MANITOBA–MINNESOTA TRANSMISSION PROJECT

Environmental Monitoring Plan

SHARP-TAILED GROUSE MONITORING REPORT 2020

Prepared for

Manitoba Hydro

By

Wildlife Resource Consulting Services MB Inc.

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SENSITIVE DATA REDACTED

EXECUTIVE SUMMARY

The sharp-tailed grouse (*Tympanuchus phasianellus*), which typically inhabits grasslands and aspen parkland, can be found in the Manitoba-Minnesota Transmission Project Regional Assessment Area. Like most grassland birds, it has experienced widespread habitat loss through most of the prairies. In spring, sharp-tailed grouse assemble at grassy areas called leks to mate. Males dance, coo, and rattle to attract females. The objectives of sharp-tailed grouse monitoring were to evaluate the effects of transmission line installation on grouse at lekking sites and to identify an association between avian and terrestrial predators, sharp-tailed grouse, and transmission lines.

Pre-construction surveys for sharp-tailed grouse conducted in spring 2017 and 2019 were repeated in 2020, the first year after Project construction. With permission from landowners, two trail cameras were set up to photograph sharp-tailed grouse activity at eight leks. Reconnaissance surveys were then carried out at 76 sites identified as leks or potential leks during previous survey years, where access was not permitted or could not be obtained from landowners. Surveyors scanned for sharp-tailed grouse and listened for indications of mating behaviour or for signs of the species' presence. Observations of ground and avian predators, if any, were recorded including short-eared owl (*Asio flammeus*), which is a species of conservation concern.

Trail camera photos were reviewed and the maximum number of grouse photographed during five-second intervals was recorded, along with the behaviour most often displayed by each. The proportion of time spent engaged in each behaviour was calculated and the maximum number of individuals photographed engaged in reproductive behaviour each day was recorded, with the greatest considered the number of males at each site. Statistical comparisons were made between potentially affected leks (within 1,500 m of the transmission line right-of-way) and reference leks (more than 1,500 m from the right-of way) before and after construction to test the effect of the transmission line on grouse alert behaviour, time spent on the lek by grouse, and the abundance of males at lekking sites.

Of the 84 sites surveyed in spring 2020, 16 were identified as leks and 18 were identified as potential leks. No sharp-tailed grouse activity was recorded at 50 sites. Analyses of sharp-tailed grouse abundance and behaviour from approximately 638,000 trail camera photos indicated that there was no difference in the proportion of alert behaviour at potentially affected and reference leks or from the pre- to post-construction period. No difference in the proportion of time grouse were photographed on-lek at potentially affected and reference sites in 2020 was detected, and no change was observed from the pre- to post-construction period. There was no difference in the mean number of male sharp-tailed grouse photographed at potentially affected and reference leks in 2020. There were more males at potentially affected and reference leks after construction than before, but the difference was not significant. Relatively few predators were photographed in 2020; no increase in predator activity at potentially affected leks relative to the pre-construction period was observed.

No significant effects on sharp-tailed grouse near the transmission line have been identified to date, and no unexpected effects have been observed. Monitoring at sharp-tailed grouse leks will continue during post construction and results will be added to the analysis of the effects of transmission line installation on grouse at lekking sites.

STUDY TEAM

Biologists and technicians who designed, participated in, and drafted the survey results included:

- Robert Berger – Design, analysis, surveys, and reporting
- Andrea Ambrose – Analysis and reporting
- Mark Baschuk – Mapping
- Derric Trudeau – Survey personnel
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INTRODUCTION

The sharp-tailed grouse (*Tympanuchus phasianellus*), which typically inhabits grasslands and aspen parkland (Taylor 2003), can be found in the Manitoba-Minnesota Transmission Project (the Project) Regional Assessment Area (RAA). Like most grassland birds, it has experienced widespread habitat loss through most of the prairies, as indicated in the *Manitoba–Minnesota Transmission Project Environmental Impact Statement* (EIS). In spring, sharp-tailed grouse assemble at grassy areas called leks to mate (Taylor 2003). Nearby forest or shrubs are important for cover (Taylor 2003). Males dance, coo, and rattle to attract females, which begin to congregate in mid-April, and the mating season ends in June (Taylor 2003).

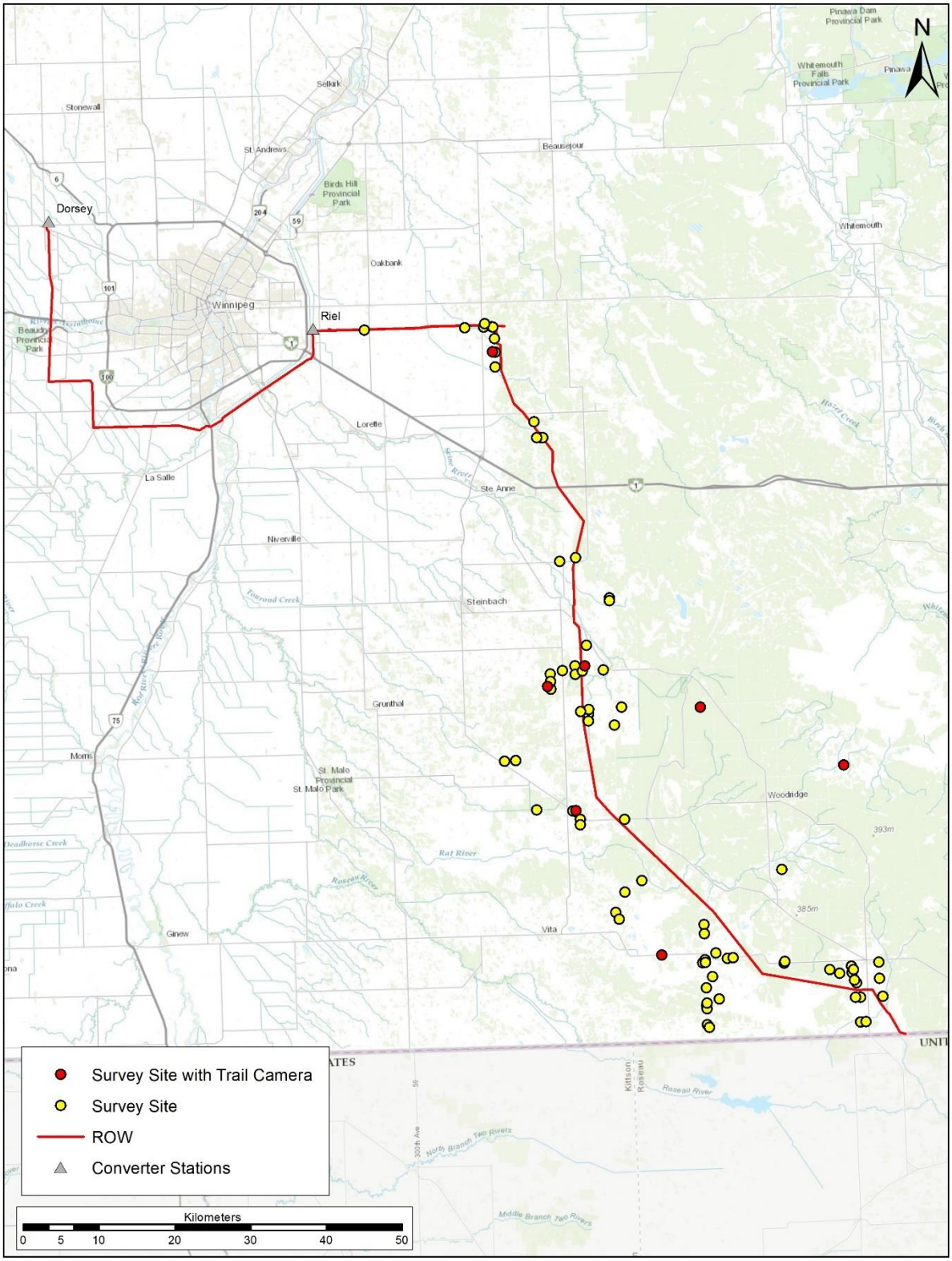
As outlined in the EIS, anticipated Project effects on sharp-tailed grouse included the temporary loss of some habitat at tower sites and the compaction of vegetation cover along the transmission line right-of-way (ROW). Additionally, grouse are vulnerable to increased rates of predation if birds of prey (raptors) use transmission towers as perches when hunting or nesting near leks. As described in Section 4.5.4 of the *Manitoba-Minnesota Transmission Project Environmental Monitoring Plan* (Manitoba Hydro 2019), the primary objectives of sharp-tailed grouse monitoring were to evaluate the effects of transmission line installation on sharp-tailed grouse alert behaviour, time spent on the lek, and the abundance of males at lekking sites. A secondary objective was to identify an association between avian and terrestrial predators, sharp-tailed grouse, and transmission lines.

METHODS

Pre-construction surveys for sharp-tailed grouse conducted in spring 2017 and 2019 were repeated in 2020, the first year after Project construction. From March 27 to April 13, 2020, trail cameras were placed at eight known leks after receiving permission from landowners (Map 1). Surveyors walked to the lek, marked its location with a Global Positioning System (GPS) unit, and conducted an active count, where all birds in the area were flushed out and counted. Data were collected in a manner similar to sharp-tailed grouse lek survey protocols previously established by Manitoba Sustainable Development (B. Kiss 2017, pers. comm.). Two Reconyx™ PM35C31 trail cameras, one facing north and the other east, were set up to photograph sharp-tailed grouse activity (Photo 1). Short metal stakes were driven into the ground, to which trail cameras were fastened with zip ties. Cameras were programmed to take a series of 30 rapid-fire photos every five minutes from 4:00 a.m. until 8:00 a.m.

From April 14 to 24, 2020, reconnaissance surveys were carried out at 76 sites identified as leks or potential leks during previous survey years, where access was not permitted or could not be obtained from landowners. Surveys were done from the road between 5:00 a.m. and 8:30 a.m. At each site surveyors scanned for sharp-tailed grouse with binoculars and listened for rattling, cooing, and hooting, which are indicative of mating behaviour, or for clucking, which is only a sign of the species' presence. Each site was surveyed for five minutes and the presence or absence of sharp-tailed grouse, the number heard or observed, their behaviour, and a brief description of the habitat in the area were recorded. Sites where dancing was observed or sounds of mating behaviour were heard were identified as leks, and sites with other indications of sharp-tailed grouse (clucking, observations) were identified as potential leks. Observations of ground and avian predators, if any, were recorded including (*Asio flammeus*), which is a species of conservation concern.

Photo 1: Trail camera at a sharp-tailed grouse lek



Map 1: Locations surveyed for sharp-tailed grouse, spring 2020

Approximately 638,000 trail camera photos were reviewed and the number of grouse and their behaviour were recorded. Photos taken between 5:00 a.m. and 8:00 a.m. were reviewed in groups, where sharp-tailed grouse behaviours were interpreted, categorized, and summarized for five seconds at a time for the first 15 seconds of each five-minute period, with six to eight photos in each five-second interval. The maximum number of grouse photographed during each five-second interval was recorded, along with the activity most often displayed by each individual (Appendix A). Behaviours were categorized as reproductive (i.e., dancing, rattling, facing off or fighting, copulating), loafing/feeding (resting, feeding, walking, perching), flush (suddenly taking off and flying away from the lek), alert (standing still with head and neck stretched out while looking around), and unknown (behaviour undetermined due to light conditions, obscured camera lens, distant grouse, etc.).

As two cameras were placed at each site, many of the observations of grouse behaviour were duplicated. Data from the camera with the most grouse behaviours each day were included in the analysis (Appendix B). If no grouse were photographed on a particular day, the north-facing camera was selected. The total number of grouse at each lek could not be definitively determined because grouse entered and left the frame and were not distinguishable from one another. The proportion of time spent engaged in each behaviour was calculated by summing the number of instances of each behaviour at each site and dividing by the sum of all behaviours. The maximum number of individuals photographed engaged in reproductive behaviour each day was recorded, with the greatest considered the number of males at each site. Because the total number of camera operating days was different at the eight leks, only photos taken over a consistent period (April 15 to May 7, 2020 for seven sites and April 9 to 26, 2020 for one site) were considered in the analyses.

As described in Section 7.3.2.2 of the Environmental Monitoring Plan (Manitoba Hydro 2019), the purpose of sharp-tailed grouse lek monitoring was to test two hypotheses:

Hypothesis 1:

- H_0 (null): The installation of the transmission line does not affect the abundance of male sharp-tailed grouse at lekking sites.
- H_1 (alternate): The installation of the transmission line does affect the abundance of male sharp-tailed grouse at lekking sites.

Hypothesis 2:

- H_0 (null): The installation of the transmission line does not increase sharp-tailed grouse alert behaviour or decrease time spent on the lek.
- H_1 (alternate 1): The installation of the transmission line does increase sharp-tailed grouse alert behaviours.
- H_2 (alternate 2): The installation of the transmission line does decrease time spent on the lek by sharp-tailed grouse.

To test the first hypothesis, the number of males at leks within 1,500 m of the ROW centreline (potentially affected sites) and at leks more than 1,500 m from the ROW centreline (reference sites) over the 17- or 23-day period was compared with statistical *t*-tests. Significance was determined at the $\alpha = 0.05$ level. Results were also compared with those from the pre-construction period.

For the second hypothesis, statistical *t*-tests were performed to compare the mean proportion of each activity to test Project effects on sharp-tailed grouse alert behaviour. The presence or absence of sharp-tailed grouse during the first 15 seconds of each five-minute interval from April 15 to May 7 or April 9 to 26, 2020 was noted, and the proportion of time at least one grouse was present was calculated daily. The mean and variance of the daily proportions of time grouse were present on a lek at potentially affected and reference sites were calculated and compared with statistical *t*-tests, to test Project effects on time spent on the lek by sharp-tailed grouse. Comparisons were also made with results from the pre-construction period. Significance was determined at the $\alpha = 0.05$ level.

RESULTS

Of the 84 sites surveyed in spring 2020, 16 were identified as leks and 18 were identified as potential leks (Map 2; Appendix C). No sharp-tailed grouse activity was recorded at 50 sites, 21 of which were identified as leks and 29 of which were identified as potential leks in 2019. Of the 21 lekking sites that were inactive at the time of the survey, 5 were potentially affected and 16 were reference. Thirty-six percent of the potentially affected leks identified in 2019 were inactive during the 2020 survey. Of the leks identified in 2019, 36% of potentially affected sites and 55% of reference sites were inactive during the 2020 survey. At least one sharp-tailed grouse was heard during passive counts at leks and up to eight were observed at potential leks (Appendix D). Two leks and 8 potential leks were at potentially affected sites and there were 5 leks and 10 potential leks at reference sites.

During the standardized survey period, sharp-tailed grouse were photographed at all eight leks where trail cameras were deployed. Up to 21 individuals were photographed during 15-second intervals from April 9 to May 7, 2020 and up to 16 individuals were observed from April 8 to 13, 2020 (Table 1). A total of 11 photos of grouse were taken at site 042L over 3 days of the 23-day survey period, possibly due to camera placement. This site was removed from further analyses.

Table 1: Maximum number of sharp-tailed grouse observed during on-site active counts (April 8–13, 2020) and from trail camera photos (April 9–May 7, 2020)

Site Type	Site	Active Count	Photo Count
Potentially affected	042L	2	2
	359L	0	9
	369L	7	8
	462L	8	10
Reference	158L	4	5
	263L	14	15
	463L	17	19
	464L	16	21

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Map 2: Sharp-tailed grouse leks and potential leks identified in the study area, spring 2020

The greatest proportion of grouse activity photographed was loafing/feeding at four of seven leks (Table 2). Reproductive behaviour (Photo 2), which was observed as early as 5:00 a.m. and typically continued until the end of the programmed photo period at 8:00 a.m., was photographed at all seven leks and was the most frequent activity at three. Flush and alert behaviours were observed at all sites, but there was very little of each (Figure 1). Flush and alert behaviours were greatest at reference sites 463L and 158L, respectively. There was a weak positive correlation between the greatest number of sharp-tailed grouse observed during active counts or in photos and the proportion of behaviours that were reproductive at each lek (Figure 2).

Table 2: Proportion of sharp-tailed grouse behaviours photographed at seven leks from April 9 to May 7, 2020

Site Type	Site	Reproductive	Loafing/Feeding	Flush	Alert	Unknown
Potentially affected	359L	0.43	0.50	<0.01	<0.01	0.06
	369L	0.27	0.64	<0.01	<0.01	0.09
	462L	0.62	0.14	<0.01	0.01	0.22
Reference	158L	0.13	0.69	<0.01	0.07	0.11
	263L	0.36	0.60	<0.01	<0.01	0.04
	463L	0.50	0.46	0.01	<0.01	0.03
	464L	0.52	0.44	<0.01	<0.01	0.04

Photo 2: Sharp-tailed grouse dancing and loafing at site 464L April 20, 2020

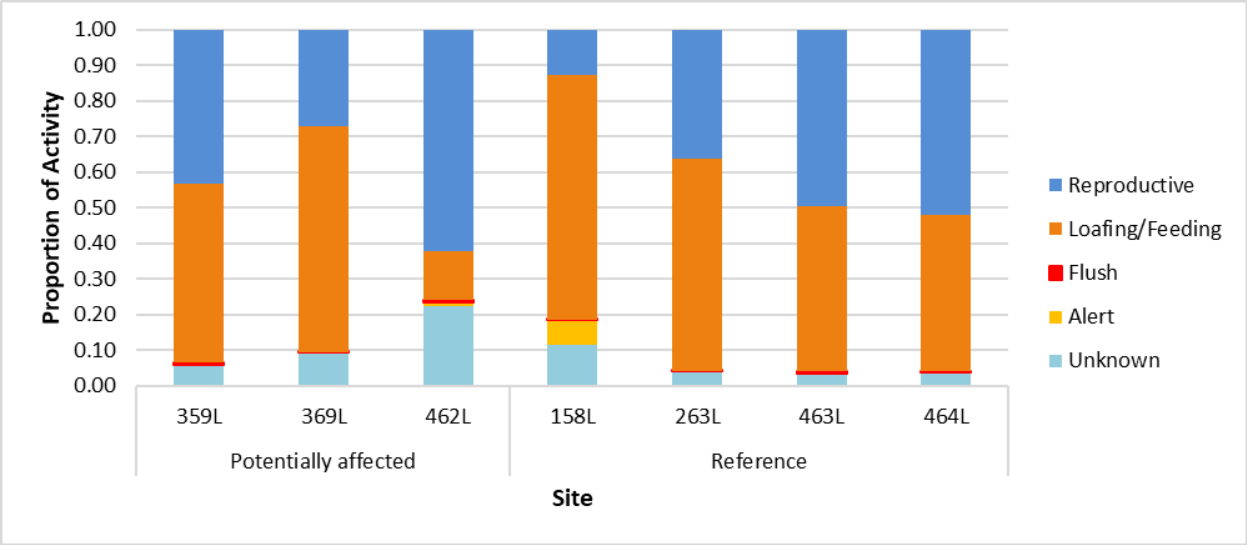

Figure 1: Proportion of sharp-tailed grouse behaviours photographed at seven leks from April 9 to May 7, 2020

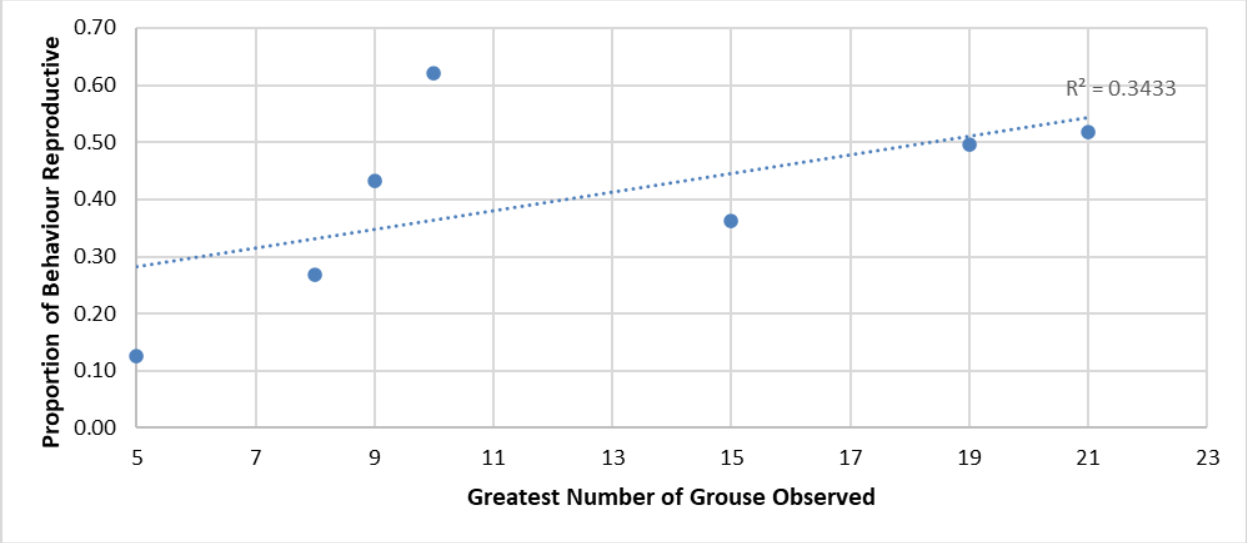

Figure 2: Relationship between the greatest number of sharp-tailed grouse actively counted or photographed and the proportion of behaviours that were reproductive at seven leks from April 8 to May 7, 2020

The maximum number of males photographed per day was 7 or 8 at potentially affected sites and ranged from 4 to 19 at reference sites (Table 3). The mean number of males over the standardized survey period was greatest at reference site 464L.

Table 3: Number of male sharp-tailed grouse photographed at seven leks from April 9 to May 7, 2020

	Site						
	<1,500 m from ROW			>1,500 m from ROW			
Day[1]	359L	369L	462L	158L	263L	463L	464L
1	0	4	6	2	11	0	4
2	0	3	6	2	8	0	16
3	0	4	6	0	9	0	6
4	0	5	6	2	9	0	13
5	0	3	7	2	10	0	19
6	0	5	7	0	11	0	17
7	0	4	5	2	11	0	17
8	3	4	7	2	9	0	11
9	5	5	7	0	11	11	12
10	7	3	6	3	13	7	10
11	4	4	7	1	11	8	13
12	7	5	4	4	9	12	12
13	8	6	6	0	10	9	7
14	8	7	8	2	13	13	13
15	7	6	7	2	11	10	11
16	8	3	7	2	10	7	7
17	7	3	7	2	11	8	11
18	7	4	8	0	13	10	12
19	6	4	–	3	13	10	10
20	7	4	–	3	8	9	9
21	4	6	–	2	8	8	10
22	3	5	–	2	7	10	9
23	7	6	–	0	10	5	11
Maximum	8	7	8	4	13	13	19
Mean	4.3	4.5	6.5	1.7	10.3	6.0	11.3
SD[2]	3.2	1.1	1.0	1.1	1.8	4.9	3.7

1. Photos were analyzed from April 15 to May 7, 2020 at all sites but 462L, where photos were analyzed from April 9 to 26, 2020.
2. Standard deviation.

On average, sharp-tailed grouse spent the greatest proportion of time on-lek at reference sites 263L and 464L in 2020 (0.76; Figure 3). Grouse were photographed on-lek at least 39% of the time at all other sites. Grouse were photographed on-lek an average of 55% of the time at potentially affected sites and 60% of the time on-lek at reference sites. The difference was not significant ($t = 1.98$, $p = 0.21$). During the pre-construction period, trail camera photos were taken at 5 leks in 2017 and 10 leks in 2019 (Wildlife Resource Consulting Services MB Inc. [WRCS] 2018, 2020). A total of five leks were at potentially affected sites and nine leks were at reference sites, one of which (010L) was surveyed both years (Appendix E). Because grouse behaviour was photographed at a small number of leks in 2017 the results were combined with those of

2019 for comparison with 2020, after Project construction was complete. When compared with the pre-construction period, there was no change in the mean proportion of time sharp-tailed grouse spent on-lek before or after construction at potentially affected sites (Table 4). The mean proportion of time grouse spent on-lek at reference sites was significantly greater after construction than before. No effect of transmission line installation on time spent on leks by sharp-tailed grouse was detected.

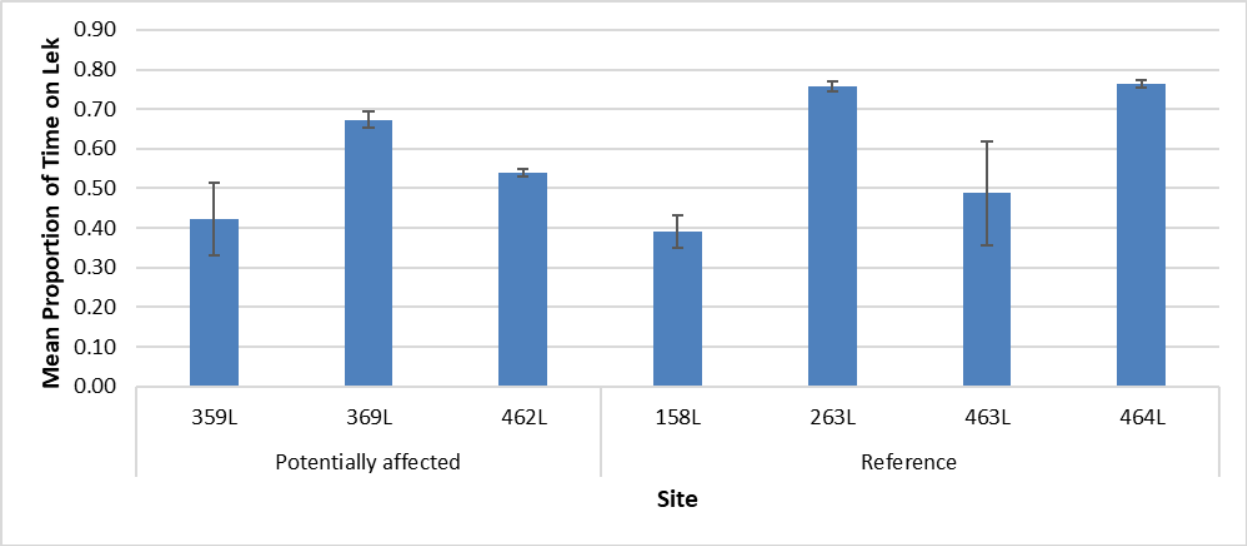

Figure 3: Mean proportion of time sharp-tailed grouse spent on seven leks from April 9 to May 7, 2020

Table 4: Mean proportion of time sharp-tailed grouse spent on leks before (2017 and 2019) and after (2020) construction

Site Type	2017 & 2019			2020				
	Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Potentially affected	0.56	0.30	0.09	0.55	0.24	0.06	1.98	0.86
Reference	0.47	0.25	0.06	0.60	0.28	0.08	1.97	<0.01

When only known behaviours were considered, there was no significant difference between the mean proportion of reproductive (t = 3.18, p = 0.52), loafing/feeding (t = 2.57, p = 0.50), flush (t = 2.57, p = 0.61), or alert (t = 3.18, p = 0.50) sharp-tailed grouse behaviour at potentially affected and reference sites in 2020. There was more reproductive behaviour at potentially affected and reference sites after construction than before, but the difference was not significant (Table 5). There was less loafing/feeding behaviour at potentially affected and reference sites after construction than before, but the difference was not significant. There was relatively little flush or alert behaviour at potentially affected and reference sites before and after construction. No significant differences were observed, indicating that the installation of the transmission line did not affect alert behaviours.

Table 5: Proportion of known sharp-tailed grouse behaviours before (2017 and 2019) and after (2020) construction

Behaviour	Site Type	2017 & 2019			2020				
		Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Reproductive	Potentially affected	0.13	0.07	<0.01	0.52	0.26	0.07	4.30	0.12
	Reference	0.27	0.12	0.01	0.39	0.18	0.03	2.18	0.16
Loafing/	Potentially affected	0.85	0.05	<0.01	0.47	0.27	0.07	4.30	0.13
Feeding	Reference	0.71	0.13	0.02	0.58	0.15	0.02	2.18	0.13
Flush	Potentially affected	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.45	0.55
	Reference	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.18	0.36
Alert	Potentially affected	0.02	0.04	<0.01	0.01	0.01	<0.01	2.78	0.56
	Reference	0.01	0.02	<0.01	0.02	0.04	<0.01	2.18	0.67

In 2020, the mean number of male sharp-tailed grouse was smaller at potentially affected than reference sites (Table 6), but the difference was not significant (t = 3.18, p = 0.24). When pre-construction photo data from leks surveyed in 2017 and 2019 were combined, the mean number of males was somewhat greater at potentially affected sites than reference sites (Table 6); the difference was not statistically significant (t = 2.16, p = 0.31). At potentially affected sites, the mean number of males was somewhat greater after construction than before, but there was no significant difference (Table 6). The mean number of males was greater at reference sites after construction than before, but the difference was not significant. No effect of transmission line installation on the abundance of male sharp-tailed grouse at lekking sites was detected.

Table 6: Mean number of male sharp-tailed grouse photographed before (2017 and 2019) and after (2020) construction

Site Type	2017 & 2019			2020				
	Mean	SD	Variance	Mean	SD	Variance	*t*	*p*
Potentially affected	6.60	3.65	13.30	7.67	0.58	0.33	2.78	0.56
Reference	5.00	2.26	5.11	12.25	6.18	38.25	3.18	0.11

No avian or ground predators were observed at the leks and potential leks surveyed in 2020. Coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and unidentified hawks were photographed at three leks (Table 7). At site 369L, a coyote and two sharp-tailed grouse were photographed together on April 30. The coyote paid no attention to the grouse and the grouse did not react to the coyote, other than to glance at it (Photo 3). No other grouse were photographed in the two preceding five-minute periods, possibly indicating that none were flushed when it appeared. A hawk was photographed flying over five grouse dancing at site 463L, none of which reacted (Photo 4). At site 464L, two alert grouse were photographed with a red fox, which had what appeared to be a small prey item in its mouth (Photo 5). A third grouse flushed a moment later. A hawk was also photographed at the same site; no grouse were on-camera at the time or immediately preceding its appearance (Photo 6). There did not appear to be more predator activity at potentially affected than reference sites. Where avian and land predators were photographed with grouse, their presence did not appear to affect grouse behaviour.

Table 7: Predators photographed at sharp-tailed grouse leks April 9 to May 7, 2020

Site Type	Site	Date	Time	Species	Grouse Reaction
Potentially affected	369L	April 30	6:30 a.m.	Coyote	Two grouse, no reaction
Reference	463L	May 4	7:00 a.m.	Hawk sp.	Grouse dancing, no reaction
	464L	April 16	6:20 a.m.	Red fox	Two grouse, alert
		April 30	6:20 a.m.	Hawk sp.	No grouse in photo

In 2017, a coyote was photographed at each of two reference sites. No ground or avian predators were detected at potentially affected sites. In 2019, avian predators were observed at one potentially affected site and two reference sites during the initial survey for sharp-tailed grouse. A northern harrier (*Circus cyaneus*) was photographed at each of two reference sites. No grouse were on-camera at one site and two grouse were flushed at the other.

White-tailed deer (*Odocoileus virginianus*) were photographed at sites 359L, 369L, and 464L and eastern cottontail (*Sylvilagus floridanus*) was photographed at site 369L in 2020 (Appendix F). No other wildlife or environmental observations were made, including short-eared owl.

Photo 3: Coyote and sharp-tailed grouse at site 369L April 30, 2020

Photo 4: Hawk at site 463L May 4, 2020

Photo 5: Red fox and two sharp-tailed grouse (red arrows) at site 464L April 16, 2020

Photo 6: Hawk at site 464L April 30, 2020

DISCUSSION

Fewer sharp-tailed grouse leks were found during the 2020 survey than in 2019, particularly leks further from the ROW. The sharp-tailed grouse population could be declining in the study area as part of the natural ten-year cycle that has been reported for the species (e.g., Keith 1963 in Moss and Watson 2001). The disappearance of small leks or satellite leks (i.e., transient lek active for only one or a few years) supports a possible downturn in the population cycle, but other factors such as habitat loss might also be affecting the population in the region (Baydack 1986; Berger and Baydack 1992).

Approximately 638,000 trail camera photos taken in spring 2020 were analyzed for sharp-tailed grouse behaviour. In 2020, after Project construction, there was no difference in the proportion of alert behaviour at potentially affected and reference leks. When compared with the combined results in 2017 and 2019, there was no difference in the proportion of alert behaviour at leks pre- and post-construction. Alert and flush behaviours comprised a small proportion of sharp-tailed grouse activity at all leks over the three-year study period. There was no difference in the proportion of time grouse were photographed on-lek at potentially affected and reference sites in 2020. No change in the proportion of time spent on-lek at potentially affected sites was observed from the pre-construction period to the first year of operation.

There was no significant difference in the mean number of male sharp-tailed grouse photographed at potentially affected and reference leks in 2020. There were more males at potentially affected and reference leks after construction than before, but the difference was not significant.

Relatively few predators were photographed in 2020. All avian predators were photographed at reference leks. While a coyote was photographed at a potentially affected lek, it had no apparent effect on the behaviour of the single sharp-tailed grouse nearby. There was no increase in predator activity at potentially affected leks relative to the pre-construction period. Data from the remote infrared camera trap arrays situated along the ROW and in adjacent habitat to monitor ungulates and predators will be used to evaluate changes in predator activity as they become available, or after the conclusion of operation monitoring.

No differences in sharp-tailed grouse behaviour or abundance at potentially affected and reference leks were observed during the first year of operation monitoring, or at potentially affected leks when compared with the pre-construction period. As such, no significant effects on sharp-tailed grouse near the transmission line have been identified to date, and no unexpected effects were observed. Monitoring at sharp-tailed grouse leks will continue during Project operation and results will be added to the analysis of the effects of transmission line installation on grouse alert behaviours, time spent on the lek by grouse, and the abundance of males at lekking sites.

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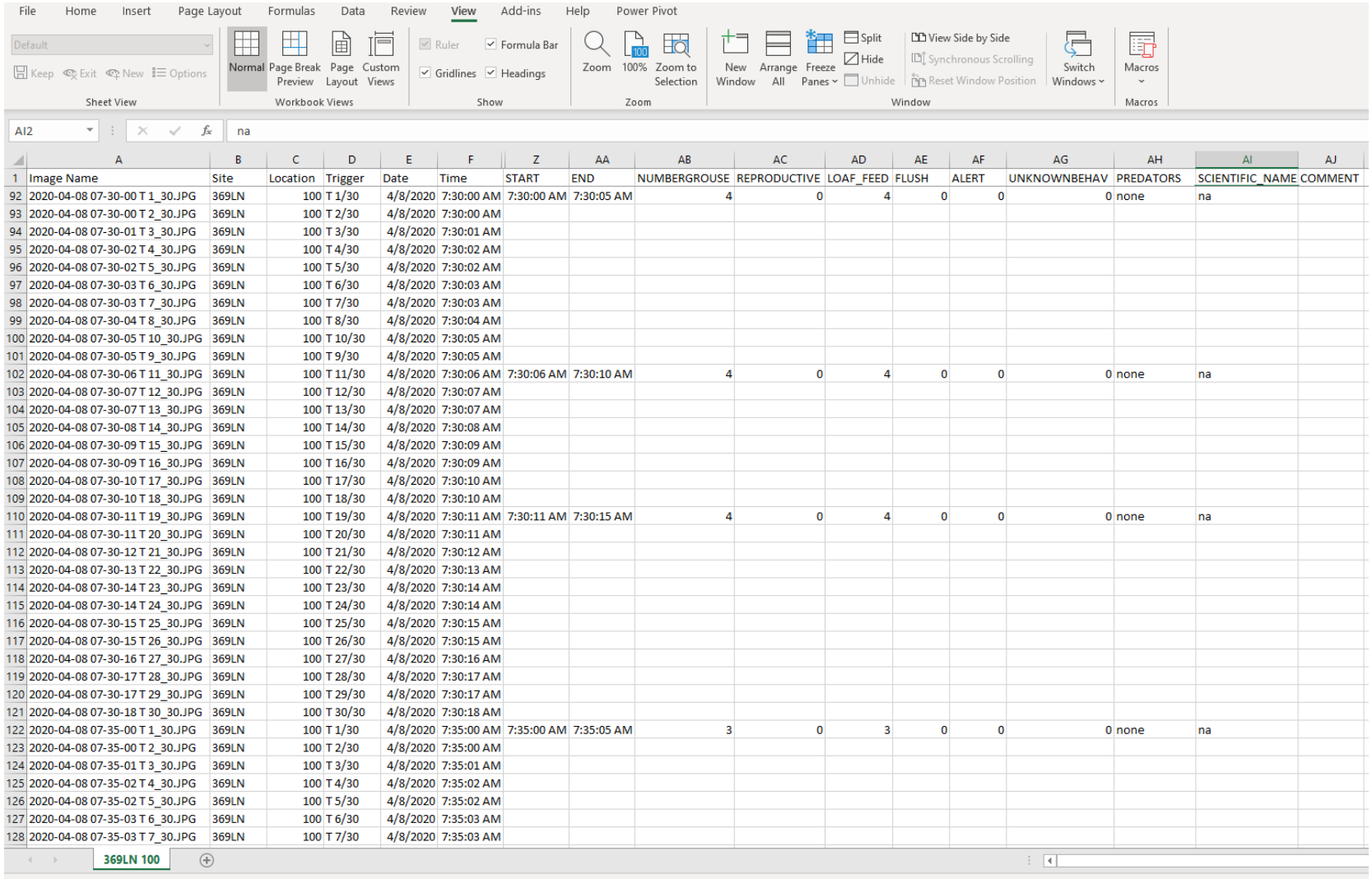
APPENDIX A

Example of spreadsheet used to record sharp-tailed grouse behaviours in trail camera photographs



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	A	B	C	D	E	F	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1	Image Name	Site	Location	Trigger	Date	Time	START	END	NUMBERGROUSE	REPRODUCTIVE	LOAF_FEED	FLUSH	ALERT	UNKNOWNBEHAV	PREDATORS	SCIENTIFIC_NAME	COMMENT
92	2020-04-08 07-30-00 T 1_30.JPG	369LN	100	T 1/30	4/8/2020	7:30:00 AM	7:30:00 AM	7:30:05 AM	4	0	4	0	0	0	none	na	
93	2020-04-08 07-30-00 T 2_30.JPG	369LN	100	T 2/30	4/8/2020	7:30:00 AM											
94	2020-04-08 07-30-01 T 3_30.JPG	369LN	100	T 3/30	4/8/2020	7:30:01 AM											
95	2020-04-08 07-30-02 T 4_30.JPG	369LN	100	T 4/30	4/8/2020	7:30:02 AM											
96	2020-04-08 07-30-02 T 5_30.JPG	369LN	100	T 5/30	4/8/2020	7:30:02 AM											
97	2020-04-08 07-30-03 T 6_30.JPG	369LN	100	T 6/30	4/8/2020	7:30:03 AM											
98	2020-04-08 07-30-03 T 7_30.JPG	369LN	100	T 7/30	4/8/2020	7:30:03 AM											
99	2020-04-08 07-30-04 T 8_30.JPG	369LN	100	T 8/30	4/8/2020	7:30:04 AM											
100	2020-04-08 07-30-05 T 10_30.JPG	369LN	100	T 10/30	4/8/2020	7:30:05 AM											
101	2020-04-08 07-30-05 T 9_30.JPG	369LN	100	T 9/30	4/8/2020	7:30:05 AM											
102	2020-04-08 07-30-06 T 11_30.JPG	369LN	100	T 11/30	4/8/2020	7:30:06 AM	7:30:06 AM	7:30:10 AM	4	0	4	0	0	0	none	na	
103	2020-04-08 07-30-07 T 12_30.JPG	369LN	100	T 12/30	4/8/2020	7:30:07 AM											
104	2020-04-08 07-30-07 T 13_30.JPG	369LN	100	T 13/30	4/8/2020	7:30:07 AM											
105	2020-04-08 07-30-08 T 14_30.JPG	369LN	100	T 14/30	4/8/2020	7:30:08 AM											
106	2020-04-08 07-30-09 T 15_30.JPG	369LN	100	T 15/30	4/8/2020	7:30:09 AM											
107	2020-04-08 07-30-09 T 16_30.JPG	369LN	100	T 16/30	4/8/2020	7:30:09 AM											
108	2020-04-08 07-30-10 T 17_30.JPG	369LN	100	T 17/30	4/8/2020	7:30:10 AM											
109	2020-04-08 07-30-10 T 18_30.JPG	369LN	100	T 18/30	4/8/2020	7:30:10 AM											
110	2020-04-08 07-30-11 T 19_30.JPG	369LN	100	T 19/30	4/8/2020	7:30:11 AM	7:30:11 AM	7:30:15 AM	4	0	4	0	0	0	none	na	
111	2020-04-08 07-30-11 T 20_30.JPG	369LN	100	T 20/30	4/8/2020	7:30:11 AM											
112	2020-04-08 07-30-12 T 21_30.JPG	369LN	100	T 21/30	4/8/2020	7:30:12 AM											
113	2020-04-08 07-30-13 T 22_30.JPG	369LN	100	T 22/30	4/8/2020	7:30:13 AM											
114	2020-04-08 07-30-14 T 23_30.JPG	369LN	100	T 23/30	4/8/2020	7:30:14 AM											
115	2020-04-08 07-30-14 T 24_30.JPG	369LN	100	T 24/30	4/8/2020	7:30:14 AM											
116	2020-04-08 07-30-15 T 25_30.JPG	369LN	100	T 25/30	4/8/2020	7:30:15 AM											
117	2020-04-08 07-30-15 T 26_30.JPG	369LN	100	T 26/30	4/8/2020	7:30:15 AM											
118	2020-04-08 07-30-16 T 27_30.JPG	369LN	100	T 27/30	4/8/2020	7:30:16 AM											
119	2020-04-08 07-30-17 T 28_30.JPG	369LN	100	T 28/30	4/8/2020	7:30:17 AM											
120	2020-04-08 07-30-17 T 29_30.JPG	369LN	100	T 29/30	4/8/2020	7:30:17 AM											
121	2020-04-08 07-30-18 T 30_30.JPG	369LN	100	T 30/30	4/8/2020	7:30:18 AM											
122	2020-04-08 07-35-00 T 1_30.JPG	369LN	100	T 1/30	4/8/2020	7:35:00 AM	7:35:00 AM	7:35:05 AM	3	0	3	0	0	0	none	na	
123	2020-04-08 07-35-00 T 2_30.JPG	369LN	100	T 2/30	4/8/2020	7:35:00 AM											
124	2020-04-08 07-35-01 T 3_30.JPG	369LN	100	T 3/30	4/8/2020	7:35:01 AM											
125	2020-04-08 07-35-02 T 4_30.JPG	369LN	100	T 4/30	4/8/2020	7:35:02 AM											
126	2020-04-08 07-35-02 T 5_30.JPG	369LN	100	T 5/30	4/8/2020	7:35:02 AM											
127	2020-04-08 07-35-03 T 6_30.JPG	369LN	100	T 6/30	4/8/2020	7:35:03 AM											
128	2020-04-08 07-35-03 T 7_30.JPG	369LN	100	T 7/30	4/8/2020	7:35:03 AM											

369LN 100

APPENDIX B

Camera (north or east facing) used for analysis of grouse behaviour, spring 2020

	Site							
Day[1]	**042L**	**158L**	**263L**	**359L**	**369L**	**462L**	**463L**	**464L**
1	North	North	North	North	East	East	North	East
2	North	East	North	North	North	North	North	North
3	North	North	North	North	North	North	North	East
4	North	North	North	North	East	North	North	North
5	North	North	North	North	East	East	North	North
6	North	North	North	North	East	East	North	North
7	North	East	North	North	East	East	North	North
8	North	North	North	North	East	East	North	North
9	North	North	North	East	East	East	North	North
10	North	North	North	East	North	East	North	North
11	North	North	North	East	East	East	North	North
12	North	North	North	East	North	North	North	North
13	East	North	North	East	East	East	North	North
14	North	North	North	North	East	East	North	North
15	North	North	North	North	East	East	North	North
16	North	North	North	North	East	East	North	North
17	North	North	North	North	East	East	North	North
18	North	North	East	North	East	East	North	North
19	North	North	East	North	East	–	North	North
20	North	North	North	North	East	–	North	North
21	North	North	North	North	East	–	North	North
22	North	North	North	North	East	–	North	North
23	North	North	North	North	East	–	North	North

1. Photos were analyzed from April 15 to May 7, 2020 at all sites but 462L, where photos were analyzed from April 9 to 26.

APPENDIX C

Locations of leks and potential leks surveyed in spring 2020

Site Class	Site Type	Site	Approximate Location	Status in 2019	Status in 2017
Lek	Potentially affected	002L	REDACTED	Lek	Lek
		042L		Lek	Lek
		359L		Lek	Potential lek
		369L		Lek	None
		377L		Lek	None
		462L		Lek	None
	Reference	008L		Lek	Lek
		010L		Lek	Lek
		118L		Potential lek	Potential lek
		158L		Lek	None
		167L		Potential lek	None
		263L		Lek	None
		461L		Lek	None
		463L		Lek	None
		464L		Lek	None
		475L		Lek	None
Potential lek	Potentially affected	003PL		Lek	Lek
		363PL		Potential lek	None
		367PL		Lek	Lek
		371PL		Potential lek	None
		375PL		Lek	Lek
		488PL		–	–
		489PL		–	–
		490PL		–	–
	Reference	070PL		Potential lek	None
		090PL		Lek	Potential lek
		117PL		Lek	None
		169PL		Potential lek	None
		182PL		Potential lek	None
		187PL		Potential lek	None
		362PL		Lek	None
		477PL		Lek	None
		480PL		None	None
		484PL		Lek	None
None	Potentially affected	114		Lek	Lek
		130		Lek	None
		131		Potential lek	None

Site Class	Site Type	Site	Approximate Location	Status in 2019	Status in 2017
None	Potentially affected	206		Potential lek	None
		207		Lek	None
		208		Lek	None
		226		Potential lek	None
		273		Potential lek	None
		279		Potential lek	Lek
		285		Potential lek	None
		349		Potential lek	None
		354		Potential lek	Potential lek
		398		Potential lek	None
		423		Potential lek	None
		424		Potential lek	None
		473		Lek	None
		474		Potential lek	Lek
	Reference	5		Lek	Lek
		6		Lek	Potential lek
		7		Potential lek	Lek
		60		Potential lek	None
		69		Potential lek	None
		72		Potential lek	None
		86		Potential lek	None
		91		Potential lek	None
		93		Lek	None
		112		Lek	Lek
		113		Lek	Potential lek
		136		Potential lek	None
		179		Potential lek	Lek
		221		Potential lek	None
		241		Lek	None
		251		Lek	Lek
		252		Potential lek	Lek
		269		Lek	Potential lek
		298		Potential lek	None
		299		Lek	Potential lek
		301		Potential lek	None
		309		Lek	None
		310		Potential lek	None
		355		Potential lek	Potential lek
		356		Lek	Potential lek
		406		Lek	None
		412		Potential lek	None
		440		Lek	None

Site Class	Site Type	Site	Approximate Location	Status in 2019	Status in 2017
None	Reference	472		Potential lek	None
		476		Lek	None
		485		Lek	None
		486		Potential lek	None
		487		Lek	None

1. Trail cameras deployed.

APPENDIX D

Passive counts of sharp-tailed grouse at leks and potential leks surveyed in spring 2020

Site Class	Site Type	Site	Number of Birds[1]
Lek	Potentially affected	002L	1+
		377L	2+
	Reference	008L	1+
		010L	4
		118L	1+
		167L	1
		475L	7
Potential lek	Potentially affected	003PL	1
		363PL	9
		367PL	1
		371PL	1
		375PL	1+
		488PL	8
		489PL	2
		490PL	3
	Reference	070PL	1+
		090PL	6
		117PL	5
		169PL	6
		182PL	1+
		187PL	2
		362PL	1+
		477PL	6
		480PL	1
		484PL	4

1. "+" indicates minimum number, typically because the number of birds heard was uncertain.

APPENDIX E

Proportion of known sharp-tailed grouse behaviours photographed at 14 leks during pre-construction surveys, 2017 and 2019

Site Type	Year	Site	Reproductive	Loafing/Feeding	Flush	Alert
Potentially affected	2017	367L	0.14	0.85	<0.01	<0.01
	2019	042L	0.05	0.86	0	0.08
		359L	0.09	0.91	0	<0.01
		369L	0.16	0.84	0	<0.01
		462L	0.20	0.79	0.01	0
Reference	2017	010L	0.39	0.59	0.01	<0.01
		112L	0.28	0.72	0	<0.01
		179L	0.13	0.87	0	<0.01
		290L	0.20	0.76	0.01	0.03
	2019	010L	0.47	0.53	<0.01	<0.01
		158L	0.34	0.63	<0.01	0.03
		263L	0.10	0.90	<0.01	<0.01
		461L	0.32	0.62	<0.01	0.06
		463L	0.33	0.65	<0.01	0.02
		464L	0.15	0.84	0.01	0

APPENDIX F

White-tailed deer (red circle) at site 359L May 1, 2020

White-tailed deer (red circle) at site 369L May 8, 2020

White-tailed deer (second indicated in red) at site 464L, east-facing camera May 2, 2020

White-tailed deer at site 464, north-facing camera May 2, 2020

Eastern cottontail at site 369L April 25, 2020

Available in accessible formats upon request