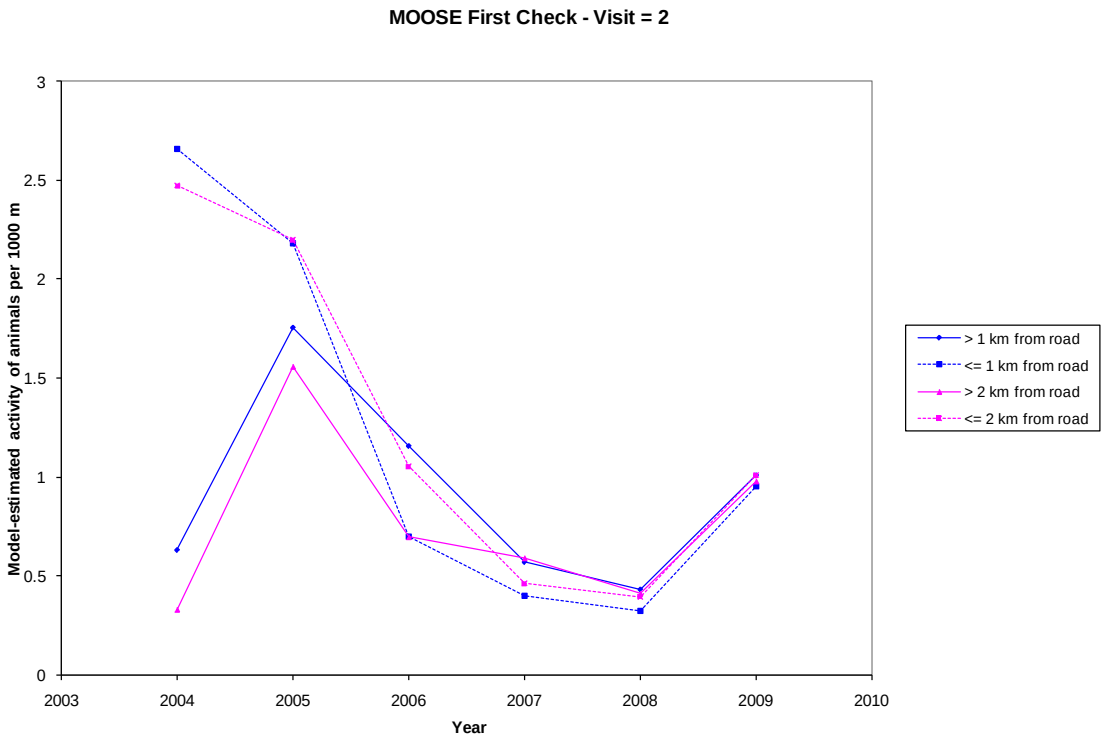


Figure 3.0-18. Moose activity during the first check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009, with zero values.

Table 3.0-35. Analysis of moose activity during the first check on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction, with zero values.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	85.17 (more activity within 2 km of road)	< **0.0001**
	Activity of animals≤ 1 km vs. > 1km of road	57.13 (more activity within 1 km of road)	< **0.0001**
2005	Activity of animals≤ 2 km vs. > 2 km of road	3.56 (more activity within 2 km of road)	0.0593
	Activity of animals≤ 1 km vs. > 1 km of road	1.21	0.2714
2006	Activity of animals≤ 2 km vs. > 2 km of road	2.38	0.1227
	Activity of animals≤ 1 km vs. > 1 km of road	0.79	0.3753
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.57	0.4493
	Activity of animals≤ 1 km vs. > 1 km of road	0.77	0.3791
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.01	0.9266
	Activity of animals≤ 1 km vs. > 1 km of road	0.28	0.5969
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.01	0.9061
	Activity of animals≤ 1 km vs. > 1 km of road	0.04	0.8362
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	17.39 (smaller distance effect in 2007 to 2009)	< **0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	6.11 (smaller distance effect in 2007 to 2009)	**0.0134**

*Bold indicates significance.

Estimated moose activity significantly decreased within 1 km and 2 km of the road from the pre-construction through construction periods (Table 3.0-36). There was also a significant decline in activity more than 1 km from the road.

Table 3.0-36. Comparison of moose activity on transects along the Wuskwatim access road during the first check before and during construction of the road, with zero values.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	48.91	**< 0.0001**	**68% decline**
	More than 2 km	0.60	0.4398	13% decline
	Within 1 km	22.48	**< 0.0001**	**69% decline**
	More than 1 km	11.33	**0.0008**	**38% decline**

*Bold indicates significance.

3.2.2.2 Generating Station Transects

No moose activity was observed on GS transects in 2004 and only three signs were observed in 2007. There was only one sign moose observed farther than 2 km from the GS in 2005 and therefore distance to GS classes 2001 – 3000 m and > 3000 m were combined into a single class of > 2000 m. The effects of distance to the GS (χ^2 = 36.32, with 2 degrees of freedom and $p < 0.0001$) and the interaction between distance to the GS and year (χ^2 = 16.48, with 6 degrees of freedom and $p = 0.0114$) were statistically significant. The effect of year (χ^2 = 4.02, with 3 degrees of freedom and $p = 0.2591$) was not significant.

In all years, there was evidence of more activity observed within 1 km and/or 2 km of the GS (Figure 3.0-19). Distance to GS effects were stronger in 2005 and 2006 than in the latter years – there was a bigger difference in the number of moose observed within 2 km versus more than 2 km from the GS in 2005 through 2006 than was observed in 2008-2009 (Table 3.0-37).

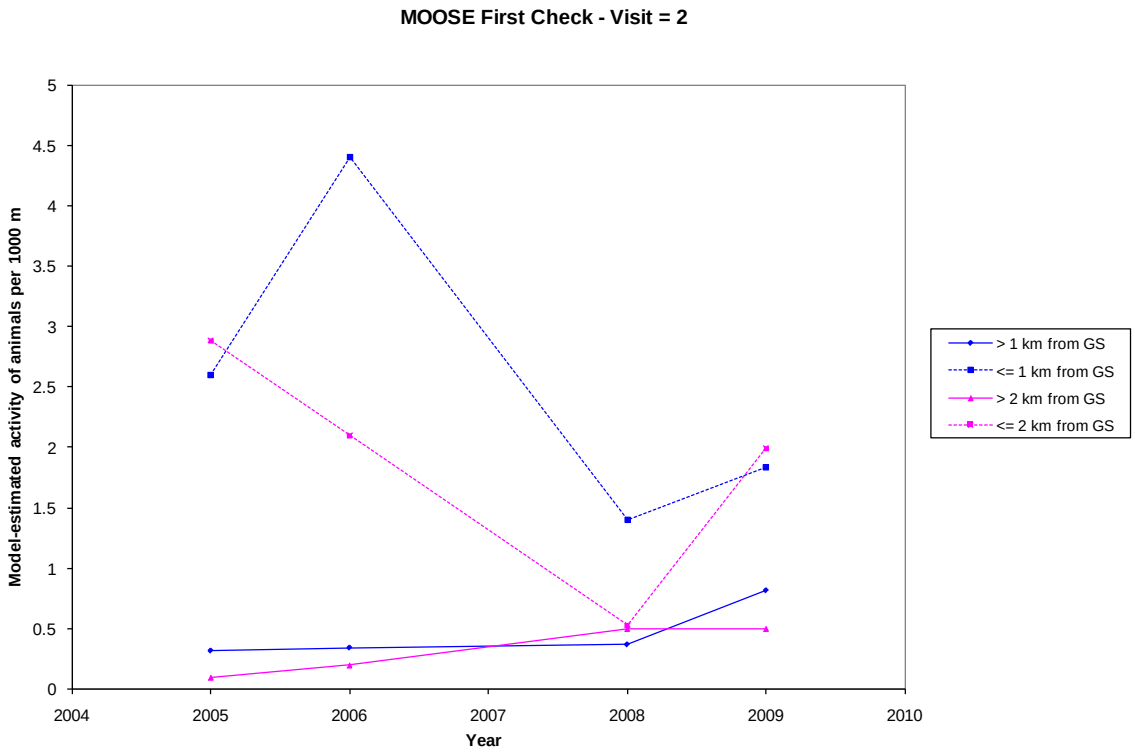


Figure 3.0-19. Moose activity during the first check on GS transects at varying distances to the generating station from 2005 to 2009, with zero values. Little or no moose sign was observed in 2004 and 2007.

Table 3.0-37. Analysis of moose activity during the first check on GS transects by distance from the generating station before (2005-2006) and during (2008-2009) construction, with zero values. Little or no moose sign was observed in 2004 and 2007.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of GS	10.13 (more activity within 2 km of GS)	**0.0015**
	Activity of animals≤ 1 km vs. > 1 km of GS	6.96 (more activity within 1 km of GS)	**0.0083**
2006	Activity of animals≤ 2 km vs. > 2 km of GS	8.61 (more activity within 2 km of GS)	**0.0033**
	Activity of animals≤ 1 km vs. > 1 km of GS	16.44 (more activity within 1 km of GSd)	**< 0.0001**
2008	Activity of animals≤ 2 km vs. > 2 km of GS	0.01	0.9400
	Activity of animals≤ 1 km vs. > 1 km of GS	3.96 (more activity within 1 km of GS)	**0.0466**
2009	Activity of animals≤ 2 km vs. > 2 km of GS	6.94 (more activity within 2 km of GS)	**0.0084**
	Activity of animals≤ 1 km vs. > 1 km of GS	2.50	0.1139
2008 to 2009 vs. 2005 to 2006	Activity of animals≤ 2 km vs. > 2 km of GS	7.03 (a larger distance to GS effect in 2005-2006 than in 2008-2009)	**0.0080**
	Activity of animals≤ 1 km vs. > 1 km of GS	3.62 (some evidence of a larger distance to GS effect in 2005-2006 than in 2008-2009)	0.0573

*Bold indicates significance.

Estimated moose activity significantly decreased within 2 km of the GS from the pre-construction through construction periods (Table 3.0-38). There was also a marginally significant increase in activity more than 2 km from the GS and a marginally significant decrease within 1 km of the GS.

Table 3.0-38. Comparison of moose activity during the first check on GS transects before and during construction, with zero values. Little or no moose sign was observed in 2004 and 2007.

Contrast	Distance from GS	χ^2 value	p-value*	Estimated Effect
Average activity 2005 to 2006 vs. average activity 2008 to 2009	Within 2 km	5.28	**0.0216**	**58% decline**
	More than 2 km	3.16	0.0756	257% increase
	Within 1 km	3.36	0.0667	53% decline
	More than 1 km	0.96	0.3279	60% decline

*Bold indicates significance.

3.2.2.3 Control Area Transects

No moose activity was observed on control transects in 2004. The effect of year (χ^2 = 97.87, with 4 degrees of freedom and $p < 0.0001$) was statistically significant. The effects of distance to the road (χ^2 = 5.05, with 3 degrees of freedom and $p = 0.1684$) and the interaction between distance to the road and year (χ^2 = 12.67, with 12 degrees of freedom and $p = 0.3935$) were not significant.

There were no significant distance to control road effects in any year (Figure 3.0-20, Table 3.0-39).

Figure 3.0-20. Moose activity during the first check on control transects at varying distances to the control road from 2005 to 2009, with zero values. No moose sign was observed in 2004.

Table 3.0-39. Analysis of moose activity during the first check on control transects by distance from the control road before (2005-2006) and during (2007-2009) construction, with zero values. No moose sign was observed in 2004.

Year	Contrast	χ^2 value	p-value
2005	Activity of animals≤ 2 km vs. > 2 km of road	0.16	0.6893
	Activity of animals≤ 1 km vs. > 1 km of road	0.06	0.8066
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.14	0.7117
	Activity of animals≤ 1 km vs. > 1 km of road	0.16	0.6934
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.41	0.5198
	Activity of animals≤ 1 km vs. > 1 km of road	0.08	0.7805

Year	Contrast	χ^2 value	p-value
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9822
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9719
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.55	0.4599
	Activity of animals ≤ 1 km vs. > 1 km of road	0.05	0.8188
2007 to 2009 vs. 2005 to 2006	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9813
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9729

Estimated moose activity significantly decreased more than 2 km from the control road from the pre-construction through construction periods (Table 3.0-40). See Appendix I for comparisons of moose activity on the three transect types.

Table 3.0-40. Comparison of moose activity during the first check on control transects before and during construction, with zero values. No moose sign was observed in 2004.

Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2005 to 2006 vs. average activity 2007 to 2009	Within 2 km	0.00	0.9715	95% decline
	More than 2 km	5.23	**0.0222**	**65% decline**
	Within 1 km	1.27	0.2601	45% decline
	More than 1 km	0.00	0.9646	92% decline

*Bold indicates significance.

3.2.3 Second Check

3.2.3.1 Access Road Transects

Nine habitat broad classifications (representing categories 011, 022, 031, 044, 046, 101, 211, 321, 501 and comprising 20 observations) were excluded from the analysis. No moose activity was observed in 2006. Only the effect of distance to the road (χ^2 = 9.82, with 3 degrees of freedom and p = 0.0202) was statistically significant. The effects of habitat broad (χ^2 = 4.61, with 6 degrees of freedom and p = 0.5952), gray wolf presence

(χ^2 = 0.18, with 1 degree of freedom and p = 0.6695), year (χ^2 = 5.75, with 4 degrees of freedom and p = 0.2185), and the interaction between distance to the road and year (χ^2 = 10.68, with 12 degrees of freedom and p = 0.5566) were not significant.

In 2004, there was evidence of more activity within 1 km of the road, and some evidence of more activity within 2 km of the road (Figrue 3.0-21). In 2007 there was evidence of more activity within 1 km of the road, and in 2009, there was some evidence of more activity observed within 1 km of the road. In comparing 2007 to 2009 vs. the other years, there was a stronger distance to road effect, characterized by more activity within 1 km of the road (Table 3.0-41).

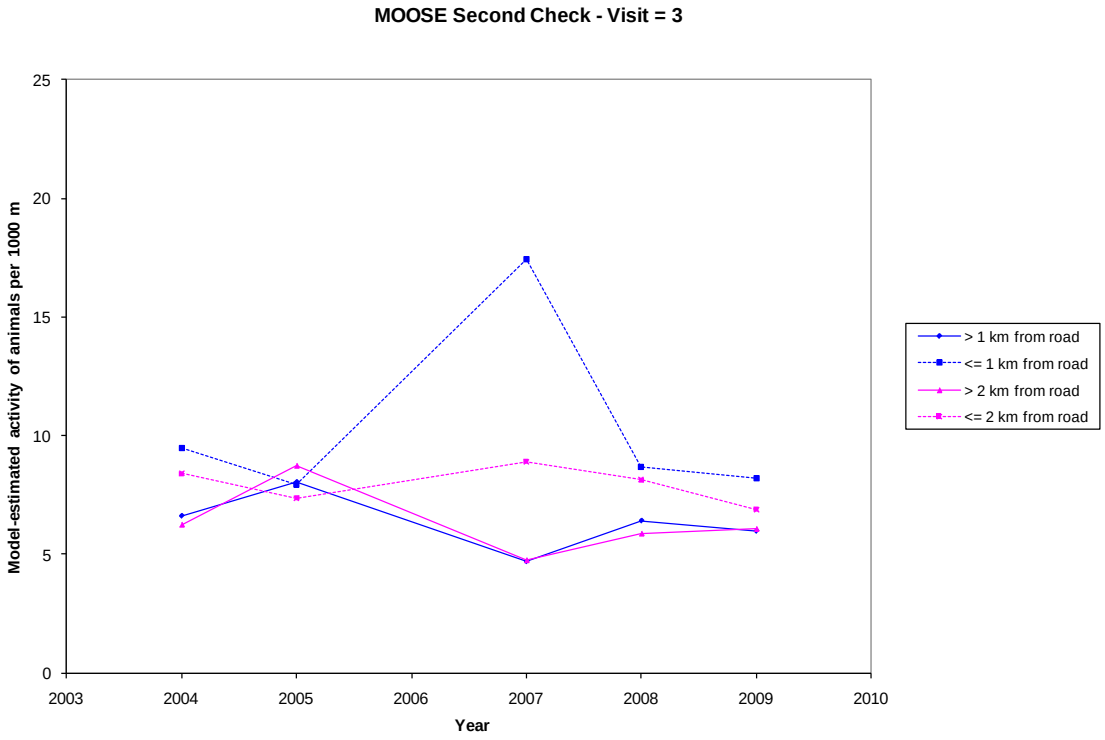


Figure 3.0-21. Moose activity during the second check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009. There was no second check in 2006.

Table 3.0-41. Analysis of moose activity during the second check on transects along the Wuskwatim access road by distance from the road before (2004-2005) and during (2007-2009) construction. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	2.78 (marginally more activity within 2 km of road)	0.0952
	Activity of animals≤ 1 km vs. > 1 km of road	5.98 (more activity within 1 km of road)	**0.0144**
2005	Activity of animals≤ 2 km vs. > 2 km of road	2.04	0.1535
	Activity of animals≤ 1 km vs. > 1 km of road	0.05	0.8299
2007	Activity of animals≤ 2 km vs. > 2 km of road	1.14	0.2846
	Activity of animals≤ 1 km vs. > 1 km of road	5.44 (more activity within 1 km of road)	**0.0197**
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.60	0.4388
	Activity of animals≤ 1 km vs. > 1 km of road	1.11	0.2930
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.66	0.4173
	Activity of animals≤ 1 km vs. > 1 km of road	3.61 (more activity within 1 km of road)	0.0575
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	1.14	0.2850
	Activity of animals≤ 1 km vs. > 1 km of road	3.73 (stronger distance to road effects in 2007-2009 vs. earlier years)	0.0536

*Bold indicates significance.

Estimated moose activity did not change significantly from the pre-construction through construction periods (Table 3.0-42).

Table 3.0-42. Comparison of moose activity during the second check on transects along the Wuskwatim access road before and during construction. There was no second check in 2006.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 to 2005 vs. average activity 2007 to 2009	Within 2 km	0.35	0.5563	10% decline
	More than 2 km	1.07	0.3001	25% decline
	Within 1 km	1.02	0.3128	23% decline
	More than 1 km	1.67	0.1956	23% decline

When zero values were included for 200 m segments where moose activity was not observed, the effects of distance to the road (χ^2 = 74.58, with 3 degrees of freedom and $p < 0.0001$), year (χ^2 = 52.30, with 4 degrees of freedom and $p < 0.0001$), and the interaction between distance to the road and year (χ^2 = 58.12, with 12 degrees of freedom and $p < 0.0001$) were statistically significant. The effect of gray wolf presence (χ^2 = 0.08, with 1 degree of freedom and $p = 0.7773$) was not significant.

In all years, there was evidence of more activity observed within 1 km and/or 2 km of the road (Figure 3.0-22). In comparing 2007 to 2009 vs. the other years, there was little evidence for either an increase or decrease in activity within 1 km and 2 km of the road (Table 3.0-43).

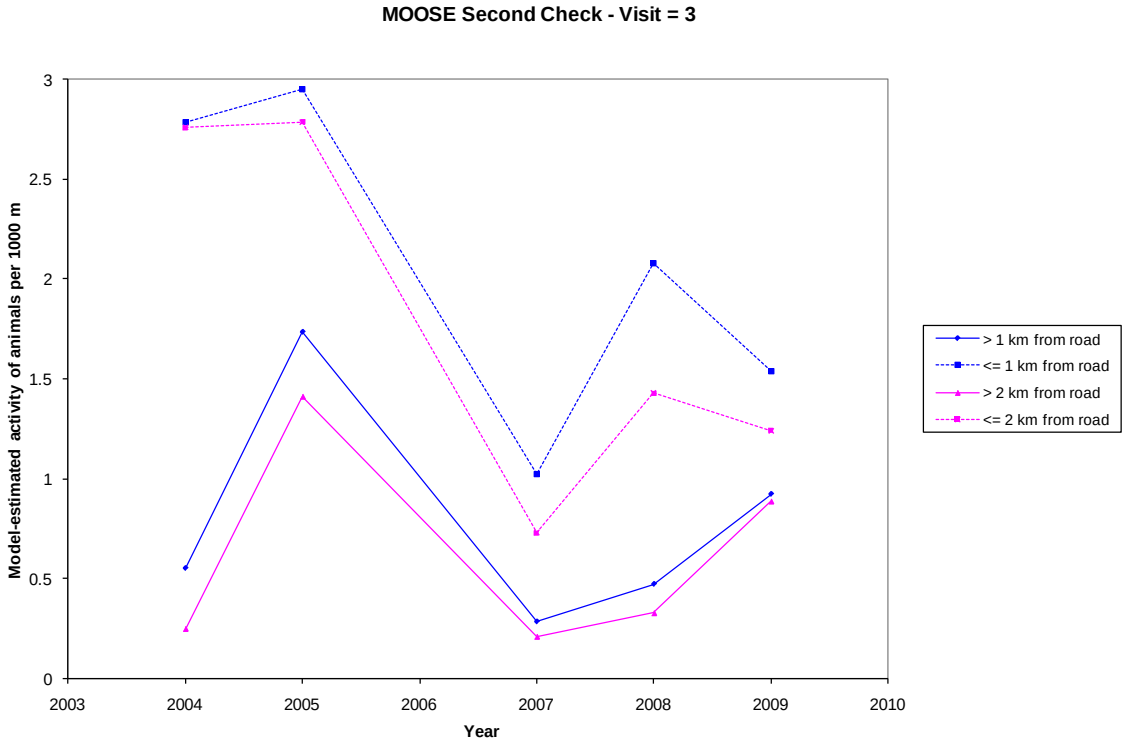


Figure 3.0-22. Moose activity during the second check on transects along the Wuskwatim access road at varying distances to the access road from 2004 to 2009, with zero values. There was no second check in 2006.

Table 3.0-43. Analysis of moose activity during the second check on transects along the Wuskwatim access road by distance from the road before (2004-2005) and during (2007-2009) construction, with zero values. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	85.93 (more activity within 2 km of road)	**< 0.0001**
	Activity of animals≤ 1 km vs. > 1 km of road	54.34 (more activity within 1 km of road)	**< 0.0001**
2005	Activity of animals≤ 2 km vs. > 2 km of road	10.41 (more activity within 2 km of road)	**0.0013**
	Activity of animals≤ 1 km vs. > 1 km of road	5.37 (more activity within 1 km of road)	**0.0205**
2007	Activity of animals≤ 2 km vs. > 2 km of road	3.42 (marginally more activity within 2 km of road)	0.0645
	Activity of animals≤ 1 km vs. > 1 km of road	4.63 (more activity within 1 km of road)	**0.0314**
2008	Activity of animals≤ 2 km vs. > 2 km of road	6.47 (more activity within 2 km of road)	**0.0110**
	Activity of animals≤ 1 km vs. > 1 km of road	10.01 (more activity within 1 km of road)	**0.0016**
2009	Activity of animals≤ 2 km vs. > 2 km of road	1.99	0.1579
	Activity of animals≤ 1 km vs. > 1 km of road	3.96 (more activity within 1 km of road)	**0.0467**
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	2.22	0.1359
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9499

*Bold indicates significance.

Estimated moose activity significantly decreased close to the road from the pre-construction through construction periods (Table 3.0-44). There was also a significant decline in activity more than 1 km from the road.

Table 3.0-44. Comparison of moose activity during the second check on transects along the Wuskwatim access road before and during construction, with zero values. No moose sign was observed in 2006.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2004 to 2005 vs. average activity 2007 to 2009	Within 2 km	9.81	**0.0017**	**43% decline**
	More than 2 km	1.78	0.1818	34% decline
	Within 1 km	9.18	**0.0025**	**48% decline**
	More than 1 km	9.30	**0.0023**	**49% decline**

*Bold indicates significance.

3.2.3.2 Generating Station Transects

No moose activity was observed on the GS transects in 2004 or 2006 and only three signs were found in 2007. There was only one moose observed farther than 2 km from the GS in both 2008 and 2009 and therefore distance to GS classes 2001 – 3000 m and > 3000 m were combined into a single class of > 2000 m. The effects of distance to the GS (χ^2 = 46.73, with 2 degrees of freedom and $p < 0.0001$), year (χ^2 = 18.34, with 2 degrees of freedom and $p = 0.0001$), and the interaction between distance to the GS and year (χ^2 = 19.31, with 4 degrees of freedom and $p = 0.0007$) were all statistically significant.

In 2005, there was evidence of more activity observed within 2 km of the GS (Figure 3.0-23). In 2008 and 2009, there was evidence of more activity observed within 1 km and 2 km of the GS. Distance to GS effects were smaller in 2005 than in the latter years (Table 3.0-45).

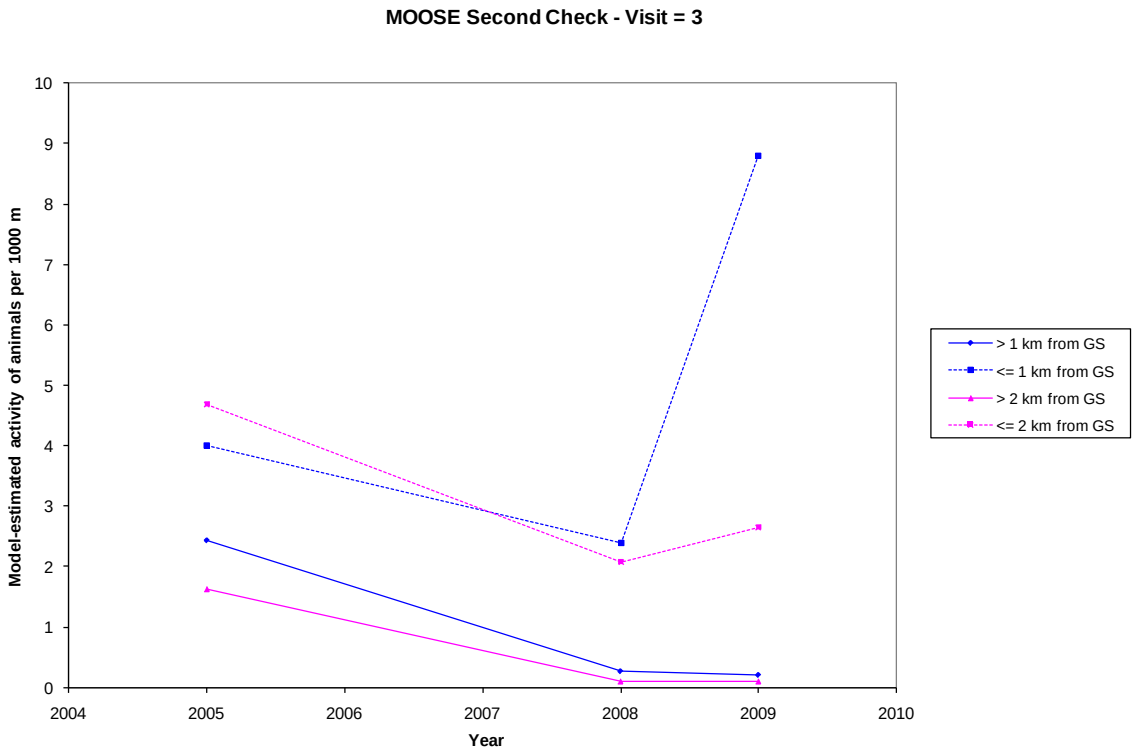


Figure 3.0-23. Moose activity during the second check on GS transects at varying distances to the generating station from 2005 to 2009, with zero values. No moose sign was observed in 2004. There was no second check in 2006.

Table 3.0-45. Analysis of moose activity during the second check on GS transects by distance from the generating station before (2005) and during (2008, 2009) construction, with zero values. Little or no moose sign was observed in 2004 and 2007. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value*
2005	Activity of animals≤ 2 km vs. > 2 km of GS	5.77 (more activity within 2 km of GS)	**0.0163**
	Activity of animals≤ 1 km vs. > 1 km of GS	1.10	0.2948
2008	Activity of animals≤ 2 km vs. > 2 km of GS	8.21 (more activity within 2 km of GS)	**0.0045**
	Activity of animals≤ 1 km vs. > 1 km of GS	7.70 (more activity within 1 km of GS)	**0.0055**
2009	Activity of animals≤ 2 km vs. > 2 km of GS	9.42 (more activity within 2 km of GS)	**0.0021**

Year	Contrast	χ^2 value	p-value*
	Activity of animals≤ 1 km vs. > 1 km of GS	24.20 (more activity within 1 km of GS)	**< 0.0001**
2008 to 2009 vs. 2005	Activity of animals≤ 2 km vs. > 2 km of GS	5.78 (a larger distance to GS effect in 2008-2009 than in 2005)	**0.0162**
	Activity of animals≤ 1 km vs. > 1 km of GS	11.84 (a larger distance to GS effect in 2008-2009 than in 2005)	**0.0006**

*Bold indicates significance.

Estimated moose activity significantly decreased more than 1 km and 2 km from the GS from the pre-construction through construction periods (Table 3.0-46). There was also a significant decline in activity within 2 km of the GS.

Table 3.0-46. Comparison of moose activity during the second check on GS transects before and during construction, with zero values. Little or no moose sign was observed in 2004 and 2007. There was no second check in 2006.

Contrast	Distance from GS	χ^2 value	p-value	Estimated Effect
Average activity 2005 vs. average activity 2008 to 2009	Within 2 km	4.00	**0.0455**	**50% decline**
	More than 2 km	12.14	**0.0005**	**94% decline**
	Within 1 km	0.09	0.7652	15% increase
	More than 1 km	17.84	**< 0.0001**	**91% decline**

*Bold indicates significance.

3.2.3.3 Control Area Transects

No moose activity was observed on control transects in 2004, 2006 or 2008. The effect of year ($\chi^2 = 25.51$, with 2 degrees of freedom and $p < 0.0001$) was statistically significant. The effects of distance to the road ($\chi^2 = 2.72$, with 3 degrees of freedom and $p = 0.4364$) and the interaction between distance to the road and year ($\chi^2 = 2.95$, with 6 degrees of freedom and $p = 0.8151$) were not significant.

There were no significant distance to control road effects in any year (Figure 3.0-24, Table 3.0-47).

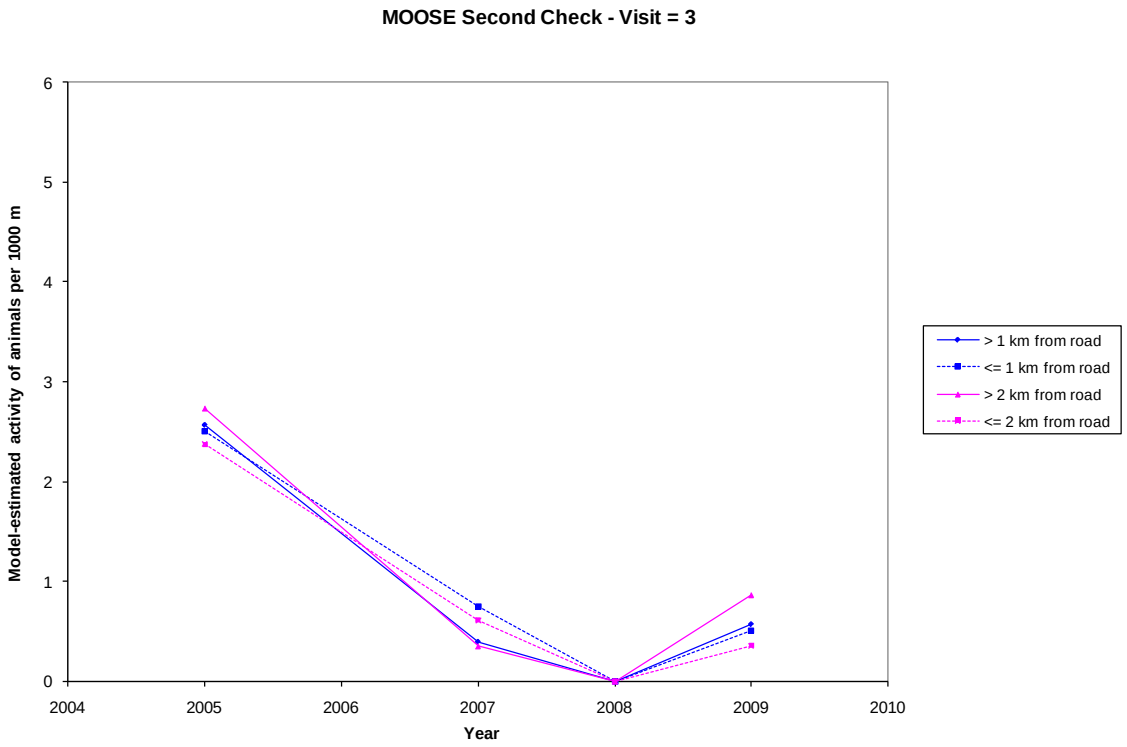


Figure 3.0-24. Moose activity during the second check on control transects at varying distances to the control road from 2005 to 2009. No moose sign was observed in 2004. There was no second check in 2006.

Table 3.0-47. Analysis of moose activity during the second check on control transects by distance from the control road before (2005) and during (2007, 2009) construction, with zero values. Little or no moose sign was observed in 2004 and 2008. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value
2005	Activity of animals≤ 2 km vs. > 2 km of road	0.14	0.7040
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9524
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.49	0.4853
	Activity of animals≤ 1 km vs. > 1 km of road	0.67	0.4128
2009	Activity of animals≤ 2 km vs. > 2 km of road	1.44	0.2301

Year	Contrast	χ^2 value	p-value
	Activity of animals ≤ 1 km vs. > 1 km of road	0.03	0.8738
2007 to 2009 vs. 2005	Activity of animals ≤ 2 km vs. > 2 km of road	0.00	0.9645
	Activity of animals ≤ 1 km vs. > 1 km of road	0.15	0.7008

Estimated moose activity significantly declined by at least 75% within each distance from the control road category from the pre-construction through construction periods (Table 3.0-48). See Appendix J for comparisons of moose activity on the three transect types.

Table 3.0-48. Comparison of moose activity during the second check on control transects before and during construction, with zero values. Little or no moose sign was observed in 2004 and 2008. There was no second check in 2006.

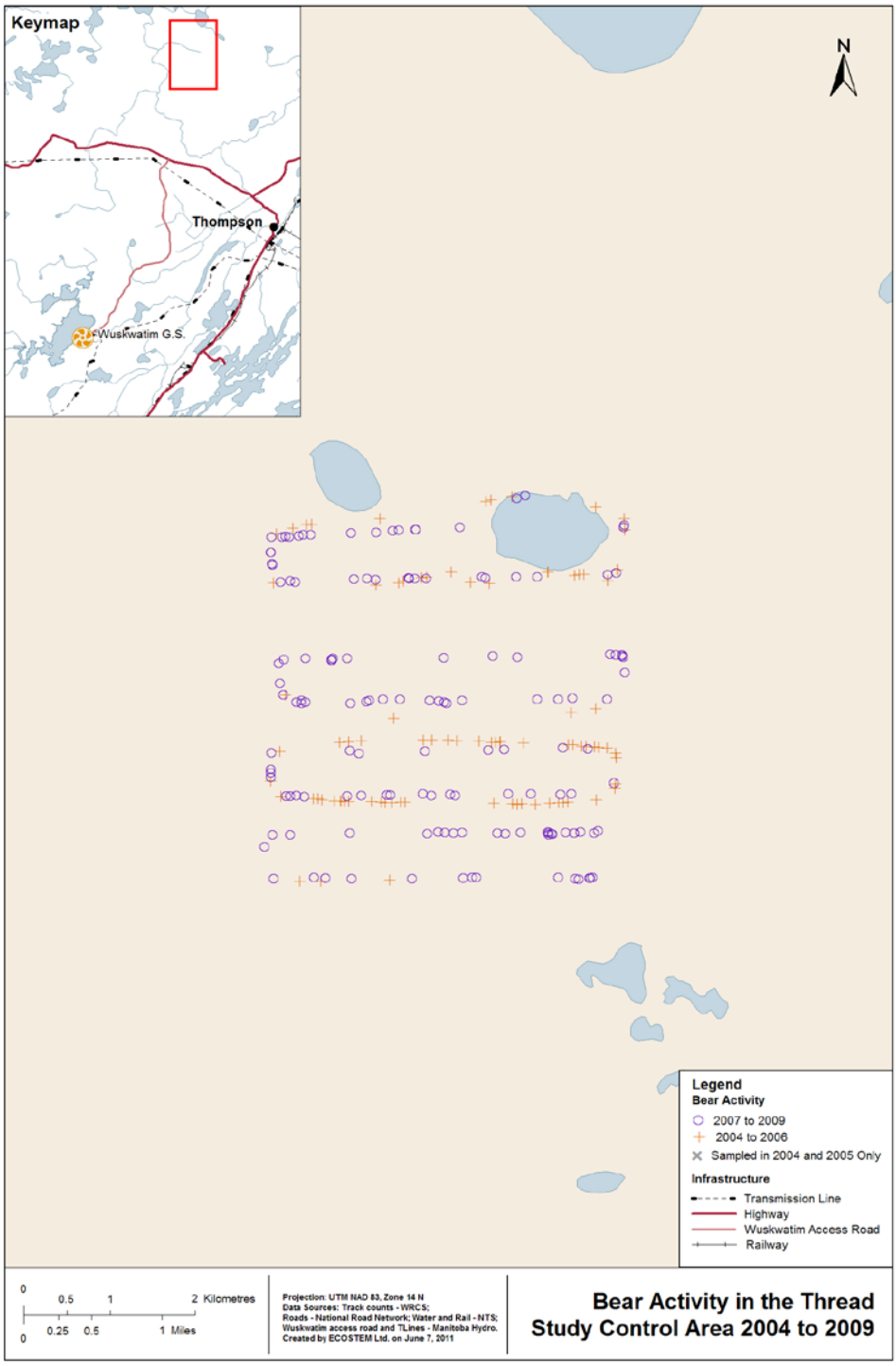
Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2005 vs. average activity 2007 to 2009	Within 2 km	11.74	**0.0006**	**80% decline**
	More than 2 km	12.08	**0.0005**	**80% decline**
	Within 1 km	5.45	**0.0195**	**75% decline**
	More than 1 km	18.37	< **0.0001**	**81% decline**

*Bold indicates significance.

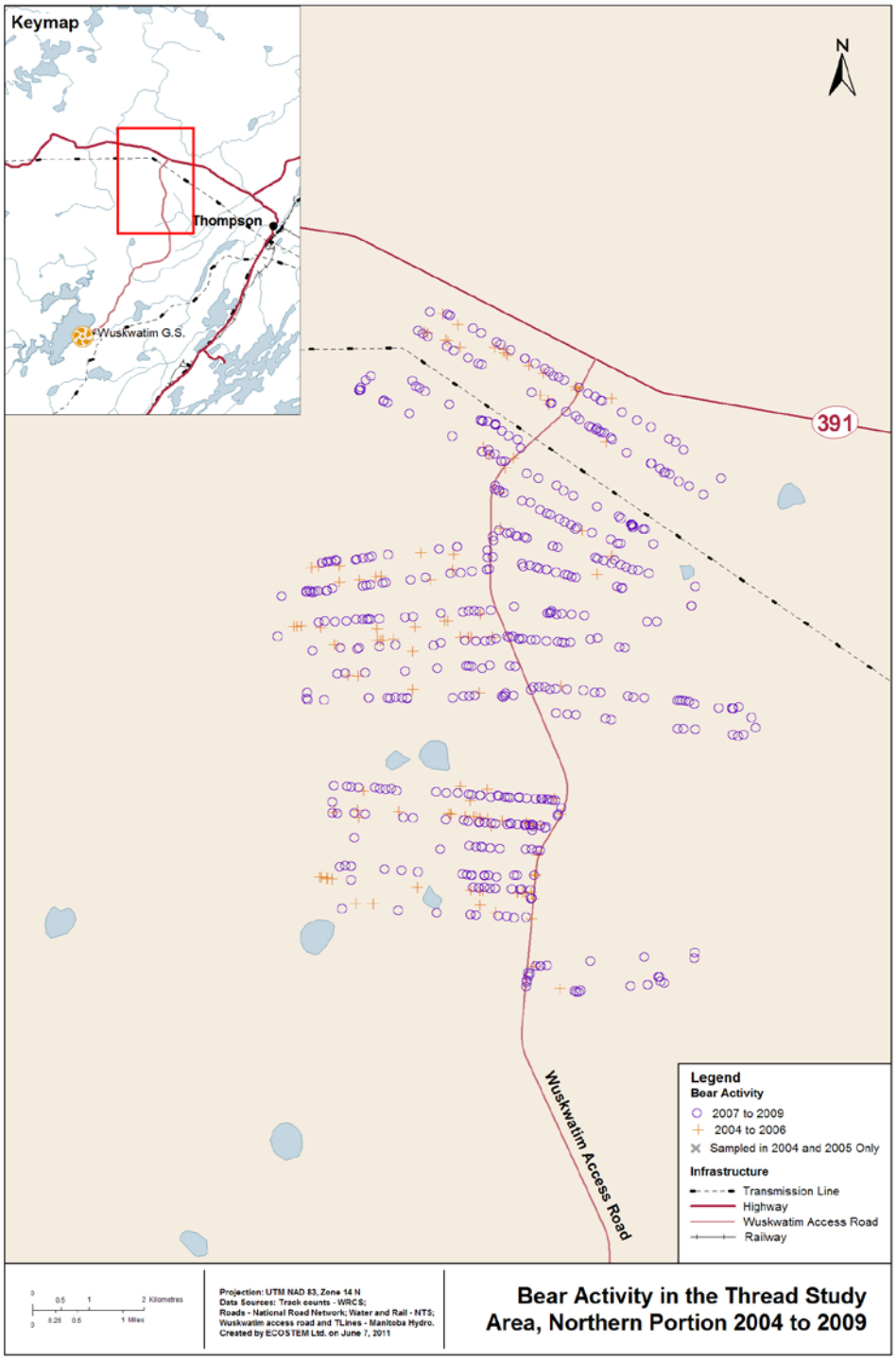
3.3 BLACK BEAR

Across all three visits, there were 25 of 547 (4.6%) 200 m segments for which habitat broad classifications were heterogeneous within a distance category. These were excluded from the conditional analyses. Black bear activity during all visits pre-construction and during construction is depicted in Map 3.0-3a to 3.0-3d.

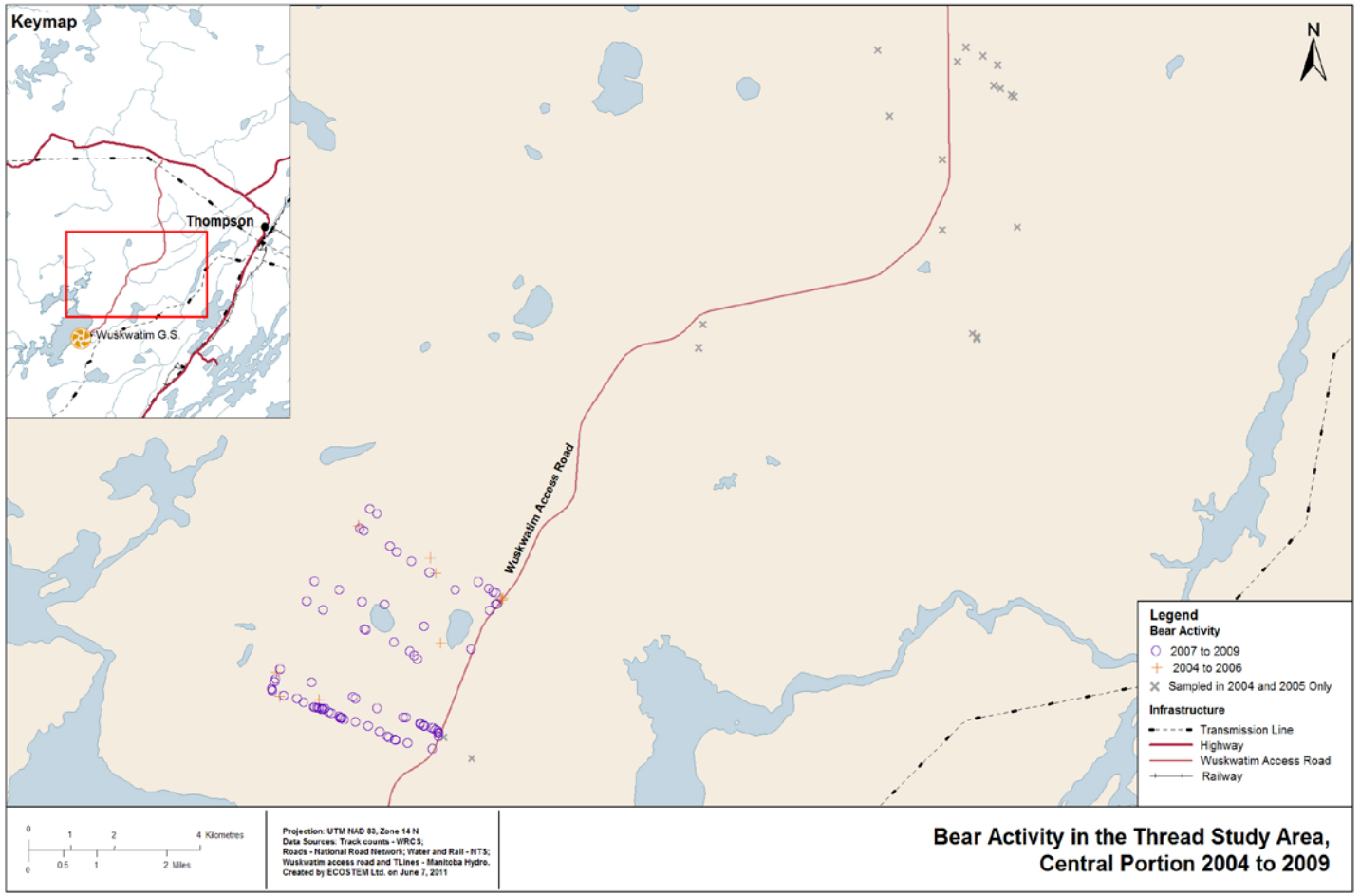
Measures were not reported near the GS site and control area during all visits because of the paucity of data.



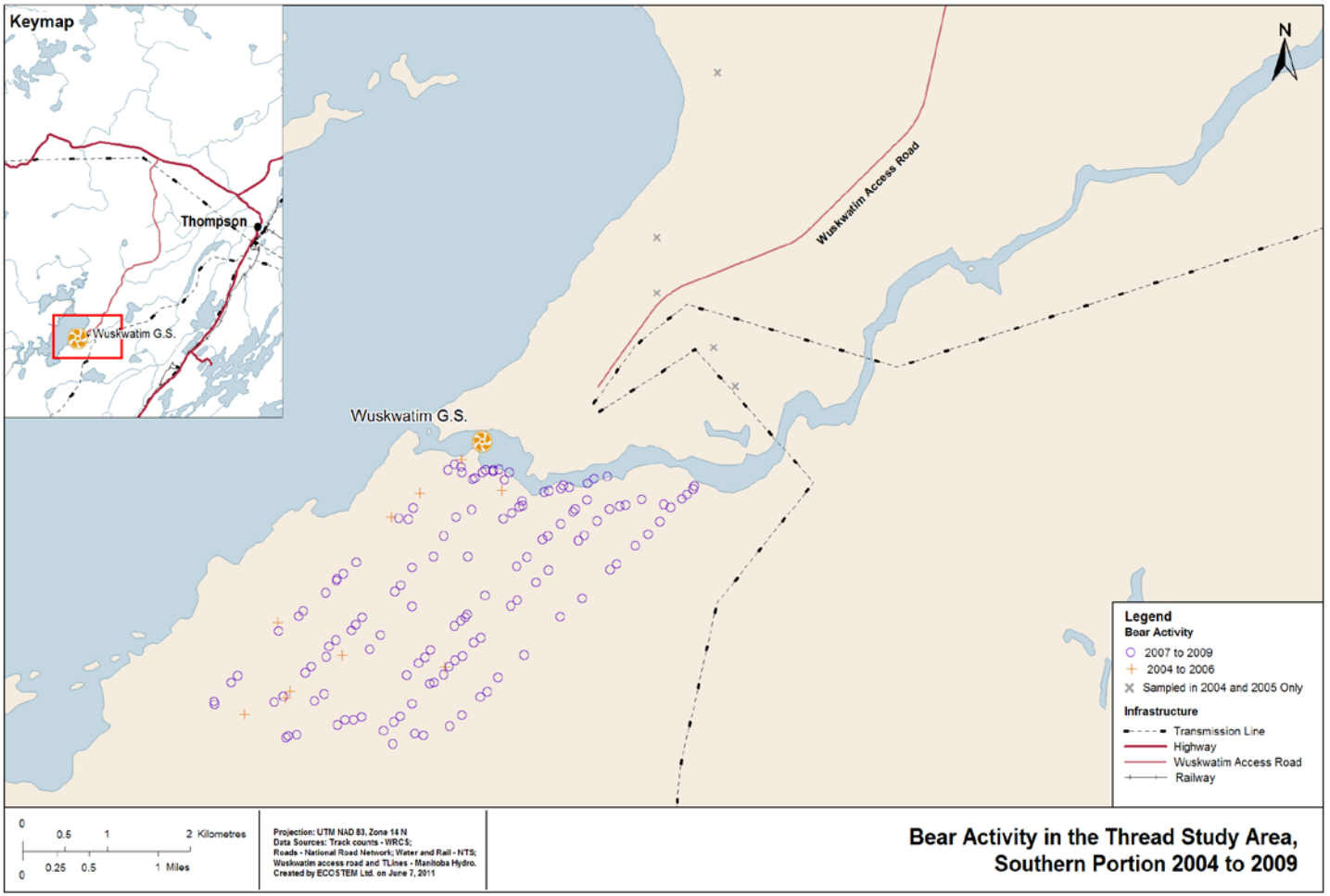
Map 3.0-3a. Black bear activity on control transects before (2004 to 2006) and during (2007 to 2009) construction.



Map 3.0-3b. Black bear activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, northern portion.



Map 3.0-3c. Black bear activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, central portion.



Map 3.0-3d. Black bear activity on GS transects before (2004 to 2006) and during (2007 to 2009) construction.

3.3.1 Thread Lay

3.3.1.1 Access Road Transects

Seven habitat broad classifications (representing categories 022, 031, 101, 211, 321, 341 and comprising 30 observations) were excluded from the analysis of transects east and west of the access road. No black bears activity was observed in 2004 or 2005. The effect of year (χ^2 = 45.22, with 3 degrees of freedom and $p < 0.0001$) was statistically significant. The effects of habitat broad (χ^2 = 5.77, with 4 degrees of freedom and p = 0.2171), gray wolf presence ($\chi^2 = 0.07$, with 1 degree of freedom and $p = 0.7987$), distance to the road (χ^2 = 0.02, with 3 degrees of freedom and p = 0.9991), and the interaction between distance to the road and year (χ^2 = 2.83, with 9 degrees of freedom and p = 0.9707) were not significant.

No effects of distance to the road were evident in any of the years (Figure 3.0-25, Table 3.0-49).

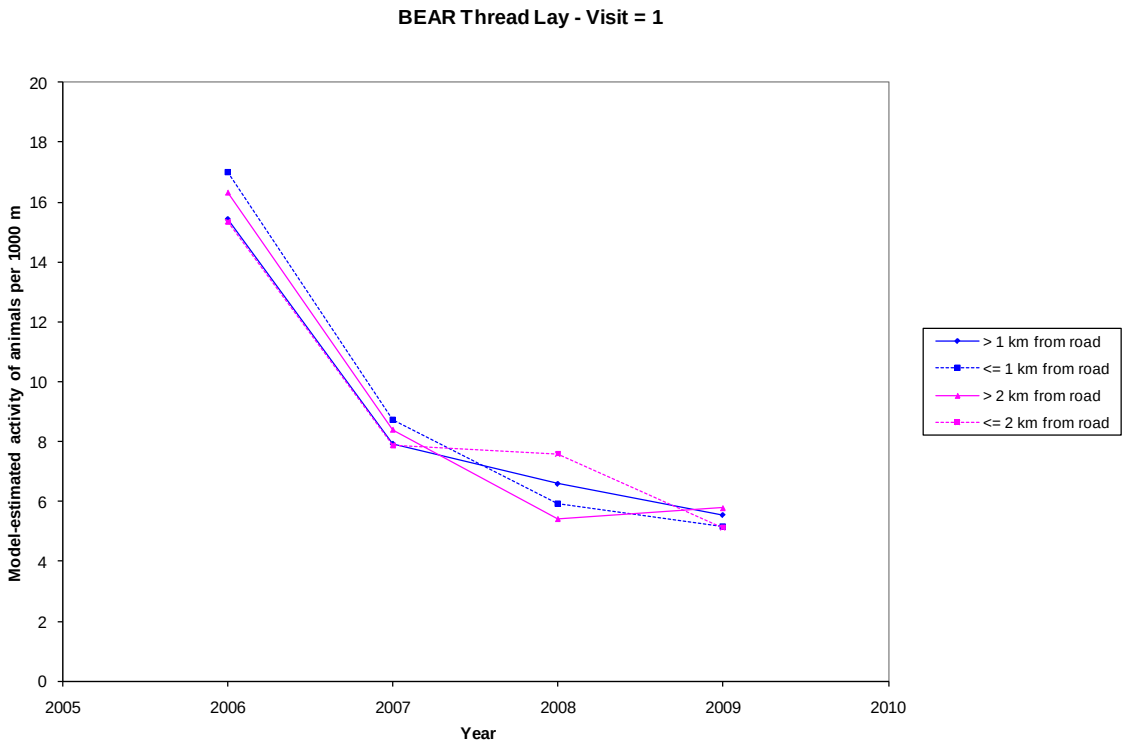


Figure 3.0-25. Black bear activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2006 to 2009. No black bear sign was observed in 2004 and 2005.

Table 3.0-49. Analysis of black bear activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2006) and during (2007-2009) construction. No black bear sign was observed in 2004 and 2005.

Year	Contrast	χ^2 value	p-value
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.14	0.7072
	Activity of animals≤ 1 km vs. > 1 km of road	0.33	0.5637
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.22	0.6417
	Activity of animals≤ 1 km vs. > 1 km of road	0.46	0.4992
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.32	0.5730

Year	Contrast	χ^2 value	p-value
	Activity of animals≤ 1 km vs. > 1 km of road	0.05	0.8176
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.06	0.8043
	Activity of animals≤ 1 km vs. > 1 km of road	0.03	0.8641
2007 to 2009 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	0.14	0.7117
	Activity of animals≤ 1 km vs. > 1 km of road	0.21	0.6464

Estimated black bear activity significantly declined by at least 57% within each distance from the road category from the pre-construction through construction periods (Table 3.0-50).

Table 3.0-50. Comparison of black bear activity during thread lay on transects along the Wuskwatim access road before and during construction. No black bear sign was observed in 2004 and 2005.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2009	Within 2 km	25.43	**< 0.0001**	**56% decline**
	More than 2 km	12.96	**0.0003**	**61% decline**
	Within 1 km	25.62	**< 0.0001**	**62% decline**
	More than 1 km	19.00	**< 0.0001**	**57% decline**

*Bold indicates significance.

When zero values were included for 200 m segments where black bear activity was not observed, the effects of distance to the road (χ^2 = 35.59, with 3 degrees of freedom and $p < 0.0001$), and year (χ^2 = 122.54, with 3 degrees of freedom and $p < 0.0001$) were statistically significant. The effects of gray wolf presence (χ^2 = 3.77, with 1 degree of freedom and $p = 0.0522$), and the interaction between distance to the road and year (χ^2 = 12.93, with 9 degrees of freedom and $p = 0.1656$) were not significant.

In all years, there was evidence of more activity observed within 1 km and/or 2 km of the road (Figure 3.0-26). In comparing 2007 through 2009 vs. 2006, there was a larger distance to road effect in 2007 through 2009, characterized by more activity within 2 km of the road (Table 3.0-51).

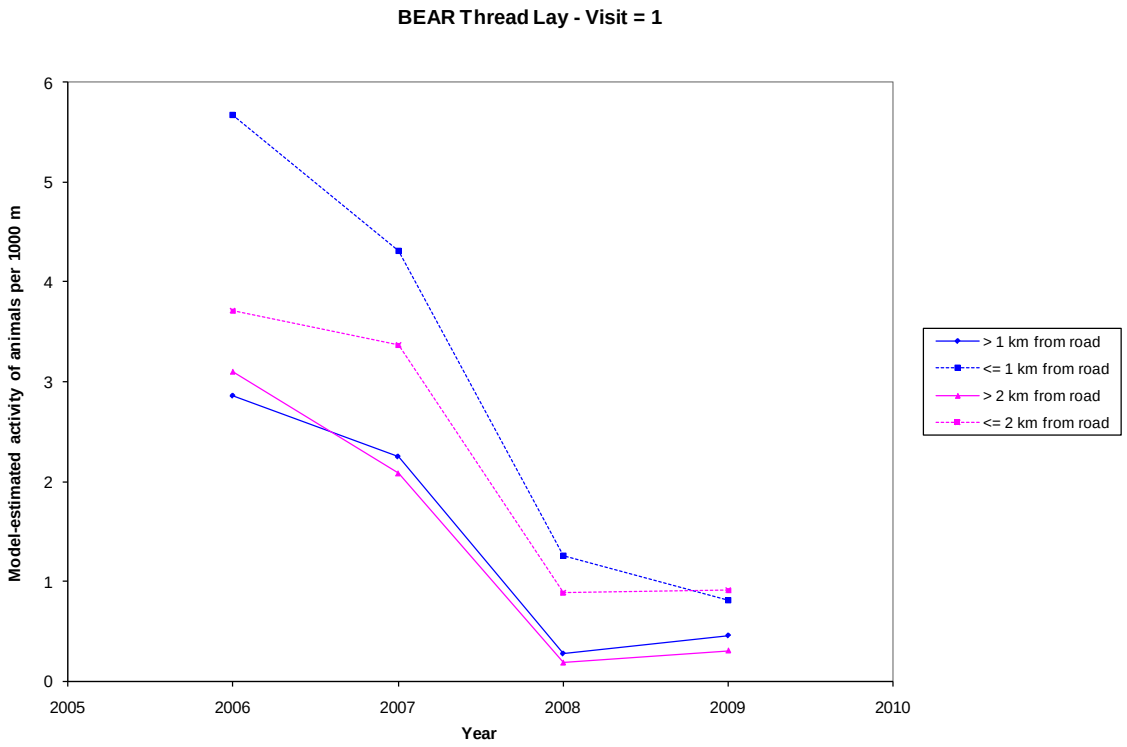


Figure 3.0-26. Black bear activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2006 to 2009, with zero values. No black bear sign was observed in 2004 and 2005.

Table 3.0-51. Analysis of black bear activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2006) and during (2007-2009) construction, with zero values. No black bear sign was observed in 2004 and 2005.

Year	Contrast	χ^2 value	p-value*
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.52	0.4704
	Activity of animals≤ 1 km vs. > 1 km of road	6.59 (more activity within 1 km of road)	**0.0102**
2007	Activity of animals≤ 2 km vs. > 2 km of road	6.89 (more activity within 2 km of road)	**0.0086**
	Activity of animals≤ 1 km vs. > 1 km of road	10.96 (more activity within 1 km of road)	**0.0009**
2008	Activity of animals≤ 2 km vs. > 2 km of road	6.56 (more activity within 2 km of road)	**0.0104**

Year	Contrast	χ^2 value	p-value*
	Activity of animals≤ 1 km vs. > 1 km of road	9.09 (more activity within 1 km of road)	**0.0026**
2009	Activity of animals≤ 2km vs. > 2km of road	5.63 (more activity within 2 km of road)	**0.0177**
	Activity of animals≤ 1 km vs. > 1 km of road	1.76	0.1847
2007 to 2009 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	5.85 (larger distance effect in 2007 to 2009)	**0.0156**
	Activity of animals≤ 1 km vs. > 1 km of road	0.42	0.5192

*Bold indicates significance.

Estimated black bear activity significantly declined by at least 62% within each distance from the road category from the pre-construction through construction periods (Table 3.0-52).

Table 3.0-52. Comparison of black bear activity during thread lay on transects along the Wuskwatim access road before and during/after, with zero values. No black bear sign was observed in 2004 and 2005.

Contrast	Distance from Road	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2009	Within 2 km	22.08	< **0.0001**	**62% decline**
	More than 2 km	39.66	< **0.0001**	**84% decline**
	Within 1 km	20.19	< **0.0001**	**71% decline**
	More than 1 km	43.99	< **0.0001**	**77% decline**

*Bold indicates significance.

3.3.1.2 Generating Station Transects

No black bear activity was observed on GS transects in 2004 or 2005, and only four signs were found during each of 2008 and 2009. The effects of year (χ^2 = 16.36, with 1 degree of freedom and $p < 0.0001$), distance to the GS (χ^2 = 27.74, with 3 degrees of freedom and $p < 0.0001$), and the interaction between distance to the GS and year (χ^2 = 12.07, with 3 degrees of freedom and $p = 0.0072$) were all statistically significant.

In 2007, there was evidence of more activity observed within 1 km and 2 km of the GS (Figure 3.0-27). Distance to GS effects did not differ appreciably by year – but the statistical power of this test is weak due to lack of data (Table 3.0-53).

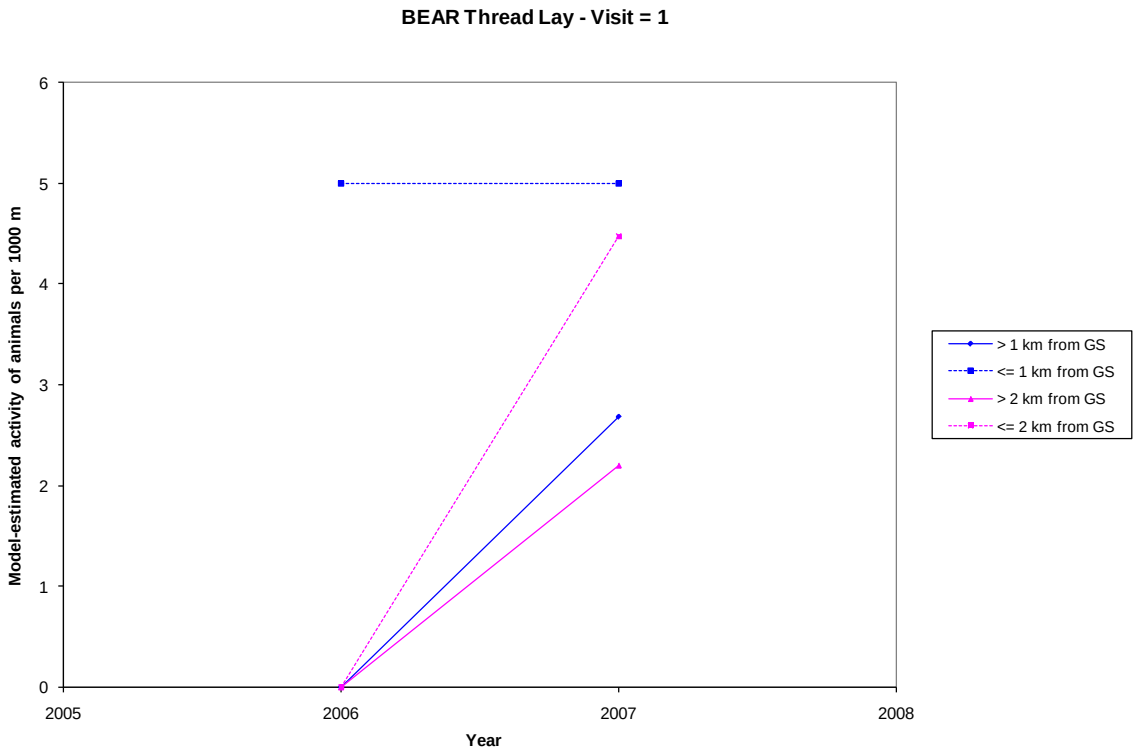


Figure 3.0-27. Black bear activity during thread lay on GS transects at varying distances to the generating station from 2004 to 2009, with zero values. Little or no black bear sign was observed in 2004, 2005, 2008, and 2009.

Table 3.0-53. Analysis of black bear activity during thread lay on GS transects by distance from the generating station before (2006) and during (2007) construction, with zero values. Little or no black bear sign was observed in 2004, 2005, 2008, and 2009.

Year	Contrast	χ^2 value	p-value*
2006	Activity of animals≤ 2 km vs. > 2 km of GS	0.00	0.9988
	Activity of animals≤ 1 km vs. > 1 km of GS	0.00	0.9748
2007	Activity of animals≤ 2 km vs. > 2 km of GS	6.22 (more activity within 2 km of GS)	**0.0126**
	Activity of animals≤ 1 km vs. > 1 km of GS	5.07 (more activity within 1 km of GS)	**0.0243**

Year	Contrast	χ^2 value	p-value*
2007 vs. 2006	Activity of animals ≤ 2 km vs. > 2 km of GS	0.00	0.9999
	Activity of animals ≤ 1 km vs. > 1 km of GS	0.00	0.9762

*Bold indicates significance.

Since black bear activity was only observed within 1 km of the GS in 2006, it was not possible to calculate a rate of change from pre- through post-construction for most of the distance categories. There was no change within 1 km of the GS (Table 3.0-54).

Table 3.0-54. Comparison of black bear activity during thread lay on GS transects before and during construction, with zero values. Little or no black bear sign was observed in 2004, 2005, 2008, and 2009.

Contrast	Distance from GS	χ^2 value	p-value	Estimated Effect
Average activity 2006 vs. average activity 2007	Within 2 km	0.00	0.9833	undefined
	More than 2 km	0.00	0.9831	undefined
	Within 1 km	0.00	1.0000	0% change
	More than 1 km	0.00	0.9763	undefined

3.3.1.3 Control Area Transects

No black bears activity was observed on control transects in 2004, 2005, or 2009. The effects of year ($\chi^2 = 59.78$, with 2 degrees of freedom and $p < 0.0001$) and distance to the road ($\chi^2 = 13.32$, with 3 degrees of freedom and $p = 0.0040$) were statistically significant. The interaction between distance to the road and year ($\chi^2 = 8.01$, with 6 degrees of freedom and $p = 0.2370$) was not significant.

There were no significant distance to road effects in any year (Figure 3.0-28, Table 3.0-55).

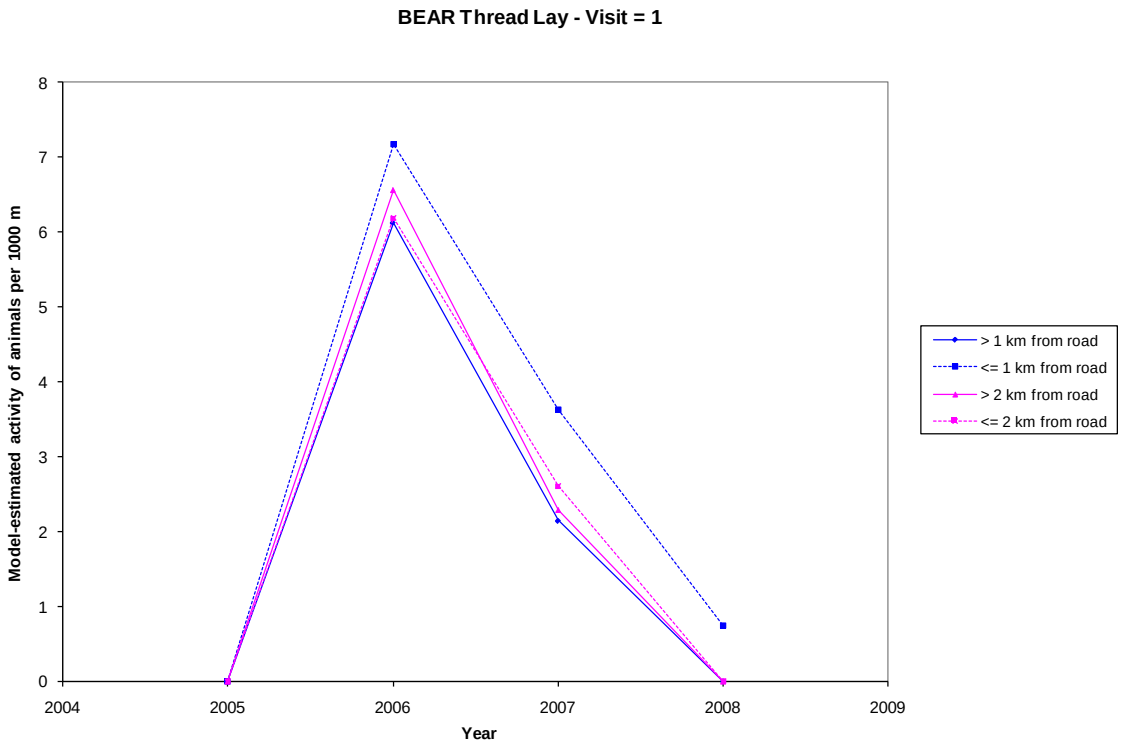


Figure 3.0-28. Black bear activity during thread lay on control transects at varying distances to the control road from 2005 to 2008, with zero values. No black bear sign was observed in 2004, 2005, and 2009.

Estimated black bear activity declined significantly within 1 km of the road from the pre-construction through construction periods (Table 3.0-56). Lack of black bear activity in 2008 undermines the reliability of these tests. See Appendix K for comparisons of black bear activity on the three transect types.

Table 3.0-55. Analysis of black bear activity during thread lay on control transects by distance from the control road before (2006) and during (2007-2008) construction, with zero values. No black bear sign was observed in 2004, 2005, and 2009.

Year	Contrast	χ^2 value	p-value
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.04	0.8431
	Activity of animals ≤ 1 km vs. > 1 km of road	0.21	0.6465
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.17	0.6841
	Activity of animals≤ 1 km vs. > 1 km of road	2.34	0.1259
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9995
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9730
2007 to 2008 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	0.00	1.0000
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9732

Table 3.0-56. Comparison of black bear activity on control transects during thread lay before and during construction, with zero values. No black bear sign was observed in 2004, 2005, and 2009.

Contrast	Distance from Control Road	χ^2 value	p-value*	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2008	Within 2 km	0.00	0.9731	99% decline
	More than 2 km	0.00	0.9731	99% decline
	Within 1 km	10.04	**0.0015**	**77% decline**
	More than 1 km	0.00	0.9648	> 99% decline

*Bold indicates significance.

3.3.2 First Check

3.3.2.1 Access Road Transects

Ten habitat broad classifications (representing categories 011, 022, 031, 043, 044, 045, 101, 211, 321, 341 and comprising 28 observations) were excluded from the analysis of transects east and west of the access road. There were only two signs observed in 2005 and only one in 2006. Therefore, only data from 2004 and 2007 through 2009 were used. None of the effects of habitat broad (χ^2 = 0.83, with 2 degrees of freedom and p = 0.6589), gray wolf presence (χ^2 = 0.09, with 1 degree of freedom and p = 0.7693), distance to the road (χ^2 = 0.96, with 3 degrees of freedom and p = 0.8118), year (χ^2 = 0.35, with 3 degree of freedoms and p = 0.9502), and the interaction between distance to the road and year (χ^2 = 1.85, with 8 degrees of freedom and p = 0.9852) were statistically significant.

No effects of distance to the road were evident in any of the years (Figure 3.0-29, Table 3.0-57).

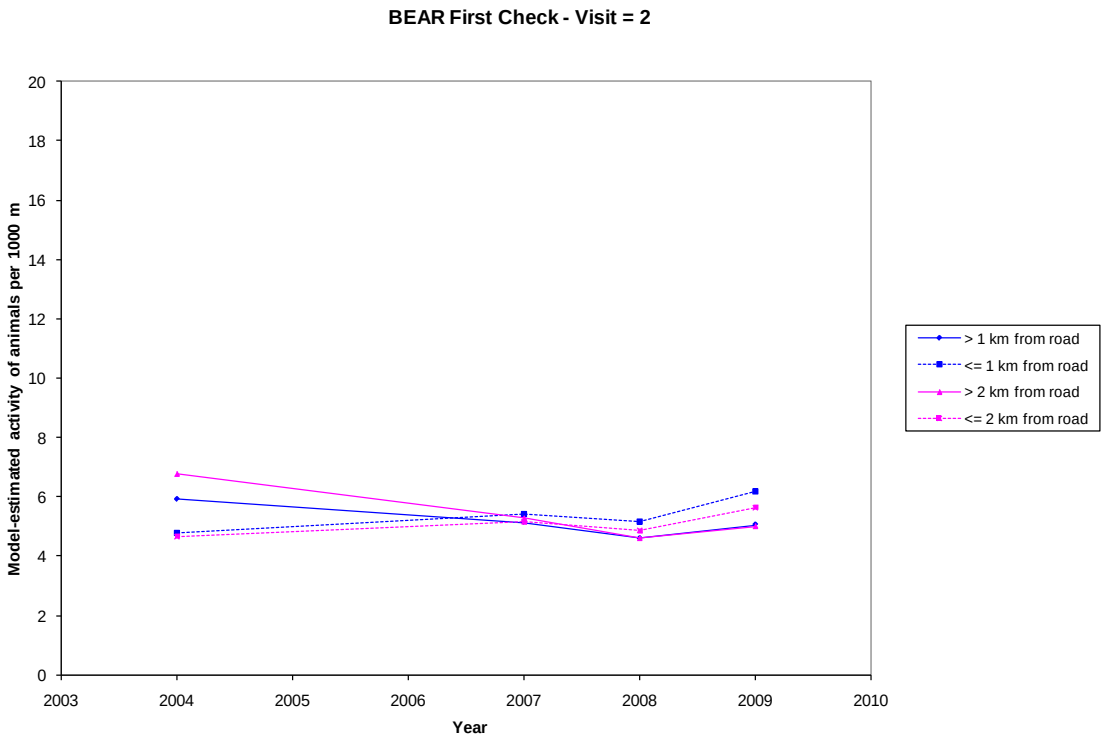


Figure 3.0-29. Black bear activity during the first check on transects along the Wuskwatim access road at varying distances to the access road from 2004 to 2009. Little or no black bear sign was observed in 2005 and 2006.

Table 3.0-57. Analysis of black bear activity during the first check on transects along the Wuskwatim access road by distance from the road before (2004) and during (2007-2009) construction. Little or no black bear sign was observed in 2005 and 2006.

Year	Contrast	χ^2 value	p-value
2004	Activity of animals ≤ 2 km vs. > 2 km of road	0.45	0.5007
	Activity of animals ≤ 1 km vs. > 1 km of road	0.21	0.6452
2007	Activity of animals ≤ 2 km vs. > 2 km of road	0.00	0.9721
	Activity of animals ≤ 1 km vs. > 1 km of road	0.04	0.8396
2008	Activity of animals ≤ 2 km vs. > 2 km of road	0.03	0.8641
	Activity of animals ≤ 1 km vs. > 1 km of road	0.11	0.7419

2009	Activity of animals≤ 2 km vs. > 2 km of road	0.03	0.8522
	Activity of animals≤ 1 km vs. > 1 km of road	0.13	0.7188
2007 to 2009 vs. 2004	Activity of animals≤ 2 km vs. > 2 km of road	0.33	0.5681
	Activity of animals≤ 1 km vs. > 1 km of road	0.29	0.5884

Estimated black bear activity did not change significantly from the pre-construction through construction periods (Table 3.0-58).

Table 3.0-58. Comparison of black bear activity on transects along the Wuskwatim access road during the first check before and during construction. Little or no black bear sign was observed in 2005 and 2006.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 vs. average activity 2007 to 2009	Within 2 km	0.10	0.7540	11% increase
	More than 2 km	0.23	0.6342	26% decline
	Within 1 km	0.13	0.7162	16% increase
	More than 1 km	0.15	0.6961	13% increase

When zero values were included for 200 m segments where black bear activity was not observed, the effects of distance to the road (χ^2 = 35.59, with 3 degrees of freedom and $p < 0.0001$), and year (χ^2 = 122.54, with 3 degrees of freedom and $p < 0.0001$) were statistically significant. The effects of gray wolf presence (χ^2 = 3.77, with 1 degree of freedom and $p = 0.0522$), and the interaction between distance to the road and year (χ^2 = 12.93, with 9 degrees of freedom and $p = 0.1656$) were not significant.

In 2004, there was evidence of more activity observed within 1 km and 2 km of the road (Figure 3.0-29, Table 3.0-59). In 2008 there was evidence of more activity observed within 2 km of the road, and in 2009 there was evidence of more activity within 1 km of the road,

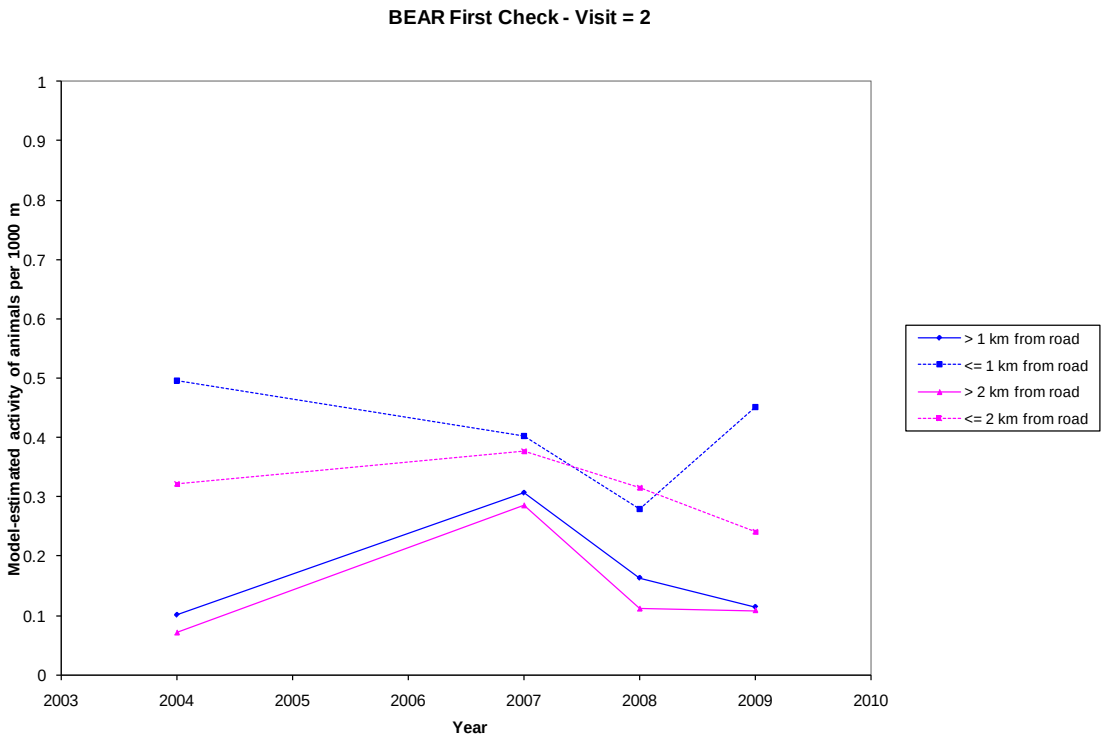


Figure 3.0-29. Black bear activity during the first check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009, with zero values. Little or no black bear sign was observed in 2005 and 2006.

Table 3.0-59. Analysis of black bear activity during the first check on transects along the Wuskwatim access road by distance from the road before (2004) and during (2007-2009) construction, with zero values. Little or no black bear sign was observed in 2005 and 2006.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	7.03 (more activity within 2 km of road)	**0.0080**
	Activity of animals≤ 1 km vs. > 1 km of road	11.28 (more activity within 1 km of road)	**0.0008**
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.69	0.4058
	Activity of animals≤ 1 km vs. > 1 km of road	0.66	0.4174
2008	Activity of animals≤ 2 km vs. > 2 km of road	4.37 (more activity within 2 km of road)	**0.0365**
	Activity of animals≤ 1 km vs. > 1 km of road	1.22	0.2695

Year	Contrast	χ^2 value	p-value*
2009	Activity of animals ≤ 2 km vs. > 2 km of road	1.21	0.2704
	Activity of animals ≤ 1 km vs. > 1 km of road	4.86 (more activity within 1 km of road)	**0.0275**
2007 to 2009 vs. 2004	Activity of animals ≤ 2 km vs. > 2 km of road	1.54	0.2145
	Activity of animals ≤ 1 km vs. > 1 km of road	2.43	0.1193

*Bold indicates significance.

Estimated black bear activity did not change significantly from the pre-construction through construction periods (Table 3.0-60).

Table 3.0-60. Comparison of black bear activity on transects along the Wuskwatim access road during the first check before and during construction, with zero values. Little or no black bear sign was observed in 2005 and 2006.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 vs. average activity 2007 to 2009	Within 2 km	0.03	0.8742	5% decline
	More than 2 km	1.77	0.1836	113% increase
	Within 1 km	0.64	0.4220	25% decline
	More than 1 km	1.87	0.1720	75% increase

3.3.2.2 Control Area Transects

No black bears were observed on control transects in 2004, 2005, or 2009. The effect of year (χ^2 = 15.57, with 2 degrees of freedom and p = 0.0004) was statistically significant. The effects of distance to the road (χ^2 = 2.07, with 3 degrees of freedom and p = 0.5587) and the interaction between distance to the road and year (χ^2 = 12.22, with 6 degrees of freedom and p = 0.0572) were not significant.

There were no significant distance to road effects in any year (Figure 3.0-30, Table 3.0-61).

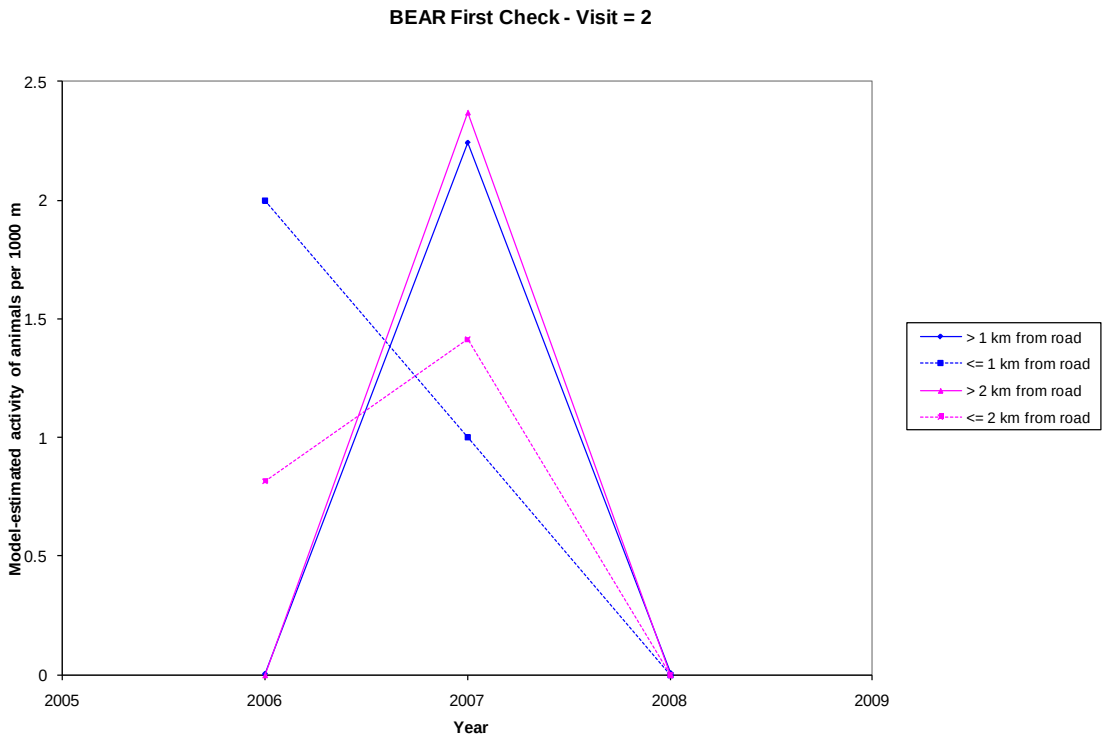


Figure 3.0-30. Black bear activity during the first check on control transects at varying distances to the control road from 2006 to 2008, with zero values. No black bear sign was observed in 2004, 2005, and 2009.

Table 3.0-61. Analysis of black bear activity during the first check on control transects by distance from the control road before (2006) and during (2007, 2008) construction, with zero values. No black bear sign was observed in 2004, 2005, and 2009.

Year	Contrast	χ^2 value	p-value
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9820
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9776
2007	Activity of animals≤ 2 km vs. > 2 km of road	1.09	0.2972
	Activity of animals≤ 1 km vs. > 1 km of road	1.72	0.1891
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9996
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9893
2007 to 2008 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9846
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9782

Estimated black bear activity declined significantly within 1 km of the control road from the pre-construction through construction periods (Table 3.0-62). Lack of black bear activity in 2008 undermines the reliability of these tests and precludes estimation of the magnitude of change. See Appendix L for comparisons of black bear activity on the three transect types.

Table 3.0-62. Comparison of black bear activity during the first check on control transects before and during construction, with zero values. No black bear sign was observed in 2004, 2005, and 2009.

Contrast	Distance from Control Road	χ^2 value	p-value	Estimated Effect
Average activity 2006 vs. average activity 2007 to 2008	Within 2 km	0.00	0.9842	--
	More than 2 km	0.00	0.9902	--
	Within 1 km	0.00	0.9811	--
	More than 1 km	0.00	0.9888	--

3.3.3 Second Check

3.3.3.1 Access Road Transects

Eight habitat broad classifications (representing categories 022, 031, 043, 044, 045, 201, 211, 341 and comprising 29 observations) were excluded from the analysis of transects east and west of the access road. There were only 12 signs observed in 2004, all within 2 km of the road, and only 8 signs observed in 2005. No activity was observed in 2006. Therefore, only data from 2007 through 2009 were used. Wolves were not used as a covariate as these animals were not present during the second check. None of the effects of habitat broad (χ^2 = 0.12, with 2 degrees of freedom and p = 0.9409), distance to the road (χ^2 = 0.13, with 3 degrees of freedom and p = 0.9885), year (χ^2 = 0.11, with 2 degree of freedoms and p = 0.9467), and the interaction between distance to the road and year (χ^2 = 0.25, with 6 degrees of freedom and p = 0.9997) were statistically significant.

No effects of distance to the road were evident in any of the years (Figure 3.0-31, Table 3.0-63). There was insufficient data in 2004 and 2005 to estimate magnitude of activity change from pre- through post-construction periods.

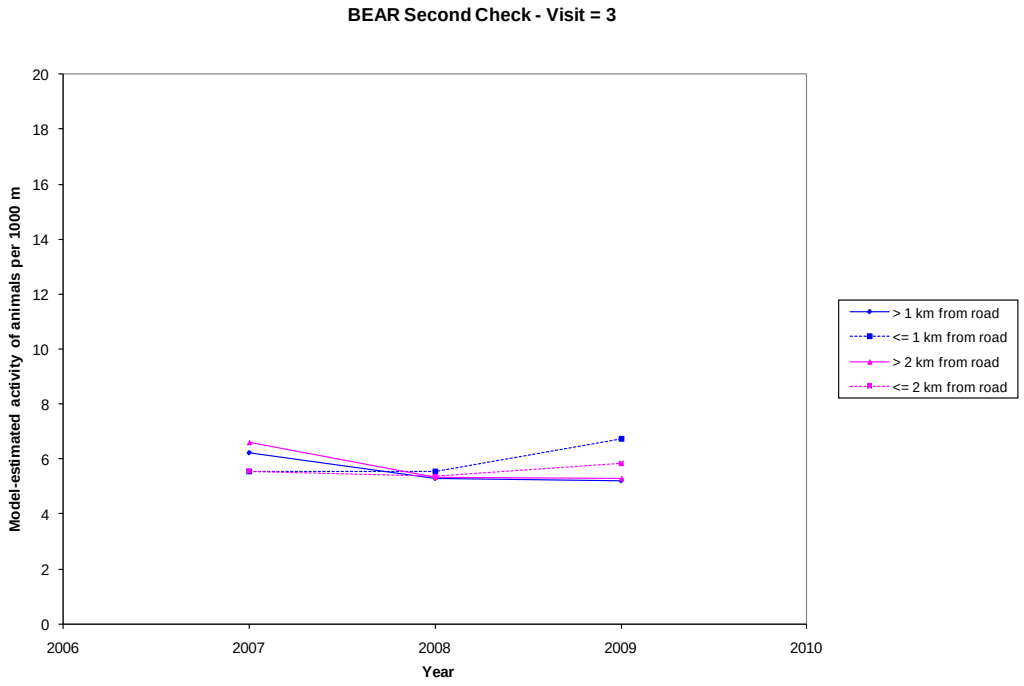


Figure 3.0-31. Black bear activity during the second check on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009. No black bear sign was observed in 2004 and 2005. There was no second check in 2006.

Table 3.0-63. Analysis of black bear activity during the second check on transects along the Wuskwatim access road by distance from the road during construction (2007-2009). No black bear sign was observed in 2004 and 2005. There was no second check in 2006.

Year	Contrast	χ^2 value	p-value
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.16	0.6883
	Activity of animals≤ 1 km vs. > 1 km of road	0.10	0.7566
2008	Activity of animals ≤ 2 km vs. > 2 km of road	0.00	0.9897
	Activity of animals≤ 1 km vs. > 1 km of road	0.01	0.9362
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.02	0.8941
	Activity of animals≤ 1 km vs. > 1 km of road	0.13	0.7141

When zero values were included for 200 m segments where black bear activity was not observed, the effects of distance to the road (χ^2 = 27.95, with 3 degrees of freedom and $p < 0.0001$) and year (χ^2 = 7.66, with 2 degrees of freedom and p = 0.0217) were statistically significant. The effects of gray wolf presence (χ^2 = 1.87, with 1 degree of freedom and p = 0.1716) and the interaction between distance to the road and year (χ^2 = 1.01, with 6 degrees of freedom and p = 0.9852) were not significant.

In 2007, there was evidence of more activity within 1 km and 2 km of the road (Figure 3.0-32, Table 3.0-64). In 2008 and 2009, there was evidence of more activity within 1 km of the road..

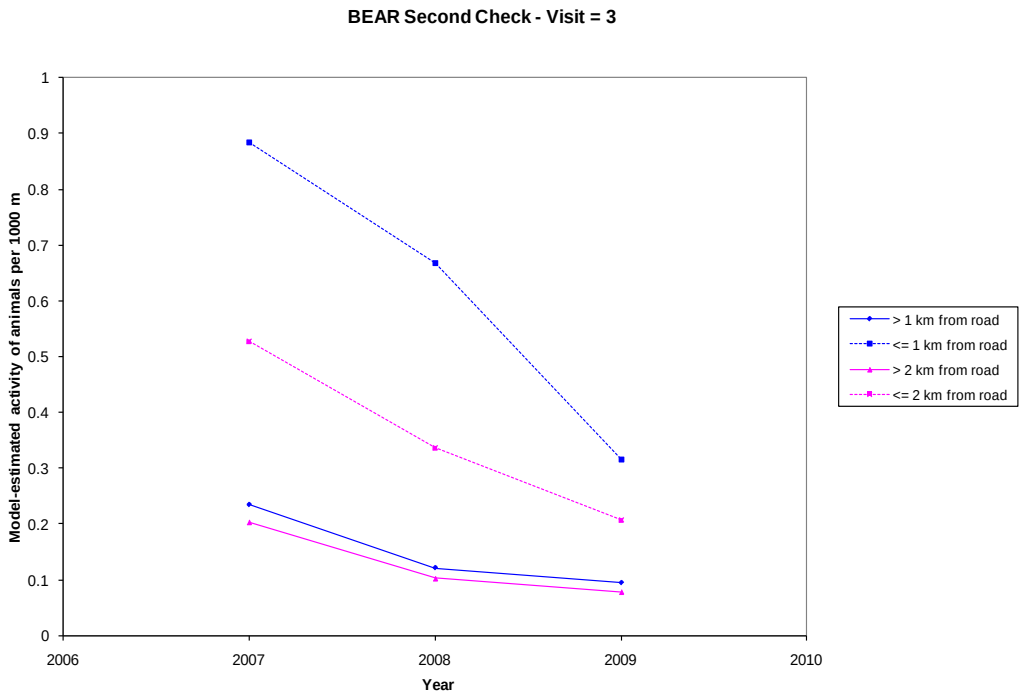


Figure 3.0-32. Black bear activity during the second check on transects along the Wuskwatim access road at varying distances to the road from 2007 to 2009, with zero values. No black bear sign was observed in 2004 and 2005. There was no second check in 2006.

Table 3.0-64. Analysis of black bear activity during the second check on transects along the Wuskwatim access road by distance from the road before (2004-2005) and during (2007-2009) construction, with zero values. No black bear sign was observed in 2004 and 2005. There was no second check in 2006.

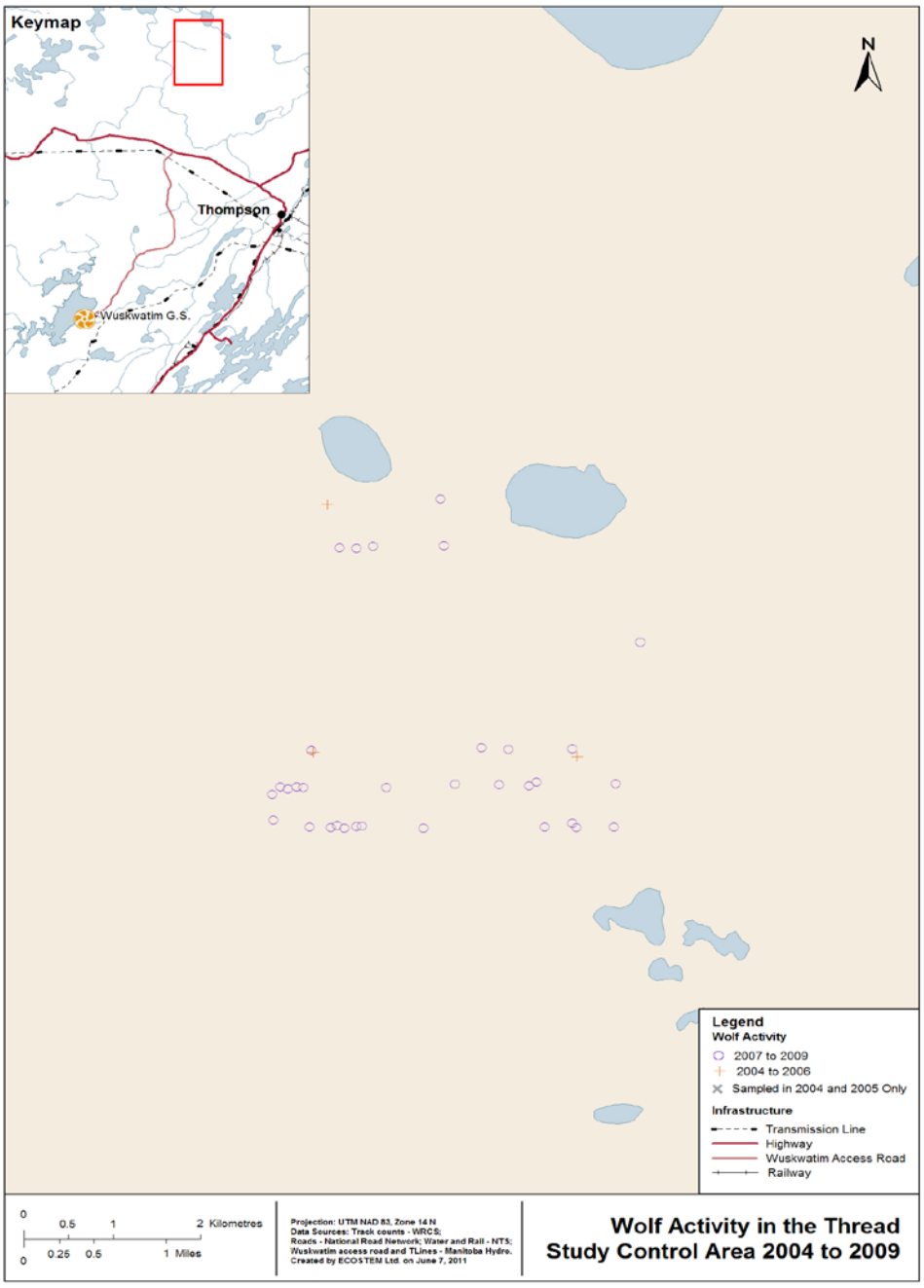
Year	Contrast	χ^2 value	p-value*
2007	Activity of animals≤ 2 km vs. > 2 km of road	8.89 (more activity within 2 km of road)	**0.0029**
	Activity of animals≤ 1 km vs. > 1 km of road	23.24 (more activity within 1 km of road)	**< 0.0001**
2008	Activity of animals≤ 2 km vs. > 2 km of road	3.74 (more activity within 2 km of road)	0.0530
	Activity of animals≤ 1 km vs. > 1 km of road	12.55 (more activity within 1 km of road)	**0.0004**
2009	Activity of animals≤ 2 km vs. > 2 km of road	2.04	0.1535
	Activity of animals≤ 1 km vs. > 1 km of road	4.33 (more activity within 1 km of road)	**0.0374**

*Bold indicates significance.

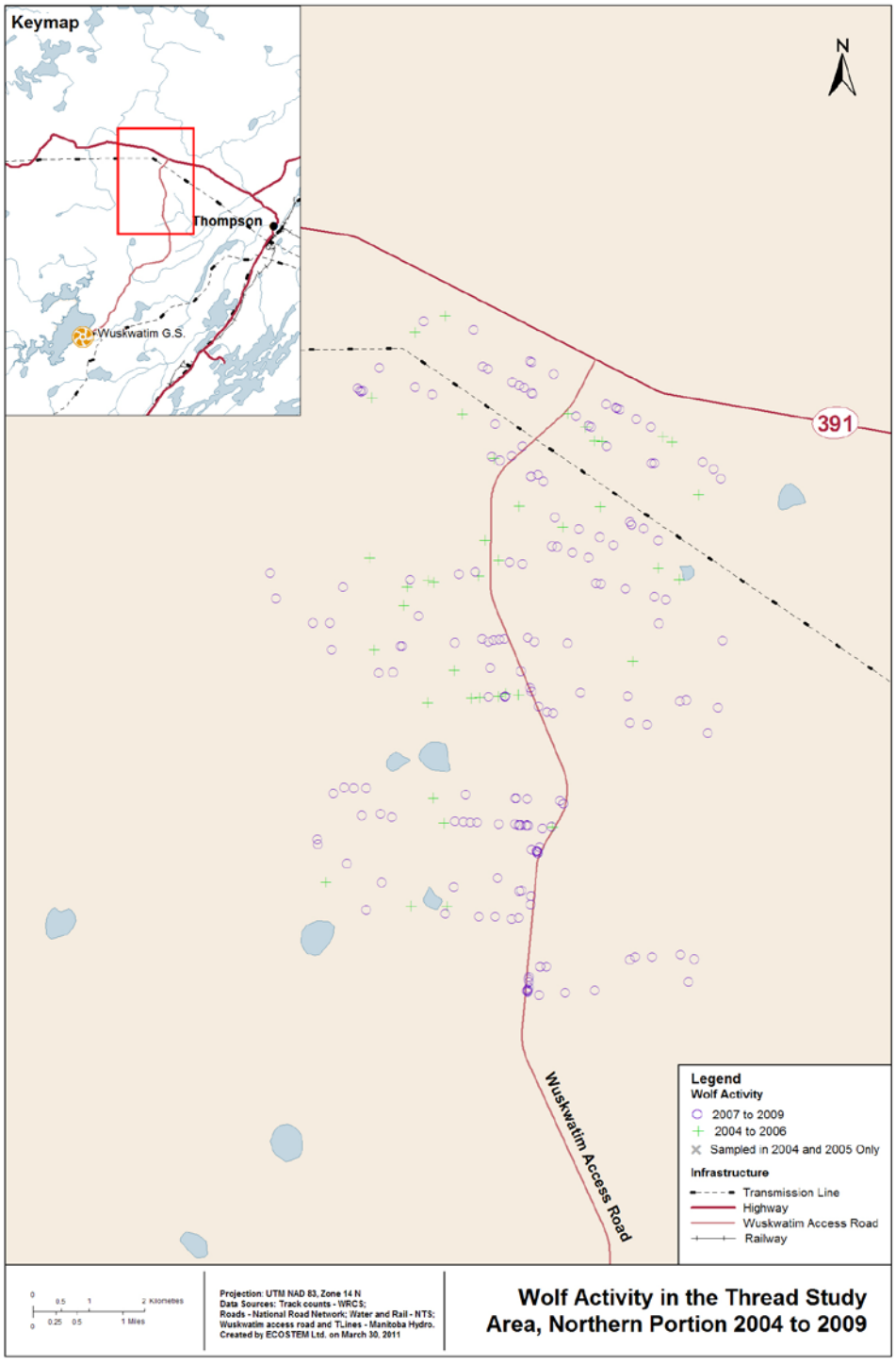
3.4 GRAY WOLF

Across all three checks, there were 3 of 218 (1.4%) 200 m segments for which habitat broad classifications were heterogeneous within a distance category. These were excluded from the conditional analyses. There were only 24 observations during the first check and 27 observations during the second check and therefore no analyses were conducted. Gray wolf activity during all visits before and during construction is depicted in Map 3.0-4a to 3.0-4d.

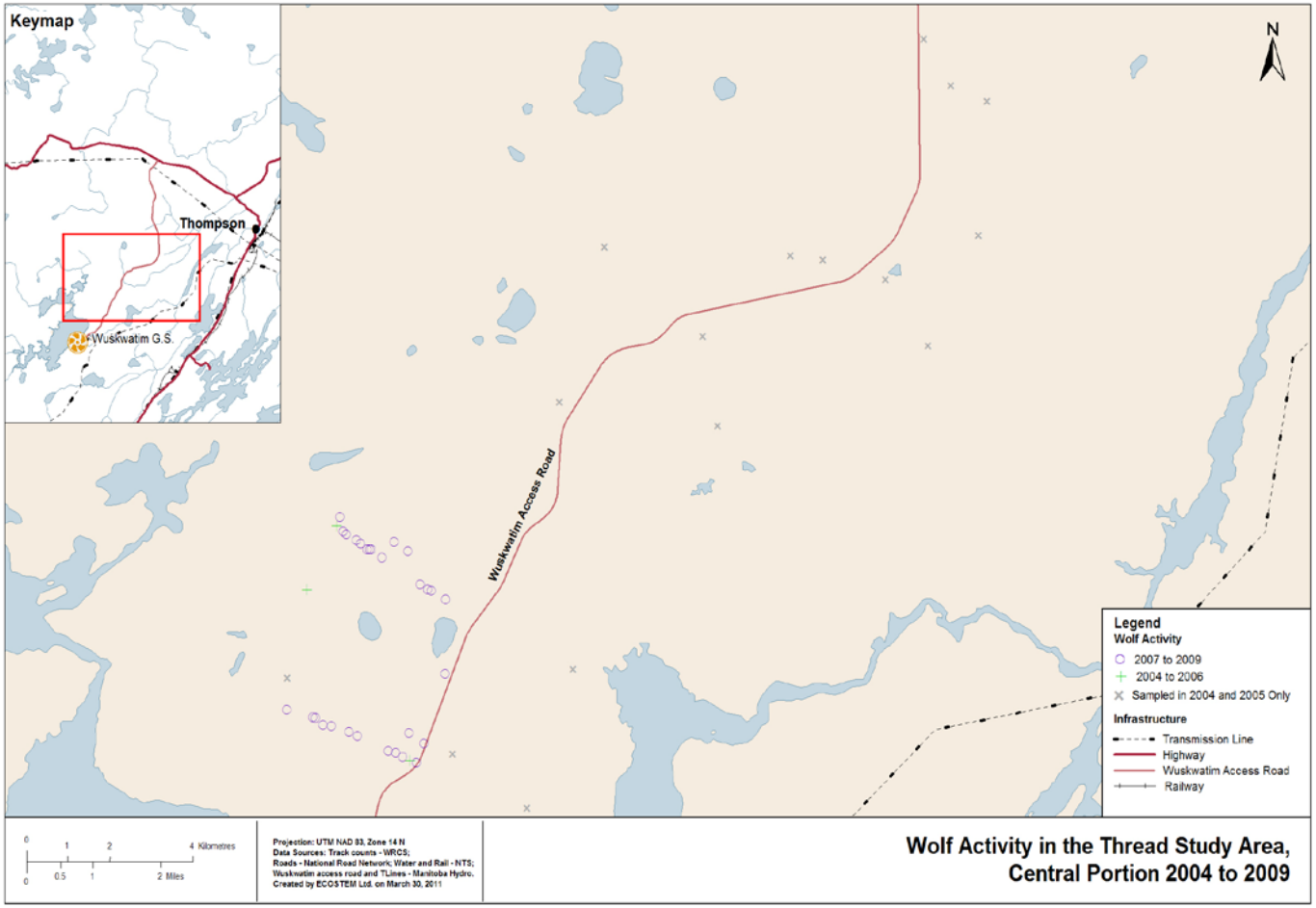
Measures were not reported near the GS site and control area because of the paucity of data.



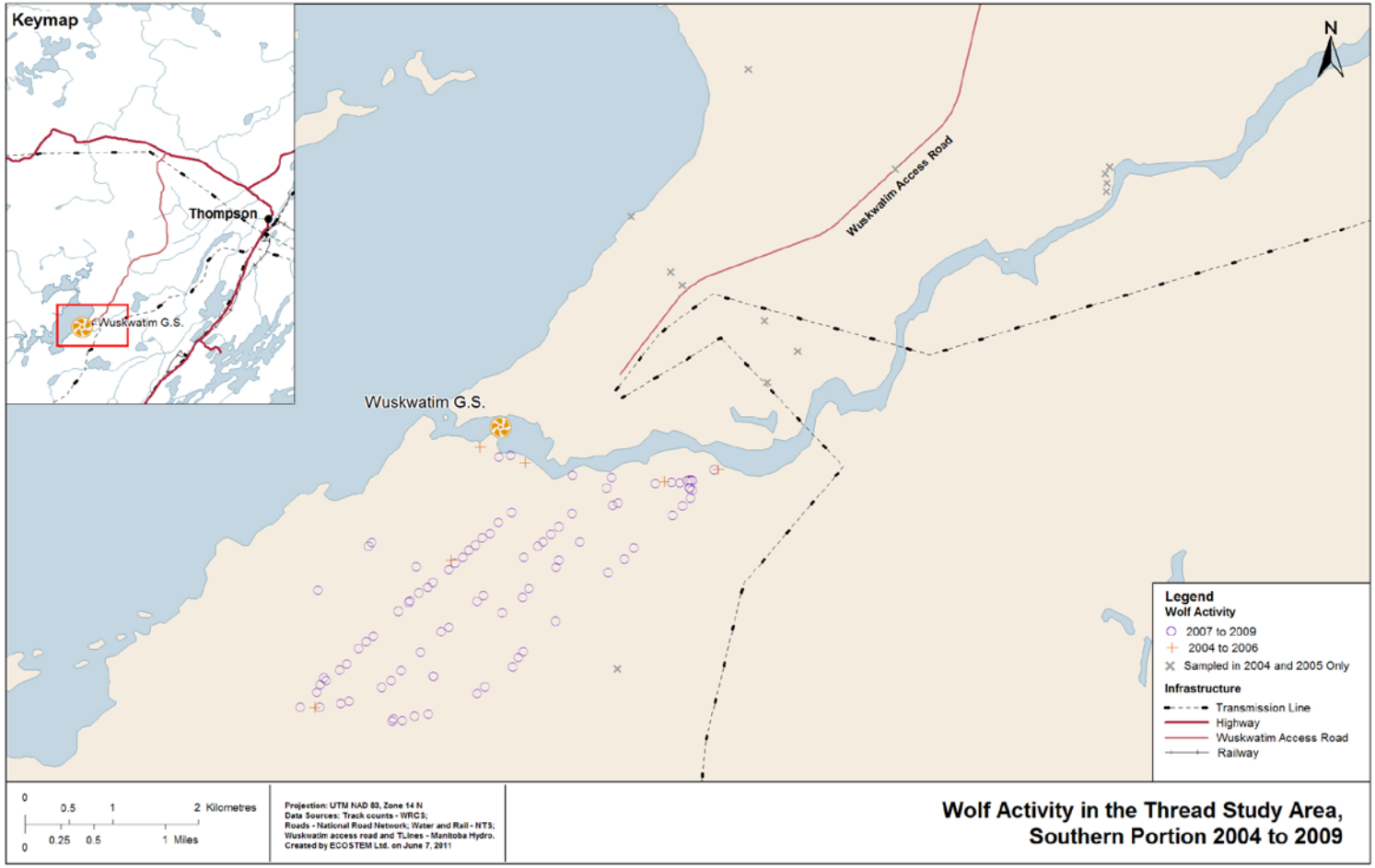
Map 3.0-4a. Gray wolf activity on control transects before (2004 to 2006) and during (2007 to 2009) construction.



Map 3.0-4b. Gray wolf activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, northern portion.



Map 3.0-4c. Gray wolf activity on transects along the Wuskwatim access road before (2004 to 2006) and during (2007 to 2009) construction, central portion.



Map 3.0-4d. Gray wolf activity on GS transects before (2004 to 2006) and during (2007 to 2009) construction.

3.4.1 Thread Lay

3.4.1.1 Access Road Transects

Five habitat broad classifications (representing categories 022, 044, 045, 201, 341 and comprising 24 observations) were excluded from the analysis of transects east and west of the access road. The effects of habitat broad (χ^2 = 14.58, with 4 degrees of freedom and p = 0.0057), and year (χ^2 = 12.14, with 5 degrees of freedom and p = 0.0330) were statistically significant. The effects of distance to the road (χ^2 = 0.94, with 3 degrees of freedom and p = 0.8158), and the interaction between distance to the road and year (χ^2 = 9.25, with 13 degrees of freedom and p = 0.7539) were not significant.

No effects of distance to the road were evident in any of the years (Figure 3.0-33, Table 3.0-65).

Figure 3.0-33. Gray wolf activity during thread lay on transects along the Wuskwatim access road at varying distances to the road from 2004 to 2009.

Table 3.0-65. Analysis of gray wolf activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction.

Year	Contrast	χ^2 value	p-value
2004	Activity of animals≤ 2 km vs. > 2 km of road	0.17	0.6775
	Activity of animals≤ 1 km vs. > 1 km of road	0.11	0.7452
2005	Activity of animals≤ 2 km vs. > 2 km of road	0.01	0.9127
	Activity of animals≤ 1 km vs. > 1 km of road	1.03	0.3111
2006	Activity of animals≤ 2 km vs. > 2 km of road	1.38	0.2400
	Activity of animals≤ 1 km vs. > 1 km of road	1.30	0.2535

Year	Contrast	χ^2 value	p-value
2007	Activity of animals≤ 2 km vs. > 2 km of road	0.70	0.4014
	Activity of animals≤ 1 km vs. > 1 km of road	0.04	0.8494
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.07	0.7928
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9512
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.02	0.8965
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9992
2007 to 2009 vs. 2006	Activity of animals≤ 2 km vs. > 2 km of road	0.68	0.4108
	Activity of animals≤ 1 km vs. > 1 km of road	0.01	0.9191

There was also marginal evidence of declines within 2 km of the road and more than 1 km from the road (Table 3.0-66).

Table 3.0-66. Comparison of gray wolf activity during thread lay on transects along the Wuskwatim access road before and during construction.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	2.75	0.0974	31% decline
	More than 2 km	1.84	0.1752	38% decline
	Within 1 km	0.49	0.4860	19% decline
	More than 1 km	3.59	0.0581	39% decline

When zero values were included for 200 m segments where gray wolf activity was not observed, the effects of distance to the road (χ^2 = 28.22, with 3 degrees of freedom and $p < 0.0001$), year (χ^2 = 52.90, with 5 degrees of freedom and $p < 0.0001$), and the interaction between distance to the road and year (χ^2 = 32.41, with 15 degrees of freedom and $p = 0.0057$) were all statistically significant.

In 2004 there was evidence of more activity within 1 km of the road, and 2007, there was evidence of more activity observed within 1 km and 2 km of the road (Figure 3.0-34, Table 3.0-67).

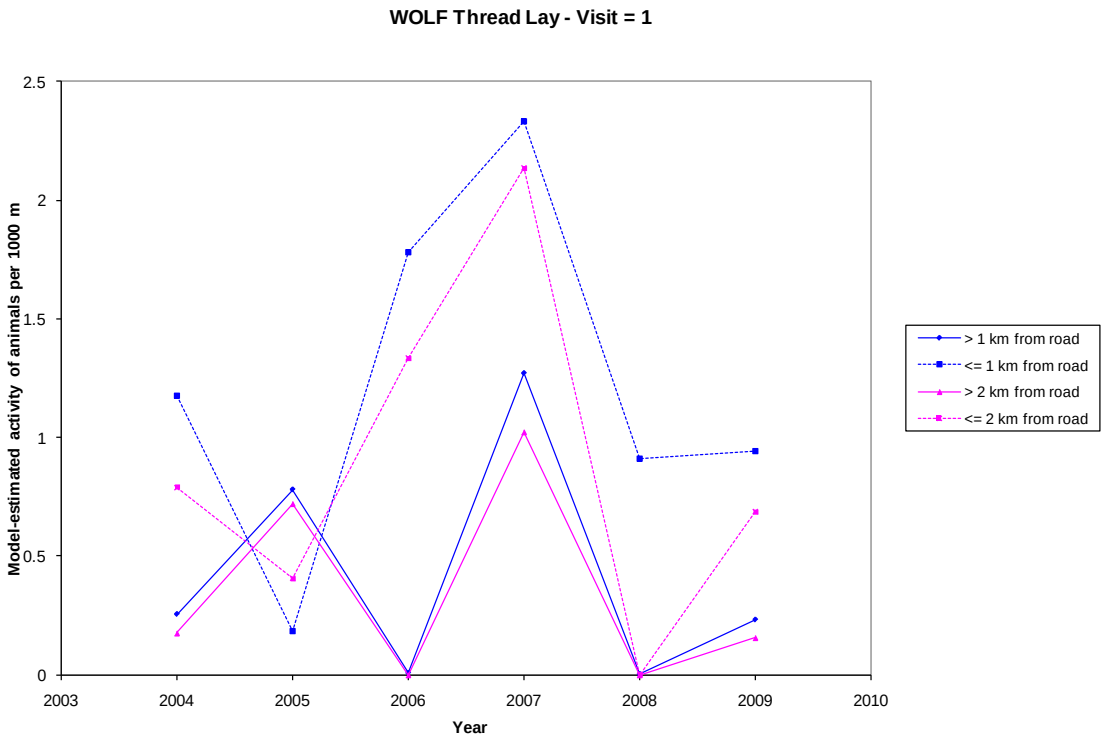


Figure 3.0-34. Gray wolf activity on transects along the Wuskwatim access road during thread lay at varying distances to the road from 2004 to 2009, with zero values.

Table 3.0-67. Analysis of gray wolf activity during thread lay on transects along the Wuskwatim access road by distance from the road before (2004-2006) and during (2007-2009) construction, with zero values.

Year	Contrast	χ^2 value	p-value*
2004	Activity of animals≤ 2 km vs. > 2 km of road	1.59	0.2078
	Activity of animals≤ 1 km vs. > 1 km of road	4.24 (more activity within 1 km of road)	**0.0395**
2005	Activity of animals≤ 2 km vs. > 2 km of road	1.35	0.2457
	Activity of animals≤ 1 km vs. > 1 km of road	0.35	0.5561
2006	Activity of animals≤ 2 km vs. > 2 km of road	0.73	0.3943
	Activity of animals≤ 1 km vs. > 1 km of road	1.47	0.2251

Year	Contrast	χ^2 value	p-value*
2007	Activity of animals≤ 2 km vs. > 2 km of road	5.94 (more activity within 2 km of road)	**0.0148**
	Activity of animals≤ 1 km vs. > 1 km of road	4.26 (more activity within 1 km of road)	**0.0390**
2008	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9809
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9809
2009	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9799
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9773
2007 to 2009 vs. others	Activity of animals≤ 2 km vs. > 2 km of road	0.00	0.9991
	Activity of animals≤ 1 km vs. > 1 km of road	0.00	0.9725

*Bold indicates significance.

Estimated gray wolf activity did not change significantly from the pre-construction through construction periods (Table 3.0-68).

Table 3.0-68. Comparison of gray wolf activity during thread lay on transects along the Wuskwatim access road before and during construction, with zero values.

Contrast	Distance from Road	χ^2 value	p-value	Estimated Effect
Average activity 2004 to 2006 vs. average activity 2007 to 2009	Within 2 km	0.00	0.9819	88% decline
	More than 2 km	0.00	0.9844	669% increase
	Within 1 km	2.07	0.1500	75% increase
	More than 1 km	0.00	0.9979	22% decline

4.0 WILDLIFE REPORTS

Reports of wildlife observations and encounters were recorded during construction of the access road and generating station. See Appendix M for large mammal observations logged from 2007 to 2008. The following descriptions of wildlife observations are adapted from accounts collected or observed by Manitoba Hydro Project Environmental Inspectors. All photographs were provided Manitoba Hydro employees or contractors.

4.1 GRAY WOLF

In 2007, gray wolves were repeatedly observed in camp and the contractors' work area at night. Manitoba Conservation set up power snares, and two males were dispatched in December. The same wolf pack, estimated at 10 individuals, continued to be problematic along the access road. By November and December MIT and the road contractor expressed concern about the safety of workers due to the aggressive behavior of the wolves. Bangers and other deterrents were deployed in an attempt to scare off the pack.

It should be noted that camp wolf encounters in 2007 coincided with the large number of wolf sign detections during the 2007 monitoring program (N=347). Wolf activity detections in 2007 were approximately 440% higher than the next highest activity level reported in 2008.

Wildlife-vehicle collisions resulted in the deaths of two gray wolves. A juvenile that was struck appeared to have mange, which was not confirmed by pathology. Since winter 2007 occasional wolf sightings have been reported along the access road, usually of a single individual. A lone gray wolf was observed near the camp security office in 2010. The wolf was missing its right rear paw.

4.2 RED FOX

Red foxes were commonly seen in camp, along the access road, and the contractors' marshalling yards. All three colour phases (red, silver, and cross) were observed. Twenty-five foxes were live trapped and released at various locations. Trapped individuals were covered with a blanket to ease the animals' stress. Two foxes were marked with orange spray paint to determine if relocated individuals return to camp. To date, they have not been observed back in camp.

Two fox litters were produced at the camp. Each was left undisturbed until the pups began roaming around camp and the construction area. The foxes were live trapped and relocated.

An education campaign was conducted by the Project Environmental Inspectors during contractors' daily tail board meetings, to discourage the feeding of foxes. Advertisements were located on safety bulletin boards throughout the camp and offices discouraging any interaction with these animals. Fox are thought to reduce the small mammal population around camp; however it has been difficult to reduce the number of red foxes in camp.

Security reported that a red fox was observed several times near the Cultural Centre, foaming at the mouth. No date was provided. It was reported to the Thompson office of Manitoba Conservation, which recommended live trapping the animal and transporting it to Thompson. The red fox was not live trapped and was not seen again.

4.3 BLACK BEAR

From spring 2007 to fall 2010, black bears were frequently observed between KM 15 and KM 25 on the access road. Numerous sightings were also reported at KM 40. A female with two cinnamon cubs was observed repeatedly on the access road at KM 40, and another female with a black cub and a cinnamon cub were observed several times between KM 15 and KM 35. More bears were reported along the access road in 2007 and 2008 than in 2009 and 2010. This was thought to be due to the large number of blueberries adjacent to the road in 2007. Black bear sightings appeared to be more common in late July and August. Most of the bears reported by construction workers were females with cubs. Twins and triplets were common. Most bear sightings were in the early morning and evening, with the occasional report of bear activity around mid-day. Black bears frequently crossed the access road, and were also observed feeding on grasses in the roadside ditches that were seeded for erosion control.

Black bears have also been observed in camp. A live trap was set up twice by the Project Environmental Inspectors in response. The bears were not captured and were not seen again.

In summer 2010 a black bear cub entered the contractor's main office after the cleaning staff left the doors open. The cub was startled by the cleaning

staff and ran off. A live trap was set up, but the cub was not captured and was not seen again. The female and three cubs in the photograph above were dispatched by Manitoba Conservation in 2007, after becoming nuisances at S2 camp.

Manitoba Conservation and Manitoba Hydro held annual joint workshops in the Wuskwatim Recreation Centre about bear safety and awareness.

4.4 AMERICAN MARTEN AND MINK

An American marten was photographed at the Main Gate House (below left). No other reports have been submitted. A mink was reported upstream of the Stage I coffer dam on October 18, 2008 (below right). While originally identified as a fisher, the photograph is of a mink.

4.5 WOLVERINE

Two wolverine observations have been reported. In 2010 a wolverine crossed the contractors' work area, and then crossed the access road near the camp security office. It was not disturbed. In summer 2010, a surveys and mapping crew observed a wolverine swimming across the Burntwood River. It was not disturbed.

4.6 STRIPED SKUNK

Two striped skunks were spotted in S2 camp in the fall of 2008. Live traps were set up and attempts were made to capture them with dip nets on long poles, but they could not be captured. Local trappers from Nisichawayasihk Cree Nation (NCN) were called to the site to trap the skunks. Small mammal live traps were used successfully.

As striped skunks occur rarely in northern Manitoba, it was thought that these two animals may have been transported into the camp from elsewhere. Periodic inspections for invasive species such as striped skunk were initiated for equipment coming into Wuskwatim after this incident.

4.7 RIVER OTTER

Numerous river otter sightings have been reported on the south bank of the Burntwood River. As they were observed almost daily, it is suspected that they have a den nearby. Activity was noted at access road stream crossings in winter, as slide marks were left by their passage. The river otter in the photograph was observed at outlet #4, a lagoon outlet.

4.8 COUGAR

A cougar was observed crossing the road between KM 40 and KM 39 on March 29, 2008 by two Emergency Medical Services (EMS) technicians returning from Thompson. They initially thought it was a gray wolf, but upon approaching the animal realized it was a feline. It was too large to be a lynx, and had a long tail. Photos of the animal's tracks were sent to the wildlife biologist, who confirmed that it was a cougar. A detailed report of the occurrence was sent to the Wildlife and Ecosystem Protection Branch, Manitoba Conservation. The report was accepted as a probable sighting (R. Berger, pers. obs.).

4.9 LYNX

Lynx were frequently observed at KM 37. It is thought that they were attracted by what appears to be good snowshoe hare habitat. Two lynx were photographed crossing the access road in April 2007 (below left). A lynx was also photographed at KM 42 (below right).

4.10 WOODLAND CARIBOU

Caribou tracks have been observed along the access road between KM 31 and KM 21 in winter, when tracks are easiest to see. Construction workers reported seeing caribou around KM 20 of the access road in May 2007. In the fall of 2007, three caribou were observed in the cleared area near the main camp. Project Environmental Inspectors observed four woodland caribou between KM 20 and KM 25 of the access road. Fresh caribou tracks were observed along the access road in November 2007, in an area historically used for

migration by woodland caribou. Two caribou were observed crossing the access road at KM 20 on April 16, 2008.

Signs warning drivers of woodland caribou crossing activity were posted on the access road in 2007. Southbound traffic observed the sign at 14U 549411 6193467, which is located near the security gate as traffic entered the Project area from Hwy 391. Northbound traffic from the main camp area was reminded of the caribou movement corridor with a caribou crossing sign located at 14U 543689 6170471.

As woodland caribou observations were increasing along the highway, and at least one near-miss caribou-vehicle encounter was reported, two caribou crossing signs were put up on Highway 391 to mark the stretch of road near the Sapochi River crossing. No caribou-vehicle collisions were reported between 2007 and 2010.

4.11 MOOSE

Moose sightings along the access road were reported to the Project Environmental Inspectors and were recorded on Big Game Observation Forms (BGOH; Appendix M). In the fall of 2008 two bulls were attracted to the construction noise in the General Civil Contractor area and were observed on numerous occasions near the Wuskwatim lagoon, Manitoba Hydro marshalling yard, and on the transmission line. They were not disturbed and were not seen again in camp.

A report was made of a single bull moose crossing the contractors' pad in the winter of 2008. It passed the Manitoba Hydro field office, crossed the excavated material placement area, and entered the surrounding forest. It was thought that it had been chased by a gray wolf pack. While no wolves were seen, their tracks were found near the contractors' pad.

A report was made of a single bull crossing the Burntwood River just upstream of the General Civil Contractor area, downstream of Wuskwatim Falls in fall 2009. In the summer of 2010 a young male was observed crossing the same area and ended up in the forest on the north end of Wuskwatim falls. It was not disturbed and moved on.

A cow and two calves were observed crossing the access road in April. Heavy machinery and construction workers are evident in the photo. A cow and calf were photographed at a stream crossing, SC2.

4.12 HARVESTING

No information was reported about the harvest of game in the vicinity of the access road. A local trapper had reportedly set traps along the access road in winter 2010, but few details are available.

In fall 2009 five moose were harvested by NCN resource users for the NCN Country Foods Program. Five moose were also harvested in 2010, also apparently from the Wuskwatim Lake area. The Wuskwatim access road was used to gain access to the moose harvest area, to transport equipment to and from the site, and to transport the animals harvested at the Wuskwatim Lake area.

5.0 DISCUSSION AND CONCLUSIONS

Woodland caribou and other species may experience a loss of habitat effectiveness within 1 km of the Wuskwatim access road during construction, as hypothesized for the Wuskwatim Generation Project Environmental Impact Statement (Wildlife Resource Consulting Services MN Inc. and R.K. Schmidt Environmental 2003). Field studies were conducted prior to (2004-2006) and during (2007-2009) the construction of the generating station infrastructure and access road, to test this hypothesis. In addition to the construction effects monitoring as may be measured by the loss of habitat effectiveness for woodland caribou, and potentially for moose, black bear and wolf, other monitoring included wildlife accidents, harvest near the access road, and human-wildlife encounters.

The results indicate that in some cases, the construction of the access road and the generating station did have an effect on the activity levels of woodland caribou, moose, black bear and wolf as measured by corresponding changes in sign observed over time. This observation was noted less than 2 km, and particularly less than 1 km from the access road. With the exception of sites sampled nearest the Wuskwatim generating station, activity levels beyond 2 km either did not change, or in rare cases, increased. The following sections discuss the monitoring results on a species-by-species basis.

5.1 WOODLAND CARIBOU

A range of factors influence woodland caribou activity in the vicinity of the access road. Woodland caribou may avoid construction activity or the road itself. Their presence may also be influenced by the availability of suitable habitat at varying distances from the road. Woodland caribou may avoid areas where gray wolves or black bears are active, to minimize the risk of predation. When determining the effect of the access road on woodland caribou activity, these factors must also be considered.

The presence of woodland caribou on transects along the access road appeared to be influenced by habitat during all transect visits. In 2004 and 2005, woodland caribou were associated with wetland, especially with sparsely treed black spruce peat bog habitat (Blouw and Berger 2007). The majority of these habitats are generally located more than 2 km from the Wuskwatim access road. Habitats such as wetlands without trees and sparsely treed wetlands are commonly used by woodland caribou in the Wuskwatim

Study Area (Blouw and Berger 2007). Elsewhere in Manitoba, caribou use a mixture of jack pine and treed muskeg (Schindler 2005; Dyke 2008), lowland black spruce stands scattered across muskeg, and black spruce-dominated forest stands (Hirai 1998) for calving, calf-rearing, and escape cover from predators.

The interaction of habitat and woodland caribou activity were statistically significant during all three visits to transects along the access road. As habitat was only associated with segments with woodland caribou activity, no zero values (areas with no activity) were considered in the analysis. As such, analyses of woodland caribou activity and habitat were limited to areas where caribou were present, and did not include habitats where they were not found.

The first sample period (i.e., thread lay, generally in June) coincided with woodland caribou calving, which occurs in mid May and early June (Hirai 1998). At that time, woodland caribou actively select calving habitat to avoid predators (Rettie and Messier 2000). Woodland caribou appeared to select particular habitats in the vicinity of the access road, as an association was measured between caribou activity and habitat. While the analysis indicated a significant difference in caribou activity among habitats, it did not identify the habitats being selected or avoided. As previously mentioned, woodland caribou prefer sparsely treed peatlands and also conifer or jack pine stands for calving, and it is likely that activity levels were highest in these areas.

In summer woodland caribou are solitary, with females and calves occupying calving and calf rearing habitat (Fuller and Keith 1981; Bergerud *et al*. 1990). An association between woodland caribou activity and habitat was measured during the first check, which generally occurred in July and August. While the selection or avoidance of particular habitats is unknown as the study was not designed to determine resource selection function, it is most likely that woodland caribou were most active in the calf-rearing habitats such as sparsely treed peatland (R. Berger, Pers. Obs.).

Woodland caribou typically congregate in the fall (Hirai 1998), which is generally when the second check occurred. An association with woodland caribou activity and habitat was measured in the vicinity of the access road. While woodland caribou were not selecting calving habitat at this time, they may have been selecting habitat with the lowest risk of predation (Bergerud *et al*. 1990; Rettie and Messier 2000).

Woodland caribou select habitat to avoid predation, among other factors (Bergerud *et al*. 1990; Hirai 1998; Rettie and Messier 2000). In some cases habitat that is generally

unsuitable for gray wolves, such as peatland, black spruce stands (Rettie and Messier 2000), and islands (Bergerud *et al*. 1990) is favored. Woodland caribou may also avoid habitat associated with moose (Ouelett *et al*. 1996; Rettie and Messier 2000), common prey of gray wolves (Fuller and Keith 1980). An association was measured between woodland caribou activity and moose activity in the vicinity of the access road during thread lay. More caribou activity was recorded in areas with no moose sign. Woodland caribou in the area may have been avoiding habitat favored by moose in order to decrease the risk of predation, as wolves are often positively associated with moose. Although caribou mortality due to gray wolf predation increases near linear corridors (James and Stuart-Smith 2000), woodland caribou activity was not influenced by gray wolf presence, as there was no apparent association between woodland caribou activity and gray wolf activity along the access road. However, the detectability of gray wolf sign is low and wolves may be more abundant in these areas than indicated by the data.

Woodland caribou activity was likely affected by black bear presence, as there was a significant correlation between black bear presence and woodland caribou activity during the second check of transects along the access road for the conditional analysis and during the first check when zero values were considered. Black bears are opportunistic predators of caribou (Pitt and Jordan 1996; Rettie and Messier 1998; Weclaw and Hudson 2004). As black bear activity generally increased near the access road (see Section 3.3), the decline in caribou activity might be attributed, at least in part, to black bear presence. As the first and second checks represented overlap of woodland caribou and black bear presence during a known time period (approximately one month between sampling visits), the effect of black bear presence on woodland caribou activity would be more apparent during the checks. During thread lay, there was no reference period to determine the age of sign; black bear and caribou signs could, have been left during different time frames with no temporal overlap.

When 200 m segments with no woodland caribou activity (i.e., zero signs) were considered in the analysis, there was more woodland caribou activity near the road before construction during thread lay. There was significantly less activity within 1 km of the road during the construction years than pre-construction years, and in a few cases marginal declines in activity were observed within 2 km of the road. Average activity declined at all increments from the road during construction, with the greatest decline (91%) less than 1 km from the road.

Woodland caribou activity levels appeared to be influenced by the construction of the access road and generating station. Overall, it appears that there was a general decline in

caribou activity levels, at about 22% per year, including in the control area. However, in the control area, there were no substantial changes detected between the pre-construction and construction periods. Declines were greater near the generating station compared to locations near the access road. Declines were greater in all construction areas, including near the road and generating station, compared to the control area. The average decline in activity levels by location was highly variable among seasons, ranging from declines up to 98% to increases as high as 39%.

Woodland caribou avoid human development (Dyer *et al*. 2001). Caribou activity is reported to decrease within 1 to 10 km of industrial developments (Vors *et al*. 2007). During the first and second checks, there was no clear trend in the amount of woodland caribou activity nearer to or farther from the road during the years before construction. There was significantly less activity near the road than farther away during the construction years. A larger distance effect was measured during construction than before construction. Average woodland caribou activity declined near the road from the pre-construction to construction periods and tended to increase farther from it, indicating in some cases, a shift in activity from near the road to farther away from the road during construction. The greatest decline was within 1 km of the road during both checks (92% and 76%).

Woodland caribou activity appeared to be influenced by construction of the access road, as a greater decline in woodland caribou activity was observed on the access road transects than the control transects within 1 km, more than 1 km, and within 2 km of the access road during the first two visits (see Appendices E and F). However, a greater decline in woodland caribou activity was observed on control transects than access road transects more than 1 km and more than 2 km from the road or control road during the third visit (see Appendix G). With few exceptions, a loss of habitat effectiveness was observed up to 2 km from the access road. There was significantly less woodland caribou activity nearer the access road (within 1 km versus more than 1 km) and generally less activity within 2 km versus more than 2 km of the access road during each construction year. Woodland caribou activity also declined from the pre-construction to construction periods near the access road and in some cases increased, but not significantly, farther from it. Seasonal differences were apparent throughout all sampling periods.

Woodland caribou activity appeared to be influenced by construction disturbances at the generating station site. There was generally more woodland caribou activity closer to the proposed generating station than farther away in the years prior to construction and during construction. While woodland caribou activity levels were higher near the

generating station than further away in each study year, there was an overall decline in activity levels less than 2 km from the generating station during the construction years. Corresponding increases in activity further than 2 km from the generating station did not occur. A greater decline in woodland caribou activity was observed on generating station transects than control transects at most increments from the road (see Appendices E to G). Seasonal differences in activity were most apparent in August.

During thread lay, there was less activity closer to the control road prior to construction than during construction. Average activity declined at all intervals from the control road from the pre-construction to construction period. There were few significant differences between activity levels pre-construction and during construction during the first check. Average activity was significantly lower during construction than pre-construction at all intervals from the control road.

As woodland caribou activity declined significantly near the access road and increased farther away, it would appear that the Wapisu woodland caribou tended to avoid disturbance due to construction, as predicted in the Environmental Impact Statement. The lack of distance from the road effects and significant declines in activity at all intervals from the generating station during construction indicate that the disturbance from construction activities at the generating station extended up to 2 km. There was a greater decline in woodland caribou activity on generating station transects than access road transects, where a significant difference was measured, likely indicating that construction activity associated with the generating station created a greater disturbance effect than construction activities on the access road. While noise disturbance due to construction is likely the cause of decreased activity near the access road and generating station construction zones, woodland caribou activity also decreased significantly on control transects during thread lay and the second check. Woodland caribou activity did not change within 1 km of the access road during the first check, and increased slightly more than 1 km away.

Signs warning motorists of woodland caribou activity were posted on the access road and on Highway 391 in areas where woodland caribou activity crossing was reported. While woodland caribou were observed on or near the access road, no collisions with vehicles were reported. As there were no collisions reported before the signs were set up, it is difficult to determine the effectiveness of the signs. There were no reports of woodland caribou mortality due to gray wolf predation or harvest by resource users on the access road.

Conclusion

Woodland caribou activity was associated with habitat, moose activity, and black bear activity. Woodland caribou activity was likely greatest in their preferred calf-rearing habitat, sparsely treed peatland. Predator avoidance strategies were occasionally indicated by woodland caribou activity. Less woodland caribou activity was associated with areas with black bear and moose activity during some visits. However, there was no association between woodland caribou activity and gray wolf activity, which could be explained in part by the low detectability of gray wolf sign.

Woodland caribou activity decreased near construction sites as expected, creating a loss of effective habitat, usually within 2 km of construction zones, which was greater than the 1 km predicted by the EIS. However, sightings of caribou on the access road during construction, and the relative level of habitat use within 1 and 2 km of the road as measured by activity levels confirmed that the road did not create an impassable barrier to caribou movement, or it did not reduce the effective habitat loss near the road to zero.

While there were no collisions with caribou reported on the road during the six-year study period, mitigation measures such as signs warning motorists of areas with high activity might benefit woodland caribou and motorists in the area. Traditional harvest of caribou was not reported from the access road area. No gray wolf predation on woodland caribou was reported near the access road. As such, and to date, it would appear that the Project has had a small, if any, effect on caribou mortality in the active construction area.

5.2 MOOSE

As with woodland caribou, moose presence near the access road could be influenced by construction-related disturbance, the road itself, habitat suitability in the area, or by the presence of predators. Moose activity was not influenced by habitat in the study area. Moose were fairly evenly distributed throughout the habitat types in the vicinity of the access road in 2004 and 2005 (Blouw and Berger 2007). Although gray wolves prey on moose (Bergerud *et al*. 1993; Messier 1994; Seip 2008), gray wolf presence did not appear to affect moose activity as measured on transects perpendicular to the access road. This may be explained in part however, by the low detectability of gray wolf signs.

Overall, there was a general decline in moose activity levels, at about 36% per year, including in the control area. The average decline in activity levels by location was highly variable among the seasons monitored between June and September, ranging from 95% declines to increases as high as 257%.

Average moose activity declined along the access road from the pre-construction to construction periods at each visit when segments with no moose activity were incorporated into the analysis. However, there was more activity closer to the road during construction years, when a significant difference was observed. Workers in the area reported "moose attracted to work areas by construction noise" (see Section 5.11). Although some types of noise might attract animals, it is more likely that moose were attracted to work areas by exposed minerals (i.e., salt licks), improved browse at roadsides (Dussault *et al*. 2007; Laurian *et al*. 2008), or by openings that may be used for travel. Moose activity did not often differ significantly on access road and control transects, but where differences were measured, the decline in activity was generally greater on control transects compared to access road transects.

Construction activities and associated disturbances likely influenced the distribution and activity level of moose in the area, but not in the same way that woodland caribou were influenced. During construction, stronger effects were measured in areas less than 1 km from the road, and in a few cases less than 2 km from the road, where there was a significant increase in moose activity nearer the road. In some cases, corresponding shifts occurred for locations where activity levels decreased further away from the access road while activity levels increased closer to the access road during construction.

Construction activities and associated disturbances also influenced the distribution and activity levels of moose near the generating station. Moose activity was greater closer to the proposed generating station in the years before construction. Although some seasonal differences were apparent in late June-early July, and in mid-July-August, this trend continued, or at times, activity levels increased closer to the generating station during construction. Stronger effects were measured in areas less than 1 km from the generating station site, and occasionally less than 2 km from the generating station. Where a difference was measured, a consistently greater decline in moose activity was observed on control transects as opposed to the generating station transects.

Average moose activity also declined on control transects from the pre-construction to construction periods at each visit. The decline was most significant during thread lay and

the second check, where significant effects were measured at all increments from the road.

Several moose observations were made along the access road and at work sites. Moose were harvested in the general Wuskwatim area, but it is unclear whether the harvest was facilitated by the newly constructed access road. No wildlife-vehicle collisions with moose were reported on the access road.

Conclusion

Moose activity declined during construction of the generating station and access road; however, greater declines were recorded on control transects than those near construction activity. As such, a general decline in moose activity in the study area is indicated. Moose activity did not decline near active construction zones. Despite the overall decline in activity levels from the pre-construction to construction periods, moose not only continued to use areas near the disturbances, but in some cases, may have been attracted to them. Moose were expected to avoid active construction zones due to sensory disturbance (see the Wuskwatim Generation Project Environmental Impact Statement Volume 6). No loss of effective habitat was observed, and the apparent increase in moose activity adjacent to all construction zones including the road and the generation station was unanticipated.

Despite their apparent attraction to the access road, no moose-vehicle collisions were reported. However, mitigation measures to reduce moose activity near the road and generating station should be considered (see Section 6.0). Improved access for resource users via the access road did contribute to a moose harvest in the region. To date however, it would appear that the Project had a small, if any, effect on moose mortality in the active construction area.

5.3 BLACK BEAR

Black bears did not exhibit a preference for a particular habitat type. This result may have been influenced by the paucity of data, or by other factors. As black bears are generally considered generalists (Rice *et al*. 2008), whose habitat is characterized mainly by an ample vegetative food supply (Pelton 1982), habitat was not expected to influence their activity.

Overall, black bear activity levels were hard to define with no clear changes in overall activity levels. Declines appeared to be substantial, averaging 46% per year, but only during the construction period. When segments with no black bear activity were incorporated into the analysis, a decline in average black bear activity was observed along the access road during thread lay from the pre-construction to construction phase. No significant effect was measured during the first check, but average activity declined closer to the road (within 1 km and 2 km) and increased farther from it (more than 1 km and 2 km away). In individual study years, black bear activity was greater closer to the road during thread lay and the second check, where a difference was measured. Average activity levels were highly variable among seasons monitored between June and August/September, ranging from declines up to 99% to increases as high as 75%.

Data for the generating station transects are limited. During thread lay, black bear activity was analyzed for 2006 and 2007. Black bear activity increased closer to the generating station in 2007, during construction. No effects were measured when the two years were compared. Construction activities and associated disturbances may have influenced the distribution and activity levels of blacks in the area. Although black bear activity declined near the GS, especially during construction, it did not prevent black bears from using habitat adjacent to the disturbances.

There was a general decline in average black bear activity on control transects from the pre-construction to construction period during thread lay, the only visit for which there was sufficient data to make a comparison. The decline was only significant within 1 km of the control road. No differences in black bear activity were measured in the control area transects during thread lay or the first check.

Conclusion

Although black bear activity generally declined in the study area during construction, black bears did not avoid the access road. There are indications of increased black bear activity in close proximity to the access road during individual study years. These results are corroborated by a number of human-bear encounters, or evidence of a few black bears, in the vicinity of the access road and work camps. No loss of effective habitat was observed for some black bears. No black bear-vehicle collisions were reported on the access road, but wildlife control actions at camp and work sites contributed to black bear mortality. Encounters with black bears were expected, but the reduction or elimination of the need for lethal black bear control actions would be ideal (Section 6.0).

5.4 GRAY WOLF

Gray wolf activity along the access road was influenced by habitat. Gray wolves tend not to select for specific habitats, but are associated with areas with forest cover, ample prey, and lower human density (Oakleaf *et al*. 2006). Based solely on observations of sign, gray wolf activity tended to be greatest in habitats where woodland caribou activity was greatest, and were absent from habitats with little woodland caribou activity.

In the early stages of construction, a pack of gray wolves was also observed in camps, work areas, and along the road. Two gray wolves were killed by large trucks on the access road. Single wolves were seen along the access road. Wolf sightings were not unanticipated as gray wolves have been observed crossing two-lane highways; however their willingness to do so may differ among individuals (Mech *et al*. 1995).

Conclusion

There was no change in average gray wolf activity along the access road from the pre-construction to construction phase; no loss of effective habitat was observed. There is evidence that some gray wolves are not deterred by construction activity or human presence. Wildlife-vehicle collisions and wildlife control actions at camps contributed to gray wolf mortality. The Project has contributed to gray wolf mortality. As human encounters and collisions with gray wolves were more frequent than expected, mitigation measures to reduce these effects should be considered for future hydro-electric generation projects (see Section 6.0).

6.0 RECOMMENDATIONS

The following recommendations are based on observed gaps in information and actions during the construction monitoring. Recommendations 1 to 8 below could be employed at future generating station construction projects to decrease the loss of effective habitat for caribou during construction, to improve reporting, manage or reduce the apparently small number of wildlife-vehicle collisions along access roads and to reduce the number of encounters with wildlife in camp and work areas.

1. Limit construction activity within 5 km of active woodland caribou habitats during calving and calf-rearing season, from late May to mid July, to reduce sensory disturbance at this sensitive time.

2. Establish consistent and detailed reporting of wildlife observations, harvesting, and collisions along the access road. Monthly submissions of reports are preferable over yearly submissions. Details such as date, time of day, location of the observation, the species, the numbers involved, and their behaviour should be included in as much detail as possible. Such information could be used to assess areas with high levels of wildlife activity and the necessity for additional mitigation measures.

3. Reduce speed limits in areas with higher-than-average wildlife activity in order to reduce wildlife-vehicle collisions. Reduced speed could increase the reaction time of drivers to wildlife on the road (Joyce and Mahoney 2001). The risk of injury to wildlife and humans increases with increased speed (Joyce and Mahoney 2001), thus a reduction in the speed limit could lessen the damage caused by a collision. However, the effectiveness of reducing speed limits to prevent ungulate-vehicle collisions is questionable, largely because drivers tend not to adhere to posted speed limits (Romin and Bissonette 1996; Joyce and Mahoney 2001; Bissonette and Kassar 2008). Strict enforcement of posted speed limits is generally required to reduce the risk of collisions with wildlife.

4. The number of foxes being attracted to the work camp or denning in the work camp area was not anticipated originally to be of concern; however, as the number of foxes, and the growing number of fox-human encounters increases, the risk of injury to both wildlife and people will also increase. Although these animals were successfully trapped and relocated, garbage policies and rules for workers

interacting with wildlife should be reviewed in order to improve existing policies. It may be possible to reassess and remove attractants from the generating station site that were missed, or by storing waste at another location or in a more secure and odor-free manner.

5. An education campaign was conducted by the Project Environmental Inspectors during contractors' daily tail board meetings, to discourage the feeding of foxes. The topic should be addressed frequently through regular project meetings to reinforce that feeding wildlife creates a hazard and could result in the destruction of persistent animals.

6. As some gray wolves are not deterred by the road or by human presence in camp, it is recommended that wolf observations near the access road be carefully and consistently documented in order to monitor gray wolf activity. The date, time, and location of the observation should be recorded, and information such as the number of individuals and their behaviour. A portion of the annual joint workshops about bear safety and awareness could be devoted to gray wolf safety and awareness, and proper documentation of wolf observations could be added to any training or orientation sessions of new staff.

7. Remove all food sources that potentially attract wildlife species to the access road. Although vegetation planted along the access road helps prevent erosion, it can also attract wildlife such as black bears and moose. The presence of moose may also attract wolves. In areas where erosion control is required, vegetation plantings should include those species that are less palatable to wildlife. Also, other non-essential vegetation along the access road such as shrubs and trees should be removed in order to reduce wildlife feeding activities near the road and to improve the visibility of wildlife movements to drivers. Although not reported as a problem for the Wuskwatim Project as of yet, all roadside carcasses should be removed and disposed of in an appropriate manner to minimize scavenging, and potentially increasing the risk of more wildlife-vehicle collisions.

8. As recommended in the Terrestrial Monitoring Plan for the project, future monitoring at Wuskwatim should be conducted to determine whether large mammal activity levels will change during the operation of the generating station. As human activities and overall disturbances along the access road and at the generating station during operations are expected to decrease compared to the construction period, woodland caribou and other large mammal activities should

return towards pre-construction activity levels. Although distance to road effects are expected to be lower during the operational period, potential effects could remain higher than during the pre-construction period, and over the lifetime of the project. A three-year roadside monitoring program should be sufficient to document large mammals including woodland caribou activities during operations.

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APPENDICES

APPENDIX A.
LIST OF TRANSECTS SURVEYED, 2004 TO 2009

Transect	2004	2005	2006	2007	2008	2009
01E	x	x	x	x	x	x
01W	x	x	x	x	x	x
02E		x	x	x	x	x
02W	x	x	x	x	x	x
03E	x	x	x	x	x	x
03EA		x	x	x	x	x
03W	x	x	x	x	x	x
03WA		x	x	x	x	x
04E	x	x	x	x	x	x
04W	x	x	x	x	x	x
05E	x	x	x	x	x	x
05W	x	x	x	x	x	x
05WA		x	x	x	x	x
06E	x	x				
06W	x	x	x	x	x	x
07E	x	x				
07W	x	x				
08E	x	x				
08W	x	x				
08EA		x				
09E	x	x				
10E	x	x				
10W	x	x				
11E	x	x				
11W	x	x				
12E	x	x				
12W	x	x				
13E	x	x				
13W	x	x	x	x	x	x
13WA		x	x	x	x	x
14E	x	x				
14W	x	x				
14WA		x	x	x	x	x
15W	x	x				
16W	x	x				
01S		x	x	x	x	x
02S		x	x	x	x	x
03S		x	x	x	x	x
04S		x				
Control 1		x	x	x	x	x
Control 2		x	x	x	x	x
Control 3		x	x	x	x	x
Control 4		x	x	x	x	x

APPENDIX B.
COMBINED HABITAT BROAD CLASSIFICATIONS

Code	Habitat Broad Category	Sample Size
011	Sparsely treed on dry sites- exposed bedrock	75
021	Jack pine forest on mineral or dry mineral soil- new to immature	783
022	Jack pine or mixedwood forest on mineral or dry mineral soil- mature	419
031	Jack pine mixed forest on dry mineral soil- new to immature	39
041	Black spruce forest on mineral peaty soil or peaty mineral soil- new to immature	2,086
042	Black spruce forest on mineral peaty soil or peaty mineral soil- mature	253
043	Black spruce forest on mineral soil- new to immature	848
044	Black or white spruce forest on mineral soil- mature	108
045	Black spruce forest on peatland- new to immature	1,430
046	Black spruce forest on peatland- mature	112
101	Black spruce mixedwood forest on mineral peaty soil or peatland- new to immature	127
201	Hardwood mixedwood forest on mineral soil- new to mature	151
211	Hardwood forest on mineral soil- new to immature	58
301	Sparsely treed on wet sites- peatland	9,153
321	Tall shrub or water - wetland river or lake	50
341	High water table wetland or low shrub graminoid and or emergent- fen with patches of water to wet bog	1,015

APPENDIX C.
ACTIVITY OF WOODLAND CARIBOU, MOOSE, BLACK BEAR, AND GRAY WOLF FROM ALONG COMMON TRANSECTS IN THE WUSKWATIM SUB-REGION, 2004 TO 2009

	Woodland Caribou						Moose						Black Bear						Gray Wolf						Total
Location	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	
01E	93	44	36	36	18	3	8	11	110	6	5	30	1	1	0	17	13	5	4	6	3	3	10	2	**465**
01S	-	439	95	115	27	0	-	66	156	25	67	117	-	4	12	42	1	5	-	5	0	3	2	1	**1,182**
01W	8	1	68	70	8	1	11	6	47	46	14	21	1	1	33	25	3	1	1	0	4	12	2	0	**384**
02E	26	98	503	50	7	0	12	37	25	20	21	38	2	1	0	27	3	9	4	0	0	10	3	2	**898**
02S	-	10	481	106	27	1	-	2	34	59	15	67	-	0	0	35	11	4	-	2	0	78	1	5	**938**
02W	15	0	61	19	3	0	17	10	14	24	15	12	2	0	3	30	2	6	2	6	0	3	4	6	**254**
03E	49	153	760	49	32	5	18	25	22	90	27	75	1	0	16	24	16	9	3	0	0	10	0	3	**1,387**
03EA	-	174	722	77	28	30	-	75	8	35	28	59	-	0	0	24	5	3	-	2	0	1	3	2	**1,276**
03S	-	492	800	133	18	7	-	49	29	87	27	35	-	1	0	44	4	1	-	9	0	68	6	3	**1,813**
03W	182	46	219	117	82	41	32	20	141	29	21	44	2	0	24	41	5	6	8	0	4	4	1	1	**1,070**
03WA	-	65	213	115	77	27	-	46	150	101	45	61	-	1	65	31	1	1	-	0	7	17	3	0	**1,026**
04E	33	24	380	68	20	19	20	70	23	47	17	54	1	0	0	34	2	2	0	0	0	7	4	2	**827**
04W	157	27	170	112	85	38	37	12	143	44	23	75	0	0	6	28	6	6	5	0	5	1	4	4	**988**
05E	3	51	411	69	24	0	28	39	16	35	56	19	2	0	0	17	12	3	0	0	0	1	15	12	**813**
05W	530	406	564	266	191	181	72	59	104	63	8	21	4	3	31	64	9	5	1	1	4	34	2	6	**2,629**
05WA	-	179	10	155	204	65	-	1	0	32	4	22	-	0	6	23	5	6	-	0	0	1	8	6	**727**
06W	189	121	159	253	172	103	2	9	186	39	16	14	1	4	27	29	6	0	0	4	2	21	0	1	**1,358**
13W	8	47	147	122	20	2	26	10	122	59	16	19	0	0	13	12	1	3	0	1	0	21	1	3	**653**
13WA	-	205	243	84	19	10	-	0	7	13	18	23	-	0	4	12	0	4	-	1	0	1	0	0	**644**
14WA	-	69	53	73	5	4	-	79	142	28	28	44	-	2	3	41	7	18	-	0	5	4	5	4	**614**
Control01	-	378	180	624	275	143	-	13	78	62	23	26	-	0	8	51	8	0	-	0	0	37	3	0	**1,909**
Control02	-	0	374	488	423	306	-	0	187	14	21	7	-	0	103	28	2	0	-	0	3	3	1	0	**1,960**
Control03	-	129	430	395	195	170	-	2	73	33	11	14	-	0	11	38	12	0	-	0	0	1	0	0	**1,514**
Control04	-	772	397	899	242	209	-	38	183	53	27	25	-	1	60	47	3	0	-	1	0	6	0	0	**2,963**
Total	**1,293**	**3,930**	**7,476**	**4,495**	**2,202**	**1,365**	**283**	**679**	**2,000**	**1,044**	**553**	**922**	**17**	**19**	**425**	**764**	**137**	**97**	**28**	**38**	**37**	**347**	**78**	**63**	**28,292**

Note: 2006 counts are based on two site visits only; others include thread lay, check 1 and check 2.

APPENDIX D.
INCIDENTAL OBSERVATIONS

Small mammal sign was most frequently recorded during transect studies (Table D-1). Weasel sign was least commonly observed, and was not identified to species. Incidental observations are reported for all visits each study year, but because most species are too small to break the thread, the majority of observations were made during thread lay.

Table D-1. Incidental mammal observations along all transects in the vicinity of the Wuskwatim access road, 2004 to 2009.

Species	2004	2005	2006	2007	2008	2009	Total
Small mammal	633	282	0	1,389	1,244	395	**3,943**
Red squirrel	441	900	21	1,262	882	246	**3,752**
Snowshoe hare	105	157	30	152	195	115	**754**
Beaver	13	162	16	0	75	21	**287**
Red fox	10	15	8	16	12	25	**86**
Muskrat	0	0	0	48	9	0	**57**
American marten	4	5	2	12	16	16	**55**
River otter	1	12	4	6	16	10	**49**
Mink	1	0	3	12	14	6	**36**
Lynx	1	1	1	1	3	1	**8**
Fisher	0	0	0	1	5	1	**7**
Weasel spp.	0	4	0	0	0	0	**4**
Total	**1,209**	**1,538**	**85**	**2,899**	**2,471**	**836**	**9,038**

Incidental observations were made of sign of five bird species (Table D-2). Waterfowl species were Canada goose and mallard, and upland game bird species were ruffed grouse, spruce grouse, and willow ptarmigan. Spruce grouse sign was most frequently observed. Canada geese were heard a single time in 2009, and a mallard was observed in 2006.

Table D-2. Incidental bird observations along all transects in the vicinity of the Wuskwatim access road, 2004 to 2009.

Species	2004	2005	2006	2007	2008	2009	Total
Canada goose	0	0	0	0	0	1	**1**
Mallard	0	0	1	0	0	0	**1**
Ruffed grouse	0	0	0	6	0	1	**7**
Spruce grouse	0	0	15	1	0	0	**16**
Willow ptarmigan	0	0	0	1	3	0	**4**
Total	**0**	**0**	**16**	**8**	**3**	**2**	**29**

APPENDIX E.
COMPARISON OF WOODLAND CARIBOU ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THREAD LAY

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	17.81	< **0.0001**	Access road > Control; greater distance to the road effect on Access road transects, characterized by greater activity within 2 km vs. more than 2 km from road
	Access road - GS	5.81	**0.0159**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	23.92	< **0.0001**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	9.55	**0.0020**	Access road > Control; greater distance to the road effect on Access road transects, characterized by greater activity within 1 km vs. more than 1 km from road
	Access road - GS	12.77	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	24.59	< **0.0001**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	9.11	**0.0025**	Control > Access road; greater distance to the road effect on control transects, characterized by greater activity within 2 km vs. more than 2 km from road
	Access road - GS	27.30	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
				greater activity within 2 km vs. more than 2 km from road
	GS - Control	10.25	**0.0014**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	9.42	**0.0021**	Control > Access road; greater distance to the road effect on control transects, characterized by greater activity within 1 km vs. more than 1 km from road
	Access road - GS	35.63	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	12.69	**0.0004**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	52.05	< **0.0001**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	0.28	0.5949	
	GS - Control	29.47	< **0.0001**	GS > Control; greater decline in activity on GS transects
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9909	
	Access road - GS	16.68	< **0.0001**	GS > Access road; greater decline in activity on GS transects
	GS - Control	13.02	**0.0003**	GS > Control; greater decline in activity on GS transects

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	38.87	< **0.0001**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	0.05	0.8306	
	GS - Control	18.42	< **0.0001**	GS > Control; greater decline in activity on GS transects
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	5.06	**0.0245**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	16.01	< **0.0001**	GS > Access road; greater decline in activity on GS transects
	GS - Control	23.59	< **0.0001**	GS > Control; greater decline in activity on GS transects
2004-2006	(Activity in Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	1.48	0.2235	
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	57.77	< **0.0001**	Control > Access road; greater activity on control transects
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	163.31	< **0.0001**	Control > Access road; greater activity on control transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity in	99.71	< **0.0001**	Control > Access road; greater activity on control transects

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
	Control Transects, 0-4 km from Road)			

*Bold indicates significance

APPENDIX F.
COMPARISON OF WOODLAND CARIBOU ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THE FIRST CHECK

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road – Control	2.30	0.1293	
	Access road – GS	31.28	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS – Control	16.79	< **0.0001**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.12	0.7260	
	Access road - GS	31.42	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	20.20	< **0.0001**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	59.24	< **0.0001**	Control > Access road; greater distance to the road effect on control transects, characterized by greater activity within 2 km vs. more than 2 km from road
	Access road - GS	21.04	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	4.34	**0.0371**	GS > Control; greater distance to the road effect on GS transects, characterized by

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
				greater activity within 2 km vs. more than 2 km from road
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	49.59	< **0.0001**	Control > Access road; greater distance to the road effect on Access road transects, characterized by less activity within 1 km vs. more than 1 km from road
	Access road - GS	40.27	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	8.39	**0.0038**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	41.49	< **0.0001**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	1.44	0.2298	
	GS - Control	7.02	**0.0081**	GS > Control; greater decline in activity on GS transects
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.55	0.4576	
	Access road - GS	1.26	0.2609	
	GS - Control	1.74	0.1867	
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	43.78	< **0.0001**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	8.37	**0.0038**	Access road > GS; greater decline in activity on Access road transects
	GS - Control	3.43	**0.0638**	GS > Control; greater decline in activity on GS transects

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	2.89	**0.0890**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	2.13	0.1448	
	GS - Control	3.94	**0.0470**	GS > Control; greater decline in activity on GS transects
2004-2006	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	65.78	< **0.0001**	Control > Access road; greater activity on control transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	57.18	< **0.0001**	Control > Access road; greater activity on control transects
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	238.40	< **0.0001**	Control > Access road; greater activity on control transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	90.84	< **0.0001**	Control > Access road; greater activity on control transects

*Bold indicates significance

APPENDIX G.
COMPARISON OF WOODLAND CARIBOU ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THE SECOND CHECK

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.47	0.4930	
	Access road - GS	34.26	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	22.10	< **0.0001**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.31	0.5784	
	Access road - GS	39.53	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	23.06	< **0.0001**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	61.30	< **0.0001**	Control > Access road; greater distance to the road effect on control transects, characterized by greater activity within 2 km vs. more than 2 km from road
	Access road - GS	10.85	**0.0010**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	0.11	0.7385	
2007-2009; (Activity within 1 km) – (Activity	Access road - Control	54.50	< **0.0001**	Control > Access road; greater distance to the road effect on control transects,

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
more than 1 km from road)				characterized by greater activity within 1 km vs. more than 1 km from road
	Access road - GS	34.10	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	1.48	0.2244	
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	1.86	0.1723	
	Access road - GS	18.42	< **0.0001**	GS > Access road; greater decline in activity on GS transects
	GS - Control	10.20	**0.0014**	GS > Control; greater decline in activity on GS transects
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	46.15	< **0.0001**	Control > Access road; greater decline in activity on control transects
	Access road - GS	1.52	0.2171	
	GS - Control	5.30	**0.0214**	Control > GS; greater decline in activity on control transects
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	1.23	0.2671	
	Access road - GS	4.75	**0.0293**	GS > Access road; greater decline in activity on GS transects
	GS - Control	9.37	**0.0022**	GS > Control; greater decline in activity on GS transects
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	57.76	< **0.0001**	Control > Access road; greater decline in activity on control transects
	Access road - GS	9.95	**0.0016**	GS > Access road; greater decline in activity on GS transects
	GS - Control	0.83	0.3630	

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	268.06	< **0.0001**	Control > Access road; greater activity on control transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	232.80	< **0.0001**	Control > Access road; greater activity on control transects
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	239.51	< **0.0001**	Control > Access road; greater activity on control transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	136.26	< **0.0001**	Control > Access road; greater activity on control transects

*Bold indicates significance

APPENDIX H.
COMPARISON OF MOOSE ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THREAD LAY

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	2.68	0.1019	
	Access road - GS	4.46	**0.0346**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	0.31	0.5779	
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	2.62	0.1055	
	Access road - GS	4.65	**0.0310**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	0.33	0.5640	
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.00	0.9755	
	Access road - GS	11.23	**0.0008**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	6.50	**0.0108**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	2.91	**0.0880**	Control > Access road; greater distance to the road effect on control transects, characterized by greater activity within 1 km vs. more than 1 km from road
	Access road - GS	22.18	< **0.0001**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
				km from road
	GS - Control	4.67	**0.0306**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	10.11	**0.0015**	Control > Access road; greater decline in activity on control transects
	Access road - GS	3.41	**0.0648**	Access road > GS; greater decline in activity on Access road transects
	GS - Control	15.52	< **0.0001**	Control > GS; greater decline in activity on control transects
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	1.38	0.2405	
	Access road - GS	1.64	0.2009	
	GS - Control	3.59	**0.0583**	Control > GS; greater decline in activity on control transects
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	3.34	**0.0678**	Access road > Control; greater decline in activity on Access road transects
	Access road - GS	3.42	**0.0645**	Access road > GS; greater decline in activity on Access road transects
	GS - Control	8.52	**0.0035**	Control > GS; greater decline in activity on control transects
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	5.95	**0.0147**	Control > Access road; greater decline in activity on control transects
	Access road - GS	2.24	0.1345	
	GS - Control	9.09	**0.0026**	Control > GS; greater decline in activity on control transects
2004-2006	(Activity on Access road Transects, 0-2 km from	1.92	0.1653	

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
	Road) - (Activity on Control Transects, 0-4 km from Road)			
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.16	0.6896	
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	22.69	< **0.0001**	Access road > Control; greater activity on Access road transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	3.70	**0.0545**	Access road > Control; greater activity on Access road transects

*Bold indicates significance

APPENDIX I.
COMPARISON OF MOOSE ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THE FIRST CHECK

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	1.90	0.1676	
	Access road - GS	9.75	**0.0018**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	11.77	**0.0006**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.11	0.7416	
	Access road - GS	13.70	**0.0002**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	9.01	**0.0027**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1 km from road
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.04	0.8405	
	Access road - GS	2.76	**0.0967**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
	GS - Control	1.39	0.2387	
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.54	0.4642	
	Access road - GS	7.06	**0.0079**	GS > Access road; greater distance to the road effect on GS transects, characterized by greater activity within 1 km vs. more than 1

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
				km from road
	GS - Control	2.07	0.1499	
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.15	0.6952	
	Access road - GS	0.40	0.5273	
	GS - Control	0.02	0.8790	
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	1.34	0.2466	
	Access road - GS	4.42	**0.0355**	Access road > GS; greater distance to the road effect on Access road transects, characterized by greater activity within 1 km vs. more than 1 km from road
	GS - Control	6.17	**0.0130**	Control > GS; greater distance to the road effect on control transects, characterized by greater activity within 1 km vs. more than 1 km from road
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.14	0.7093	
	Access road - GS	0.69	0.4070	
	GS - Control	0.06	0.8106	
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.71	0.3989	
	Access road - GS	3.92	**0.0477**	Access road > GS; greater decline in activity on Access road transects
	GS - Control	4.79	**0.0286**	Control > GS; greater decline in activity on control transects
2004-2006	(Activity on Access road Transects, 0-2 km from Road) - (Activity on	0.44	0.5093	

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
	Control Transects, 0-4 km from Road)			
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	5.59	**0.0180**	Control > Access road; greater activity on control transects
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.11	0.7421	
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.03	0.8678	

*Bold indicates significance

APPENDIX J.
COMPARISON OF MOOSE ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THE SECOND CHECK

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	10.24	**0.0014**	Access road > Control; greater distance to the road effect on Access road transects, characterized by greater activity within 2 km vs. more than 2 km from road
	Access road - GS	0.83	0.3612	
	GS - Control	2.92	**0.0876**	GS > Control; greater distance to the road effect on GS transects, characterized by greater activity within 2 km vs. more than 2 km from road
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	3.42	**0.0642**	Access road > Control; greater distance to the road effect on Access road transects, characterized by greater activity within 1 km vs. more than 1 km from road
	Access road - GS	1.03	0.3100	
	GS - Control	0.44	0.5055	
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	3.24	**0.0719**	Access road > Control; greater distance to the road effect on Access road transects, characterized by greater activity within 2 km vs. more than 2 km from road
	Access road - GS	0.00	0.9665	

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
	GS - Control	0.00	0.9613	
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	17.36	< **0.0001**	Access road > Control; greater distance to the road effect on Access road transects, characterized by greater activity within 1 km vs. more than 1 km from road
	Access road - GS	1.50	0.2203	
	GS - Control	0.00	0.9634	
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	1.44	0.2295	
	Access road - GS	0.32	0.5718	
	GS - Control	1.89	0.1695	
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	3.65	**0.0562**	Control > Access road; greater decline in activity on control transects
	Access road - GS	0.00	0.9655	
	GS - Control	0.00	0.9706	

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.98	0.3214	
	Access road - GS	1.87	**0.0717**	Access road > GS; greater decline in activity on Access road transects
	GS - Control	2.90	**0.0884**	Control > GS; greater decline in activity on control transects
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	3.93	**0.0474**	Control > Access road; greater decline in activity on control transects
	Access road - GS	0.00	0.9648	
	GS - Control	0.00	0.9714	
2004-2006	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.33	0.5677	
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	23.38	< **0.0001**	Control > Access road; greater activity on control transects

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	6.44	**0.0112**	Access road > Control; greater activity on Access road transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.23	0.6306	

*Bold indicates significance.

APPENDIX K.
COMPARISON OF BLACK BEAR ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THREAD LAY

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.40	0.5259	
	Access road - GS	0.00	0.9992	
	GS - Control	0.00	0.9988	
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	1.41	0.2345	
	Access road - GS	0.00	0.9785	
	GS - Control	0.00	0.9744	
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.00	0.9566	
	Access road - GS	0.79	0.3732	
	GS - Control	0.00	0.9972	
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.00	0.9774	
	Access road - GS	0.58	0.4476	
	GS - Control	1.99	0.1580	
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9780	
	Access road - GS	0.00	0.9832	
	GS - Control	0.00	0.9768	
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9828	
	Access road - GS	0.00	0.9812	
	GS - Control	0.00	0.9765	
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.22	0.6410	
	Access road - GS	2.29	0.1304	
	GS - Control	2.59	0.1073	
More than 1 km from road;	Access road - Control	0.00	0.9727	

Conditions	Contrast	χ^2 value	p-value*	Nature of Effect
(Activity in 2007-2009) – (Activity in 2004-2006)	Access road - GS	0.00	0.9755	
	GS - Control	0.00	0.9679	
2004-2006	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	10.58	**0.0011**	Control > Access road; greater activity on control transects
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	16.03	< **0.0001**	Control > Access road; greater activity on control transects
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.00	0.9746	
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.00	0.9829	

*Bold indicates significance

APPENDIX L.
COMPARISON OF BLACK BEAR ACTIVITY ON ACCESS ROAD, GS, AND CONTROL TRANSECTS DURING THE FIRST CHECK

Conditions	Contrast	χ^2 value	p-value
2004-2006; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.00	0.9858
2004-2006; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.00	0.9836
2007-2009; (Activity within 2 km) – (Activity more than 2 km from road)	Access road - Control	0.00	0.9963
2007-2009; (Activity within 1 km) – (Activity more than 1 km from road)	Access road - Control	0.00	0.9868
Within 2 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9845
More than 2 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9919
Within 1 km of road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9820
More than 1 km from road; (Activity in 2007-2009) – (Activity in 2004-2006)	Access road - Control	0.00	0.9909
2004-2006	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.00	0.9844
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.00	0.9918
2007-2009	(Activity on Access road Transects, 0-2 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.00	0.9826
	(Activity on Access road Transects, 2-4 km from Road) - (Activity on Control Transects, 0-4 km from Road)	0.00	0.9875

APPENDIX M.
LARGE MAMMAL OBSERVATIONS 2007 AND 2008

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH_May 2007 – April 2008_____ **OBSERVER**_____WDC_____

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
Moose	May ?, 2007	SC # 1		1			Observed by M. Linklater
Caribou	April ?, 2007	J6 Pit			1		Observed by JV Crew
Caribou	April ?, 2007	S2 Site			2		Moving through construction site
Black bear	September, 2007	R2 camp	1				
Black bear	September 18, 2007	S2 camp		1		3	Sow with 3 cubs, dispatched by Man. Conservation
Black bear	September 9, 2007	R2 camp	1				Capture in bear trap
Moose	September , 2007	Wuskwatim site		1		1	Cow and calf observed numerous times around construction site
Timber wolves	Sept./07 – Dec./07	Access road			7		Pack of wolves observed along access road and S2 camp, dispatched 2 wolves

M = Male; F = Female; U = Unknown

Reproduced from original form.

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH May 08 **OBSERVER** J. V.

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
Wolverine	May 10	R2 Camp			✓		Young
Moose	May 6	Km 5		✓		2	

M = Male; F = Female; U = Unknown

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH MAY **OBSERVER** MIT

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
Cross Fox	22/05/2008	Km 1			X		
Lynx	22/05/2008	Km 34			X		
Red Fox	23/05/2008	Km 5			X		
Red Fox	25/05/2008	Km 6			X		

M = Male; F = Female; U = Unknown

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH June/08 OBSERVER [illegible]

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
LYNX	June 2	Km 5			✓		skinny
MOOSE	June 18	SC # 6		✓		2	

M = Male; F = Female; U = Unknown

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH JULY **OBSERVER** MIT

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
Lynx	03/07/2008	Km 41			X		
Fox	07/07/2008	Km 44			X		
Bear & 2 cubs	09/07/2008	Km 19		X			
Wolverine	15/07/2008	Km 41			X		
Lynx	25/07/2008	Km 39	X				
Fox	28/07/2008	Km 43	X				

M = Male; F = Female; U = Unknown

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH AUGUST **OBSERVER** MIT

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
Black Bear	08/08/2008	Km 38			X		
Fox	11/08/2008	Km 45			X		
Black Bear	15/08/2008	Km 37			X		
Black Bear	16/08/2008	Km 38			X		

M = Male; F = Female; U = Unknown

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH SEPTEMBER **OBSERVER** MIT

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
Bear	06/09/2008	Km 38			X		
Lynx	08/09/2008	Km 37			X		
Timberwolf	10/09/2008	Km 34			X		
Bear	18/09/2008	Km 38			X		
Moose	24/09/2008	Km 43	X				

M = Male; F = Female; U = Unknown

WUSKWATIM CONSTRUCTION DEPARTMENT
BIG GAME OBSERVATION FORM

MONTH OCTOBER **OBSERVER** MIT

Species	Date	Location	Number Observed				General Remarks (Condition, etc.)
			Adult			Calf	
			M	F	U		
2 Moose	17/10/2008	SC#9		X			2 cows
2 Moose	18/10/2008	SC#2	X	X			1 bull, 1 cow

M = Male; F = Female; U = Unknown