

2023

Baker Lake Harvest Study

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Large Winter Herd

Georgina Kamimallik

January | ᓆᓇᓂᓂᓐ 2023

Baker Lake Harvest Study
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Sunday ᓆᓇᓂᓂᓐ	Monday ᓆᓇᓂᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐ	Tuesday ᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐ	Wednesday ᓆᓇᓂᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐ	Thursday ᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐ	Friday ᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐ	Saturday ᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐᓂᓐ
1	2	3	4	5	6	7
New Year's Day						
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	<div><div>December 2022</div><div><div>S</div><div>M</div><div>T</div><div>W</div><div>T</div><div>F</div><div>S</div></div><div><div></div><div></div><div></div><div></div><div>1</div><div>2</div><div>3</div></div><div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div></div><div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>16</div><div>17</div></div><div><div>18</div><div>19</div><div>20</div><div>21</div><div>22</div><div>23</div><div>24</div></div><div><div>25</div><div>26</div><div>27</div><div>28</div><div>29</div><div>30</div><div>31</div></div></div> <div><div>February 2023</div><div><div>S</div><div>M</div><div>T</div><div>W</div><div>T</div><div>F</div><div>S</div></div><div><div></div><div></div><div></div><div>1</div><div>2</div><div>3</div><div>4</div></div><div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div></div><div><div>12</div><div>13</div><div>14</div><div>15</div><div>16</div><div>17</div><div>18</div></div><div><div>19</div><div>20</div><div>21</div><div>22</div><div>23</div><div>24</div><div>25</div></div><div><div>26</div><div>27</div><div>28</div><div></div><div></div><div></div><div></div></div></div>			



February | 2023

Baker Lake Harvest Study
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Sunday ከባር	Monday ከሐር	Tuesday ከሐር ልደት	Wednesday ከሐር ልደት	Thursday ከሐር ልደት	Friday ከሐር ልደት	Saturday ከሐር ልደት
			1	2 Groundhog Day	3	4
5	6	7	8	9	10	11
12	13	14 Valentine's Day	15	16	17	18
19	20 Family Day	21	22 Ash Wednesday	23	24	25
26	27	28	<div>January 2023<div>SMTWTFSS123456789101112131415161718192021222324252627283031</div></div> <div>March 2023<div>SMTWTFSS12345678910111213141516171819202122232425262728293031</div></div>			



Winter Bulls

Richard Aksawnee

March | 2023

Baker Lake Harvest Study
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Sunday ከሐርሰት	Monday ከሐርሰትጋሌሙክና	Tuesday ጋንባሳ፡ጊወክና ሥንጥና	Wednesday እግረኅረ	Thursday ሥርረ	Friday ርርረ	Saturday ሙክልጋንባና																																											
<div>February 2022</div> <table><tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr><tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr><tr><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr><tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr><tr><td>27</td><td>28</td><td></td><td></td><td></td><td></td><td></td></tr></table>			S	M	T	W	T	F	S			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28									1	
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12	13	14	15	16	17	18																																											
Daylight Savings Time Starts					St. Patrick's Day																																												
19	20	21	22	23	24	25																																											
First Day of Spring																																																	
26	27	28	29	30	31																																												



Mom with Three Cubs

Lars Qaggaq

April | ᐅᐃᐅᐅ 2023

Baker Lake Harvest Study
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Sunday ᖃᐅᐅᐅᐅ	Monday ᖃᐅᐅᐅᐅᐅᐅᐅᐅᐅ	Tuesday ᐅᐅᐅᐅᐅᐅᐅᐅ ᐅᐅᐅᐅᐅᐅ	Wednesday ᐅᐅᐅᐅᐅᐅᐅ	Thursday ᐅᐅᐅᐅᐅ	Friday ᐅᐅᐅᐅᐅ	Saturday ᐅᐅᐅᐅᐅᐅᐅᐅᐅ
March 2023 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	May 2023 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31					1
2 Palm Sunday	3	4	5	6	7 Good Friday	8
9 Easter Sunday	10 Easter Monday	11	12	13	14	15
16	17	18	19	20	21	22 Earth Day
23	24	25	26	27	28	29
30						



Migrating Caribou

Georgina Kamimallik

May | LΔ 2023

Baker Lake Harvest Study
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Sunday ካቢሳ	Monday ከላይኛው ስኞት	Tuesday ከላይኛው ስኞት	Wednesday እስኪጠፋ	Thursday የሐረር	Friday የሐረር	Saturday በዓል
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
Mother's Day						
21	22	23	24	25	26	27
	Victoria Day					
28	29	30	31	<div><div>April 2023</div><div><div><div>S</div><div>M</div><div>T</div><div>W</div><div>T</div><div>F</div><div>S</div></div><div><div> </div><div> </div><div> </div><div> </div><div> </div><div> </div><div>1</div></div><div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div></div><div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div></div><div><div>16</div><div>17</div><div>18</div><div>19</div><div>20</div><div>21</div><div>22</div></div><div><div>23</div><div>24</div><div>25</div><div>26</div><div>27</div><div>28</div><div>29</div></div><div><div>30</div><div> </div><div> </div><div> </div><div> </div><div> </div><div> </div></div></div><div><div>June 2023</div><div><div><div>S</div><div>M</div><div>T</div><div>W</div><div>T</div><div>F</div><div>S</div></div><div><div> </div><div> </div><div> </div><div> </div><div>1</div><div>2</div><div>3</div></div><div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div></div><div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>16</div><div>17</div></div><div><div>18</div><div>19</div><div>20</div><div>21</div><div>22</div><div>23</div><div>24</div></div><div><div>25</div><div>26</div><div>27</div><div>28</div><div>29</div><div>30</div><div> </div></div></div></div></div>		



June | ८σ 2023

Baker Lake Harvest Study
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Sunday ᑭᐱᑕᐃᑦ	Monday ᑭᐱᑕᐃᑦᐅᓚᓂᑭᑭᑲ	Tuesday ᐅᑲᑭᑦᐱᑭᑲ ᑭᑦᐅᑦᑭᑲ	Wednesday ᐱᑭᓚᑦᐱᑕᑦ	Thursday ᑭᑕᓚᑕᑦ	Friday ᑕᑦᓚᑕᑦ	Saturday ᓂᑭᑲᐃᐅᑭᐱᑭᑲ
May 2023 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	July 2023 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
Father's Day			National Indigenous Peoples Day			
25	26	27	28	29	30	



Drying Fish

July | $\nabla \subset \Delta$ 2023[illegible]

Sunday ᑭᓇ ᑕᐃᑦ							Monday ᑭᓇ ᑕᐃᑦ ᐅᓂᑦ ᑭᓪᓴᑲ							Tuesday ᐅᑲᑯᑦ ᐃᓪᓴᓄᓪᓴᑲ ᑯᑦᐅᑦ ᑭᓪᓴᑲ							Wednesday ᐱᓪᓴᓂᑦ ᐃᑕᑦ							Thursday ᑯᑕᓂᓂᑦ							Friday ᑕᑦᑕᓂᓂᑦ							Saturday ᓂᓪᓴᐃᐅᑯᓪᓴᓄᓪᓴᑲ																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Resting along the River

Georgina Kamimmalik

August | 2023

Baker Lake Harvest Study
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Resting on the River

Paul Kabloona

September | ୨୩rd 2023

Baker Lake Harvest Study
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October | 2023

Baker Lake Harvest Study
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November | 2023

Baker Lake Harvest Study
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Baker Lake Harvest Study
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Please return the calendar to the Agnico-Eagle office for entry into the participant draw.																																																		

Wildlife and Fish Species of Interest

Caribou Bull

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Lars Qaqqaq

Muskox Bull

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Martin Gebauer

Wolverine

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Jamie Kataluk

Grizzly Bear

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Tom Thomson

Wolf

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Paul Kabloona

Lake Whitefish

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Martin Gebauer

Arctic Char - Male & Female

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Randy Baker

Arctic Grayling

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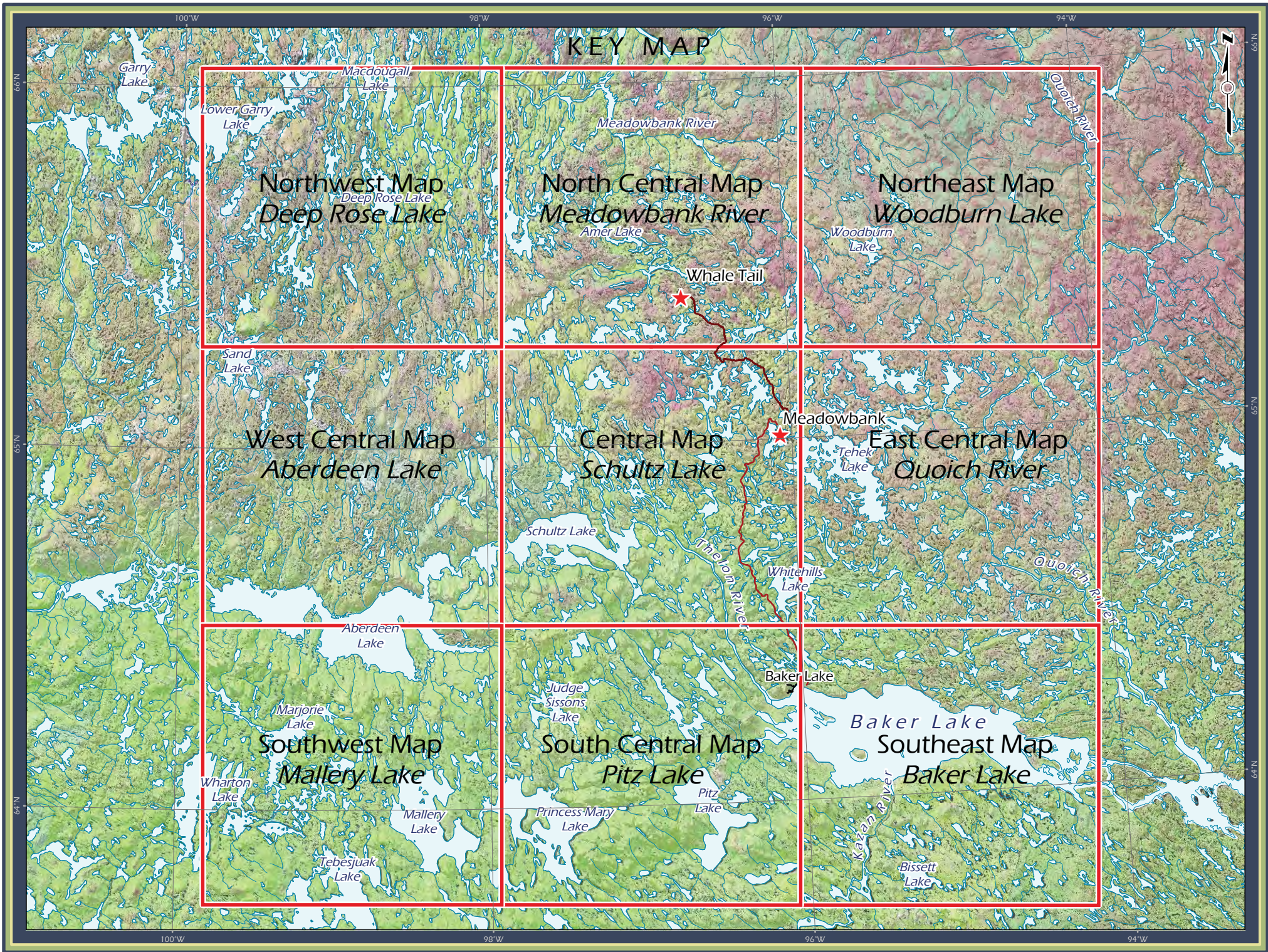
Randy Baker

Lake Trout

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Martin Gebauer



Baker Lake Harvest Study

Northwest Map Deep Rose Lake

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



Projection: UTM Zone 14 NAD83

Data Sources:

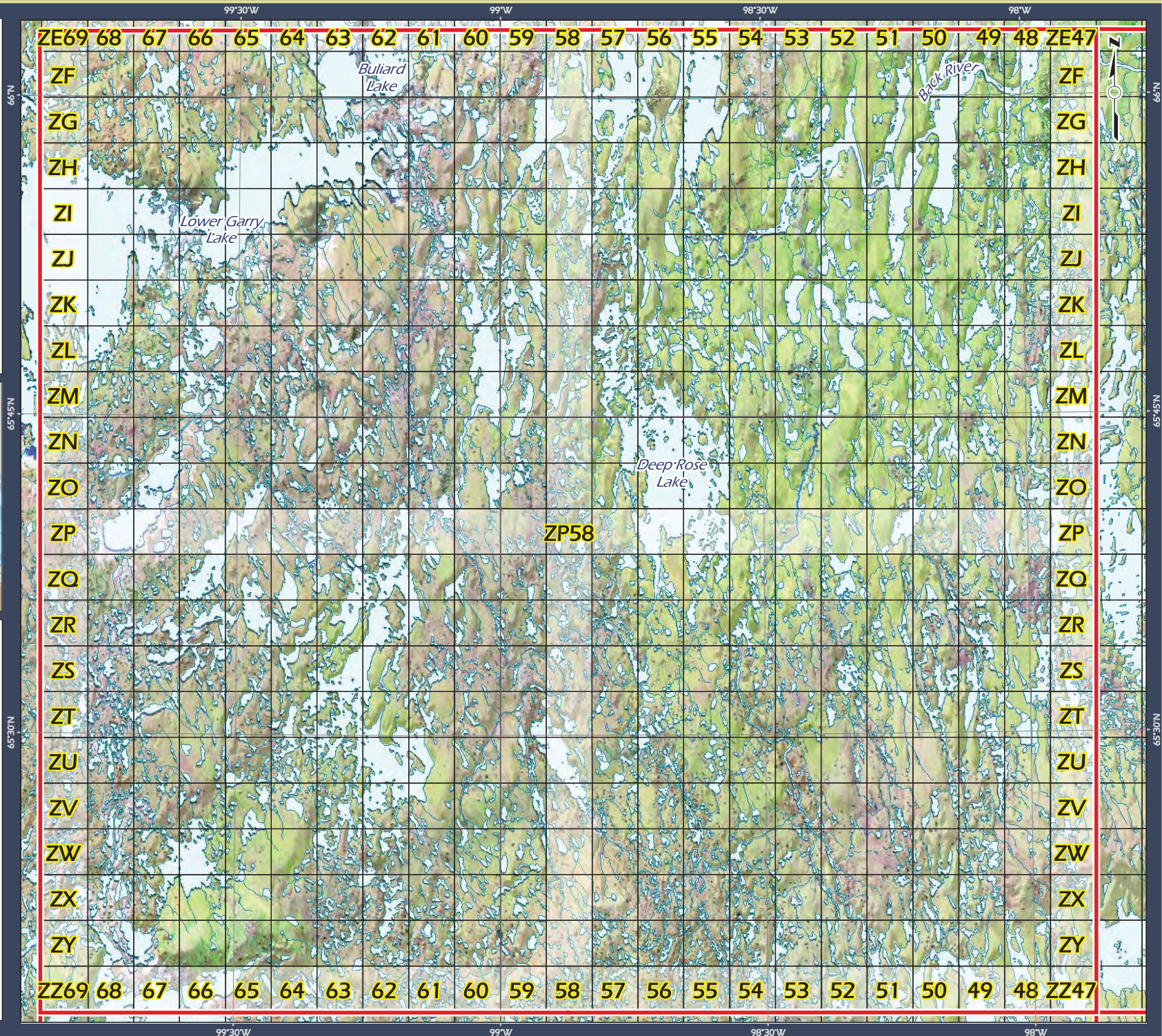
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Government of Nunavut
Agnico-Eagle Mines Inc.
Caslys Consulting Ltd.

Prepared for:



By:

Nunavut ENVIRONMENTAL CONSULTING LTD



Baker Lake Harvest Study

West Central Map Aberdeen Lake

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake



Projection: UTM Zone 14 NAD83

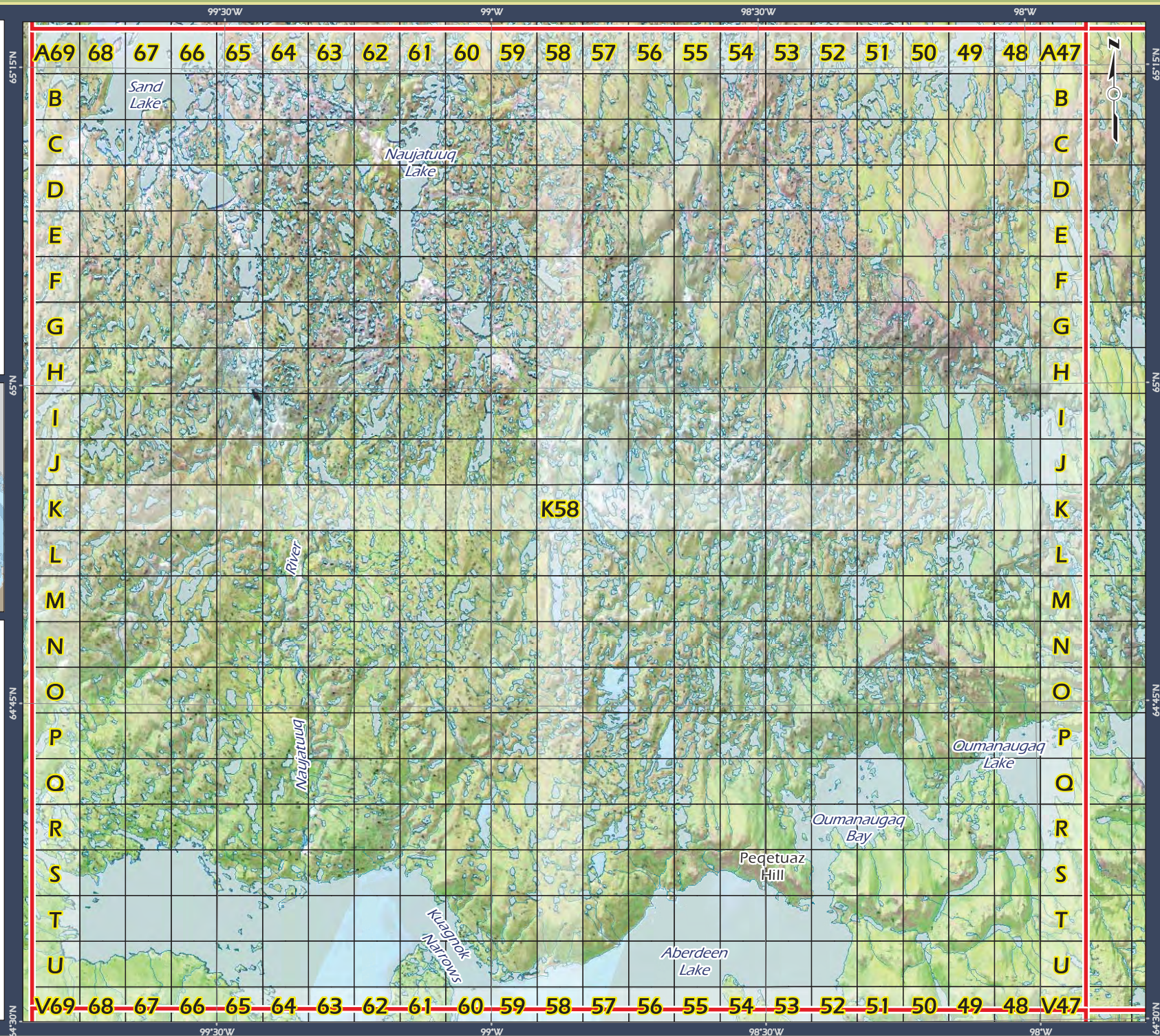
Data Sources:

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Prepared for:



By:



Baker Lake Harvest Study

Southwest Map Mallery Lake

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



0 5 10 15

Kilometres

Projection: UTM Zone 14 NAD83

Data Sources:

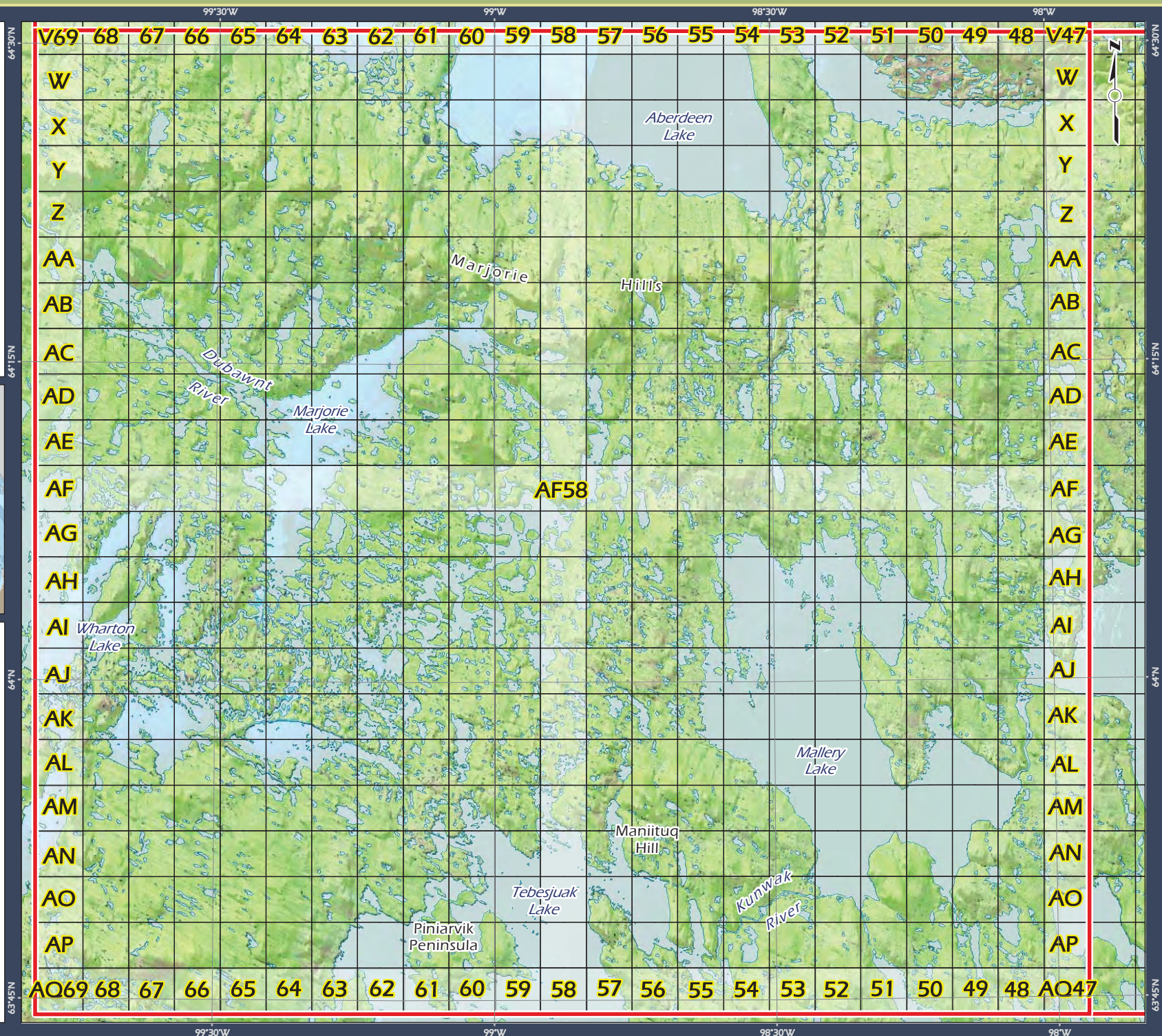
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Caslys Consulting Ltd.

Prepared for:



By:

Nunavut ENVIRONMENTAL
CONSULTING LTD



Baker Lake Harvest Study

North Central Map Meadowbank River

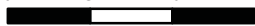
Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



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Kilometres

Projection: UTM Zone 14 NAD83

Data Sources:

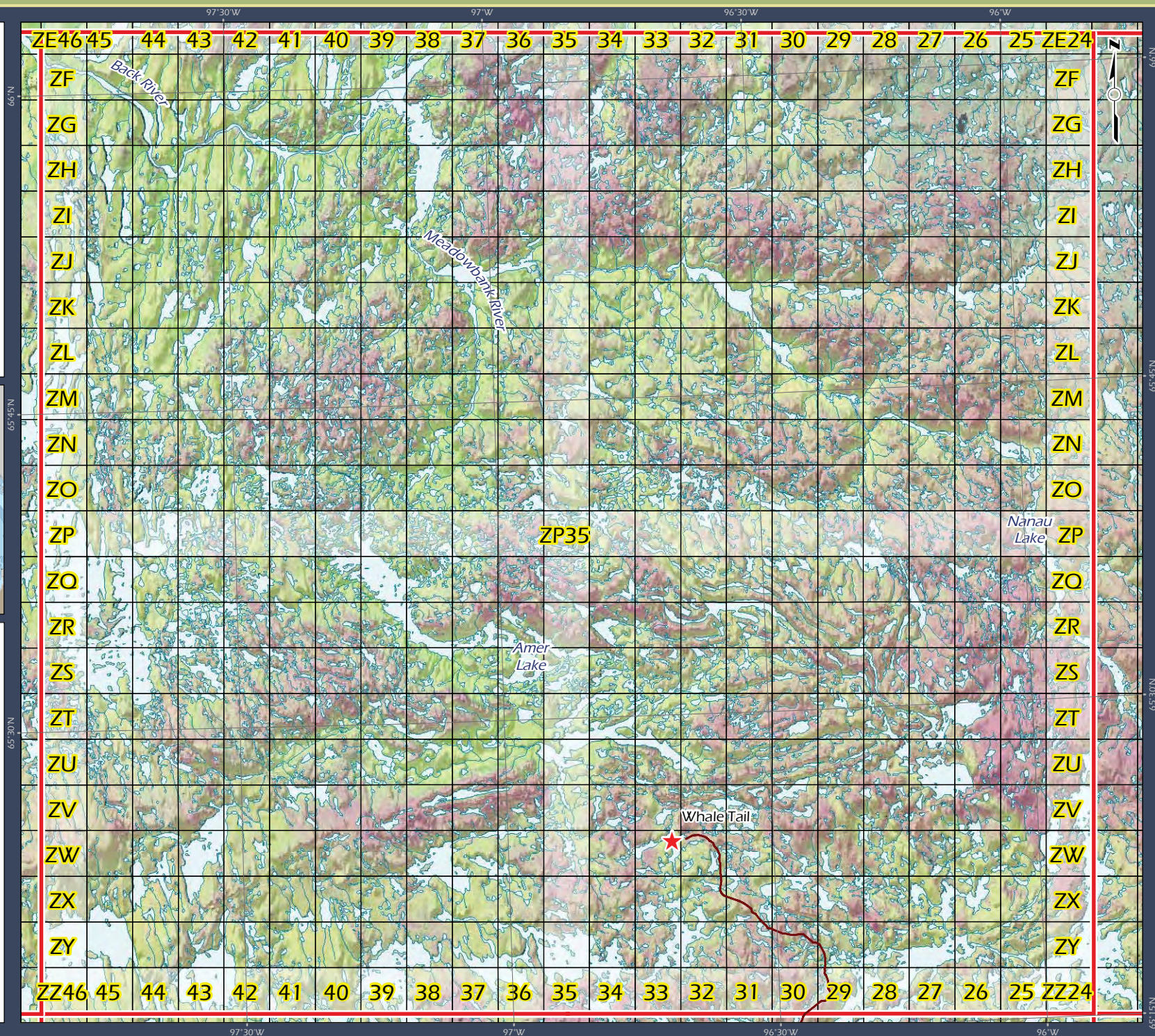
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Caslys Consulting Ltd.

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By:

Nunavut ENVIRONMENTAL CONSULTING LTD



Baker Lake Harvest Study

Central Map Schultz Lake

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



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Kilometres

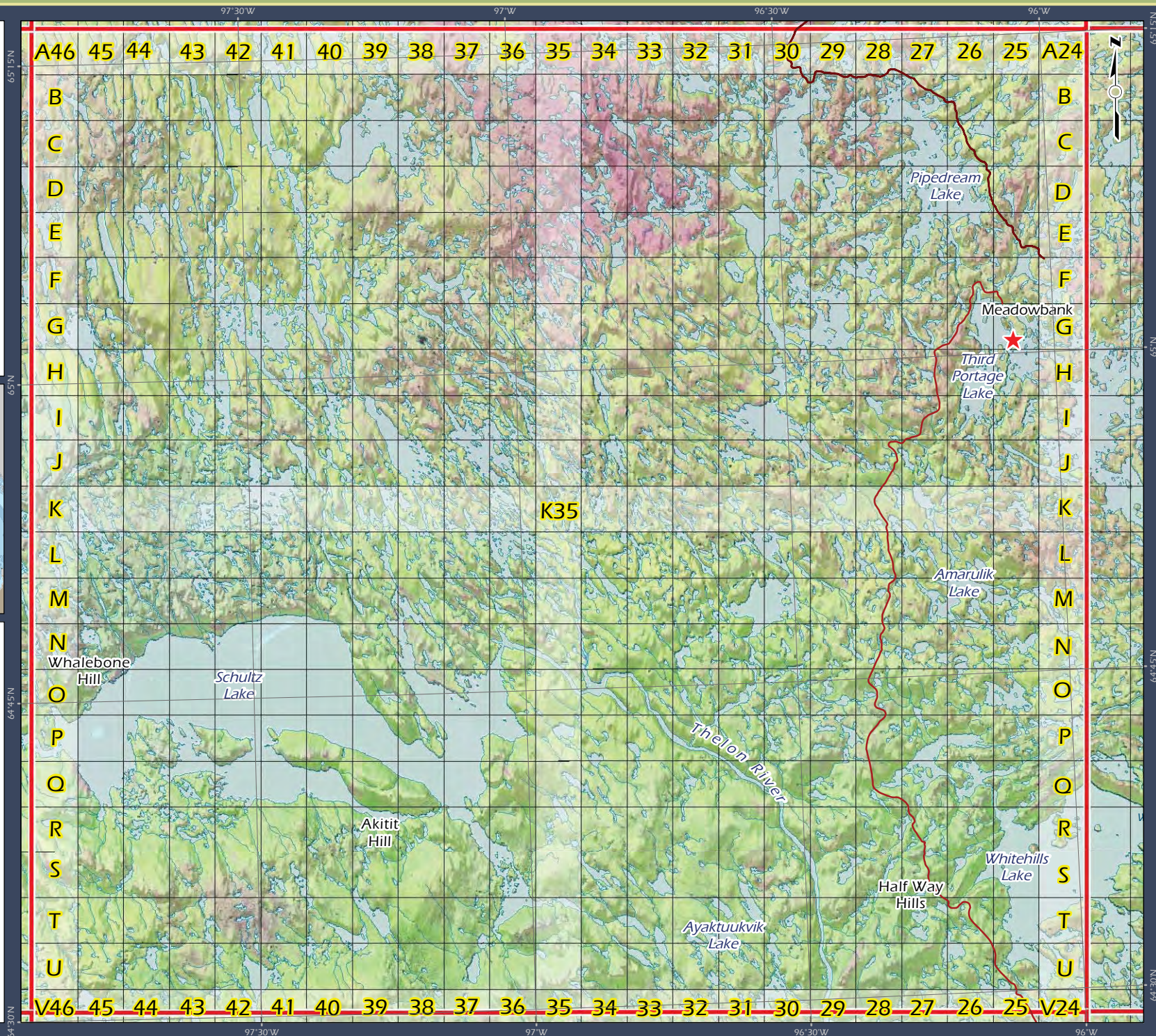
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National Topographic Database
Government of Nunavut
Agnico-Eagle Mines Inc.
Caslys Consulting Ltd.

Prepared for:



By:



Baker Lake Harvest Study

South Central Map Pitz Lake

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake



Projection: UTM Zone 14 NAD83

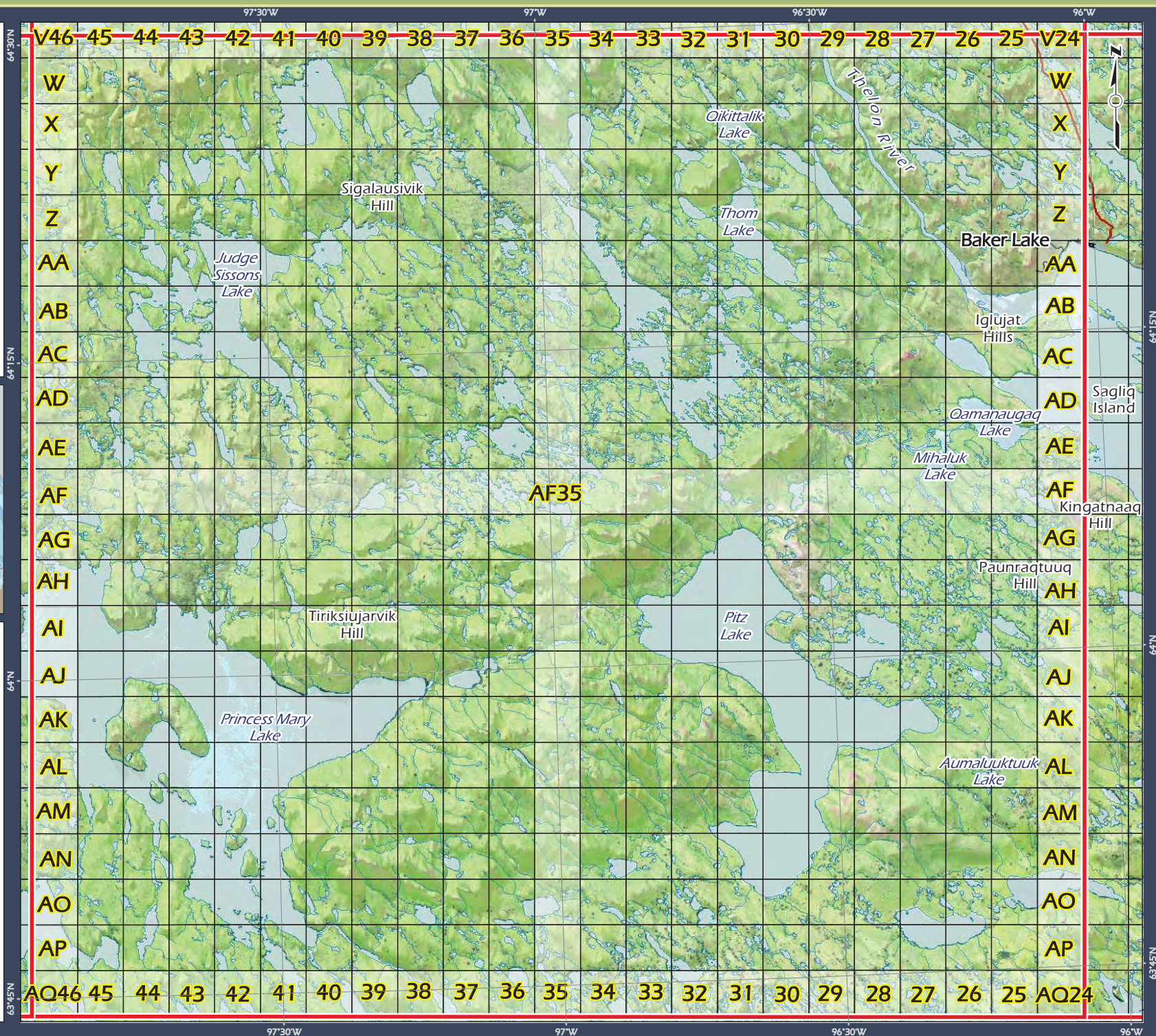
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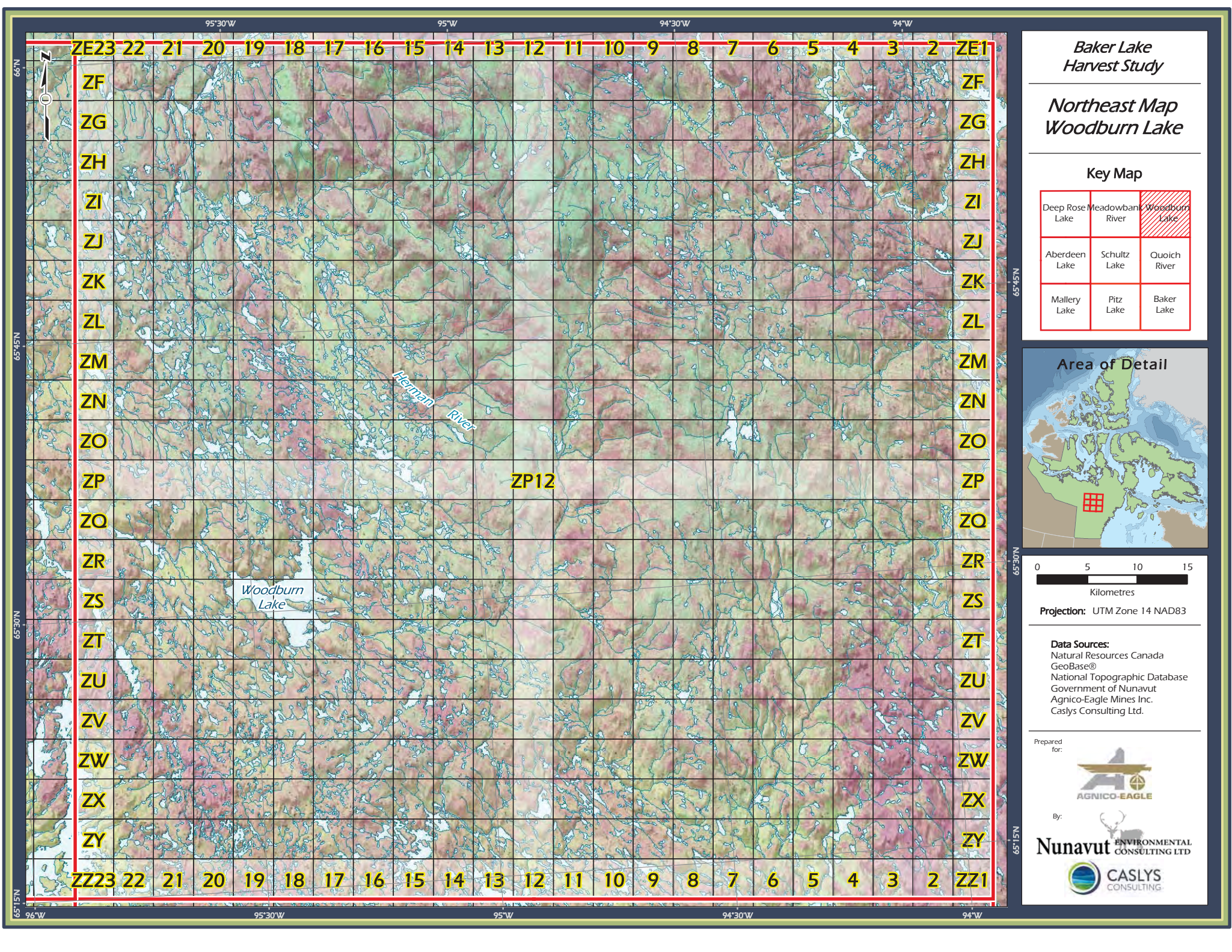
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National Topographic Database
Government of Nunavut
Agnico-Eagle Mines Inc.
Caslys Consulting Ltd.

Prepared for:



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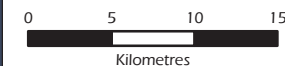
*Baker Lake
Harvest Study*

*Northeast Map
Woodburn Lake*

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Ouoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



Projection: UTM Zone 14 NAD83

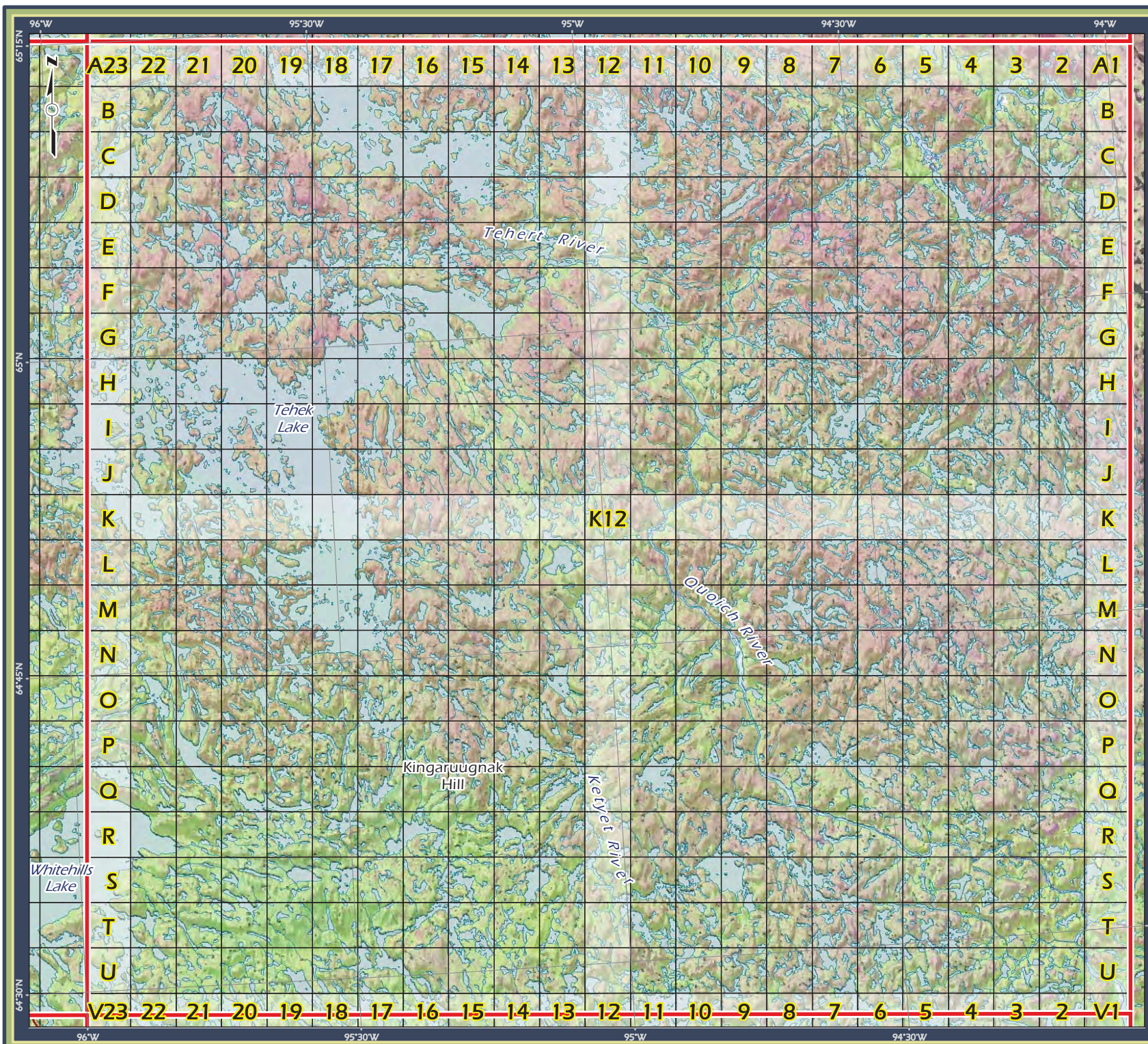
Data Sources:
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National Topographic Database
Government of Nunavut
Agnico-Eagle Mines Inc.
Caslys Consulting Ltd.

Prepared for:



By:





Baker Lake Harvest Study

East Center Map Quoich River

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Quoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



Projection: UTM Zone 14 NAD83

Data Sources:

Natural Resources Canada
GeoBase®
National Topographic Database
Government of Nunavut
Agnico-Eagle Mines Inc.
Caslys Consulting Ltd.

Prepared for:



By:





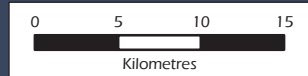
*Baker Lake
Harvest Study*

*Southeast Map
Baker Lake*

Key Map

Deep Rose Lake	Meadowbank River	Woodburn Lake
Aberdeen Lake	Schultz Lake	Ouoich River
Mallery Lake	Pitz Lake	Baker Lake

Area of Detail



Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada
GeoBase®
National Topographic Database
Government of Nunavut
Agnico-Eagle Mines Inc.
Caslys Consulting Ltd.

Prepared for:



By:



How to Use the Baker Lake Harvest Calendar

Agnico Eagle Mines Ltd., in cooperation with the Baker Lake Hunters and Trappers Organization (HTO), want to understand hunting and fishing patterns by Baker Lake residents. Specifically, we want to understand how the Meadowbank and Whale Tail Gold Project, located north of Baker Lake, might change traditional harvesting patterns. To ensure that traditional hunting and fishing activities are not negatively affected, we have developed this calendar where participants can record harvest information throughout the year.

Near the back of the calendar is a page that shows the animal and fish species that are included in the study. Please write down the species, number, sex, and location of animals or fish that you have harvested on each date on the calendar. When writing down the location, please use the XY coordinate system provided on the nine maps at the back of the calendar.

For example, if you harvested a male caribou on January 16th on Big Hips Island you would write down “1 male caribou, AF19” in the January 16th square of the calendar.

You will also be visited or contacted by the hunter harvest coordinator occasionally throughout the year. The coordinator's job will be much easier if you write down your harvest information in the calendar as soon as possible.

Please return the calendar to the Agnico Eagle office in Baker Lake at the end of the year or give the calendar to the coordinator when he visits in January. Although each participant will receive a gift expressing our thanks, a draw will also be held in January for a number of high quality prizes.

If you have any questions., please contact the Baker Lake Harvest Study Consultant, Dylan White, at 1-266-500-4202 or dsgwhite@gmail.com. You can also contact an HTO member in the community or email Martin Gebauer at martin@gebauerassociates.com.

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Produced By:



AGNICO EAGLE



and



APPENDIX H

Arctic Raptors Report



ARCTIC RAPTORS

Prepared For:
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Environmental Project Coordinator
marie-pier.marcil@agnicoeagle.com
Agnico Eagle Mines Limited
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Suite 540
Baker Lake, Nunavut
X0C 0A0

Prepared By:
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170 52260 RR223
Sherwood Park, Alberta
T8C 1J3

Contact:
Alastair Franke PhD
alastair.franke@ualberta.ca

Background

Broad scale monitoring of raptors in the vicinity of the Meadowbank Mine including the Whale Tail site (Meadowbank Complex) was first initiated in 2015. The purpose of the monitoring program from 2015 through 2019 focused on searching for nesting sites located near to, and far from proposed or existing infrastructure. In 2018, the Government of Nunavut (GN) indicated that monitoring to that point did not have the power to detect and mitigate Project-related effects on raptor nesting success. In addition, the GN argued that the study design did support analysis that would allow detection of project-related nest failures (e.g., by examining nest success as a function of intensity of project-related disturbance). Starting in 2021 (no monitoring was completed in 2020 due pandemic restrictions), Agnico Eagle conducted two broad-scale helicopter surveys per year with the intent of estimating project effects. In addition, Agnico Eagle has conducted regular monitoring of project-related infrastructure considered to be typical of nesting habitat (e.g., road-side quarries).

Monitoring objectives are outlined in the Agnico Eagle Meadowbank Division Terrestrial Ecosystem Management Plan (TEMP; Agnico Eagle Mine 2019). The TEMP outlines requirements for avoiding and managing disturbance to nesting raptors, as follows:

- Develop a nest-specific response plan for identified raptor nests within areas of concern to ensure that nesting success is not affected by development activities
- Follow GN-DoE guidelines for avoiding disturbance to raptor nests
- Active nest monitoring

In addition, the TEMP also outlines the general monitoring approach, as follows:

- document and map raptor nesting sites (see Project Certificate No. 008 Condition 33)
- evaluate the success of mitigation to prevent disturbance to raptors or raptor nests
- estimate project-related disturbance effects.
- develop site-specific management plans for nesting sites within 1.5km of project infrastructure, including minimum “no disturbance” buffers.
- in the event of deterrence or removal of a nest, Agnico Eagle must contact the Government of Nunavut (GN) and secure the required permits (see Project Certificate No. 008 Condition 36).

Species Descriptions

Peregrine Falcon (*Falco peregrinus tundrius*)

The Arctic peregrine falcon (Figure 1) is medium- to large-sized falcon. It has a dark hood and face with distinct dark malar stripe, cream to white throat, slate-grey back, barred belly, legs, and tail. Long pointed wings, stocky body. Plumage of immature birds brown rather than grey, and the breast is streaked rather than barred. In adults, the cere and orbital ring are yellow, and bluish in immature birds. Compared with gyrfalcons, the peregrine is smaller and less stocky. In flight, the wings of peregrines appear narrower and more pointed. In peregrine falcons, wing tips extend to bottom of the tail when perched, while in gyrfalcons, wing tips extend two-thirds down the length of tail.

F. p. tundrius breeds mainly north of the treeline from Alaska east throughout northern Canada to Greenland. It breeds throughout the taiga and tundra wherever suitable nesting habitat and sufficient prey are present. In Nunavut, peregrines appear to have their highest densities in the Kivalliq and

Kitikmeot regions. Highest breeding density on record is on the western shores of Hudson Bay in the Kivalliq Region.



Figure 1 Peregrine Falcon (male)

F. p. tundrius is a long-distance migrant, wintering mainly throughout South and Central America, but also in southern United States and Mexico. Northern-breeding American and Arctic peregrines are highly migratory (Yates et al. 1988, Schmutz et al. 1991, Fuller et al. 1998), and although fall migration occurs over a broad geographic range (Fuller et al. 1998), Yates et al. (1988) indicated that “separate and distinct autumn migratory populations pass through the east and Gulf coasts” of the United States.

Peregrine falcons usually nests on cliffs and rocky outcrops, but also nest on hilltops, river canyons, rock screes, and on occasion directly on the ground (Court et al. 1988, Ratcliffe 1993). They prefer nesting in locations close to water in south-facing, rugged terrain. Hunting habitat includes rugged coastline areas and rolling tundra that consists of raised beaches, dry tundra, sedge meadows, wetlands, and lakes that are inhabited by a diversity of breeding songbirds and shorebirds.

Peregrine Falcons do not build a nest but make a depression (called a scrape) in the substrate on a cliff ledge. Scrapes are usually approximately 20 cm in diameter and 4 cm deep. Females usually do the majority of incubation and brooding of small young. Males provision incubating females and provide most of the prey when nestlings are small. Thereafter, females do most of the feeding, beginning to hunt after young are large enough to thermoregulate on their own. Clutch size is typically 3 or 4 eggs in Nunavut. In Rankin Inlet and Igloolik, the median incubation period of the first egg was 36 days and decreased 1 day for each additional egg. The incubation period of the 4th egg (33 days) was similar to what has been reported elsewhere (Burnham 1983).

The Arctic peregrine falcon is a generalist predator with a diverse diet that includes passerines, shorebirds, ducks, gulls, terns, jaegers, black guillemots, and, when available, collared lemmings, brown lemmings, and Arctic ground squirrels. Bradley and Oliphant (1991) indicated that, around Rankin Inlet, small birds (64% of prey items) represented the greatest portion of prey items, followed by microtine rodents (25%), large birds (8%), and Arctic ground squirrels (4%). The most important prey measured by percent biomass were large birds (43%), followed by small birds (25%), microtine rodents (18%), and Arctic ground squirrels (15%).

In Nunavut, the earliest documented arrival for Peregrine Falcons is 10 May at a known breeding site near Rankin Inlet. Although arrival timing varies with spring conditions, most sites are occupied during the 3rd week of May. Median laying date in Rankin Inlet (9 June) is typically earlier than Igloodik (15 June) and northern Baffin Island (16 June). Median date of hatching ranges from 14 July at Rankin Inlet to 18 July on northern Baffin Island and 20 July at Igloodik (Jaffre et al. 2015). Birds depart the breeding grounds from mid-September through early October, arriving on the wintering grounds throughout Central and South America in November.

The peregrine falcon is no longer included on the list of endangered and threatened species in Canada (SARA 2002, as amended); furthermore North American populations including those monitored in Nunavut are considered to be stable (Franke 2016, Franke et al. 2020).

Gyrfalcon (*Falco rusticolus*)

The gyrfalcon (Figure 2) is large with pointed wings, but more rounded and broader than the wings of other falcon species. The tail is relatively long. When perched, wings extend 2/3 down the tail. The body is thick and powerful, particularly in females. Adults have yellow ceres, eye-rings and legs. As in all falcons, the eyes appear black. Three main color morphs occur: black, grey and white. White adults have almost pure white breasts and bellies, with dark wingtips (dipped-in-ink appearance). Grey adults have slate-colored back, with white underparts mottled with gray arrowhead-shaped markings. Dark adults are dark grey overall above and dark-streaked breasts and belly. There is extreme reverse sex dimorphism, with males being approximately 2/3 the size of females (Ferguson-Lees et al. 2001).

Gyrfalcons distribution extends throughout the circumpolar Arctic. Most of the breeding range occurs north of 60°N, but breeding pairs are known to exist as far south as 55°N, mainly along seacoasts in eastern Canada. Many adults remain within the breeding range throughout the year, but some disperse southwards in winter, small numbers reaching the northern United States (Cade 1982, Poole 1987). Immature birds are much more likely to winter to south of breeding range, and females are thought to disperse more widely, with many males remaining relatively close to breeding territories throughout the year.

Ptarmigan are often cited as the most important prey species by biomass, but Arctic ground squirrel and Arctic hare are also important, as well as small mammals (mice and voles) and other birds (ducks, sparrows, buntings). In central Nunavut, Poole and Boag (1988) identified eleven species of birds and five species of mammals among the prey. Birds accounted for three quarters of the diet, and adult rock ptarmigan were the most common. Arctic ground squirrel and arctic hare made up the bulk of mammalian prey.

Males occupy and defend nesting territories as early as the end of January, with females arriving in mid-March. In Nunavut, laying typically begin in the first week of May with most pairs laying by the end of the second week in May. Nestlings typically hatch in mid-June, but hatching can occur throughout June. Nestlings fledge in late July or early August after 7 weeks in the nest. In Nunavut, gyrfalcon usually nest

on cliff ledges, ideally beneath sheltering overhang; sometimes nests in trees or on man-made structures. Nests are generally on rock ledges or abandoned rough-legged hawk or common raven nests. Use of alternate nest sites is not uncommon. Pairs do not necessarily attempt breeding every year, depending on food supply. Typical clutch size is 3-4 eggs (Booms et al. 2008) that are incubated for 34-36 days mostly by the female (ca. 80%). The North American population including Nunavut is considered to be stable (Clum and Cade 1994, Kirk and Hyslop 1998). Although low spring temperatures are associated with later arrival at nesting territories in Nunavut (Poole and Bromley 1988), there was no effect on laying dates. However, (Poole and Bromley 1988) indicated that increased spring precipitation (snow) reduced reproductive success.



Figure 2. Gyrfalcon (female)

Rough-legged Hawk (*Buteo lagopus*)

The rough-legged hawk (Figure 3) is a medium-large bird of prey, with a small beak, predominantly brown in colour and often mottled. Plumage is highly variable with recognized light and dark morphs. Extensive field experience is required to distinguish between males and females, and between adults and juveniles based on plumage alone. A broad chest band is evident in most plumage variations, and in flight, a dark carpal patch is characteristic in light morph individuals. One or more dark terminal bands appear on the tail. The wing tips are long enough to reach or extend past the tail when the animal is perched. Legs are feathered to feet (Ferguson-Lees et al. 2005).

Widespread throughout North America, breeding from the Aleutian Islands, the interior of Alaska, Yukon, northern Mackenzie, and across Nunavut to northern Labrador and Newfoundland and south to Manitoba and southeastern Quebec. In Nunavut, rough-legged hawks are present over most of the territory except for islands without lemmings (Bechard and Swem 2002).

Regularly hovers, or “kites” while facing into the wind scanning for prey. Soars with wings raised in a slight dihedral (V-shape). It is a diurnal raptor that still-hunts from prominent perching structure on both breeding and wintering grounds. Prey is captured on the ground. Courtship involves soaring and calling, with the male engaged in a flight display of repeated undulating stoops rising upward to mid-air stall. It is gregarious on migration, often travelling in flocks, but small groups or individuals are not uncommon.

Breeding pairs prefer rugged terrain areas with steeper slopes in areas associated with vegetation, and were most likely to nest in large, productive valleys surrounded by high-elevation plateaus (Galipeau et al. 2016). It is widely distributed in winter, usually found in open habitat such as prairies, plains, coastal marshes, agricultural fields, and airports (Johnsgard and Johnsgard 1990). More common in wintering areas with short growing seasons and low precipitation, with highest densities in the northern United States, Great Basin area, and the western shortgrass prairies (Bock and Lepthien 1976, Bock et al. 1977).

The rough-legged hawk is a small mammal specialist; thus, its breeding activity is generally associated with local abundance of ground squirrels, voles, or lemmings (Hanski 1991, Potapov 1997). It will prey on birds when small mammals are scarce, particularly juvenile passerines and shorebirds, and will resort to consuming carrion (Watson 1986). Usually reproductively mature at 2 years of age. Stick-nests are built soon after arrival on territory, typically on cliffs, bluffs, or on the ground. Clutch size varies (1-7 eggs), depending on food availability, but 3-5 eggs are usual and laid in May. Incubation 31-33 days, provided almost entirely by the female. Nestling period is 35-40 days, and fledglings remain dependent on adults for another 2 weeks. The male provisions the young and the female feeds the young. Pairs show nest site fidelity, and in locations where ground squirrels are entirely absent, they may forgo breeding or have small broods when lemmings are low (Bechard and Swem 2002). Bechard and Swem (2002) indicated that egg-laying date was associated with spring temperatures and snow-free ledges, but Potapov (1997) reported no effect of snow melting date or spring/summer temperatures on number of nesting pairs.



Figure 3. Rough-legged Hawk (male)

Methods

Field Surveys

Structured surveys were conducted from 2015 – 2017, 2019 and 2021-2023 (Table 1). The focus of these surveys was to search known nesting sites for the presence of cliff-nesting raptors. In addition to the structured surveys, favorable habitat was searched opportunistically when ferrying between known sites, camps, or other mine infrastructure and when raptors or signs of site use (e.g., whitewash, orange-colored lichen, and unused nests) were observed. Sites were considered occupied if one or more adults displayed territorial or reproductive behavior (e.g., vocalization and/or flight behavior associated with defense of breeding territory or presence of nest building, nest, or eggs). Locations with partially built or unused nests without detection of breeding aged adults were noted as such (e.g., old stick nest; no birds detected). Raptor monitoring in 2023 involved two helicopter surveys (23 May – 28 May, 09 – 12 August), and ground monitoring of potential nesting habitat (natural cliffs, quarries and borrow pits) along the Whale Tail Haul Road (WTHR; Meadowbank to Whale Tail) and All Weather Access Road (AWAR; Baker Lake to Meadowbank).

Table 1. Broad scale survey effort from 2015-2023 for raptors breeding in the vicinity of the Meadowbank Complex.

Year	2015		2016		2017		2018		2019		2020		2021		2022		2023	
Survey	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Start	28/05	—	18/05	21/07	28/05	—	—	—	13/06	—	—	—	23/05	04/08	28/05	12/08	23/05	09/08
End	30/05	—	20/05	23/07	30/05	—	—	—	15/06	—	—	—	30/05	08/08	03/06	17/08	28/05	12/08
Hours	12	—	10	10	12	—	—	—	10	—	—	—	12	12	11.7	12.4	10.7	11.4

Mapping

Shapefiles for the most recent projection of the combined footprint of the AWAR, WTHR, and project site were read into R using the `readOGR` function in the `rddal` package and converted to a data frame for `ggplot2` using the `fortify` function. The spatial extent for the mapping exercise was set using the `get_map` function in the `ggmap` package. Maps portraying species-specific nesting sites were plotted using `ggmap`.

Data Analysis

Distance to disturbance

Spatial objects (lines and polygons) describing the project footprint were acquired from Agnico Eagle. Euclidean distances from nesting sites to the nearest spatial object were calculated in R (R Development Core Team 2017) using the `sp`, `rgeos`, and `geosphere` packages.

Occupancy

Although estimation of nesting site occupancy can serve as a metric of population status (MacKenzie et al. 2002, 2003), detection of nesting pairs is imperfect, and estimating the proportion of occupied sites without accounting for detection error can lead to underestimation of true occupancy (Kéry and Schmidt 2008). Occupancy modeling estimates parameters that influence occupancy, and simultaneously accounts for imperfect detection (Marsh and Trenham 2008). In any given year, the status of a nesting site is limited to one of only two outcomes: occupied or not occupied. Occupancy modelling estimates the following parameters:

1. initial colonization – the probability that a nesting site is occupied in the first survey year (ψ),
2. colonization – the probability that an unoccupied site becomes occupied between years (ϵ),
3. extinction – the probability that occupied site becomes unoccupied between years (γ); and,
4. detection – the probability that PEFA are detected given that the nesting site is occupied (p).

Nesting site survival is estimated as the reciprocal of extinction (i.e., the probability an occupied site remains occupied between years; $1-\gamma$). In addition, environmental covariates can be added to an occupancy model to test whether they influence the above parameters using a logit link function. Multi-year occupancy was calculated in R (R Development Core Team 2019) using the ‘unmarked’ package. When appropriate, data were standardized (e.g., distance to disturbance was standardized by subtracting the mean from each distance value and dividing by the standard deviation), and then formatted specifically for ‘unmarked’ using the *unmarkedMultFrame* function.

Occupancy among years was analyzed separately for peregrine falcons, rough-legged hawks, and gyrfalcons. To do so, the total number of nesting sites was filtered to include only those nesting sites that were occupied at least once between 2015 and 2023 for each species. Model fitting of candidate models (Table 2) was performed using the *colext* function. Akaike Information Criterion (AIC) was used for model selection.

Three candidate models were selected *a priori* to estimate the effect anthropogenic disturbance or time (Table 2). The aim of this analysis was two-fold: 1) to estimate the proportion of occupied nesting sites annually, and; 2) to estimate the trend in nesting site occupancy from 2015 to 2023. Trend in occupancy was estimated using annual occupancy probabilities to calculate average rate of change (λ) at the population level (MacKenzie et al. 2003) where a value <1 indicates population decline and >1 indicates an increase. Initial occupancy and detection probability were set to constant (i.e., 1) time varying (i.e., year), respectively, for all models. Model structure for extinction and colonization varied according to the test for effects (see Table 2).

Table 2. Candidate models

Model structure	Model #	Tests for effect of:
$\psi(1) + \epsilon(1) + \gamma(1) + p(\text{year})$	m0	Null (contrast to m1 and m2)
$\psi(1) + \epsilon(d2d) + \gamma(d2d) + p(\text{year})$	m1	Distance to disturbance (project infrastructure)
$\psi(1) + \epsilon(\text{year}) + \gamma(\text{year}) + p(\text{year})$	m2	Time (captures effect of missing covariates)

Reproductive success

Over the course of the nine-year period, four surveys were conducted during brood rearing (2016, and 2021 -2023). For this report, estimates of reproductive success are reported as the number of young hatched from a single nesting attempt by a pair of birds, regardless of age at the time they were observed. Because nestling age varied considerably between years and among sites, measures of annual productivity *per se* are expected to be biased high. All nesting sites were assumed to be contained within a unique nesting territory (i.e., no nesting territories were occupied by more than one pair of birds of the same species, regardless of the potential for alternative nesting sites within nesting territories).

Results

Mapping

Among survey years (see Table 1), 144 locations considered to be typical of raptor nesting habitat were surveyed at least once from 2015 – 2017, 2019, and 2021 - 2023. Of the 144 locations surveyed (Figure 4), nesting raptors have been detected at 96 nesting sites (Table 13). Peregrine falcons have been documented at 77 nesting sites, rough-legged hawks at 33 nesting sites and gyrfalcons have been documented at 13 nesting sites.

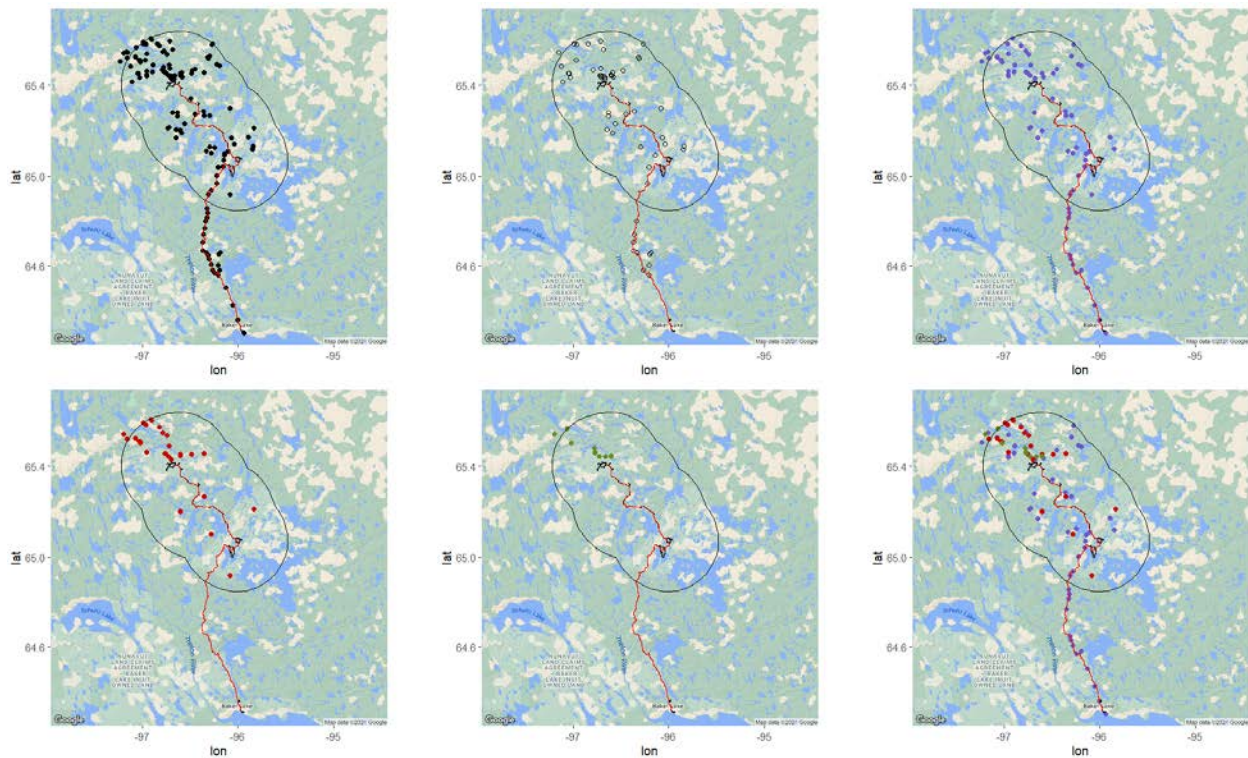


Figure 4. All cliffs surveyed (n=144; top L), cliffs with no record of occupancy (n= 48; top C), PEFA nesting sites (n = 77; top R), RLHA nesting sites (n=33; bottom L), GYRF nesting sites (n=13; bottom C), and all recorded nesting sites combined (bottom R) for the period 2015 – 2023 in the vicinity of the Meadowbank Complex

Distance to Disturbance

Mean distance from known occupied nesting sites to project infrastructure was 8.93 km (SD=8.30 km, range = 0 – 25.42 km). Twenty-one nesting sites fell within 1.5 km of the footprint of AWAR Road, Whale Tail Haul Road, or MBK Complex and are considered candidates for development of a site-specific management plans. Twenty of the 21 nesting sites within 1.5 km of the footprint have been occupied by only peregrine falcons, one nesting site has been occupied by only rough-legged hawks. Sixteen of the 20 peregrine falcon nesting sites were in rock quarries that were excavated for road building and maintenance, and four were located on natural cliffs. The two rough-legged hawk nesting sites located within 1.5 km of the project footprint were located on natural cliffs. There were no gyrfalcon nesting sites detected within 1.5 km of the project footprint. Seventeen nesting sites were within the 600m limit (500m baseline setback, plus additional 100m setback during the breeding season) identified by the Government of British Columbia (2013) for species with moderate ability to co-exist with human activity.

Occupancy

Peregrine Falcons

The minimum and maximum number of nesting sites sampled in any year was 16 (2018) and 77 (2022 and 2023), respectively (Table 3). The minimum and maximum number of breeding pairs detected was 8 (2020) and 36 (2022), respectively (Table 3). The top occupancy model (i.e., m1) included colonization and extinction effects of distance to disturbance, and a year effect for detection (Table 4; see Table 5 for parameter estimates). Delta AIC for the second-ranked model (m0, the null model) compared to m1 was 3.28 (i.e., >2.0), suggesting that effect size associated with distance to disturbance was important (Table 4). In this regard, the relationship between distance to disturbance and the probability that an unoccupied site would become occupied was negative (i.e., unoccupied nesting sites closer to the project footprint had a higher probability of becoming occupied when contrasted with those further from the project; Figure 5). Similarly, occupied nesting sites closer to the project footprint had a lower probability of becoming unoccupied when contrasted with those further away (Figure 5). Using m1, trend in occupancy (Figure 6) was $\lambda = 0.99$ (SE=0.04).

Table 3. Count of peregrine falcon nesting sites sampled, detected, colonized, extinct, static, and common from 2015 – 2023 for birds breeding in the vicinity of the Meadowbank Complex.

year	sampled	detected	colonized	extinct	static	common
2015	60	29	NA	NA	NA	NA
2016	63	32	8	9	39	56
2017	71	31	4	9	50	63
2018	16	9	2	3	11	16
2019	71	28	1	5	10	16
2020	17	8	4	2	11	17
2021	75	25	3	2	12	17
2022	77	36	19	10	46	75
2023	77	31	15	20	42	77

Table 4. Model selection based on AIC score for peregrine falcons.

Model structure	Model #	Parameters	AIC score	delta AIC	AICwt	Cumltwt
-.d2d.d2d.year	m1	14	979.50	0	0.84	0.84
-.-.-.year	m0	12	982.78	3.28	0.16	1
-.year.year.year	m2	26	991.87	12.37	1.7E-03	1

Table 5. Parameter estimates (null model; log odds scale) for peregrine falcon initial occupancy (ψ), colonization (γ) and extinction (ϵ), and a year effect for detection (ρ).

	$\psi(\text{Int})$	$\text{col}(\text{Int})$	$\text{col}(\text{d2d})$	$\text{ext}(\text{Int})$	$\text{ext}(\text{d2d})$	$p(\text{Int})$	$p(2016)$	$p(2017)$	$p(2018)$	$p(2019)$	$p(2020)$	$p(2021)$	$p(2022)$	$p(2023)$
estimate	0.54	-0.91	-0.29	-0.73	0.26	0.65	1.01	9.08	1.31	1.62	1.93	-0.44	0.28	-0.81
SE	0.46	0.17	0.17	0.19	0.17	0.58	0.68	32.33	0.98	1.24	1.25	0.69	0.66	0.65

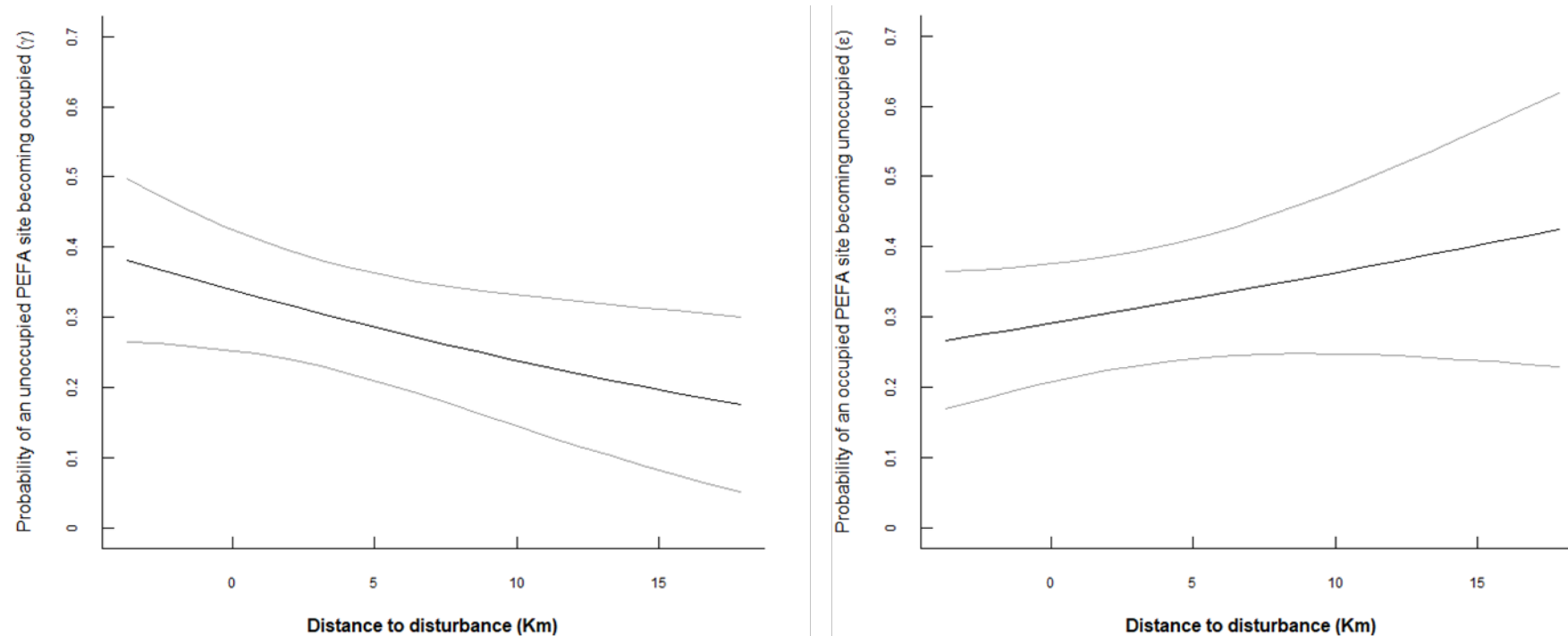


Figure 5. The effect of distance to disturbance on the probability that an unoccupied site would become occupied (γ), and the effect of distance to disturbance on the probability that an occupied site would become unoccupied (ϵ).

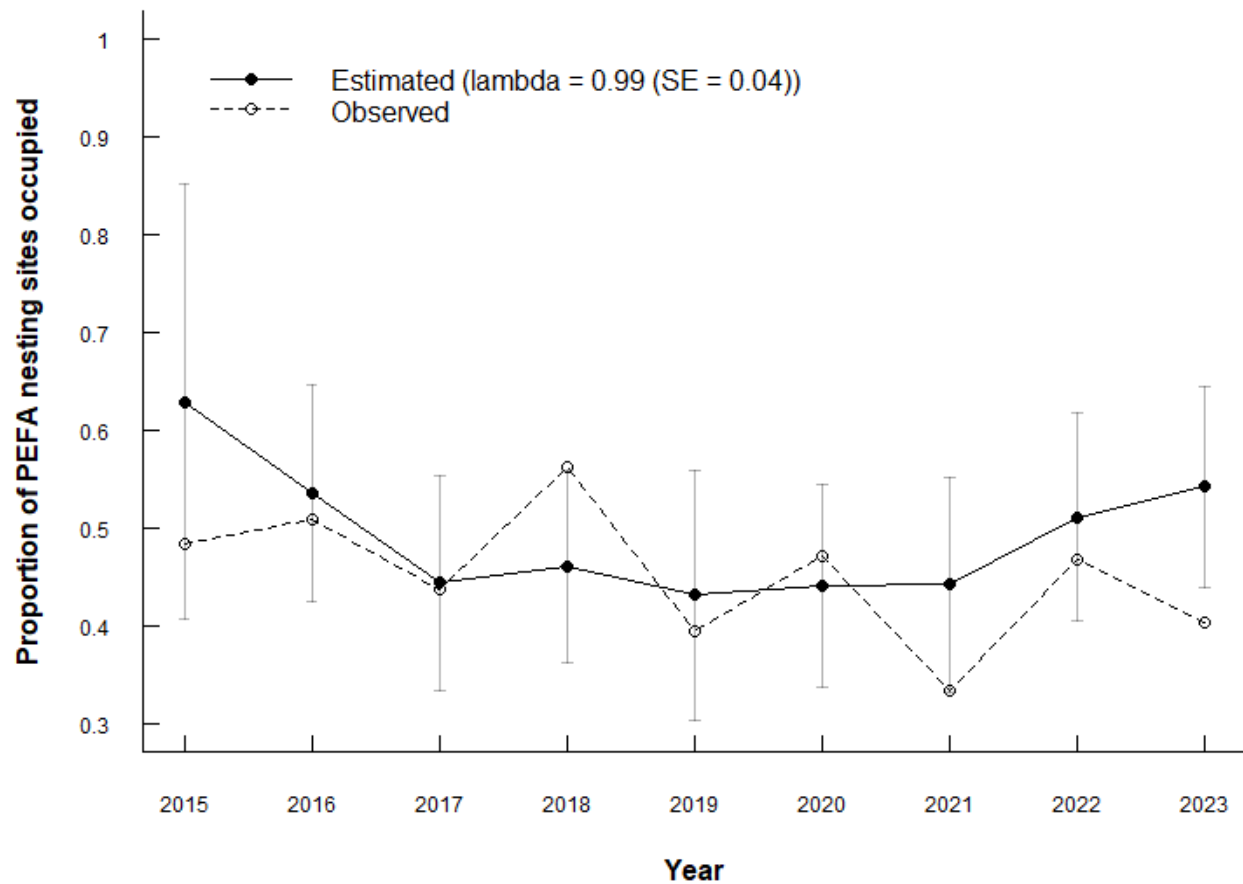


Figure 6. Proportion of PEFA nesting sites occupied from 2015 – 2023 in the vicinity of the Meadowbank Complex. The proportion observed (open circles with dashed lines) are point estimates, and do not account for detection error. The proportion estimated (closed circles with solid lines) accounts for detection error and includes standard error bars. $\lambda = 0.99 \pm 0.04$

Rough-legged Hawks

The null model was ranked first among the candidates for rough-legged hawk occupancy (Table 6; see Table 7 for parameter estimates). Trend in occupancy (Figure 7) calculated as average rate of change at the population level was $\lambda = 1.01$ ($SE=0.11$), where a value <1 indicates population decline and >1 indicates an increase (MacKenzie et al. 2003). The minimum and maximum number of nesting site sampled in any year was 0 (2018 and 2020) and 33 (2022 and 2023), respectively (Table 8). The minimum and maximum number of breeding pairs detected was 0 (2018 and 2020) and 16 (2017), respectively (Table 8).

Table 6. Model selection based on AIC score for rough-legged hawks.

Model structure	Model #	Parameters	AIC score	delta AIC	AICwt	Cumltvwt
-.-.year	m0	12	342.31	0	0.78	0.78
-.d2d.d2d.year	m1	14	344.38	2.51	0.21	1.00
-.year.year.year	m2	26	363.13	20.81	0.00	1.00

Table 7. Parameter estimates (null model; log odds scale) for rough-legged hawk initial occupancy (ψ) colonization (γ) and extinction (ϵ), and a year effect for detection (ρ).

	$\psi(\text{Int})$	$\gamma(\text{Int})$	$\epsilon(\text{Int})$	$p(\text{Int})$	$p(2016)$	$p(2017)$	$p(2018)$	$p(2019)$	$p(2020)$	$p(2021)$	$p(2022)$	$p(2023)$
estimate	-0.90	-0.51	-0.54	0.65	0.13	6.44	0.00	-0.88	0.00	-0.96	-1.10	-1.93
SE	2.45	0.41	0.42	5.17	5.03	24.71	84.04	5.35	84.02	5.32	5.33	5.31

Table 8. Count of rough-legged hawk nesting sites sampled, detected, colonized, extinct, static, and common from 2015 - 2023 for birds breeding in the vicinity of the Meadowbank Complex.

year	sampled	detected	colonized	extinct	static	common
2015	22	4	NA	NA	NA	NA
2016	29	12	5	1	16	22
2017	30	16	6	4	18	28
2018	0	0	0	0	0	0
2019	31	7	0	0	0	0
2020	0	0	0	0	0	0
2021	32	10	0	0	0	0
2022	33	9	5	7	20	32
2023	33	6	3	6	24	33

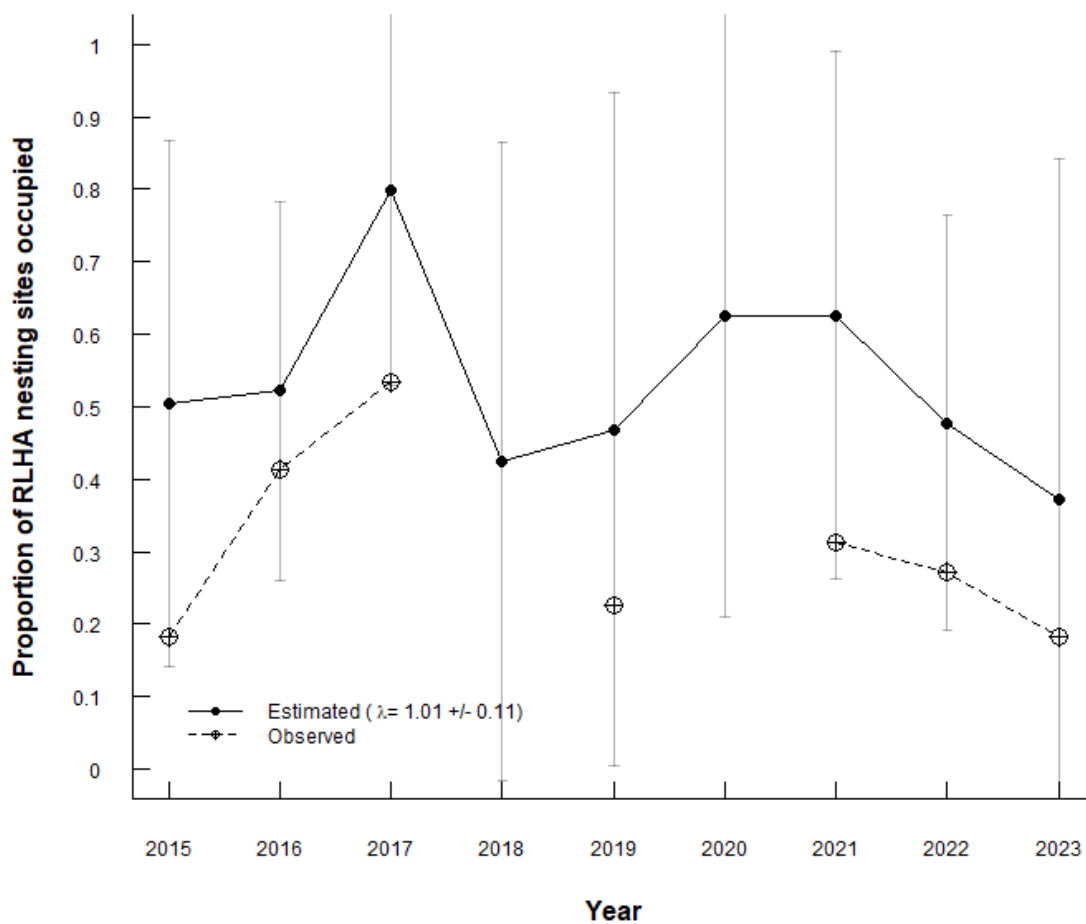


Figure 7. Proportion of RLHA nesting sites occupied from 2015 – 2023 in the vicinity of the Meadowbank Complex. The proportion observed (open circles with dashed lines) are point estimates without error bars,

and do not account for detection error. The proportion estimated (closed circles with solid lines) accounts for detection error and includes standard error bars. $\Lambda = 1.01 \pm 0.11$

Gyrfalcons

The null model was ranked first among the candidates for gyrfalcon occupancy (Table 9; see Table 10 for parameter estimates). Although, the delta AIC was less than 2.0 (1.90) for the second-ranked model which included distance to disturbance as an explanatory variable, this should not be interpreted as being an important effect size of distance to disturbance. Using the null model, trend in occupancy (Figure 8) calculated as average rate of change at the population level was λ 1.13 (SE=0.22), where a value <1 indicates population decline and >1 indicates an increase (MacKenzie et al. 2003). The minimum and maximum number of nesting site sampled in any year was 0 (2018 and 2020) and 13 (2022 and 2023), respectively (Table 11). The minimum and maximum number of breeding pairs detected was 0 (2018 and 2020) and 5 (2022 ad 2023), respectively (Table 11).

Table 9. Model selection based on AIC score for gyrfalcons.

Model structure	Model #	Parameters	AIC score	delta AIC	AICwt	Cumltvwt
-.-.year	m0	12	151.91	0.00	0.72	0.72
-.d2d.d2d.year	m1	14	153.81	1.90	0.28	1.00
-.year.year.year	m2	26	176.05	24.14	0.00	1.00

Table 10. Parameter estimates (null model; log odds scale) for gyrfalcon initial occupancy (psi) colonization (gamma) and extinction (epsilon), and a year effect for detection (rho).

	psi(Int)	col(Int)	ext(Int)	p(Int)	p(2016)	p(2017)	p(2018)	p(2019)	p(2020)	p(2021)	p(2022)	p(2022)
estimate	-0.36	-0.34	-0.59	3.18	-3.77	-3.64	0.00	-3.84	0.00	-3.40	-3.73	-3.53
SE	1.42	0.74	0.87	18.60	18.43	18.59	97.62	18,62	97.63	18.61	18.64	18.62

Table 11. Count of gyrfalcon nesting sites sampled, detected, colonized, extinct, static, and common from 2015 - 2023 for birds breeding in the vicinity of the Meadowbank Complex.

year	sampled	detected	colonized	extinct	static	common
2015	10	4	NA	NA	NA	NA
2016	11	2	1	3	6	10
2017	10	2	1	1	8	10
2018	0	0	0	0	0	0
2019	11	2	0	0	0	0
2020	0	0	0	0	0	0
2021	12	5	0	0	0	0
2022	13	4	1	3	8	12
2023	13	5	3	2	8	13

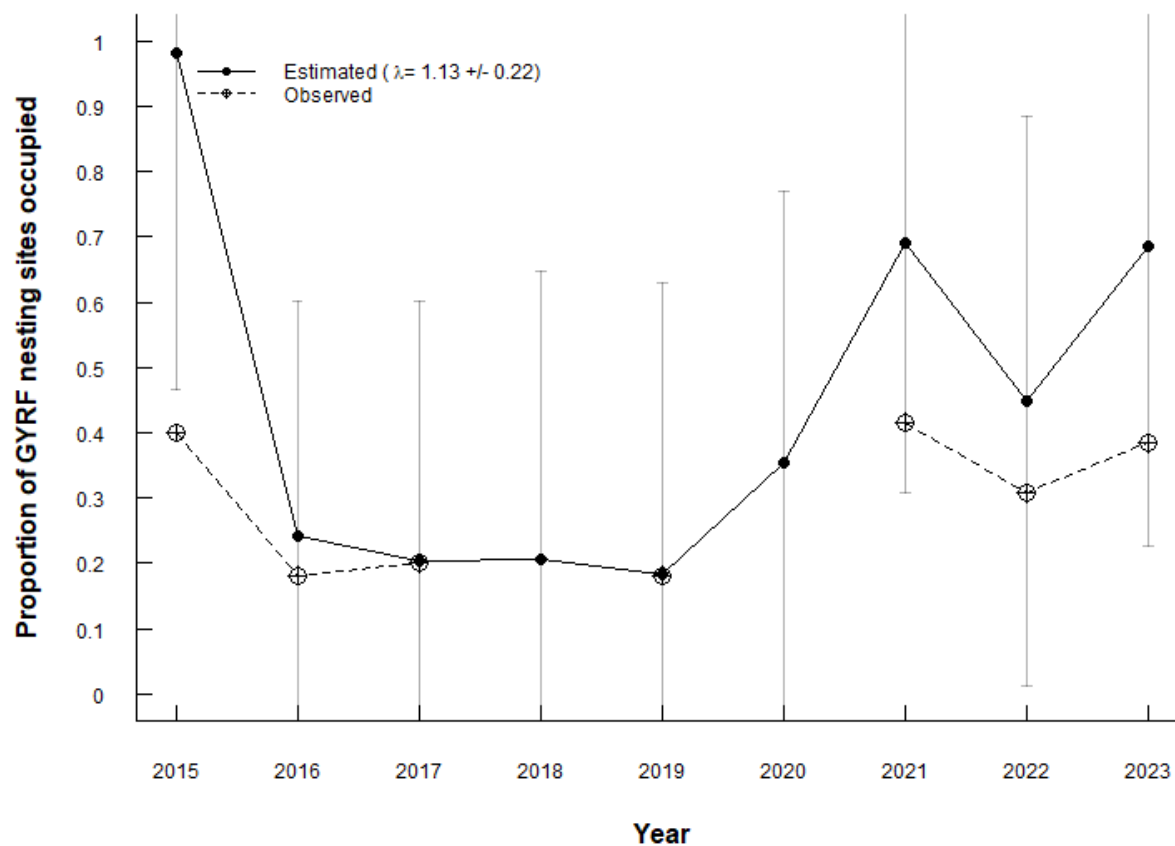


Figure 8. Proportion of GYRF nesting sites occupied from 2015 – 2023 in the vicinity of the Meadowbank Complex. The proportion observed (open circles with dashed lines) are point estimates without error bars, and do not account for detection error. The proportion estimated (closed circles with solid lines) accounts for detection error and includes standard error bars. $\lambda = 1.13 \pm 0.22$

Reproductive Success

Table 12. Estimates of reproductive success for peregrine falcons, rough-legged hawks, and gyrfalcons detected in 2016 and 2021 – 2023 during broad scale surveys in the vicinity of the Meadowbank Complex. Values are reported as number of young hatched from a single nesting attempt, regardless of nestling age at the time they were observed. Because nestling age varied considerably between years and among sites, measures of annual productivity per se are expected to be biased high.

	Peregrine falcons				Rough-legged Hawks				Gyrfalcons			
Year	2016	2021	2022	2023	2016	2021	2022	2023	2016	2021	2022	2023
Count of occupied sites	32	25	32 [†]	30	12	10	7	6	2	5	4	5
Count of nestlings	9	9	37	9	20	11	6	3	4	6	0	2
Productivity (apparent)	0.28	0.36	1.16	0.30	1.67	1.1	0.86	0.50	2.00	1.2	0.0*	0.4*

[†] Count of sites at which nestlings were detected, * Gyrfalcon nestlings may have fledged prior to surveys.

Conclusion

This report applies GN-DoE guidelines (Government of British Columbia 2013) to assess potential disturbance to known nesting sites that have been identified over the course of nine survey-years. Agnico

Eagle has detected peregrine falcon nesting sites in 15 rock quarries excavated for building and maintenance of the AWAR Road. To date there have been no instances of rough-legged hawks or gyrfalcons nesting in rock quarries. To date there have been no instances of raptors establishing nests on artificial structures along the Whale Tail Haul Road or Whale Tail site.

Monitoring has focused on searching for, documenting, and mapping nesting sites for three raptor species (peregrine falcons, rough-legged hawks, and gyrfalcons). Study design was limited to single surveys in some years, which limits estimation of detection error. To address this limitation, starting in 2021, the study design was updated to incorporate multiple surveys annually, and took advantage of the distribution of known nesting sites to monitor occupancy as a function of distance to project-related disturbance. This approach addresses the GN comment in the 2018 Annual Report regarding the potential for insufficient power to detect to project-related effects by correcting for inconsistent monitoring within and among seasons. There has been no incident requiring permitting for removal of a nest (Term and Condition 36).

This report meets Term and Condition 33 by documenting and mapping raptor nesting sites (Figure 4, Table 13). There is no evidence for project-related related disturbance effects for peregrine falcons, rough-legged hawk occupancy, and gyrfalcons.

In 2023, pre-season deterrence was conducted at two sites known to harbour raptors for quarries along the AWAR where project-related activity was expected. Despite ongoing in-season and broad scale monitoring there is currently no history of nesting raptors along the WTHR (all habitat with the potential to harbour nesting raptors will be monitored in 2024). Where occupied nesting sites were detected, mine-related activity within the quarries was restricted. Nesting sites were monitored to minimize disturbance. Nest visits were conducted periodically to conduct egg and nestling counts. Presence of nesting pairs was not made public to minimize disturbance. In the next iteration of the TEMP, expected to be completed in 2024, Agnico Eagle will look at updating the management and response plans. Improved monitoring and management of these nesting sites has the potential to fulfill the requirements outlined in the TEMP (active nest monitoring, evaluating the success of mitigation to limit disturbance to raptors or raptor nests, and estimating project-related nest failures). However, for this to be achieved, factors associated with natural disturbance (e.g., weather, prey abundance, predation) must also be estimated to avoid confounding the effect of natural disturbance with project-related disturbance. In 2024, in addition to the regular monitoring conducted by Agnico Eagle Environment, two broad scale surveys are expected, and will contribute to meeting NIRB Project Certificate Term and Condition. It is possible that the effect of distance to disturbance for peregrine falcons is related to the quantity of nesting sites that have been established in quarries creating a bias for nesting sites located close to the project footprint. Searching for nesting sites parallel to, and far from the AWAR would reduce any potential bias that exists.

Table 13. Geographic coordinates (decimal degrees), distance to disturbance (Km) for known nesting sites surveyed between 2015 and 2023. Nesting sites that require management plans are identified.

NSID	Quarry	LAT	LON	PEFA.	RLHA.	GYRF.	minD2D	Mgt Plan
117	NA	65.4444	-96.9512	1	0	0	10.3	No
69	NA	65.4399	-96.9561	1	0	0	10.4	No
83	NA	65.5043	-97.2294	1	0	0	24.8	No
108	NA	65.5387	-97.1977	0	1	1	25.4	No
109	NA	65.5396	-97.1966	1	1	0	25.4	No
121	NA	65.5451	-97.1639	1	0	0	24.6	No
122	NA	65.5435	-97.1504	0	1	0	23.9	No
95	NA	65.5180	-97.1627	1	1	0	22.8	No
90	NA	65.5239	-97.0747	1	0	0	19.8	No
89	NA	65.5229	-97.0726	1	1	0	19.7	No
88	NA	65.5104	-97.0353	1	1	0	17.5	No
87	NA	65.5096	-97.0309	1	1	0	17.3	No
86	NA	65.5060	-97.0200	0	1	0	16.6	No
85	NA	65.5011	-97.0226	1	1	1	16.4	No
94	NA	65.4598	-96.9551	1	1	0	11.2	No
123	NA	65.4592	-96.8975	1	0	0	8.9	No
126	NA	65.4299	-96.6958	0	1	0	1.3	Yes
112	NA	65.4418	-96.7152	0	0	0	2.7	No
14	NA	65.4419	-96.7278	1	0	0	2.9	No
16	NA	65.4441	-96.7286	0	1	1	3.1	No
17	NA	65.4449	-96.7334	1	0	0	3.3	No
74	NA	65.4548	-96.7583	1	1	0	4.7	No
75	NA	65.4552	-96.7645	1	1	0	4.8	No
73	NA	65.4566	-96.7737	1	0	1	5.1	No
157	NA	65.4610	-96.7695	0	0	1	5.5	No
71	NA	65.4791	-96.7799	0	0	1	7.5	No
128	NA	65.4885	-96.8873	1	0	0	10.9	No
20	NA	65.5107	-96.9705	1	0	0	15.3	No
21	NA	65.5366	-96.9563	1	0	0	17.1	No
127	NA	65.5656	-97.0678	1	0	1	22.9	No
97	NA	65.5780	-96.9643	1	1	0	21.1	No
119	NA	65.5899	-96.9895	0	1	0	22.9	No
28	NA	65.6049	-96.9071	1	1	1	22.7	No
27	NA	65.5984	-96.9029	0	1	0	22.0	No
26	NA	65.5720	-96.8261	1	0	0	18.0	No
25	NA	65.5691	-96.8200	1	1	0	17.7	No
24	NA	65.5488	-96.7702	1	1	0	14.9	No
23	NA	65.5470	-96.7894	1	1	0	14.9	No
99	NA	65.5352	-96.7453	1	1	0	13.2	No
100	NA	65.4894	-96.7170	1	1	0	7.9	No
77	NA	65.4438	-96.6637	0	0	1	2.8	No
76	NA	65.4385	-96.6751	0	0	1	2.3	No

58	NA	65.4316	-96.6778	1	0	0	1.5	No
93	NA	65.4429	-96.6009	0	0	1	3.2	No
11	NA	65.4456	-96.6039	0	1	1	3.5	No
10	NA	65.4470	-96.6058	0	0	0	3.6	No
9	NA	65.4508	-96.6041	1	1	0	4.1	No
12	NA	65.4438	-96.5928	0	0	1	3.4	No
6	NA	65.4375	-96.5886	1	0	0	2.8	No
78	NA	65.4527	-96.4856	1	1	0	7.2	No
91	NA	65.4693	-96.4458	1	0	0	9.8	No
36	NA	65.5213	-96.3184	1	0	0	18.1	No
39	NA	65.5273	-96.2980	1	0	0	19.2	No
41	NA	65.5754	-96.2762	1	0	0	23.7	No
92	NA	65.4903	-96.2212	1	0	0	20.0	No
38	NA	65.4844	-96.1955	1	0	0	20.5	No
79	NA	65.4562	-96.3541	0	1	0	12.8	No
4	NA	65.2687	-96.2974	1	0	0	4.7	No
49	NA	65.2672	-96.3507	1	1	0	2.7	No
65	NA	65.2056	-96.6023	0	1	0	6.6	No
67	NA	65.2015	-96.6061	1	1	0	7.0	No
64	NA	65.1691	-96.6444	1	0	0	10.2	No
107	NA	65.2139	-96.7367	1	0	0	12.3	No
68	NA	65.2164	-96.7209	1	0	0	11.5	No
55	NA	65.2811	-96.6848	1	0	0	8.8	No
46	NA	65.3424	-96.4942	1	0	0	1.6	No
32	NA	65.1177	-95.8505	1	0	0	6.8	No
31	NA	65.1223	-95.8498	1	0	0	7.1	No
158	NA	65.2148	-95.8341	0	1	0	14.2	No
61	NA	65.1749	-95.8958	1	0	0	9.3	No
42	NA	65.1109	-96.1045	1	0	0	0.5	Yes
62	NA	65.1287	-96.2463	1	0	0	1.5	No
63	NA	65.1124	-96.3323	1	0	0	0.6	Yes
54	NA	65.1041	-96.2826	1	1	0	0.6	Yes
51	NA	65.0982	-96.1389	1	0	0	2.6	No
52	NA	65.0708	-96.1520	1	0	0	1.7	No
130	Q22	65.0427	-96.1570	1	0	0	0.0	Yes
34	Q21	65.2880	-96.3603	1	0	0	2.3	No
156	Q21	65.0027	-96.2243	1	0	0	0.0	Yes
131	Q20	64.9706	-96.2202	1	0	0	0.0	Yes
150	NA	64.9208	-96.0800	1	1	0	1.8	No
44	Q19	64.9376	-96.2774	1	0	0	0.0	Yes
45	Q18	64.9187	-96.3070	1	0	0	0.0	Yes
132	Q17	64.8592	-96.3248	1	0	0	0.0	Yes
133	Q16	64.8384	-96.3178	1	0	0	0.0	Yes
134	Q15	64.8166	-96.3270	1	0	0	0.0	Yes

136	Q13	64.7718	-96.3440	1	0	0	0.0	Yes
140	Q9	64.6471	-96.3090	1	0	0	0.0	Yes
141	Q8	64.6341	-96.3019	1	0	0	0.0	Yes
142	Q7	64.6092	-96.2829	1	0	0	0.0	Yes
152	NA	64.5826	-96.1892	1	0	0	1.5	No
144	Q5	64.5703	-96.2423	1	0	0	0.0	Yes
146	Q3	64.5038	-96.1266	1	0	0	0.0	Yes
147	Q2	64.4244	-96.0506	1	0	0	0.0	Yes
148	Q1	64.3576	-96.0010	1	0	0	0.0	Yes
149	NA	64.2989	-95.9356	1	0	0	0.8	Yes

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APPENDIX I

Meadowbank Bird Surveys Report



MEADOWBANK COMPLEX

FINAL

2023 BREEDING BIRD SURVEYS AND PRISM PLOTS SUMMARY REPORT

31 JANUARY 2024

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SECTION 1 • OVERVIEW

Environmental baseline studies were conducted in the Project area prior to Meadowbank Mine approvals and integrated into Project designs according to the Terrestrial Ecosystem Management Plan (TEMP). Wildlife Valued Ecosystem Components (VECs) for the Meadowbank Complex were identified in consultation with regulatory agencies and Baker Lake residents. Upland Breeding Birds was one of the key terrestrial VECs determined for the Meadowbank Mine; therefore, an extensive bird monitoring program, consisting of Program for Regional and International Shorebird Monitoring (PRISM) plots at the mine site and a reference area, and bird transects along the Meadowbank All-Weather Access Road (AWAR), was established to determine potential effects of the Meadowbank Mine. The breeding bird PRISM plot and bird transect monitoring programs were designed to evaluate potential Project-related changes in breeding bird species abundance, richness, and diversity over time.

In 2020, Agnico Eagle sent Environment and Climate Change Canada (ECCC) the comprehensive 2003-2015 analysis of all PRISM and breeding bird transect data. Results of the comprehensive analysis determined there were no significant effects of the Project or Mine-related infrastructure on bird abundance, diversity, or community composition, which supported that mitigation is effective. In 2022, Agnico Eagle Meadowbank Complex finalized a collaboration agreement with ECCC, with a focus on contributing to regional bird monitoring programs. The agreement includes a commitment to conduct 48 PRISM plots selected by Canadian Wildlife Service (CWS) over 10 years (2021 to 2031), and to complete Breeding Bird Survey (BBS) routes along the Meadowbank AWAR and the Whale Tail Haul Road (WTHR) opportunistically when qualified individuals are on site. At a minimum, BBS routes will be conducted every three (3) years during the operations, closure, and post-closure phases of the Project.

In 2022, two BBS routes, consisting of 50 stations each, were established along the AWAR and the WTHR. As well, four (4) of 48 designated PRISM plots were surveyed at Meadowbank site. In 2023, both BBS routes were surveyed, and 17 PRISM plots were completed at the Meadowbank site.

SECTION 2 • OBJECTIVES

The primary objectives of this report are to:

- 1) Provide a brief overview of the Meadowbank Complex and the rationale for breeding bird surveys;
- 2) Describe the methods used to conduct BBS and PRISM surveys;
- 3) Summarize results of the 2023 BBS and PRISM surveys; and
- 4) Make recommendations for surveys in subsequent years.

SECTION 3 • METHODOLOGY

3.1 BREEDING BIRD SURVEYS (BBS)

Breeding Bird Survey (BBS) route stops were established in accordance with the North American BBS methods provided by CWS. These methods are coordinated by the United States Geological Survey's (USGS) Patuxent Wildlife Research Center in partnership with ECCC, CWS, and Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO, Mexico).

The BBS protocol consists of 50 survey stations set every 800 m for a total of 40 km along the Meadowbank AWAR (Route 62049) and 40 km along the Whale Tail Haul Road (Route 62091). The starting points and orientation of BBS routes along the AWAR and WTHR were chosen by ECCC personnel in early 2022 (see **Figures 3.1** and **3.2**). Stations were established by field personnel on 15 June 2022, and GPS coordinates and detailed descriptions of each station were recorded. The route and stations are a permanent survey to be conducted on a schedule provided by ECCC (i.e., at a minimum every 3 years during operations, closure, and post-closure, and opportunistically when PRISM surveys are conducted). The first year of BBS surveys was scheduled between 15 and 30 June 2023, the prime bird breeding season.

Only one observer counted birds from each stationary point. Every bird seen or heard within 400 m was tallied during the designated three minutes at each stop. Birds documented beyond three minutes were not recorded. Birds seen between or before stops were not counted but were noted in the margin of the datasheet. The number of individuals in large flocks was estimated. Birds known to be non-breeding (late migrant, injured bird, or summer vagrant) were included but marked on the data sheet as a non-breeder (Mig). Species not already listed on the forms were added at the bottom. As well, the number of vehicles that passed by during each three-minute stop, excessive noise, and weather conditions were recorded.

The BBS data were entered directly into the USGS system and copies of the datasheet were provided to the ECCC CWS BBS Coordinator by August 31, 2023. Valid stop descriptions of each stop along both routes were maintained and kept up to date in the USGS database. Agnico Eagle will notify the Canadian national BBS office if adjustments to stop locations are necessary due to safety issues.

3.2 PRISM PLOTS

The PRISM plot surveys followed ECCC protocols (Bart et al. 2005) in compliance with the Meadowbank-ECCC Collaboration Agreement. A total of 48 plots were chosen by ECCC in early 2022, many of which were previously established at Meadowbank and Whale Tail (see **Figures 3.3** and **3.4**). Four (4) plots were surveyed in 2022, 17 plots were surveyed in 2023, and 12 plots are proposed to be surveyed in 2024. The remaining 15 plots will likely be surveyed in 2025 or other years prior to the expected mine closure date, although the option exists to survey some or all remaining plots each year. Plots are chosen each year depending on access logistics (e.g., helicopter support), proximity to other PRISM plots, local weather conditions, and ECCC priority.

In 2022 and 2023, the 300x400m plots were surveyed by a team of two field qualified personnel that transected the site every 25 m (team members were spaced 25 m apart and used geolocation to orient along transect lines). The purpose of the surveys was to document all birds (i.e., absolute abundance) on the plots and to contribute to the ECCC Arctic database on bird diversity and abundance.

PRISM survey raw data will be provided to ECCC CWS technical expert and the CWS Environmental Assessment Officer every year by March 31. Raw data will include: a) bird and plot habitat data entered into the CWS provided spreadsheet; and b) a digital scan of all field data sheets. Photos of PRISM plot corners as per PRISM protocols were inadvertently not taken in 2022 for the four (4) PRISM plots, but these plots were revisited in 2023 to take corner photos.

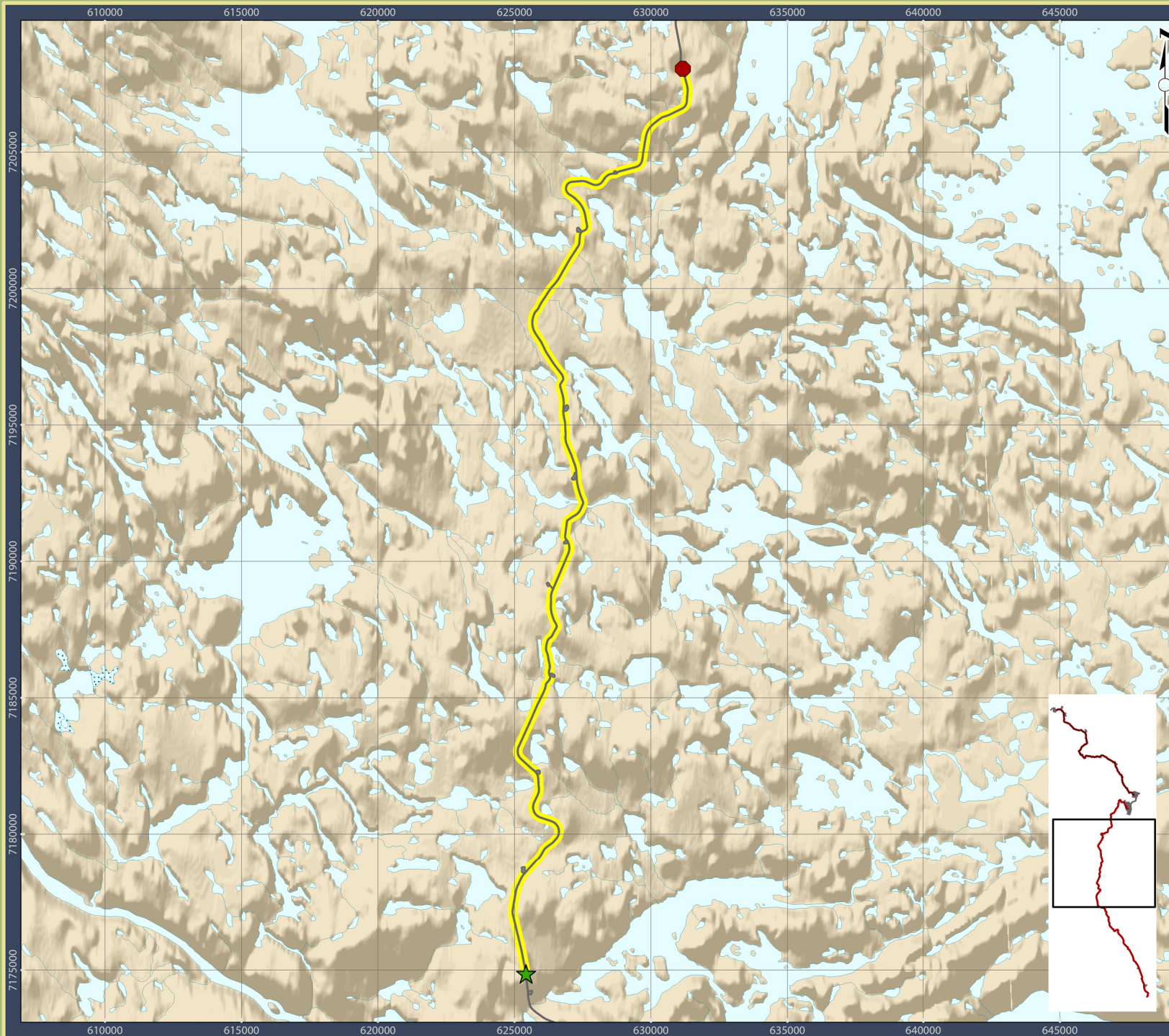


Figure 3.1:
Location of the Breeding
Bird Survey (BBS) Route
Along the Meadowbank
All-Weather Access Road
(AWAR)

— All-Weather Access Road
 BBS Survey
 ★ Start
 ● End
 — Route

Route: 62-049
MEADOWBANK MINE

Area of Detail



Projection: UTM Zone 14 NAD83

Data Sources:
 Natural Resources Canada, GeoBase®
 National Topographic Database
 Agnico-Eagle Mines Limited.
 Gebauer & Associates Ltd.

Meadowbank Gold Project

Prepared
 for:



AGNICO EAGLE

By:



December 2023

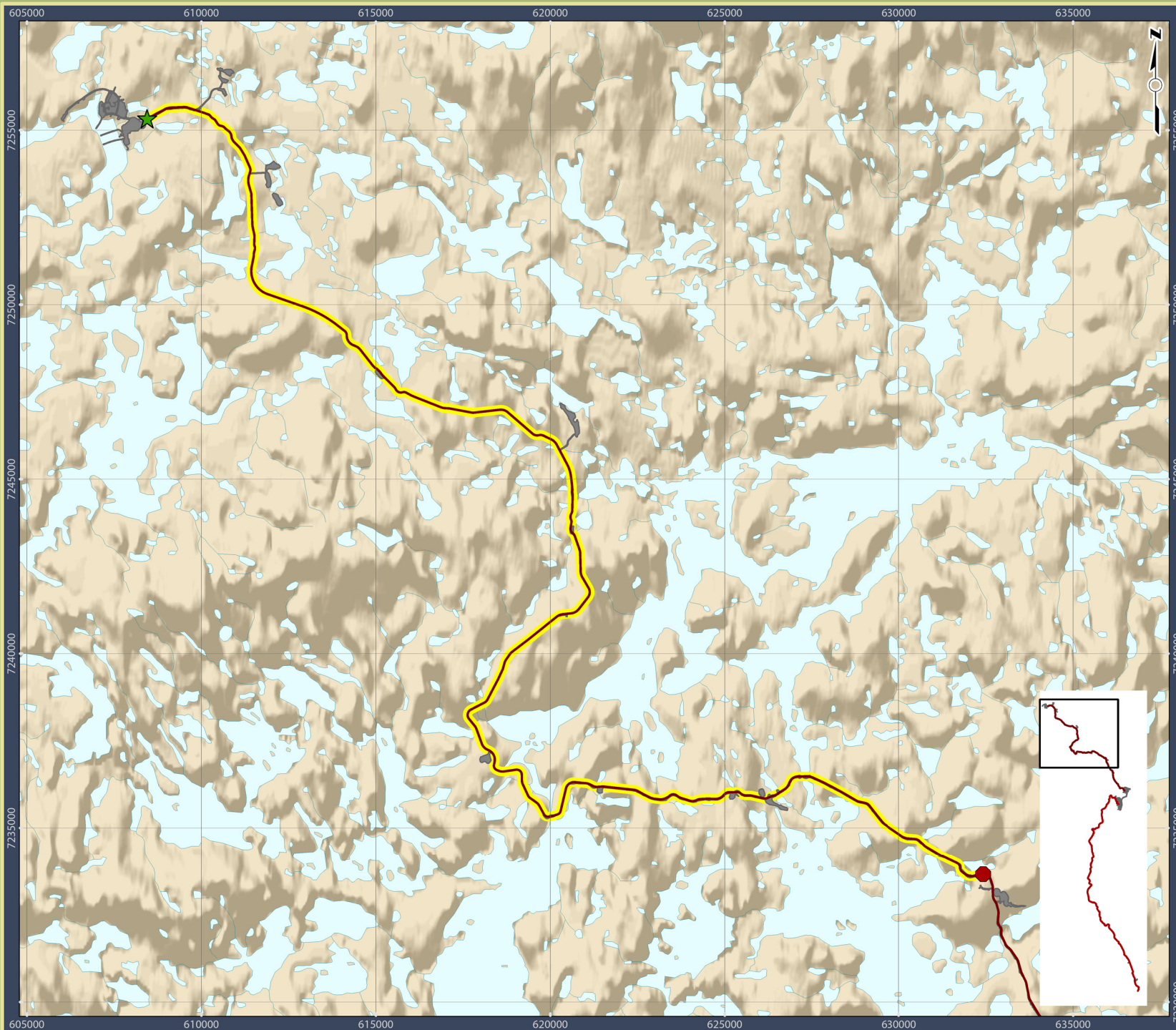


Figure 3.2:
Location of the Breeding
Bird Survey (BBS) Route
Along the Whale Tail Haul
Road (WTHR)

— Whale Tail Haul Road
 BBS Survey
 ★ Start
 ● End
 — Route

Route: 62-091
WHALE TAIL MINE

Area of Detail



0 1 2 3 4 5
 Kilometres

Projection: UTM Zone 14 NAD83

Data Sources:
 Natural Resources Canada, GeoBase®
 National Topographic Database
 Agnico-Eagle Mines Limited.
 Gebauer & Associates Ltd.

Meadowbank Gold Project

Prepared
 for:



AGNICO EAGLE

By:



December 2023



Figure 3.3:
Location of PRISM Plots at
the Meadowbank Site

- All-Weather Access Road
- Whale Tail Haul Road
- Meadowbank 2018 Mine Plan
- PRISM Plot (SW Corner)
- Survey Year
- To Be Surveyed
- 2022
- 2023



Projection: UTM Zone 14 NAD83

Data Sources:
Natural Resources Canada, GeoBase®
National Topographic Database
Agnico-Eagle Mines Limited.
Gebauer & Associates Ltd.

Meadowbank Gold Project

Prepared
for:



By:



December 2023

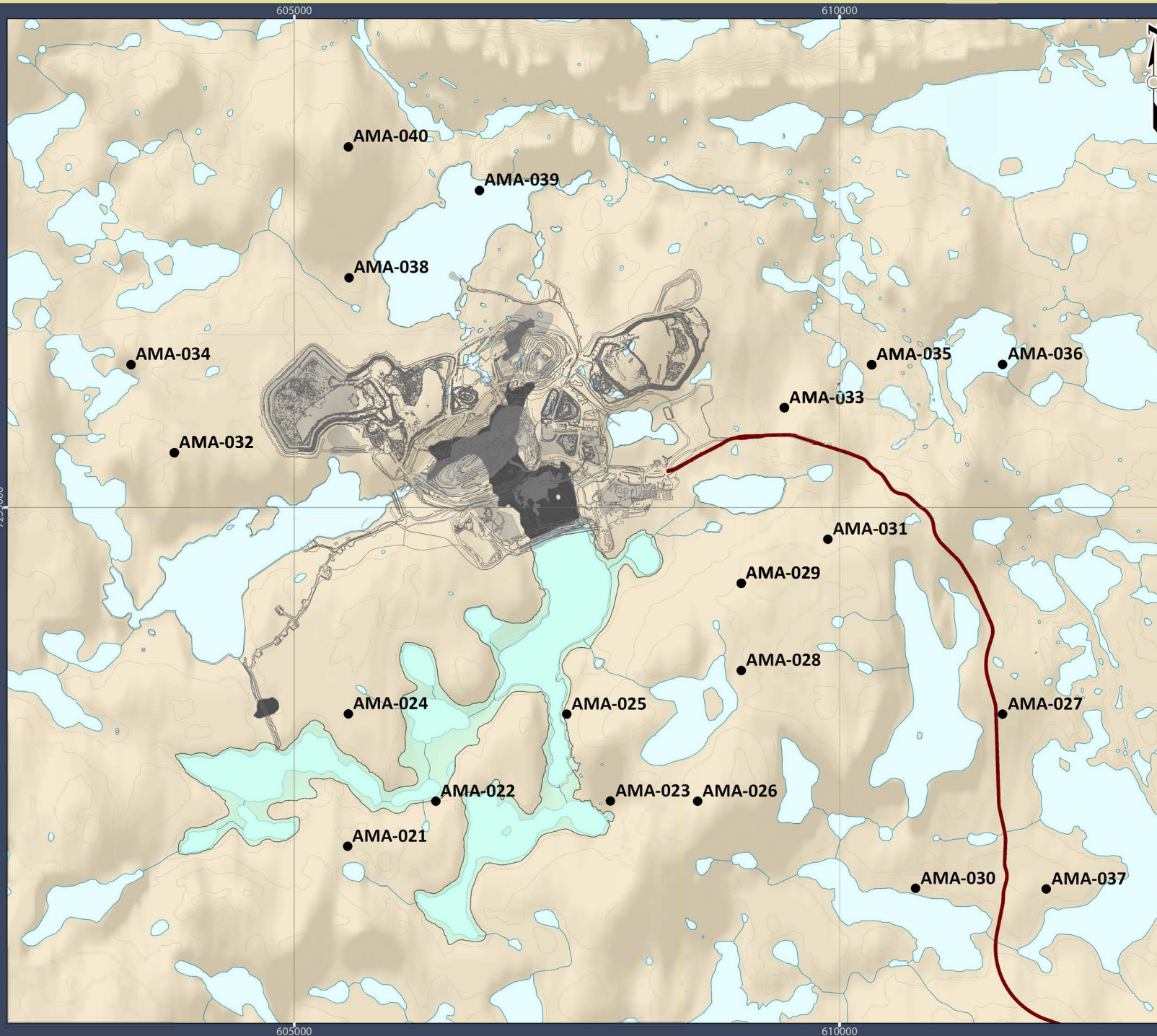
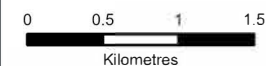


Figure 3.4: Location of PRISM Plots at the Amaruq Site

- Mine Features**
- Whale Tail Haul Road
 - Whale Tail Mine Plan
 - Whale Tail Lake (South Basin)
 - Mine Plan 2023
- PRISM Plot (SW Corner)**
- To Be Surveyed



Projection: UTM Zone 14 NAD83

Data Sources:
 Natural Resources Canada, GeoBase®
 National Topographic Database
 Agnico-Eagle Mines Limited.
 Gebauer & Associates Ltd.

Meadowbank Gold Project

Prepared
for:



AGNICO EAGLE

By:



December 2023

SECTION 4 • 2023 BIRD SURVEY RESULTS

4.1 BREEDING BIRD SURVEYS (BBS)

The Meadowbank AWAR (62049) and WTHR (62091) routes were completed in 2023 (see **Table 4.1** for survey timing, and **Figures 3.1** and **3.2** for general BBS locations).

Table 4.1: Breeding Bird Survey (BBS) 2023 Fieldwork Dates for Meadowbank All-Weather Access Road (AWAR) and Whale Tail Haul Road (WTHR) Routes.

Date & Time	Weather	Observers	Fieldwork Type
Meadowbank All-Weather Access Road (BBS Route 62049)			
June 18, 2023 03:30 to 08:28	Start: 5°C, cloudy, light breeze End: 10°C, partially cloudy, light breeze	Lars Qaqqaq Dylan White	BBS route station survey
Whale Tail Haul Road (BBS Route 62091)			
June 20, 2023 03:30 to 08:29	Start: 3°C, cloudy, light breeze End: 7°C, cloudy, breeze	Lars Qaqqaq Dylan White	BBS route station survey

A total of 24 bird species were recorded on the Meadowbank AWAR route in 2023. The five most common bird species were Lapland Longspur (200; cumulative number), Horned Lark (113), Canada Goose (106), Savannah Sparrow (52), and Sandhill Crane (34). Mammal species recorded incidentally included Arctic Hare, Arctic Fox, Caribou, and Muskox. **Table 4.2** summarizes BBS results for the Meadowbank AWAR route.

A total number of 19 bird species were recorded on the WTHR route in 2023. The five most common bird species were Lapland Longspur (142; cumulative number), Horned Lark (81), Canada Goose (51), Savannah Sparrow (32), and redpoll sp. (18). Mammal species recorded incidentally included Arctic Hare, Arctic Fox, Caribou, and Muskox. **Table 4.2** summarizes BBS results for the WTHR route.

BBS data were entered and submitted into the USGS system on 22 August 2023 and copies of the datasheet were provided by email to ECCC CWS BSS Coordinator on 31 August 2023. Valid stop descriptions of each stop along both routes were also maintained in the USGS database and no adjustments to stop locations were needed for the 2023 surveys along both AWAR and WTHR.

Table 4.2: Breeding Bird Survey (BBS) 2023 Results for Meadowbank All-Weather Access Road (AWAR) and Whale Tail Haul Road (WTHR) Routes. Numbers are cumulative across all 50 survey points.

Common Name	Scientific Name	AWAR	WTHR
BIRDS			
American Golden Plover	<i>Pluvialis dominica</i>	1	
American Pipit	<i>Anthus rubescens</i>	1	4
Bald Eagle	<i>Haliaeetus leucocephalus</i>	1	1
Canada Goose	<i>Branta canadensis</i>	106	51
Common Loon	<i>Gavia immer</i>	5	1
Common Raven	<i>Corvus corax</i>	6	2
Greater Scaup	<i>Aythya marila</i>	6	
Herring Gull	<i>Larus argentatus</i>	23	4
Horned Lark	<i>Eremophila alpestris</i>	113	81
Lapland Longspur	<i>Calcarius lapponicus</i>	200	142
Least Sandpiper	<i>Calidris minutilla</i>		3
Long-tailed Duck	<i>Clangula hyemalis</i>	12	5
Peregrine Falcon	<i>Falco peregrinus</i>	2	
Redpoll sp.	<i>Acanthis</i> sp.	31	18
Red-breasted Merganser	<i>Mergus serrator</i>		2
Red-necked Phalarope	<i>Phalaropus lobatus</i>	1	
Red-throated Loon	<i>Gavia stellata</i>		2
Rock Ptarmigan	<i>Lagopus muta</i>	2	16
Rough-legged Hawk	<i>Buteo lagopus</i>	2	
Sandhill Crane	<i>Grus canadensis</i>	34	
Savannah Sparrow	<i>Passerculus sandwichensis</i>	52	32
Semipalmated Plover	<i>Charadrius semipalmatus</i>	1	
Semipalmated Sandpiper	<i>Calidris pusilla</i>	11	13
Snow Goose	<i>Anser caerulescens</i>	4	1
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	33	14
Willow Ptarmigan	<i>Lagopus lagopus</i>	12	1
Wilson's Snipe	<i>Gallinago delicata</i>	2	
Total # of Species		24	19
MAMMALS			
Arctic Hare	<i>Lepus arcticus</i>	2	2
Arctic Fox	<i>Vulpes lagopus</i>	4	1
Barren-land Caribou	<i>Rangifer tarandus</i>	3	89
Muskox	<i>Ovibos moschatus</i>	2	16

4.2 PRISM PLOTS

Seventeen (17) PRISM plots were surveyed in 2023 between June 15 and June 21: MEA-M006, MEA-M011, MEA-M012, MEA-M014, MEA-M015, MEA-M019, MEA-M020, MEA-M022, MEA-M028, MEA-M029, MEA-M031, MEA-M034, MEA-M036, MEA-M037, MEA-M042, MEA-M043, and MEA-M045 (see **Table 4.3** for timing and weather details and **Figures 3.3** and **3.4** for plot locations). The focus on 2023 was on PRISM plots around the Meadowbank Mine because these were listed as being of higher priority by ECCC.

A total of five (5) Lapland Longspur nests and two (2) Hoary Redpoll nests were documented on PRISM plots in 2023. Nest details and photos are provided in **Table 4.4**.

Table 4.3: Meadowbank PRISM Plot 2023 Fieldwork Details.

Plot (MEA)	Date	Time	Weather	Observers ¹
M006	June 21	08:55 to 10:00	13°C, mainly clear, no precipitation, gentle breeze	LQ & DW
M011	June 16	10:52 to 11:35	ND°C, cloudy, rain, fresh breeze	LQ & DW
M012	June 16	17:20 to 18:40	ND°C, cloudy, drizzle, light breeze	LQ & DW
M014	June 17	07:20 to 08:40	4°C, cloudy, no precipitation, gentle breeze	LQ & DW
M015	June 17	09:10 to 11:20	6°C, cloudy, drizzle, gentle breeze	LQ & DW
M019	June 15	07:20 to 09:08	9°C, cloudy, drizzle, light breeze	LQ & DW
M020	June 15	09:45 to 11:15	9°C, cloudy, drizzle, gentle breeze	LQ & DW
M022	June 15	12:01 to 13:55	10°C, cloudy, no precipitation, gentle breeze	LQ & DW
M028	June 17	13:10 to 14:00	10°C, mostly cloudy, no precipitation, gentle breeze	LQ & DW
M029	June 19	06:15 to 06:50	3°C, mostly cloudy, drizzle, freezing drizzle and snow, fresh breeze	LQ & DW
M031	June 20	15:45 to 17:00	13°C, mostly cloudy, no precipitation, light breeze	LQ & DW
M034	June 19	07:20 to 08:40	ND°C, ND cloud cover, freezing drizzle, fresh breeze	LQ & DW
M036	June 21	11:15 to 12:35	14°C, mainly clear, no precipitation, moderate breeze	LQ & DW
M037	June 21	13:35 to 15:00	15°C, mainly clear, no precipitation, gentle breeze	LQ & DW
M042	June 16	14:10 to 15:30	3°C, cloudy, no precipitation, fresh breeze	LQ & DW
M043	June 15	14:30 to 15:40	9°C, cloudy, drizzle, moderate breeze	LQ & DW
M045	June 21	06:45 to 08:00	ND°C, mostly cloudy, ND precipitation, moderate breeze	LQ & DW

¹ LQ = Lars Qaqqaq; DW = Dylan White

Table 4.4: Details and Representative Photos of Nests Found during 2023 PRISM Plots.

Date (2023)	Plot (MEA)	Nest Name	Species ¹	# of Eggs	UTM Coordinates (14W)	Details	Representative Photo
June 17	M014	014_N01	LALO	5	639454 7216838	Under a Dwarf Birch; female flushed	
June 15	M019	019_N01	LALO	4	635585 7217701	Under a Dwarf Birch; nest well lined with downy feathers	
June 19	M034	034_N01	LALO	3	640300 7219200	In heath mound with vaccinium, lichen, and grass	
June 21	M045	045_N01	HORE	4	640839 7210446	Down-lined cup with 4 blue eggs, perched in Dwarf Birch	
June 21	M045	045_N02	HORE	0	640774 7210544	Qiviut (Muskox wool)-lined grass bowl perched in Dwarf Birch.	
June 21	M036	036_N01	LALO	5	633449 7212346	Down-lined grass bowl in graminoid tundra (moist area) and moss	
June 21	M036	036_N02	LALO	5	633622 7212165	Down-lined grass bowl in grass tundra near dwarf birches	

¹ LALO = Lapland Longspur; HORE = Hoary Redpoll

Twenty-three (23) bird and four (4) mammal species were observed during 2023 PRISM plot surveys (**Table 4.5**). Eleven (11) of these (9 birds and 2 mammals) were only observed incidentally outside plots, while the other species were observed while surveying PRISM plots (**Table 4.5**). Species numbers, behaviours, nests, and other details have been recorded in the PRISM plot data spreadsheets as per the templates provided by CWS that will be provided to ECCC by March 31, 2024.

MEADOWBANK COMPLEX

2023 BREEDING BIRD SURVEYS

Table 4.5: Wildlife Species Observed on Meadowbank PRISM Plots in 2023. Additional Species Observed outside Plots are Listed as Incidental. Species only Observed Incidentally are in Gray.

Common Name	Scientific Name	PRISM Plots (MEA-0)																	Incidental (Plot #s)
		06	11	12	14	15	19	20	22	28	29	31	34	36	37	42	43	45	
BIRDS																			
American Pipit	<i>Anthus rubescens</i>						1								1				28
American Robin	<i>Turdus migratorius</i>								2										
Bald Eagle	<i>Haliaeetus leucocephalus</i>																		11,43
Canada Goose	<i>Branta canadensis</i>	6														5			06,14,15,19,28,42, 43,45
Common Loon	<i>Gavia immer</i>																		12,20,37
Common Raven	<i>Corvus corax</i>																		31
Common Redpoll	<i>Acanthis flammea</i>		1			1													
Herring Gull	<i>Larus argentatus</i>																		06,12,15,19,31,43,45
Hoary Redpoll	<i>Acanthis hornemanni</i>	2		1	5	4	5	1		2	3	4	4	1	2	1		4	
Horned Lark	<i>Eremophila alpestris</i>	1	1		4	4	3	3	1		1		2	2	2	6	2	2	15,19,20,34,37,43
Lapland Longspur	<i>Calcarius lapponicus</i>	6	5	10	9	6	10	7	7	2	3	6	9	3	8	7	3	2	06,14,15,19,20,22,28,31,34,36,37,42,43,45
Least Sandpiper	<i>Calidris minutilla</i>																		12
Northern Pintail	<i>Anas acuta</i>																		11
Red-breasted Merganser	<i>Mergus serrator</i>																		15,37
Rock Ptarmigan	<i>Lagopus muta</i>	1								1		1			1	1	1		19,20,22
Sandhill Crane	<i>Grus canadensis</i>			2															19

Table 4.5: Continued.

Common Name	Scientific Name	PRISM Plots (MEA-0)																	Incidental (Plot #s)
		06	11	12	14	15	19	20	22	28	29	31	34	36	37	42	43	45	
BIRDS																			
Savannah Sparrow	<i>Passerculus sandwichensis</i>					1	3	2	3				1	3		1		1	06,12,14,15,19,28,34,36
Semipalmated Plover	<i>Charadrius semipalmatus</i>				1														
Semipalmated Sandpiper	<i>Calidris pusilla</i>		1										3					1	15,31
Tundra Swan	<i>Cygnus columbianus</i>																		15,43
White-crowned Sparrow	<i>Zonotrichia leacophrys</i>			1	2		2	1	2						1		2	1	06,19
Willow Ptarmigan	<i>Lagopus lagopus</i>											2							
Yellow-billed Loon	<i>Gavia adamsii</i>																		29
Total # of Species		5	4	4	5	5	6	5	5	3	3	4	4	5	6	6	4	6	23 Species
MAMMALS																			
Arctic Ground Squirrel	<i>Urocitellus parryii</i>							x	x										
Arctic Hare	<i>Lepus arcticus</i>																		19
Barren-ground Caribou	<i>Rangifer tarandus</i> ssp. <i>groenlandicus</i>					13													34,37
Muskox	<i>Ovibos moschatus</i>																		15,20,28,34,42

SECTION 5 • RECOMMENDATIONS

In 2024, continue PRISM and BBS survey between June 15 and 30 per the ECCC Agreement. The remaining 27 PRISM plots to be surveyed before mine closure with the BBS routes opportunistically conducted within the committed 3-year cycle.

SECTION 6 • LITERATURE CITED

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APPENDIX J

Native Plant Poster

Non-Native & Invasive species

In Nunavut

In 2010 the Canadian Endangered Species Conservation Council (CESCC) identified 17 species not normally found in Nunavut.

These are called “non-native species”. Some of these plants and animals can become an “invasive species”, which represents a potential major concern for the future health of the Arctic.

What is a non-native species?

A non-native species is defined as an organism that is not normally found in a region. They are introduced by human activities, which can be intentional (e.g. species introduced to control a pest species), accidental (e.g. shipping and ballast water exchange), or environmental (e.g. changes in climate leading to wildlife movements). An example of a non-native species in Nunavut is the European Starling (*Sturnus vulgaris*), which was introduced to North America from Europe intentionally by humans.

What is an invasive species?

Not all non-native species are considered invasive. This term is reserved for species that do so well in their new habitat that they end up causing harm to the environment, other species, human health, or economic activity (ISAC, 2006). An example of an invasive species in southern Canada is the Zebra Mussel (*Dreissena polymorpha*), which was introduced to North America by ships releasing their ballast water. The Zebra mussel reproduces quickly and establishes large colonies on any hard surface. In this way they take over habitat occupied by native species, reducing the availability of food for other species, and also attaching themselves in great numbers to boats and other infrastructure in the water. (Benson and Raikow, 2010).

Why should you be concerned about invasive species?

When invasive species are introduced and survive, their populations can increase rapidly because there are no natural predators. Invasive species may feed on native species, compete for food and space, as well as expose native species to new parasites and disease. Invasive species are now widely recognized as a leading cause of endangerment and/or extinction of native species (Lassuy and Lewis, 2010).

✳️ *There are currently no known species in Nunavut that can be classified as aquatic or terrestrial invasive species.*



Species: Field Sow Thistle (*Sonchus arvensis*)
Impact: The Field Sow Thistle grows quickly, easily and when there are many of them they can reduce the water resources available to other plants. They have the potential to decrease native plant diversity by competing for space and water.

Introduction pathway: Accidentally introduced from Europe into North America in a containment of agricultural crop seed. This plant has been able to spread long distances across Canada because the seeds can travel far in the wind.



Species: The European Starling (*Sturnus vulgaris*)
Impact: The European Starling can displace native bird species by taking over nesting sites and competing for food.

Introduction pathway: Introduced intentionally to North America from Europe. These birds then dispersed naturally into Canada through migration.

How might invasive species get into Nunavut?

Species are transported throughout the world by human activities, like shipping, which allows species to move further distances and over barriers that they could not do on their own. Nunavut remains very remote compared to the rest of Canada and so the lack of major road systems, infrequent shipping and cold climate has limited their introduction and survival.

However, as climate change alters Arctic ecosystems, it creates conditions that are more favorable to the survival and reproduction of non-native species. It also enables greater human activity and development, which gives potential invasive species more opportunities to establish themselves. (Lassuy and Lewis, 2010).

Pathways of introduction for invasive species into Nunavut

- ✳️ Ballast water exchange and hull fouling have the greatest potential for introducing invasive species into the aquatic ecosystems of Nunavut. Ballast water is used to stabilize ships. It is pumped aboard ships from different ports around the world and often exchanged far from the region it was obtained. This water can contain species that are not native, and may establish themselves locally.
- ✳️ Seeds, insects and even small mammals can be transported around the world through the shipping of grocery produce, lumber, construction supplies, and packing materials, even dirt from someone’s footwear can contain plant seeds (IASC, 2010).
- ✳️ As climate continues to change in the Arctic, many terrestrial and aquatic plants and animals will move further north looking for the food and habitat they desire. These wildlife movements are not a threat when it comes to invasive species, but it is important to note that some species, (especially rare or threatened ones) may not survive the transition. Others may do well, like flying insects, which are already increasing in number in some areas of Nunavut. (IASC, 2010).

Wildlife movements are often referred to as “range extensions” where a species expands the area they can live in when the habitat and climate is favorable for them.



How can you help?

Report

Have you seen a different plant, animal or insect in Nunavut?

You help identifying these species is important. Report the **location** where you observed the species (GPS Coordinates are very helpful) and provide a **detailed description** of the plant, animal, or insect. If possible **take a photo**.

Remember that not all non-native species are considered invasive. If you see an unknown plant or animal, it is very important to report it.

Do not take any extreme actions; the first step is reporting the species so that territorial and federal agencies can respond appropriately. We will report our findings back to you and information about the species you have observed.

Share

Keep yourself informed and educate others about non-native and invasive species. Let them know what to do if they see an unknown or uncommon species.

Report a species to your local Conservation Officer.

For More Information or if your CO is not available please contact:

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Non-Native Species in Nunavut

As of 2011, there are 17 species known to be non-native in Nunavut, these are listed below and are all terrestrial species. Please note that it is not currently known what the potential is for any of these species to become invasive and to what extent. Two species, the starling and the sow thistle are described in more detail below.

SCIENTIFIC NAME	COMMON NAME	ORGANISM TYPE
<i>Carum carvi</i>	Wild Caraway	Flowering Plant
<i>Taraxacum officinale</i>	Common Dandelion	Flowering Plant
<i>Sonchus arvensis</i>	Field Sow Thistle	Flowering Plant
<i>Leucanthemum vulgare</i>	Oxeye Daisy	Flowering Plant
<i>Thlaspi arvense</i>	Field Pennycress	Flowering Plant
<i>Capsella bursa-pastoris</i>	Shepherd's Purse	Flowering Plant
<i>Barbarea vulgaris</i>	Yellow Rocket	Flowering Plant
<i>Amaranthus retroflexus</i>	Green Amaranth	Flowering Plant
<i>Hordeum vulgare</i>	Common Barley	Flowering Plant
<i>Puccinellia distans</i>	Spreading Alkali Grass	Flowering Plant
<i>Vicia cracca</i>	Tufted Vetch	Flowering Plant
<i>Papaver somniferum</i>	Opium Poppy	Flowering Plant
<i>Plantago major</i>	Common Plantain	Flowering Plant
<i>Polygonum aviculare</i>	Prostrate Knotweed	Flowering Plant
<i>Pieris rapae</i>	Cabbage White	Butterfly
<i>Sturnus vulgaris</i>	European Starling	Passerine Bird
<i>Passer domesticus</i>	House Sparrow	Passerine Bird

Potential Invasive Species in Nunavut

As trade and shipping continues to increase, some aquatic invasive species known to commonly foul ship hulls and ballast waters, like the Chinese Mitten Crab, are more likely to arrive at ports around Nunavut.

A recent report commissioned by Fisheries and Oceans Canada identified a number of potential aquatic invasive species, mainly for the Hudson Bay region. The table below lists only those species considered as “High Risk” to Nunavut and they are found in freshwater & marine environments.

SCIENTIFIC NAME	COMMON NAME	ORGANISM TYPE
<i>Osmerus mordax</i>	Rainbow Smelt	Fish
<i>Gymnocephalus cernuus</i>	Ruffe	Fish
<i>Caprella mutica</i>	Skeleton Shrimp	Crustacean
<i>Chelicorophium curvispinum</i>	Data unavailable	Crustacean
<i>Dikrogammarus villosus</i>	Killer Shrimp	Crustacean
<i>Gmelinoides fasciatus</i>	Data unavailable	Crustacean
<i>Pontogammarus robustoides</i>	Data unavailable	Crustacean
<i>Eriocheir sinensis</i>	Chinese Mitten Crab	Crustacean
<i>Hemimysis anomala</i>	Data unavailable	Crustacean
<i>Balanus improvisus</i>	Acorn Barnacle	Crustacean
<i>Corbicula fluminea</i>	Asian Clam	Mollusc
<i>Dreissena bugensi</i>	Quagga Mussel	Mollusc
<i>Bythotrephes longimanus</i>	Spiny Water Flea	Zooplankton
<i>Cercopagis pengo</i>	Fishhook Water Flea	Zooplankton
<i>Eubosmina maritima</i>	Data unavailable	Zooplankton
<i>Marenzelleria cf. viridis</i>	Data unavailable	Worm
<i>Marenzelleria cf. wireni</i>	Data unavailable	Worm
<i>Cordylophora caspia</i>	Freshwater Hydroid	Hydrozoa
<i>Coscinodiscus wailesii</i>	Data unavailable	Phytoplankton
<i>Odontella sinensi</i>	Data unavailable	Phytoplankton
<i>Prorocentrum minimum</i>	Data unavailable	Phytoplankton
<i>Codium fragile ssp. tomentosoides</i>	Oyster Thief	Algae
<i>Glugea hertwigi</i>	Data unavailable	Protozoa
<i>Amphilina foliacea</i>	Data unavailable	Parasite



This project was undertaken with the financial support of:



Environment
Canada

Environnement
Canada



*Species photo references available upon request. Images are not to scale.

*Species photo references available upon request. Images are not to scale.

APPENDIX K

Caribou Behaviour Monitoring



Meadowbank Gold Mine

Caribou Behaviour Study, 2023

PREPARED FOR



AGNICO EAGLE

Agnico Eagle Mines Limited

DATE

23 February 2024

REFERENCE

0688749-01



ACKNOWLEDGEMENTS

Meadowbank Gold Mine

Caribou Behaviour Study, 2023

23 February 2024

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CLIENT: Agnico Eagle Mines Limited
PROJECT NO: 0688749-01 DATE: 23 February 2024 VERSION: B.1

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ACRONYMS AND ABBREVIATIONS

Agnico Eagle	Agnico Eagle Mines Limited
AIC	Akaike information criterion
ATV	All-terrain vehicle
AWAR	Meadowbank Mine All Weather Access Road
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
GLMMs	Generalized linear mixed-effects models
GN	Government of Nunavut
GNWT ENR	Government of Northwest Territories Department of Environment and Natural Resources
IOL	Inuit Owned Land
KivIA	Kivalliq Inuit Association
km	Kilometre
km/hr	Speed expressed as kilometre per hour
m	Metre
NIRB	Nunavut Impact Review Board
T&C	Terms and Conditions
the Mine	Meadowbank Gold Mine
the Mine Complex	The Mine and associated roads, including the WTHR and AWAR
TEMP	Meadowbank Mine Terrestrial Ecosystem Management Plan
WTHR	Whale Tail Haul Road

EXECUTIVE SUMMARY

The Meadowbank Complex, owned and operated by Agnico Eagle Mines Limited (Agnico Eagle), is located on Inuit Owned Land (IOL) and includes the Meadowbank Gold Mine (the Mine) approximately 90 km north of the Hamlet of Baker Lake, and the Whale Tail Mine located approximately 150 km north of the Hamlet. A 108 km All Weather Access Road (AWAR) connects the Meadowbank Gold Mine to Baker Lake, and the 72 km Whale Tail Haul Road (WTHR) connects the Meadowbank Gold Mine to the Whale Tail Mine. During spring and fall migration, Lorillard caribou, along with smaller numbers of Wager Bay and Ahiak caribou occur in the Mine area, regularly crossing through the Mine site, AWAR, and WTHR.

As part of the Nunavut Impact Review Board (NIRB) Project Certificates #004 and #008, Agnico Eagle is required to study and report on the effects of the Mine on caribou. The Agnico Eagle Terrestrial Ecosystem Management Plan (TEMP Agnico Eagle 2020) includes behaviour monitoring for caribou.

Behaviour monitoring was conducted annually from 2020 to 2023. Agnico Eagle retained ERM Consultants Canada Ltd. (ERM) to update the field protocols used for behaviour monitoring in early 2020. ERM adapted standard methods for caribou behaviour monitoring developed by the Government of Northwest Territories Department of Environment and Natural Resources (GNWT ENR).

A Terrestrial Advisory Group (TAG) was formed in 2019 as a collaborative forum to discuss Inuit Qaujimajatuqangit (IQ), Traditional Knowledge (TK) and western science applications to mitigation and monitoring programs for the Meadowbank Mine, including on caribou movement in the Mine area. Following the discussion of the caribou behaviour survey results in 2020, 2021, and 2022, the TAG and particularly the Kivalliq Inuit Association suggested several improvements to the survey protocol and analysis methods. Agnico Eagle endeavored to incorporate all the suggestions of the TAG into the 2023 data collection process and analysis.

Field surveys were conducted primarily during spring and fall migration by the Agnico Eagle environmental technicians, contractors, and Nunavummiut seasonal workers. These technicians were trained and were dedicated to conducting behaviour surveys. Each survey lasted 30 minutes, with scan samples conducted every three minutes.

The behaviour monitoring data from 2023 were combined with data from 2020 to 2022, and all results outlined in this report use all three years, unless otherwise stated. The key findings from the 2023 program aligned with the previous three study years, and included:

- 70 surveys were conducted in 2023, totalling 424 surveys collected from 2020-2023.
- Small groups (<3 caribou) tended to have a higher proportion of response behaviours (running, alert) than larger groups, irrespective of disturbances.
- Distance to the road did not appear to have a significant effect on caribou behaviour.
- Approximately half of the surveys included a disturbance event, typically from Mine vehicles, mostly pickups or heavy vehicles, and all-terrain vehicles (ATVs) used by community members on the AWAR for travel or harvesting. The AWAR was closed to Mine vehicles (with the exception of approved convoys and the survey vehicle) when caribou were near the road and

all Mine vehicles are required to stop when caribou are on the road. Note that surveys were conducted specifically to record responses to disturbances, so the proportion of surveys with disturbances is higher than the actual proportion of caribou exposed to disturbances.

- Cox's proportional hazards modelling suggests that following a single disturbance, 94% of groups will return to normal behaviour after approximately 6 minutes, and 100% of groups will return to baseline behaviour after approximately 15 minutes.
- Following a disturbance event, the proportion of response behaviours in a group of caribou was significantly higher, but generally returned to baseline behaviours within two sampling intervals (i.e., approximately six minutes).
- In response to comments from the Kivalliq Inuit Association (KivIA) in 2022, the behaviour of "walking" was investigated for whether it may be an "alert" behaviour instead of a non-response behaviour. Disturbances did statistically increase the proportion of caribou walking observed, suggesting this behaviour may be useful as a response in future analyses.
- Findings from these analyses suggest that the use of convoys to consolidate multiple essential vehicles into a single disturbance event is an effective mitigation measure for reducing disturbance to caribou.

1. PROJECT OVERVIEW

The Agnico Eagle Mines Ltd. (Agnico Eagle) Meadowbank Gold Mine (the Mine), located in the Kivalliq Region of Nunavut (Figure 1-1), received a Project Certificate (#004) from the NIRB in 2006. The adjacent Whale Tail Mine received a Project Certificate (#008) from the NIRB in 2018, which was amended in 2020. The Project Certificates, and subsequent Water Licenses (#2AM-WTP1830), GN, and Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) Land Lease, and KivIA Production Lease, allowed development of five gold deposits in the 12 years since the start of operations at the Meadowbank Gold Mine and the first phase of the Whale Tail Mine. This has included construction of a gold mine and ancillary facilities including an AWAR, WTHR, barge unloading facilities, lay-down area, and a fuel tank farm near the Hamlet of Baker Lake.

The Meadowbank Gold Mine is located approximately 90 km north of the Hamlet of Baker Lake. Mining has ceased at Meadowbank, but the site hosts accommodation, an active mill, and ancillary mechanical, maintenance facilities, and vehicles. The Whale Tail Mine, located approximately 150 km north of the Hamlet, is an open-pit, truck-and-shovel mine operation and will produce an estimated 23.5 M tons of ore. Ore is hauled from Whale Tail to the Meadowbank Gold Mine for milling on the WTHR.

Studies of caribou behaviour were conducted during spring migration, summer, and fall migration from 2020 to 2023 at the Meadowbank Gold Mine, AWAR, and WTHR to monitor for potential Mine effects on caribou.

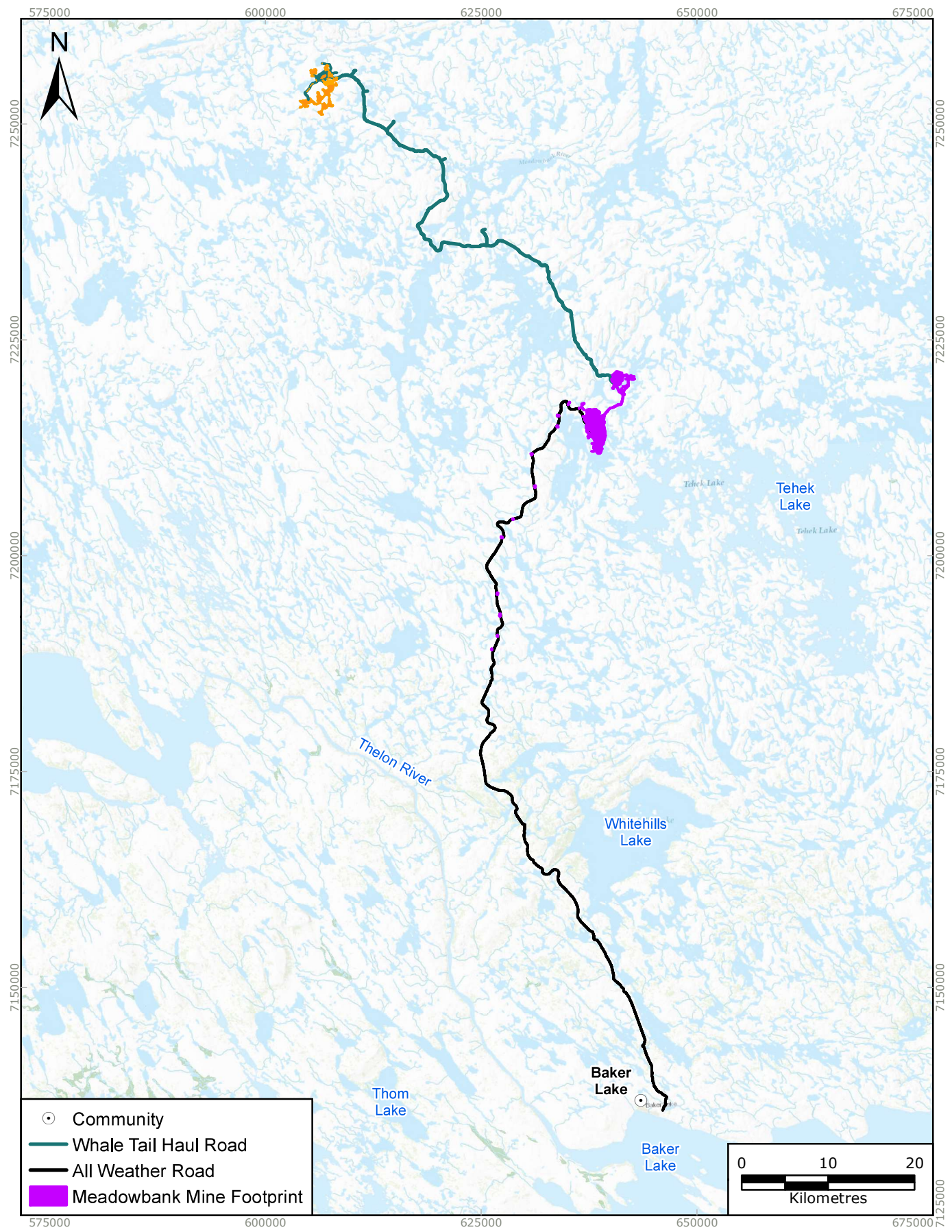
1.1 PROJECT TERMS AND CONDITIONS AND TEMP

Under the NIRB Certificate #008 for the Whale Tail Mine, Term and Condition 28 requires the Mine to have a TEMP:

(NIRB #008; T&C 28) The Proponent shall maintain a Terrestrial Ecosystem Management Plan (TEMP) throughout all phases of the Project. The Plan shall include detailed monitoring, mitigation, and adaptive management measures for wildlife, with consideration for each Project activity predicted to affect wildlife, and with inclusion of specific triggers for mitigation and adaptive management intervention. The TEMP shall demonstrate consideration for all relevant commitments made by the Proponent throughout the Nunavut Impact Review Board's review of the Project.

The Meadowbank Complex TEMP (Agnico Eagle 2020) is designed to meet this condition. The TEMP includes a survey program for caribou that records caribou behaviour in response to various disturbances.

FIGURE 1-1 LOCATION OF MEADOWBANK GOLD MINE AND WHALE TAIL PIT PROJECT



2. STUDY OBJECTIVES

Based on guidance from the TEMP, the overall objective of the caribou behaviour monitoring program is:

- To determine if caribou activity budgets (the proportion of time caribou spend exhibiting different behaviours) change with distance from the Mine, and to document caribou response to stressors.

The detailed objectives of the 2023 study were:

1. To conduct a study using behaviour survey methodology at the Mine site to estimate how the roads and other site infrastructure may contribute to the effects of the Mine on caribou.
2. To use information from the surveys (combined across three years of data collection) to determine factors predict caribou behaviour near the Mine site, specifically comparing:
 - Near vs. far;
 - Large groups of caribou vs. small groups;
 - Surveys with and without disturbances;
 - Road open vs. closed; and
 - Upstream vs. downstream side of the road (east or west side, as determined by dominant direction of travel in each season).

The primary hypothesis of this study was that caribou closer to the road would demonstrate a stronger response to vehicle disturbances.

3. BACKGROUND

Five caribou sub-populations may interact with the Meadowbank Mine Area: Lorillard, Wager Bay, Qamanirjuaq, Beverly, and Ahiak. Primarily, caribou from Lorillard herd interact with the Mine, and smaller numbers of caribou from the Ahiak and Wager Bay herds interact with the Mine. Collar data indicates that caribou occur mostly in the area in late winter and during fall rut.

3.1 LORILLARD HERD

The majority of recorded interactions of collared caribou with the Mine site and road have been from Lorillard caribou. The Lorillard caribou herd is a mid-sized caribou herd that numbered 33,454 animals in 2021 (GN DOE 2021). Previous estimates from 2002 and prior were grouped with Wager Bay because it was not known how the calving areas were delineated in the area. As a result, no assessment of trends can be made. The Lorillard herd range occurs entirely in Nunavut, with the core of its range stretching northward from Chesterfield Inlet on the Hudson Bay coast and westward toward Baker Lake.

The herd generally winters on the tundra in northern central mainland Nunavut. Spring migration is westward and north of Chesterfield Inlet, past the community of Baker Lake to a calving ground south of Wager Bay and close to the Hudson Bay coast (Nagy and Campbell 2012). During late April and early May, groups of animals from this herd interact with the community of Baker Lake, Meadowbank Mine, Whale Tail Mine, the AWAR and WTHR (Agnico Eagle 2020).

Following calving, the caribou form into large groups and generally move west and inland, gradually returning west towards their wintering areas by early December (Nagy and Campbell 2012). Throughout this period, caribou may interact with Mine infrastructure.

3.2 EXISTING CARIBOU MANAGEMENT MEASURES

As per the TEMP, during peak migration the road is closed to all but essential Mine traffic. During road closures, essential mine traffic typically occurs in the form of scheduled convoys of vehicles travelling tightly in one group to minimize the sensory disturbance to caribou. During non-peak periods, caribou observations near the road trigger speed restrictions that apply to all mine traffic. Road closures are triggered separately for the WTHR and the AWAR. Drivers for the Mine are also trained to slow when caribou are within sight and follow the mitigation measures outlined in the TEMP.

Caribou surveys were considered an essential activity by the Mine, allowing the survey pickup truck to be used on the AWAR and WTHR even when these roads were closed to normal mine traffic.

3.3 TERRESTRIAL ADVISORY GROUP

A Terrestrial Advisory Group (TAG) was formed in 2019 as a collaborative forum to discuss Inuit Qaujimajatuqangit (IQ), Traditional Knowledge (TK) and western science applications to mitigation and monitoring programs for the Meadowbank Mine, including on caribou movement in the Mine area. Members of the group include the Government of Nunavut (GN) and the KivIA and the Baker Lake Hunters and Trappers Association (HTO). Following a discussion of the caribou behaviour survey results in 2020 and 2021, the TAG and particularly KivIA suggested several improvements

to the survey protocol and analysis methods. These improvements included adding a variable for road closures and testing whether caribou walking could be considered a response behaviour. In 2022, a variable for caribou movement direction relative to the road was added and additional information was collected on the speed of passing vehicles. Agnico Eagle endeavored to incorporate all the suggestions of the TAG into the 2023 data collection process and analysis.

4. STUDY AREA

The Meadowbank Gold Mine is located approximately 90 km north of the Hamlet of Baker Lake, and the Whale Tail Mine is located approximately 150 km north of the Hamlet. Overall, the Meadowbank Complex, consisting of both mines, processing facility, roads, and associated infrastructure and activities, is approximately 300 km inland from the northwest coast of Hudson Bay and is above the tree line near the Arctic Circle. The local physiography is characterized by numerous lakes and low, rolling hills covered mainly by lichen/rock complexes, and heath tundra.

The study area for behaviour monitoring included the existing footprint for the Meadowbank Gold Mine site, the AWAR, and the WTHR (See Figure 1-1). Surveys were conducted on any caribou that could be visually surveyed from Mine infrastructure up to a distance of 3 km with the aid of binoculars.

5. METHODS

5.1 FIELD SURVEYS

Survey methods followed protocols for monitoring caribou behaviour developed by the Government of Northwest Territories Department of Environment and Natural Resources (GNWT ENR 2017). During 2020, ERM refined these methods for Agnico Eagle's Nunavut mine operations. The updated methods focus on scan samples, *in lieu* of both scan and focal samples. Given time and personnel constraints, this was determined to be a more efficient use of time and produce better quality data that is suitable for statistical analysis. The updated methods also include an initial survey step to randomize which group of caribou to monitor when multiple groups are available. In 2022 and 2021 these methods were further refined to reflect lessons learned in 2020. The 2021 updates included recording additional information such as whether the caribou occurred on the east or west side of the road. The 2022 updates included recording the direction of caribou travel and the speed of vehicle traffic. These updates were retained in 2023. Detailed survey protocols are attached in Appendix A.

The overall method for the field surveys was to identify caribou groups visible from the Mine site, AWAR and WTHR; randomly select groups for observation; and record the behaviour of individuals in groups of different sizes, including their responses without any disturbance and in response to mine-related activities and natural factors. Surveys were conducted during spring migration, summer, and fall migration with efforts to conduct roughly equal numbers of surveys in spring and fall migration seasons.

A reconnaissance survey was first conducted during the 2020 field season to identify where caribou groups were located but this initial survey was abandoned after 2020 since many caribou groups would move away from the road before a full survey could be completed and the field crew returned to conduct the behaviour survey. Where multiple groups were observed, surveyors randomly chose which group to sample, or specifically chose groups to fill data gaps. Field methods included the recording of site information at the location of each survey, including GPS coordinates, weather conditions, road structure, and location of the caribou group in relation to the surveyors and the road. Individuals in the observed-group were categorized when the survey started and every three minutes (referred to here as a "time interval") until 30 minutes had elapsed.

Behaviour categories and their definitions were standardized following GNWT ENR (2017) classifications. The behaviour categories were feeding, lying down, standing, alert, walking, and trotting or running.

At each three-minute interval, surveyors recorded the numbers of individuals in the group exhibiting each behaviour at that time. If the group was too large to be counted in each interval (>100 individuals), an identifiable subset of the group was surveyed during each interval and the total group size was recorded on the datasheet. In the case that a disturbance event occurred during the survey the time and type of disturbance was recorded. A disturbance is defined as any human-caused loud noise, low-flying aircraft, or vehicle travelling on the road. Of the disturbances recorded in the four years of data collection, 97% were from road related disturbances (vehicles) and 3% were from blasts or helicopters. Blast disturbances were monitored under the scope of the

Blast Monitoring Program, developed in collaboration with the TAG (Agnico Eagle 2020). In the analysis all disturbances are treated equally.

Alert behaviour and trotting or running were considered disturbance “response behaviours” and were grouped together in the subsequent data analysis. In this report, alert and running behaviours are referred to collectively as response behaviours, but it is important to note that this is irrespective of whether there were disturbances recorded. Caribou may exhibit these behaviours without a disturbance occurring. Walking was also assessed as a response behaviour in some analyses, which are specifically noted in the results.

Following recommendations from the TAG in 2021, an additional set of longer surveys was completed to specifically look at the behavioural response to convoys of vehicles. These surveys were 90 minutes each, consisting of a “before convoy”, “during convoy” and “after convoy” survey. Observers sought out caribou that were likely to remain within view for 90 minutes based on surrounding terrain. Nine surveys were completed in 2022 and nine in 2021 using this extended methodology. Multiple 90-minute surveys were conducted in 2023, though caribou frequently walked out of sight prior to completion of the 90-minute survey period.

5.2 DATA ANALYSIS

The objective of the data analysis was to quantify trends in the survey data and determine whether factors such as distance to Mine infrastructure (road), group size, or the disturbances could be used to explain caribou behavior. The primary hypothesis was that caribou closer to the road would demonstrate a stronger response to disturbances. An initial exploratory analysis was conducted to visualize the data and determine the appropriate method for analyzing the data.

A regression analysis was conducted to test whether the data from these surveys could be analyzed statistically. To increase the power to detect changes in caribou behaviour, the behaviour categories were grouped for analysis into response behaviours (alert and running) and non-response behaviours (feeding, lying down, standing, and walking).

Following the 2020 analysis, there was a suggestion from the TAG to explore whether the proportion of walking caribou changed as a response to disturbance. This was done to see if walking would be better categorized as a response behaviour or a non-response behaviour. To test this, a model that included walking, running, and alert behaviours was run in addition to the original model with just running and alert behaviours.

Generalized linear mixed-effects models (GLMMs) were used to assess the differences in the proportion of response behaviours in surveyed animals as a function of various controlling variables, including the occurrence of disturbances. Proportions were modelled using a binomial distribution. Because small groups naturally have greater variability in values (i.e., more likely that “all” or “none” of caribou are alarmed when there are only two caribou) an offset for the total number of caribou with tallied behaviour was included. This regression framework provides a means to control for environmental variables, repeated measurements, and spatial correlation. Random effects for survey id to control for spatial and temporal autocorrelation were also included.

Statistical analyses were conducted using R Statistical Software version 4.3.1 (R Core Development Team, 2023). Two dependent variables were tested:

1. The first dependent variable tested was the proportion of response behaviours (alert and running) in each 3-minute interval in each survey.
2. The second dependent variable tested was the proportion of walking plus response behaviours in each 3-minute interval in each survey.

The two dependent variables were each modelled against a suite of potentially important variables to determine if there was any statistical relationship with response behaviour. The variables included in this analysis were group size, distance to road, temperature, wind speed, season and side of the road (upstream/downstream), the roads status (closed or open), and a binary variable identifying whether or not a disturbance occurred during each 3-minute interval. Season and side of the road were included as an interaction term, because direction of travel is seasonally dependent. This means that season and side of the road are included in the model together as an interaction *and* individually as fixed effects. The interaction term makes it possible to identify the “upstream” and “downstream” side of the road, based on the season.

For each dependent variable, GLMMs were constructed and tested for model fit, as evidenced by the Akaike Information Criterion (AIC). AIC is a number that is helpful for comparing models as it includes measures of both how well the model fits the data and how complex the model is (simpler is usually better). The top models were identified as having a low AIC and were within a 2 unit difference in AIC ($\Delta AIC \leq 2$) of the top-ranked model (i.e., the model with the lowest AIC; Burnham & Anderson 2004). This is the industry standard for identifying models that are essentially ‘equally good’ at explaining the data. Models with a difference in AIC (ΔAIC) of 2 to 4 from the top model are generally considered to have ‘limited support’ (Burnham & Anderson 2004).

A second modelling procedure was used to investigate the amount of time caribou were engaged in response behaviour associated with disturbances during a survey. For a response to be included, the proportion of alert or running caribou after a disturbance had to be 40% greater than in the interval before disturbance. The response was considered “over” when the proportion of alert or running caribou returned to the level observed in the interval before the disturbance ($\pm 5\%$). This variable, called “duration of response”, was assessed for each survey during which at least one disturbance occurred. Surveys that started with 100% of individuals exhibiting response behaviour were excluded as the associated disturbance was unclear. In surveys where there was more than a single period of response behaviour, the total time disturbed was calculated for that survey. Because the duration of response is a ‘time to event’ variable (time to return to background behaviour), we used a Cox’s proportional hazards regression to model the duration. Durations were right-censored if the caribou did not return to background behaviour prior to the end of the observation period. As the start and end of the response could happen within 3-minute intervals, but the exact time was not recorded, we assumed the duration was three minutes for every interval included. For example, if the response behaviour occurred only within one interval it was given a duration of three minutes, while if it occurred in two intervals it was given a duration of six minutes. If no response occurred after a disturbance, it was given a duration of 0 minutes.

A model was fit with caribou group size, and a variable indicating the number of intervals which contained a disturbance (number of disturbances). The sample size was too small to include other variables or interaction terms and still achieve convergence.

6. RESULTS AND DISCUSSION

6.1 CARIBOU DISTRIBUTION RELATIVE TO THE MINE

During spring migration in the four years surveyed (2020-2023), caribou GPS collar locations were provided to Agnico Eagle by the GN. These data indicated when collared caribou were approaching the Mine site. Viewsheds or road surveys were conducted as required by Agnico Eagle personnel to trigger management actions. These data informed the decision to begin dedicated behaviour surveys for caribou as they approached the site. Through the summer, surveys were conducted opportunistically as caribou were observed. A final set of dedicated surveys was conducted in the fall during peak fall migration.

Survey locations by season are presented in Figure 6.1-1. During spring migration (March to May), calving/summer (June to August) and fall migration (September to December), scattered groups of caribou from the Lorillard herd were observed passing through or near the study area, with the highest numbers of caribou observed in May. During spring migration in 2020, most surveys were conducted on the WTHR, as this was where the caribou were observed. In contrast, the 2021 spring season saw more caribou along the AWAR. In 2022, more surveys were conducted along the WTHR in all seasons. During summer and during fall migration in 2020, caribou were observed more frequently in the southern portion of the study area along the AWAR, but these trends were not clearly visible in 2021 or 2022. In 2023, most surveys were completed on the AWAR, though surveys were distributed across both roads wherever possible.

6.2 CARIBOU BEHAVIOUR FIELD SURVEYS

In total, 70 behaviour surveys were conducted in 2023 when groups of caribou were near the Mine Complex (the Mine and associated roads, including the WTHR and AWAR) (Tables 6.2-1 and 6.2-2), including 38 surveys in spring migration, 1 survey in calving and summer, and 31 surveys in fall migration. In 2021 the survey effort was concentrated during spring migration, and fewer surveys were completed in summer and fall. In 2022 greater emphasis was put on completing surveys during fall migration. Surveys were conducted opportunistically whenever caribou were encountered during reconnaissance drives, primarily along the AWAR and WTHR.

TABLE 6.2-1 MEADOWBANK COMPLEX CARIBOU BEHAVIOUR SURVEYS SEASONAL DISTRIBUTION, 2020 TO 2023

Season	2020	2021	2022	2023
Spring Migration	71	114	63	38
Calving/ Summer	31	15	18	1
Fall Migration	14	5	23	31
Winter	-	-	1	-
Total	116	134	104	70

FIGURE 6.1-1 LOCATIONS OF BEHAVIOUR SURVEYS BY DATE

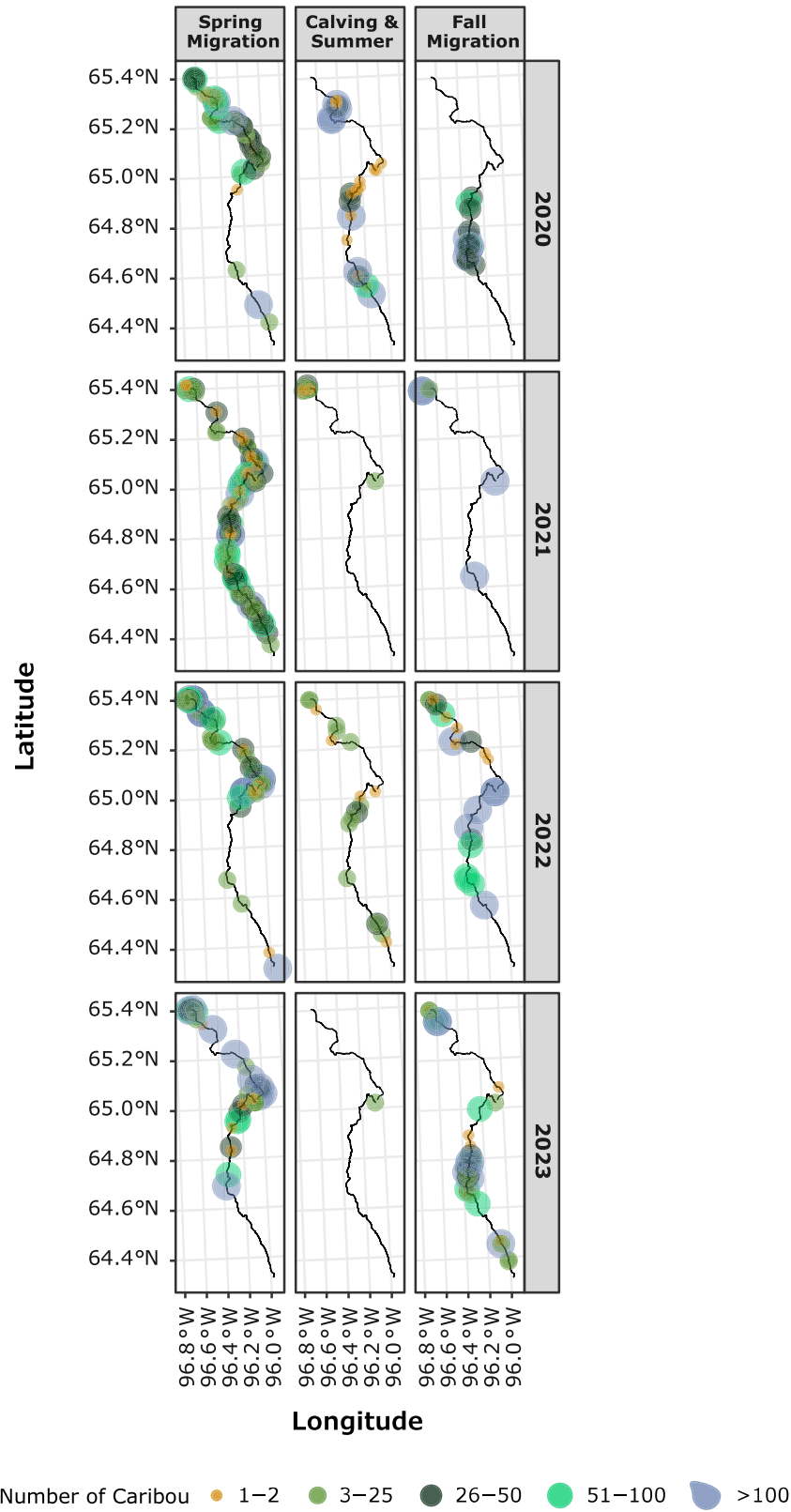


TABLE 6.2-2 MEADOWBANK COMPLEX CARIBOU BEHAVIOUR SURVEYS DATA SUMMARY, 2020 TO 2023

Caribou Group Size	Total Surveys (All Years)	Total # 2020	Surveys with Disturbance 2020	Surveys with Road Crossing 2020	Total # 2021	Surveys with Disturbance 2021	Surveys with Road Crossing 2021	Total # 2022	Surveys with Disturbance 2022	Surveys with Road Crossing 2022	Total # 2023	Surveys with Disturbance 2023	Surveys with Road Crossing 2023
1-2	67	28	15	1	23	15	0	16	10	1	10	5	1
3-25	142	35	22	1	63	35	2	44	28	3	22	6	1
26-50	60	28	13	2	21	9	0	11	4	0	12	2	2
51-100	38	9	5	0	17	9	0	12	3	1	10	0	0
>100	47	16	13	1	10	6	4	21	5	2	16	6	1
Total	354	116	68	5	134	74	6	104	50	7	70	19	5

Overall, the survey methodology worked well for the Mine Complex location and circumstances, and the survey results were generally consistent between years. All reported results use the combined data from 2020 to 2023, unless otherwise stated. General observations on survey methodology and results included:

- Surveys were well distributed across a range of group sizes (Table 6.2-2). Surveyors reported that the addition of a reconnaissance survey and random selection of survey group assisted with a relatively even distribution of survey intensity across group sizes.
- Of the 424 surveys, approximately half recorded at least one disturbance during the survey (Table 6.2-2). Most of these disturbances were haul trucks and light trucks travelling between Whale Tail Mine and Meadowbank Mine. On the AWAR, the disturbances were sometimes ATVs travelling north from Baker Lake. Non-essential Mine traffic was suspended for both roads during periods when groups of caribou above the group size threshold were within 1.5 km of the road.
- In total, 59% of disturbances were from heavy vehicles (including haul trucks, tractor trailers, fuel trucks, and graders), 30% were from light trucks, <1% were from ATVs, 1% were from blasts, and <1% were from helicopters.
- The methodology allowed for the estimation of baseline behaviour, response to disturbance, and return to baseline behaviour. Few, if any, surveys ended before caribou returned to baseline behaviour. When they did not, it was typically due to caribou disappearing from field of vision or because disturbances occurred toward the end of the 30-minute survey. Thus, 30 minutes appears to be an appropriate survey length.
- One source of uncertainty was consistently estimating distance. Hence, the average distance of each group of caribou was categorized into blocks of 0-50 m, 50-100 m, etc. Though distance has been estimated with a rangefinder since 2021, the data were still binned into distance intervals to allow the multiple years of data to be analyzed together.
- In 2020, only 16% of surveys were conducted on caribou within 300 m from the road at the start of the survey. In 2021, an effort was made to increase the number of surveys on caribou within 300 m of the road, and this resulted in an increase to 43% of surveys. In 2022, half of surveys were within 300m of the road. In 2023, 26 (37%) of surveys were within 300m of the road.
- Most caribou behaviours were calm, generally foraging, and not moving quickly (non-response). The one exception was smaller groups who moved more than larger groups – more walking and trotting. Consequently, caribou were observed crossing the road in only 4% of surveys in 2020, in 4% of surveys in 2021, in 7% of surveys in 2022, and in 8% of surveys in 2023. This occurred primarily in small groups of less than 25 individuals. In total, 15 crossings occurred during road closures, three during speed restrictions, and five when the road was open.
- During spring migration when caribou move east towards their calving grounds, 79% of caribou were observed on the west (upstream) side of the Mine infrastructure (Table 6.2-3). This was highly consistent across all years of surveying. During summer and fall migration, caribou move west towards their overwintering grounds. In 2020 and 2022, 68% and 63% of caribou were observed on the east (upstream) side of the Mine infrastructure, respectively. In summer and fall of 2021 the opposite trend was true (Table 6.2-3). This inconsistency may reflect the smaller sample size in the later seasons in 2021.

TABLE 6.2-3 SUMMARY OF SPATIAL DISTRIBUTION OF SURVEYS

Season	Surveys of Caribou on East Side of the Mine Infrastructure 2020	Surveys of Caribou on West Side of the Mine Infrastructure 2020	Surveys of Caribou on East Side of the Mine Infrastructure 2021	Surveys of Caribou on West Side of the Mine Infrastructure 2021	Surveys of Caribou on East Side of the Mine Infrastructure 2022	Surveys of Caribou on West Side of the Mine Infrastructure 2022	Surveys of Caribou on East Side of the Mine Infrastructure 2023	Surveys of Caribou on West Side of the Mine Infrastructure 2023
Spring Migration	12	46	23	89	13	47	4	34
Calving/Summer	11	7	3	12	15	12	1	0
Fall Migration	10	3	1	4	16	6	21	10
Total	33	56	27	105	45	56	26	44

Notes:

Side of the road data was not recorded in 27 surveys in 2020. It was recorded in all surveys in 2021 to 2023. Caribou observed on both sides of the road at the start of the survey are not included in this table.

6.3 EXPLORATORY ANALYSIS RESULTS

The exploratory analysis was conducted to determine if there were any trends or interactions in the following variables: road crossing group size, distance to infrastructure (AWAR, WTHR and mine site), weather and timing, road closure status, side of the road (east or west), number of disturbances, and response time following disturbances.

6.3.1 COMPARING ROAD CROSSINGS WITH GROUP SIZE AND DISTANCE TO INFRASTRUCTURE

6.3.1.1 ROAD CROSSING

Plotting the data did not show a clear relationship between caribou group size and the observation of road crossings. Although in 2020, four of the five observed road crossing events occurred in groups smaller than 25 individuals, the trend was less apparent in 2021 and 2022 when observations of road crossings included both large and small groups. In 2023, three of the six observed road crossings were in groups of 25 or less. There was also no clear relationship between caribou distance from road and the observation of road crossings, meaning that caribou located closer to the road were not more likely to cross the road than caribou positioned further away (Figure 6.3-1a).

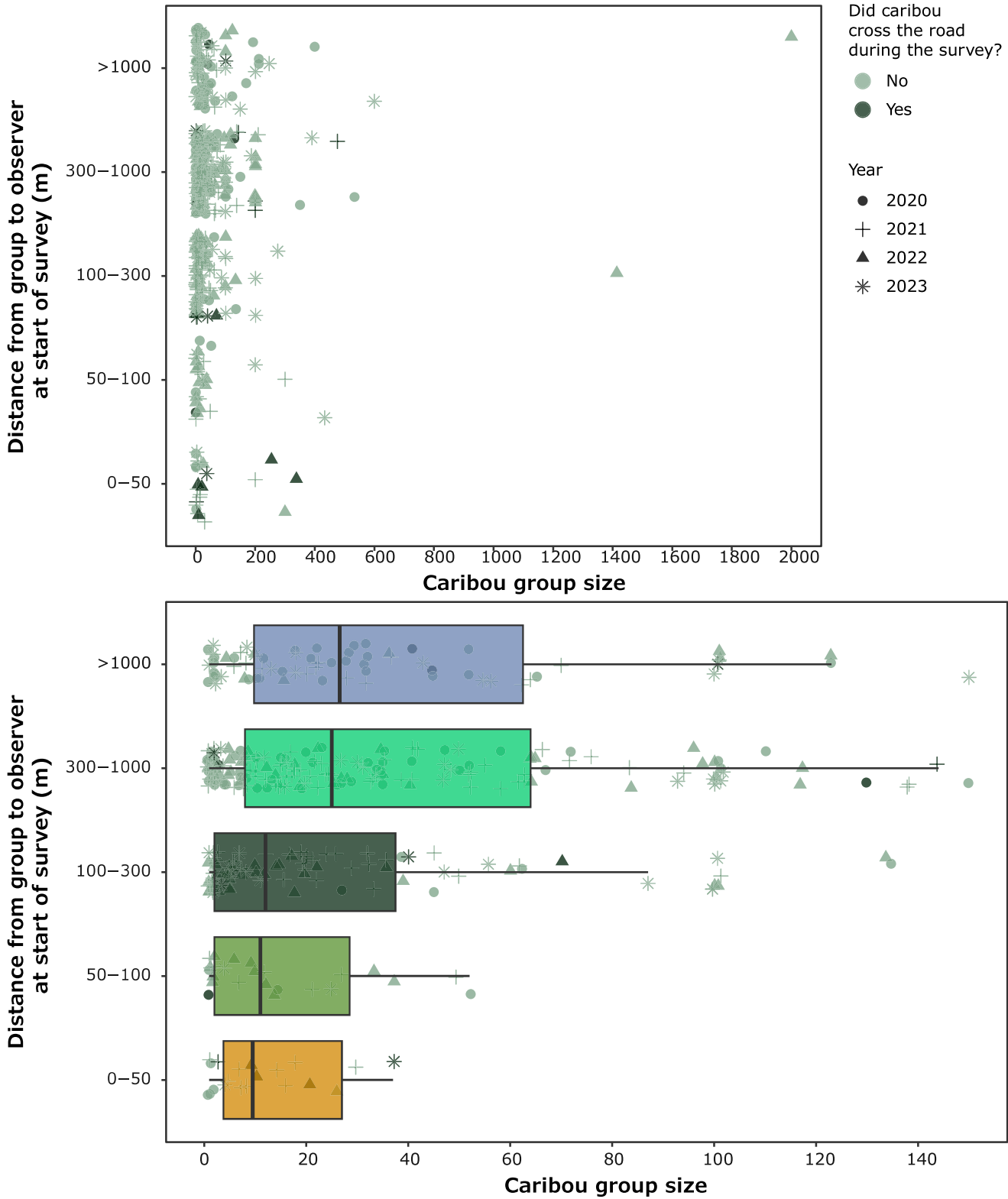
6.3.1.2 GROUP SIZE AND DISTANCE TO INFRASTRUCTURE

Plotting the caribou group size against the distance of caribou groups to the road at the start of the survey revealed that small groups (less than 50 individuals) were observed at all distances within the study area (Figure 6.3-1a). Note that distance to the road and distance to the observer/surveyor are considered equivalent in this analysis.

From 2021 to 2023, effort was taken to increase the sample size of caribou (and specifically large groups of caribou) within 300 m of the road at the start of the survey. Despite this there is still a slight trend for larger groups to be observed further from the road at the start of the survey (Figure 6.3-1b). Only seven groups larger than 100 individuals were recorded within 100 m of the road at the start of the survey, two in 2023, three in 2022 and two in 2021.

This may be indicative of a trend that caribou tend to avoid areas within 100 to 300 m of the road, or may be a by-product of observability bias, where smaller groups are more difficult to spot at distances greater than 300 m away from the road. Regardless of the mechanism, these trends highlight a potential source of error and were considered in the statistical analyses so that the results were not biased (see Section 6.4.1).

FIGURE 6.3-1 CARIBOU GROUP SIZE VERSUS DISTANCE FROM THE CARIBOU TO THE ROAD



6.3.2 COMPARING BEHAVIOUR TYPE WITH GROUP SIZE AND DISTANCE TO INFRASTRUCTURE

Average proportions of each behaviour type by group size and by distance to road are presented in Figure 6.3-2. When analyzed by group size, the results suggest that the average proportion of the response behaviours of “Alert” and “Trotting” remain stable as group size increases. The largest proportion of alert or trotting behaviours was observed in groups of one to two individuals. No group size had more than 10% alert or trotting, when averaged across observations with and without disturbances (Figure 6.3-2a).

When analyzed by distance to road, the results suggest that the proportion of response behaviours is relatively stable for groups within 1,000 m of the road and lower in groups further than 1,000 m from the road, but the difference is very small – at most one or two percent lower (Figure 6.3-2b). As with group size, no distance category had surveys with more than 10% of caribou with alert or trotting behaviour.

Overall, no clear differences in behaviour can be visually distinguished among group sizes or distances to the road. These relationships are examined in greater detail in the statistical analysis.

6.3.3 BEHAVIOUR TYPE AND ENVIRONMENTAL/TEMPORAL VARIABLES

Figure 6.3-3 shows the relationship between 1) the proportion of response behaviours and 2) environmental and temporal variables: temperature, wind speed, and date. This comparison was included to exclude the possibility that environmental factors such as heat or high winds were influencing caribou behaviour during the survey. No trend is visible in the data and trend lines fit to the weather data are nearly flat with wide confidence intervals, suggesting that the weather conditions observed during the surveys do not have a substantial effect on behaviour. It should be noted that surveyors typically did not go out in extreme weather events and therefore variability in weather conditions was low. Date was also not associated with caribou behaviour.

6.3.4 ROAD CLOSURE STATUS

An additional comparison was added in 2021 to explore the effect of the road closure status on average caribou behaviour. During caribou active months, the road may be open, closed, or open with speed restrictions. During peak caribou migration the road is closed, with some allowances for essential traffic in convoys.

Surveyors were out collecting data when the road was open and when it was closed, as caribou surveys were considered an essential activity. As a result, there are relatively even numbers of surveys from when the road was open vs. when it was closed to non-essential Mine traffic (Figure 6.3-4). Although it was expected that the level of response behaviours would be higher on average when the road was open due to an increase in traffic, this difference is not visually apparent. The level of response behaviour (averaged across all observations with and without disturbances) is low (<10%) both when the road is closed and when the road is open. If walking is included, there are a higher proportion of animals walking on average during road closed surveys. However, this may be due to closures occurring mainly during peak migration times.

FIGURE 6.3-2 AVERAGE PROPORTION OF EACH BEHAVIOUR TYPE OBSERVED

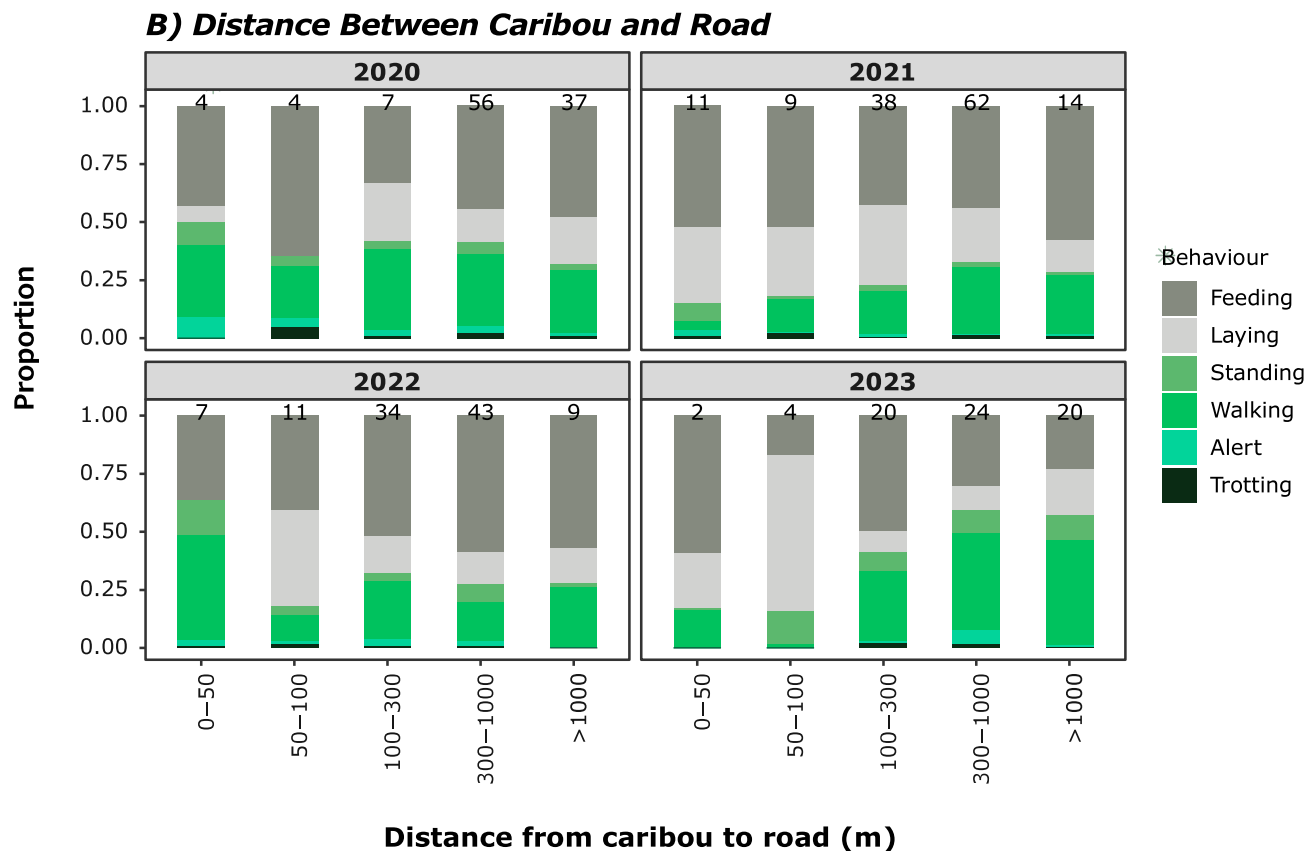
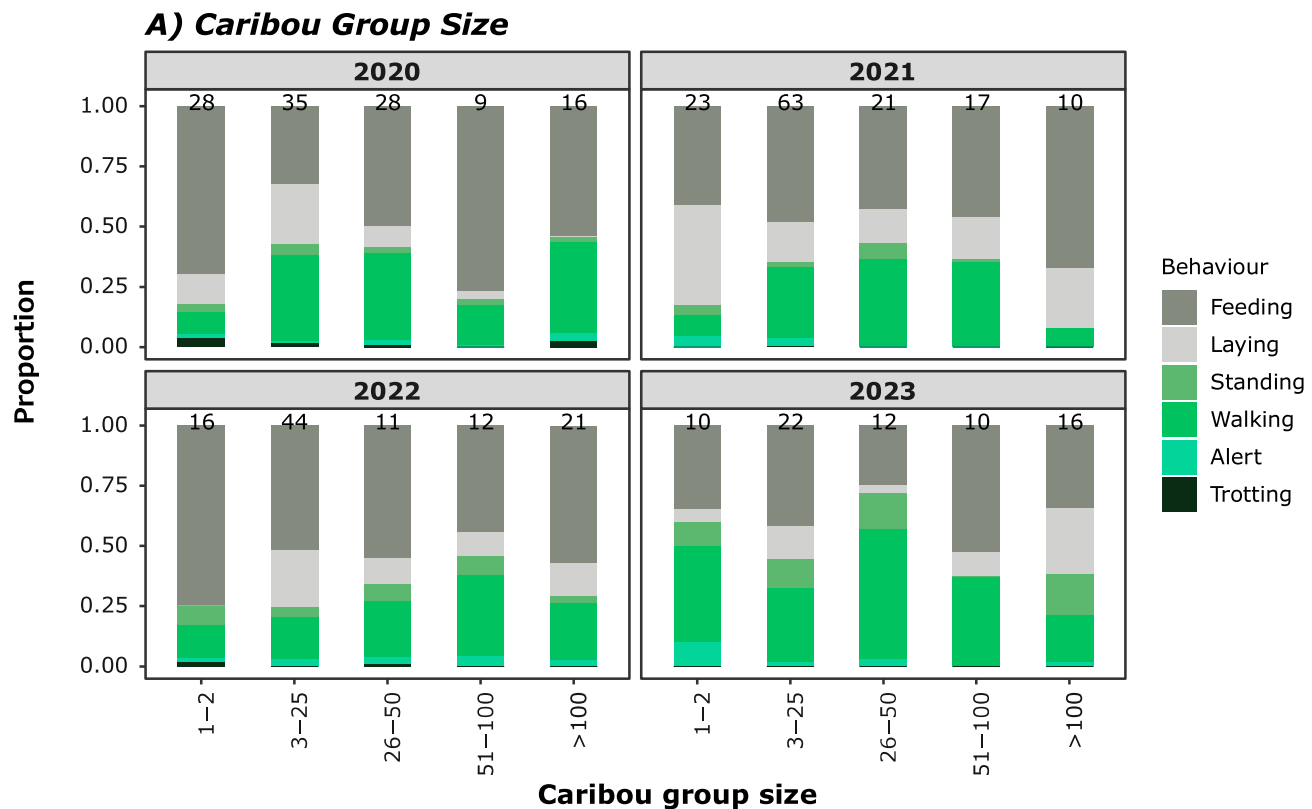


FIGURE 6.3-3 PROPORTION OF ALERT OR RUNNING CARIBOU BY TEMPERATURE, WINDSPEED AND DATE

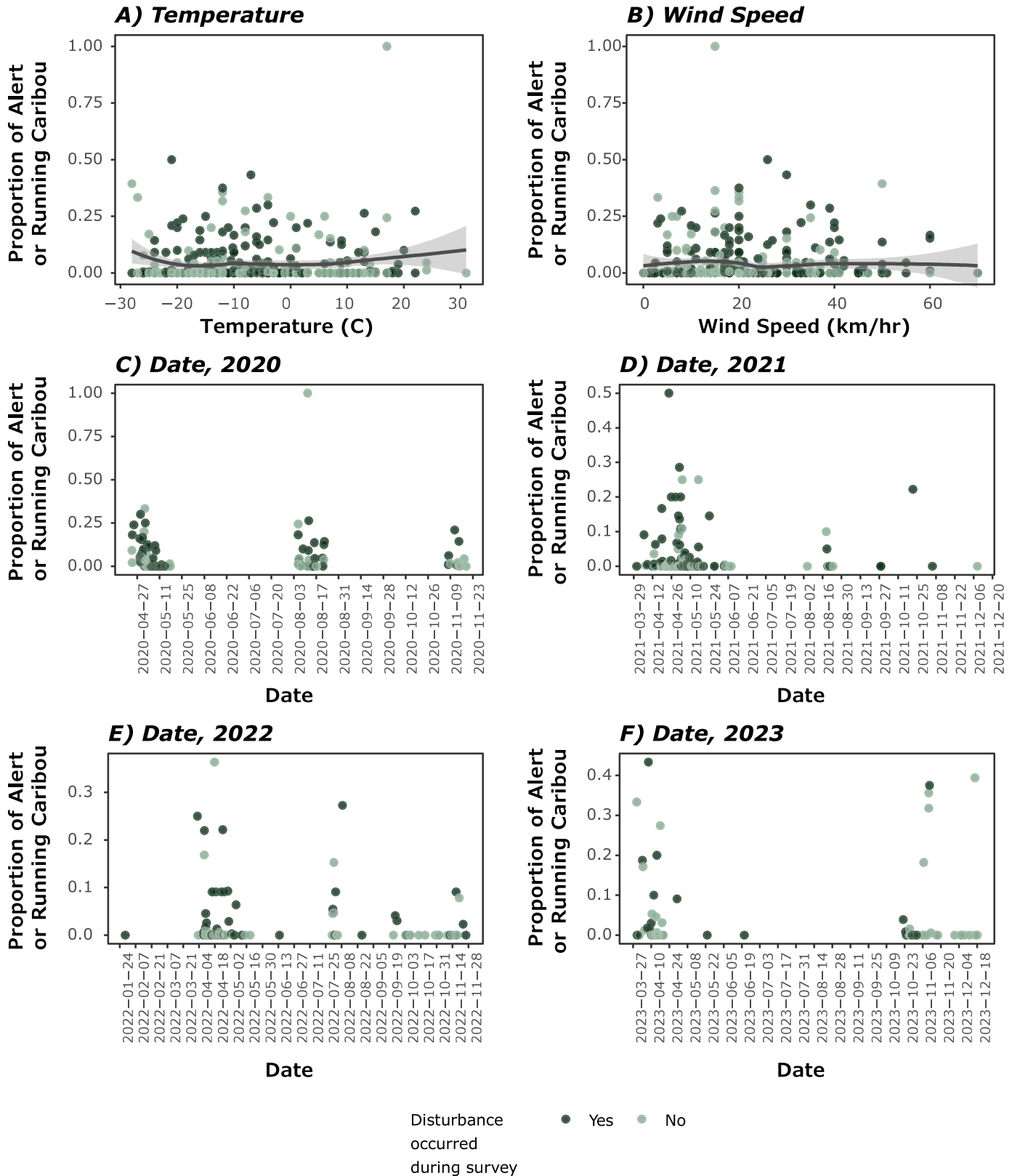
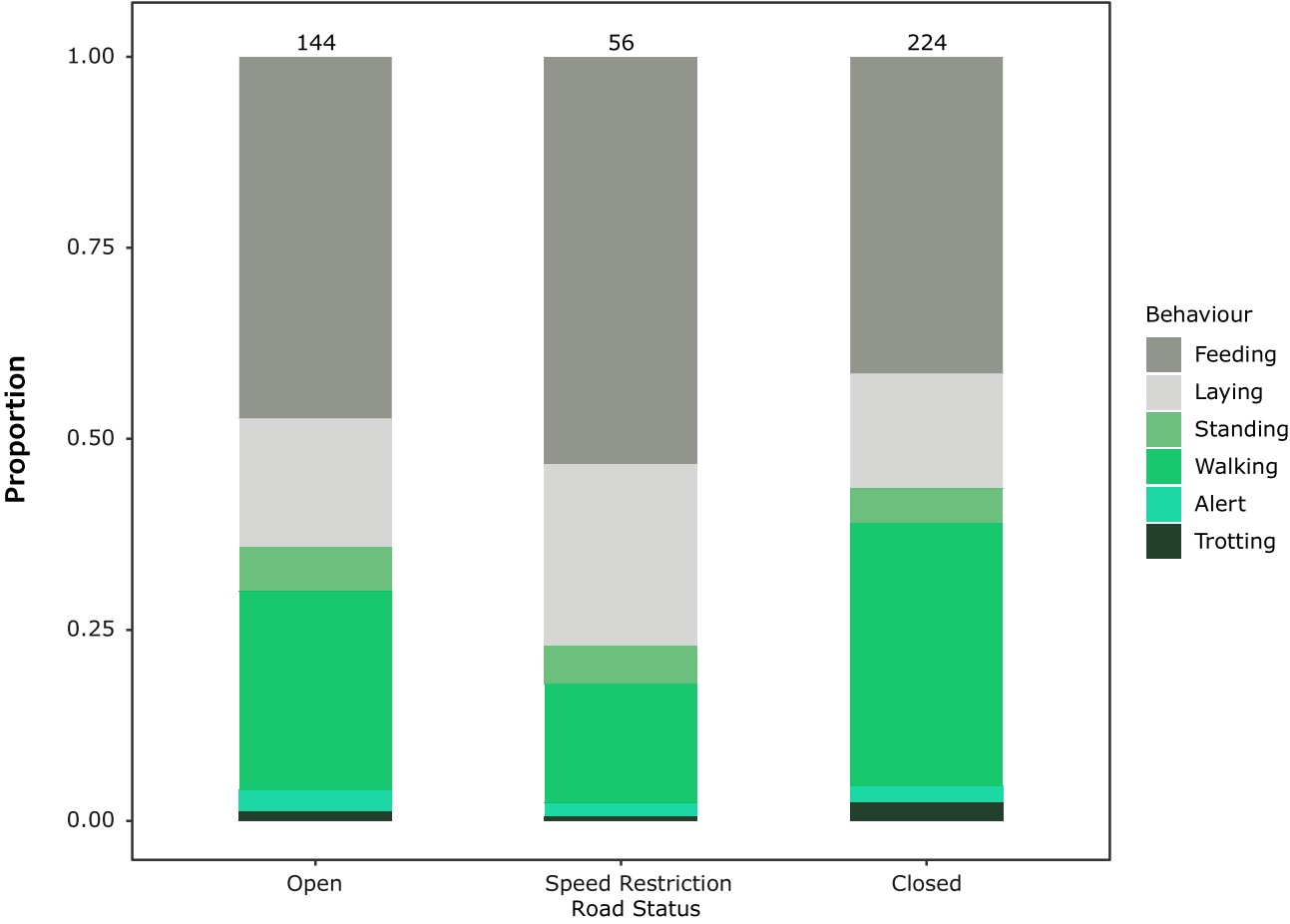


FIGURE 6.3-4 AVERAGE PROPORTION OF EACH BEHAVIOUR TYPE BY ROAD STATUS



It should be noted that convoy surveys were included in the summary figure, and these always occurred during road closures. However, this accounts for only 8% of surveys during road closures, so cannot entirely explain the differences observed in Figure 6.3-4. This relationship is further explored in the statistical analysis.

6.3.5 SEASON AND SIDE OF THE ROAD (UPSTREAM/DOWNSTREAM)

The movement pattern for caribou in the Mine area is variable based on the season. During spring migration, the dominant direction of travel is west to east, whereas in summer and during fall migration it is east to west. It was hypothesized that behaviour may vary depending on whether the caribou had crossed the road already ("downstream") or whether they were anticipating doing so ("upstream").

One hypothesis is that caribou are hesitating to cross the road but that once they cross the road, they move away quickly. If this were the case, the prediction would be that groups of caribou would be observed close to the road on the upstream side with fewer groups or groups further away on the downstream side. This predicted distribution was not observed. Instead, groups of caribou were observed near the road on both sides of the road. Figure 6.3-5 compares the distance to the road at the start of the survey with the location relative to the road (east or west). In spring migration, a greater number of surveys were recorded on caribou on the west side of the road, which is upstream for that season. This may be an indication that caribou tend to gather before crossing the road.

While differences in response behaviour (running/alert) do not appear to vary with the side of the road the observations are from, one trend that does stand out is that there appears to be a higher proportion of walking behaviour on the upstream side of the road at least during the spring migration. This is explored further in the statistical analysis.

6.3.6 NUMBER OF DISTURBANCES

When duration of response (i.e., time taken for caribou to return to a baseline condition following a disturbance) is compared with the proportion of response behaviours, it appears that surveys with a higher proportion of caribou responding to the disturbance tend to take longer to recover to a baseline condition (Figure 6.3-6 panel a). Interestingly, it appears that surveys with multiple disturbances don't consistently produce a larger response or a longer one. Although the long-lasting full-group responses are in surveys with multiple disturbances, there are surveys with multiple disturbances that don't have large reactions or longer-lasting response durations.

Figure 6.3-6 (panel b) shows a density plot for the proportion of response behaviours in three subsets of surveys, those with no disturbances, those with one disturbance, and those with multiple disturbances. The results suggest a slightly higher proportion of alert or running caribou in surveys when one or more disturbances occurred. Surveys with multiple disturbances do not appear to have a greater overall response than surveys with one disturbance. It should be noted that this figure is an average proportion of response behaviours across the entire 30-minute survey, so in some instances the proportion of response behaviours may have been obscured by the large number of intervals with no response behaviour.

FIGURE 6.3-5 AVERAGE PROPORTION OF EACH BEHAVIOUR TYPE OBSERVED ON EAST AND WEST SIDE OF ROAD

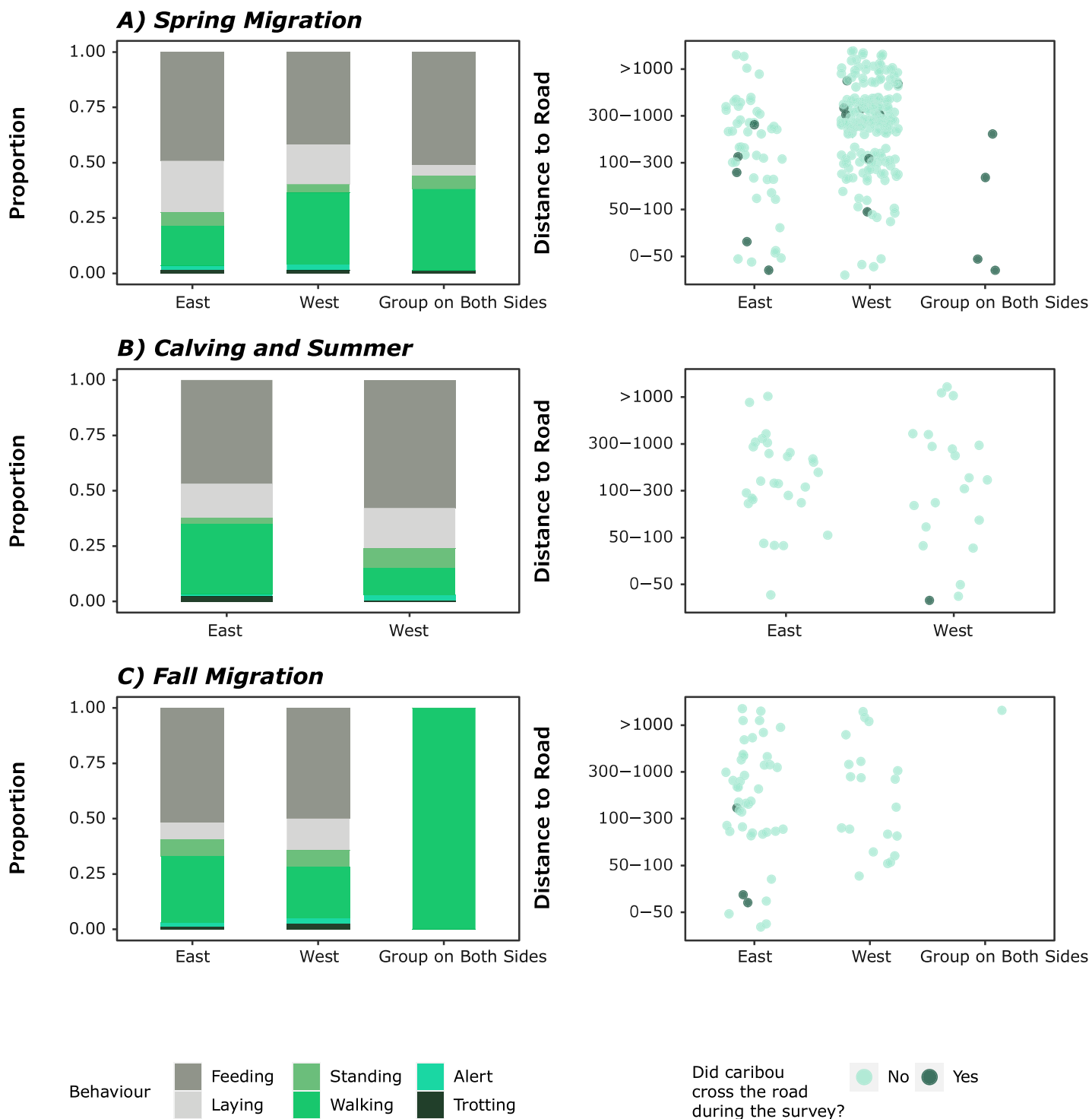
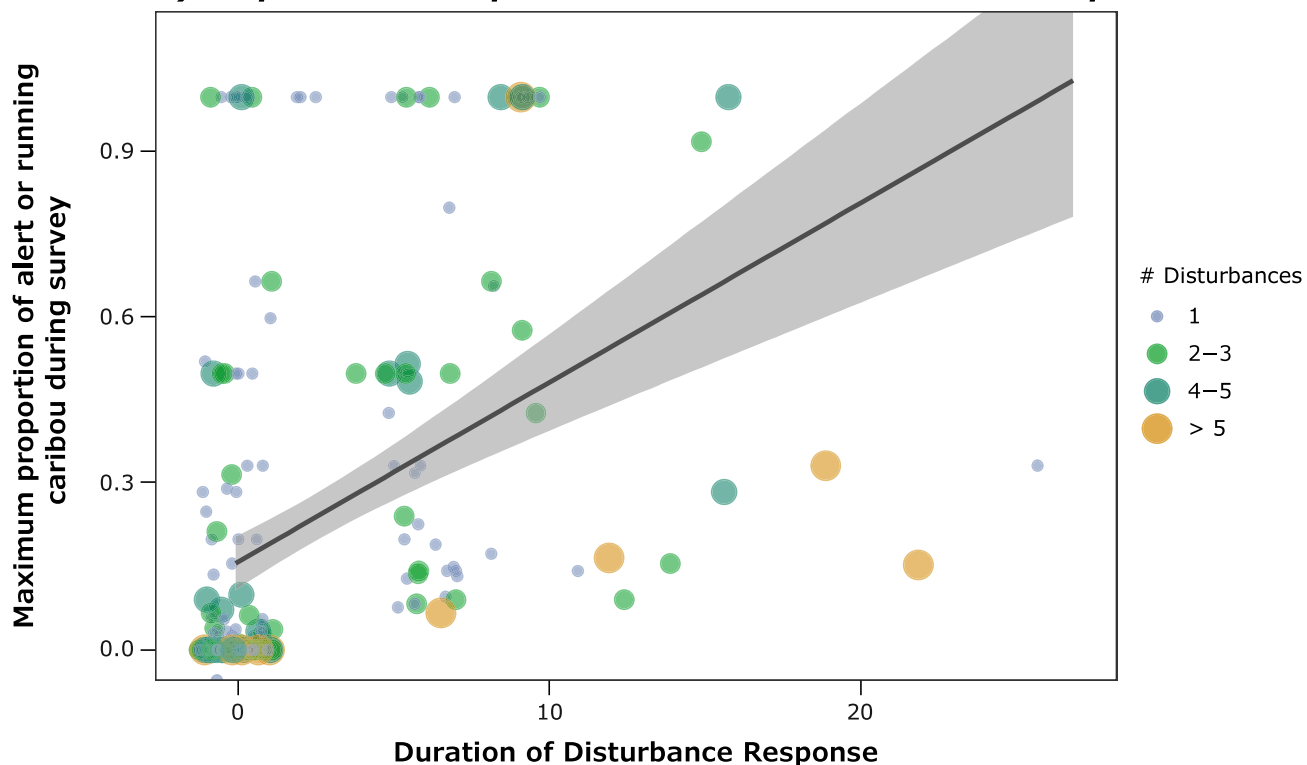
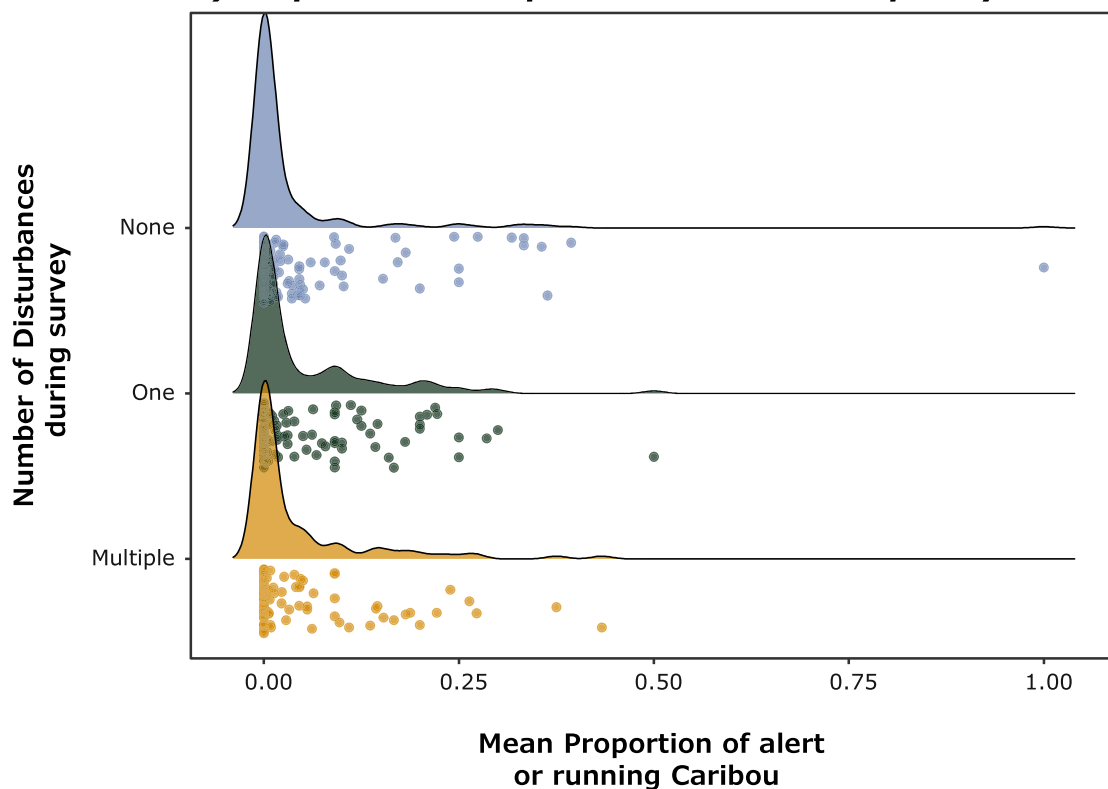


FIGURE 6.3-6 COMPARISON OF RESPONSE BEHAVIOURS BY NUMBER OF DISTURBANCES

A) Proportion of Response Behaviour vs. Duration of Response



B) Proportion of Response Behaviour Grouped by Number of Disturbances



6.3.7 RESPONSE TO DISTURBANCES

Summarizing data over the entire 30-minute survey is useful for broad comparisons but has the disadvantage that response behaviour can be obscured in a relatively uneventful survey. To examine the response to disturbances within a survey, the proportion of response behaviours was plotted by three minute interval for each survey, as shown for a subset of surveys in Figure 6.3-7. See Appendix C for plots of all surveys. In Figure 6.3-7, the response behaviours of “alert” and “trotting or running” are combined to create the total proportion of responding caribou in any given time interval and plotted over time within the 30-minute survey. Disturbances are denoted with a vertical bar. A spike in response behaviours in the interval during a disturbance or immediately following a disturbance suggests that the caribou are responding to the disturbance.

The results show that in the absence of disturbances, an average of 0-10% of caribou typically exhibit response behaviours at any given time. Figure 6.3-7 and Appendix C suggest that following many of the disturbance events, there was commonly a spike in the proportion of response behaviours to 60-90% of caribou in the group. The proportion of caribou with response behaviours returned to pre-disturbance levels quickly, often within two intervals (6 minutes). For example, when a truck passed, most caribou would look up (which is classified as a response behaviour) and then return to feeding or laying down (a pre-disturbance behaviour).

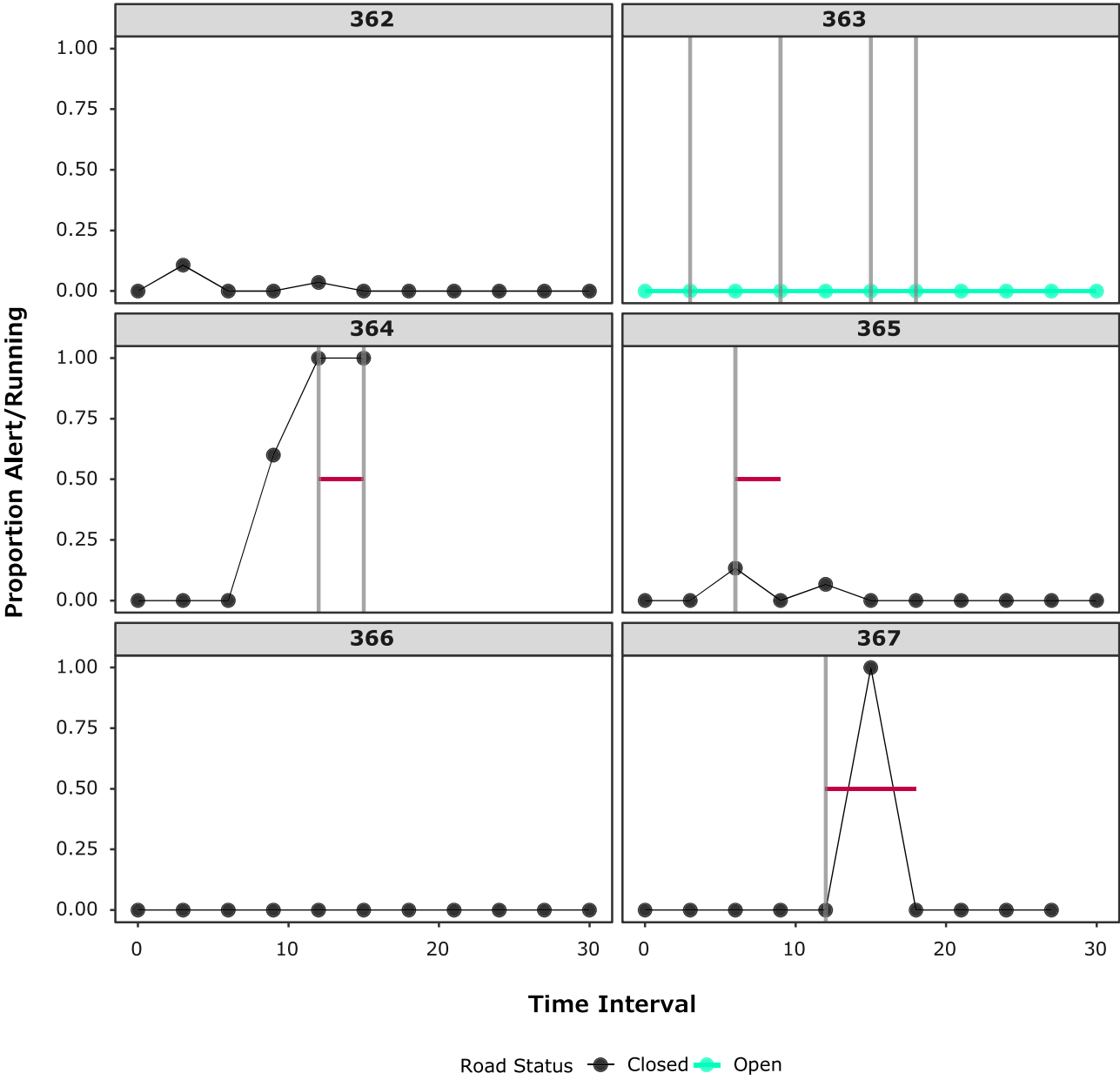
There was some variability in the proportion of response behaviours. During some surveys, there was a spike in response behaviours when no vehicle or other obvious disturbance was observed. In some surveys a vehicle passed by (a disturbance), but there was no increase in response behaviours observed in the caribou group on the subsequent time period.

6.3.8 DIRECTION OF CARIBOU TRAVEL

Following the 2021 analysis there was a suggestion from the TAG to incorporate the direction caribou travelled relative to the road, i.e., if caribou were walking parallel to the road or perpendicular. Walking parallel to a potential threat is a known behaviour in some cervid species. Inclusion of this variable in combination with whether caribou were upstream or downstream of the dominant direction of travel was suggested to help determine if caribou were walking as a response to a disturbance or not. In response to this suggestion, a field for direction of travel was added for the 2022 survey season. Note that the suggestion was made after spring migration 2022, so data are only available for surveys in summer and fall of 2022, resulting in 41 entries for direction of travel in 2022. 70 entries were available in 2023.

From the 70 surveys with this information in 2023, 29 groups were recorded as travelling parallel to the road (41%), 16 were travelling perpendicular to the road (23%), and 25 were stationary for much of the survey (36%).

FIGURE 6.3-7 PROPORTION OF RESPONSE BEHAVIOUR DURING EACH SURVEY –
EXAMPLE SUBSET



Note: See Appendix C for all surveys from 2020, 2021, 2022, and 2023.

From the 41 surveys with this information in 2022, 18 groups were recorded as travelling parallel to the road (44%), four were travelling perpendicular to the road (10%), and 19 were stationary for much of the survey (46%). Of those travelling parallel to the road, all but one were recorded upstream of the dominant direction of travel (94%). However, it should be noted that most surveys completed during this time period were of caribou on the upstream side of the road, regardless of direction of travel. 63% of stationary caribou groups were also recorded on the upstream side of the road. Caribou moving perpendicular to the road were recorded equally on the upstream and downstream side of the road. These results point to a trend that caribou may travel parallel to the road before crossing it, but the small sample size makes it challenging to form conclusions.

6.4 STATISTICAL ANALYSIS RESULTS

6.4.1 MODEL FORMULATION

As distance to road and caribou group size were identified as being potentially correlated during the exploratory analysis, a Chi-square test was conducted between the two variables to determine if they were too closely related to be included in a model together. A Chi-square (χ^2) statistic is a test that measures how a model compares to actual observed data and can be used to test for the correlation between two categorical variables. The resulting Chi-square statistic was significant ($p=0.01$), indicating that group size was statistically associated with distance from the road. To prevent overfitting, models were run that included group size as an independent variable and distance to road as an independent variable separately.

Initial model results suggested that distance of the caribou to the observer was not a good predictor for response behaviour regardless of how models were parameterized. Therefore, further models did not include this variable. The final models had many parameters, and it was difficult to attain model convergence. As a result, model variables that had little or no explanatory power and were not variables of interest (temperature and wind speed) were dropped from the models. Final models for proportion of response, or response and walking behaviour included caribou group size, whether a disturbance occurred, road status, and the interaction between season and side of road.

The estimates and significance levels for the final model that used response behaviour as the dependent variable are presented in Table 6.4-1, for the final model that used walking behaviour as the dependent variable in Table 6.4-2, and for the final model that used duration of response as the response variable in Table 6.4-3.

In Tables 6.4-1 and 6.4-2, the statistics presented include the type of term in the model (fixed vs random effects), and variable estimate (Odds Ratio), which can be interpreted as the expected effect on the dependent variable as the independent variable changes. Significant p-values (<0.05) for variables with more than two categories were followed up with pairwise post-hoc tests to determine which groups were different. A p-value of less than 0.05 suggests that the variable is an important determinant of the response, as it indicates there was less than 5% probability that we would see an association as strong as we did if there was no relationship.

TABLE 6.4-1 SUMMARY OF MODEL COEFFICIENTS AND SIGNIFICANCE LEVELS FOR RESPONSE BEHAVIOUR MODEL

Effect Type	Variable	Estimate	Standard Error	P-value	Significance
Fixed	(Intercept)	0.004	0.003		
	Caribou Group Size:			< 0.001	***
	• 1-2	Reference	Reference		
	• 3-25	0.067	0.038		
	• 26-50	0.042	0.027		
	• 51-100	0.011	0.008		
	• >100	0.018	0.012		
	Disturbance during interval	6.074	0.371	< 0.001	***
	Road status (Open)	0.691	0.261	0.33	
	Season:			-	
	• Summer and Calving	Reference	Reference		
	• Fall Migration	0.306	0.259		
	• Spring Migration	0.421	0.352		
	Side of Road:			-	
	• East	Reference	Reference		
	• West	0.59	0.636		
	Interaction (Summer and Calving* West)	Reference	Reference	0.52	
	Interaction (Spring Migration* West)	4.064	5.712		
	Interaction (Fall Migration* West)	3.885	4.866		
Random	SD for random effect	2.913			

Note:

Statistically significant p-values <0.05 are indicated with a single asterisk. Highly significant values ($p < 0.001$) are indicated with three asterisks. Near significant values ($0.09 > p > 0.05$) are indicated with a dot.

TABLE 6.4-2 SUMMARY OF MODEL COEFFICIENTS AND SIGNIFICANCE LEVELS FOR WALKING MODEL

Effect Type	Variable	Estimate	Standard Error	P-value	Significance
Fixed	(Intercept)	0.635	0.46		
	Caribou Group Size:			< 0.001	***
	• 1-2	Reference	Reference		
	• 3-25	0.121	0.061		

Effect Type	Variable	Estimate	Standard Error	P-value	Significance
Fixed (cont'd)	• 26-50	0.08	0.048		
	• 51-100	0.036	0.024		
	• >100	0.012	0.008		
	Disturbance during interval	1.128	0.045	0.003	*
	Road status (Open)	0.121	0.061	< 0.001	***
	Season:			-	
	• Summer and Calving	Reference	Reference		
	• Fall Migration	0.667	0.515		
	• Spring Migration	0.148	0.112		
	Side of Road:			-	
	• East	Reference	Reference		
	• West	0.148	0.139		
	Interaction (Summer and Calving* West)	Reference	Reference	0.003	*
	Interaction (Spring Migration* West)	3.302	4.148		
	Interaction (Fall Migration* West)	36.132	39.752		
Random	SD for random effect	3.182			

Note:

Statistically significant p-values <0.05 are indicated with a single asterisk. Highly significant values ($p < 0.001$) are indicated with three asterisks. Near significant values ($0.09 > p > 0.05$) are indicated with a dot.

TABLE 6.4-3 SUMMARY OF MODEL COEFFICIENTS AND SIGNIFICANCE LEVELS FOR DURATION OF RESPONSE MODEL

Variable	Hazard Ratio	95% Confidence Interval	P-value
Number of Disturbances ^a	0.89	0.81-0.98	0.02 *
Caribou Group Size:			0.03 *
Caribou group size 1-2	Reference	Reference	
Caribou group size 3-25	0.60	0.41-0.89	
Caribou group size 26-50	0.52	0.31-0.86	
Caribou group size 51-100	0.68	0.37-1.25	
Caribou group size >100	0.47	0.28-0.78	

Notes:

Statistically significant p-values <0.05 are indicated with a single asterisk. Highly significant values ($p < 0.001$) are indicated with three asterisks. P-values <0.10 and >0.05 are indicated with a dot.

^a Number of 3-minute intervals during which a disturbance occurred. May be the same source of disturbance over several intervals.

6.4.2 EFFECT OF DISTURBANCES

Tables 6.4-1 and 6.4-2 suggest that in both models, whether a disturbance occurred during an interval was a significant predictor of the proportion of animals exhibiting response behaviour during that interval. In the model for response alone, the Odds Ratio is approximately 6, suggesting that there is a 6 times higher odds of response behaviour in intervals containing a disturbance averaged across group size, road status, season, and side of road. In the model with walking behaviour included there is approximately 13% higher odds of exhibiting this behaviour in intervals where a disturbance occurred. This indicates that walking may be less associated with disturbance than the other response behaviours.

6.4.3 EFFECT OF GROUP SIZE

The models also suggest caribou group size is significantly associated with the proportion of caribou exhibiting response behaviour. Post-hoc pairwise test results are illustrated in Figures 6.4-1 and 6.4-2. The shaded grey bars indicate the 95% confidence intervals around the estimates of average proportion of caribou exhibiting response behaviour. The points indicate the means (averaged over whether a disturbance occurred), and the green arrows the pairwise comparisons among groups. Where these arrows do not overlap suggests a significantly different response between the groups.

For the response model, the smallest group size had the largest proportion of response behaviour and this was different from all other group sizes. The next largest size bin (3-25 animals) also showed a significantly higher proportion of response compared to the 51-100 animals group. All other pairwise comparisons were not significant. The response and walking model had a similar pattern of results except that the 3-55 and the 26-50 groups were significantly different from the >100 group.

6.4.4 EFFECT OF ROAD CLOSURE STATUS

Road closure status was not a significantly important predictor of response behaviour (Table 6.4-1), but was significantly associated with response and walking behaviour (Table 6.4-2). The model for response alone suggests that caribou respond similarly to disturbances regardless of whether the road is open or closed (see Figure 6.3-4). This may be because the analysis included convoy surveys, which occurred during road closures and had the potential to bias the results. There are typically fewer disturbances during road closures. It may also be simply because the other variables in the model are better at explaining the variation observed in the data. However, when walking is included, there was a lower proportion of animals with the response when the road was open. This may be due to closures occurring mainly during peak migration times when animals are walking.

FIGURE 6.4-1 PAIR WISE COMPARISONS OF AVERAGE PROPORTION OF CARIBOU EXHIBITING RESPONSE BEHAVIOUR AMONG CATEGORIES OF CARIBOU GROUP SIZE

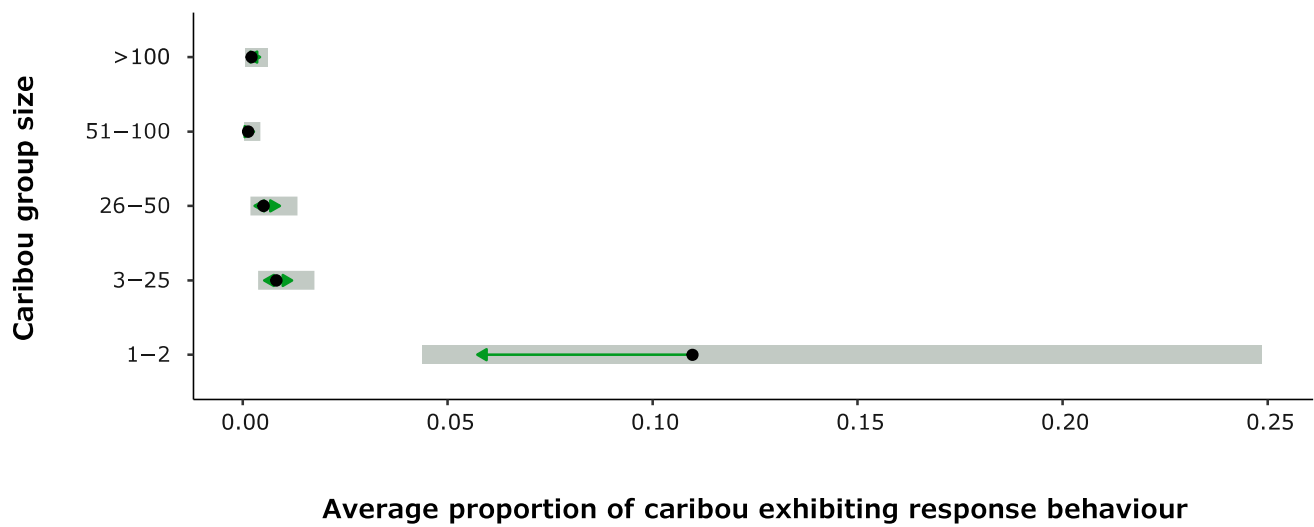
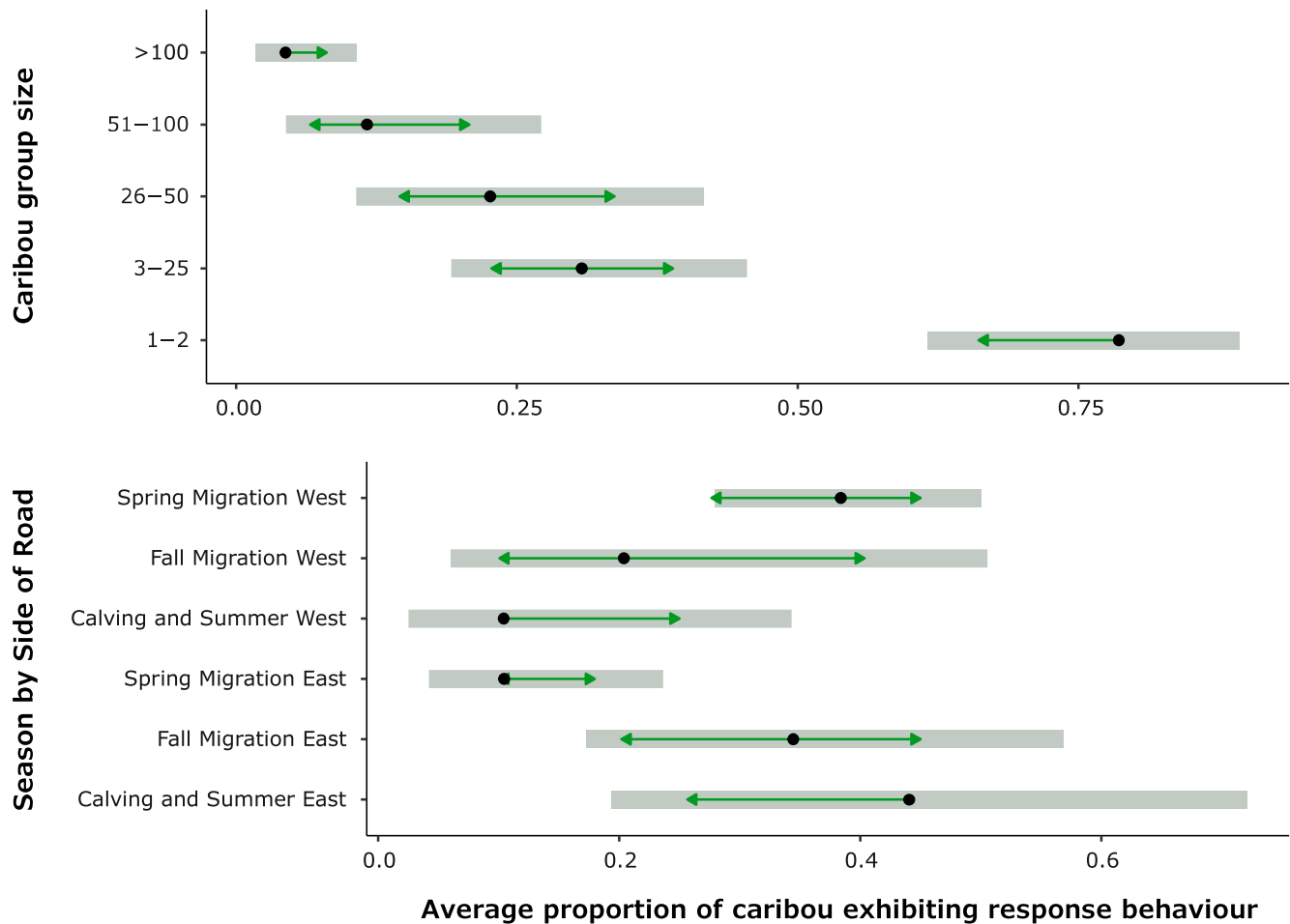


FIGURE 6.4-2 PAIR WISE COMPARISONS OF AVERAGE PROPORTION OF CARIBOU EXHIBITING RESPONSE AND WALKING BEHAVIOUR AMONG CATEGORIES OF CARIBOU GROUP SIZE AND ROAD STATUS



6.4.5 EFFECT OF SEASON AND SIDE OF THE ROAD (UPSTREAM/DOWNSTREAM)

Season and side of the road were not significant in the response behaviour model but were significant in the model that included walking as a response (Tables 6.4-1, and 6.4-2).

Model results indicate that during spring migration caribou are walking less on the east side of the road compared to the west side of the road (pairwise post-hoc p-value = 0.02). Since west is upstream of the typical direction of movement in spring, and downstream in fall, another way to interpret this result is that caribou tend to be walking more on the upstream side of the road during the spring migration. None of the other pairwise comparisons of season and side of road were significant. In this study, similar numbers of surveys were conducted on the upstream and downstream sides of the road (See Table 6.2-2).

An analysis conducted by the GN on the 2019 road survey data from Agnico Eagle reported that most observations of caribou groups were made on the upstream side of the road (GN, Feb. 2021 presentation to the TAG). In that presentation, the GN hypothesized that caribou are walking alongside and parallel to the road on the upstream side before crossing, which would be consistent with caribou hesitating to cross the road. More surveys in spring and fall would allow for greater confidence in these results.

6.4.6 DURATION OF RESPONSE

Table 6.4-3 gives the model summary for the duration of response model. The median number of survey intervals with a disturbance was 1, with a mean of 2.1, and a maximum of 9. The final model included the number of disturbances that occurred during the survey, and group size. The estimated term (Hazard ratio) for number of disturbances being less than one indicates a longer duration of response for increasing numbers of disturbances. The model also suggests that larger groups of animals took significantly longer to return to normal compared to the smallest group size (1-2 animals). We can use the estimates from the model to calculate the probability of returning to normal behaviour within a certain period of time for different group sizes and numbers of disturbances. Over the range of number of disturbances and group sizes, the model suggests that over 85% (95% CI = 72-92%) of surveys will have returned to normal behaviour within 3 minutes, 94% (85-98%) within 6 minutes, and 100% within 15 minutes of the start of the response. Table 6.4-4 and Figure 6.4-3 give the estimates and confidence intervals for the probability of returning to normal behaviour within a certain time by group size and number of disturbances.

TABLE 6.4-4 PROBABILITY OF RETURNING TO NORMAL BEHAVIOUR WITHIN A CERTAIN TIME BY GROUP SIZE AND NUMBER OF DISTURBANCES

Variable	Time to Return to Normal Behaviour			
	3 Minutes	6 Minutes	9 Minutes	15 Minutes
Caribou Group Size:				
1-2	84% (69%, 92%)	91% (77%, 96%)	100% (77%, 96%)	— (—, —)
3-25	72% (60%, 80%)	80% (70%, 87%)	87% (75%, 93%)	96% (84%, 99%)
26-50	57% (34%, 72%)	79% (56%, 89%)	95% (66%, 99%)	95% (66%, 99%)
51-100	69% (35%, 85%)	92% (50%, 99%)	— (—, —)	— (—, —)
>100	59% (36%, 73%)	77% (55%, 89%)	86% (63%, 95%)	91% (68%, 97%)

Variable	Time to Return to Normal Behaviour			
	3 Minutes	6 Minutes	9 Minutes	15 Minutes
Number of Survey Intervals with a Disturbance:				
1	72% (62%, 79%)	89% (81%, 94%)	97% (88%, 99%)	98% (89%, 100%)
2-3	69% (55%, 79%)	75% (61%, 84%)	89% (72%, 96%)	96% (77%, 99%)
>3	67% (47%, 79%)	78% (59%, 88%)	86% (69%, 94%)	92% (75%, 97%)

6.4.7 STATISTICAL ANALYSIS SUMMARY

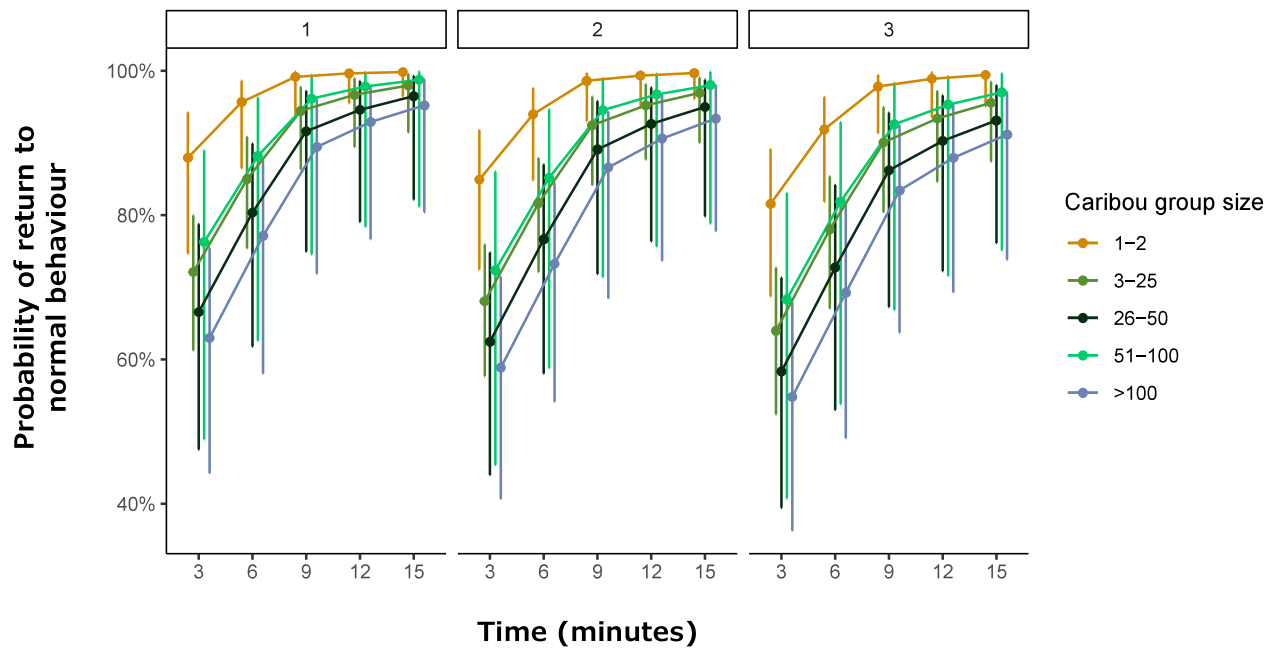
The results of the statistical analysis provided support for the key hypothesis that caribou tend to respond to disturbances, particularly when they are close to the road. However, the analysis also found that disturbances did not have a detectable effect on caribou behaviour after approximately six minutes. An interesting finding from this analysis included that behaviour was not significantly different when the road was open vs. when it was closed for the response only model, but was significantly different when walking was included as a response variable.

Cox's proportional hazards modelling using all four years of data suggests that following a single disturbance, the probability of returning to normal behaviour within 6 minutes is 94%, and 100% after 15 minutes. The probabilities for returning to normal behaviour within 6 minutes are lower for larger groups, and surveys with more disturbances – 75% for 2 to 3 intervals with a disturbance and 77% for groups with >100 individuals.

The proportion of caribou responding was linked to disturbance occurring within an interval, for both walking and response behaviours. However, caribou were significantly more likely to be walking on the upstream side of the road. The results suggest that walking behaviour should not be excluded from analyses. The inclusion of a separate model set for walking behaviour allows for the detection of trends that are not apparent with the alert/running behaviour models.

These results should be treated with caution due to the high number of variables and the variability in the behaviours observed. Nevertheless, it should be noted that the results from this analysis are highly similar to results from previous years, suggesting that the effects are stable year to year. These results are also consistent with other surveys recorded on barren-ground caribou during the post-calving and early summer periods, which suggest that caribou behavioural responses to all-season haul roads tend to taper off beyond approximately 500 m (Curatolo et al. 1987; Johnson and Lawhead 1989; Dyer et al. 2001). However, zone of influence estimates are highly variable in the literature and this method of data collection is not designed to estimate it, particularly given the observability bias noted in Section 6.3-1. In addition, responses to roads and infrastructure have previously been linked to increased harvest from roadways (Plante et al. 2018; Russell and Gunn 2019), a factor which was not included in this analysis.

FIGURE 6.4-3 CUMULATIVE PROBABILITY OF RETURN TO NORMAL BEHAVIOUR BY GROUP SIZE AND NUMBER OF DISTURBANCES



7. SUMMARY

The behaviour monitoring data from 2023 were combined with data from 2020 to 2022, to determine if caribou activity budgets change with distance from the Mine, and to document caribou response to stressors. All results outlined in this report use all four years, unless otherwise stated. The program and combined data resulted in several key findings:

- The standard monitoring protocols adapted from the GNWT ENR worked well at the Mine site.
- 70 surveys were conducted in 2023, compared to 104 surveys were conducted in 2022, 134 in 2021 and 116 in 2020; 38 surveys occurred during spring migration from March to May; 1 occurred during calving and summer from June to August; and 31 occurred during fall migration from September to December.
- Caribou mostly exhibited the non-response behaviours of standing, laying, feeding, and walking.
- Observations were well distributed across a range of caribou group sizes from 1 to 2 individuals to >1,000.
- Larger groups of caribou tended to be recorded further from the road. Seven groups larger than 100 individuals were recorded within 100 m of the road at the start of the survey.
- Caribou group size was linked to increased response behaviour or walking behaviour for groups of 1-2 caribou.
- Approximately 50% of the surveys from 2020 to 2023 included a disturbance event; typically haul traffic and light trucks from the Mine, and occasionally ATVs from Baker Lake on the AWAR for travel and harvesting.
- Following a disturbance event, the proportion of response behaviours in a group of caribou was significantly higher, but generally returned to baseline behaviours within two sampling intervals (i.e., six minutes).
- Cox's proportional hazards modelling suggests that following a single disturbance, 94% of groups will return to normal behaviour after approximately 6 minutes, and 100% of groups will return to baseline behaviour after approximately 15 minutes.
- In response to comments from the KivIA, the behaviour of "walking" was investigated for whether it may be an "alert" behaviour instead of a non-response behaviour. Disturbances did statistically effect the proportion of caribou walking.
- During periods when large groups of caribou are present, the AWAR and Haul Roads are closed to non-essential Mine traffic following a decision tree in the Meadowbank Mine TEMP, reducing the potential to record interactions between vehicles and caribou. Road closure status did not affect response behaviour in the statistical analysis, though the road being open was significantly positively correlated with walking behaviour.
- Groups of caribou were observed on both the east and west sides of the road in all seasons, but were more commonly observed on the west side during spring migration and the east side during fall migration (a.k.a. upstream of the dominant direction of travel). Statistical analysis found that side of road and season did not affect response behaviour (alert/running), but that caribou were significantly more likely to be walking on the upstream side of the road. The dominant behaviour on the downstream side was feeding or laying down.

Based on commitments in the TEMP, the overall objective of the caribou behaviour monitoring program was to determine if caribou activity budgets changed with distance from the Mine, and to document caribou response to stressors. The primary hypothesis of this study was that caribou closer to the road would demonstrate a stronger response to vehicle disturbances. Overall, the results of the statistical analysis provided support for this hypothesis, as caribou tended to respond to disturbances, particularly when close to the road. However, the analysis also found that response to disturbance typically returned to baseline levels within approximately six minutes post-disturbance (for one disturbance), suggesting that caribou behaviour returns to baseline relatively quickly following a disturbance. The updates applied to the survey protocol in previous years were helpful in improving the overall quality of the data, and precision of the analyses. Interestingly, even with these changes, the trends in the results were highly consistent between the four years of data. This increases the confidence that trends are repeatable year to year.

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APPENDIX A DETAILED METHODS FOR CARIBOU BEHAVIOUR SURVEYS