

**APPENDIX A**

**2017 Viewshed Analysis  
(submitted with v7 of the TEMP)**



## MEMORANDUM

**TO** Ryan Vanengen, Agnico Eagle Mines Ltd.

**DATE** July 14, 2017

**CC** Dionne Filiatrault, Jen Range, Damian Panayi

**FROM** Corey De La Mare, P.Biol.

**PROJECT No.** Doc 110-1658927.3200\_Rev1

### WHALE TAIL VIEWSHED ANALYSIS

#### Introduction

During the development and revisions of the Terrestrial Ecosystem Management Plan (TEMP) for the Whale Tail Project (the Project), which is an expansion of the existing Meadowbank Mine, several discussions revolved around caribou detection within and around the mine site, along the All Weather Access Road (AWAR) and the associated triggering mitigation actions. It became apparent that although caribou are regularly observed from roadside surveys along the existing Meadowbank AWAR, the sightability limit (i.e., maximum distance at which caribou could be observed based on topography) is largely unknown. This sightability distance is required to understand how much time Agnico Eagle Mines Limited (Agnico Eagle) may have to respond to caribou encountering the Project based on receiving GPS collar data and the lag time between receiving that data and caribou approaching the Project. The notion is that a greater distance of visible detection will allow for better caribou mitigation preparedness by Agnico Eagle.

The proposed Whale Tail Haul Road is a 65 km all weather haul road between the existing Meadowbank Operations (i.e., Vault Pit) and Whale Tail Pit. As part of the caribou monitoring component for this haul road, five height of land (HOL) survey locations are proposed in areas where caribou have been observed based on collar data, presence of caribou trails, caribou sign, and where topographic relief is greatest. The main methods for collecting caribou observation data are through roadside surveys along the existing Meadowbank AWAR and the proposed Whale Tail Haul Road, and at the five HOL survey locations.

To determine the extent of visibility from these locations, a viewshed analysis was completed within a GIS platform. The results of this memo are intended to validate the distance of visible detection using road surveys and HOLs will provide adequate caribou mitigation preparedness by Agnico Eagle.

#### Methods

The viewshed analysis shows the area where there is a line of sight based evaluation from elevations within the landscape, the observer height and the height of the target, in this case caribou. Visual aids, such as binoculars and spotting scopes, aid the observer to see at the extreme ends of the lines of sight so that caribou can be detected but the line of sight is not changed based on visual aids. The following assumptions were included in this viewshed analysis:

- An observer height of 2.0 m was added to each of the HOL locations, it is recognized that observers may not actually be 2.0 m but this is a standard observer measurement for viewshed analysis.
- A surface offset to simulate the height of caribou was added at 1.5 m.
- The observer height is set as: 2 m for the points and 1 m (default value) for the road; however, for the Whale Tail Haul Road the proposed road elevations based on the CAD profile was used.



## MEMORANDUM

The viewshed was required for the Regional Study Area; however, the availability of datasets was not consistent for the entire Regional Study Area in terms of data format and data resolution. Consequently, the datasets used and methods for harmonization are as follows:

- Road centerlines: Whale Tail Haul Road centerline and elevations (profile) provided by CAD, all weather road centerline generated semi-automatically using its footprint and linking its northern extremity to the Whale Tail Haul Road.
- 2016 HOL survey locations are only general and may have a high error range in their location precision, more specific coordinates will be acquired in 2017.
- Digital Elevation Model (DEM) for the haul road and the HOL survey points used a high resolution DEM (1 m). The DEM was down-sampled to 3 m resolution and merged with CDEM that has a 20 m resolution and then re-sampled back to 3 m resolution, but this is only to keep the 3 m precision where it exists and it does not make the CDEM more precise. Using a merging process avoiding edge effects and creates a smooth transition from one DEM source to the other.
- The high resolution DEM only covers the haul road (approximately 500 m on each side) and a large portion of the Whale Tail Pit and development area.
- For the AWAR, no high resolution DEM coverage exists, consequently we only used the CDEM (20 m resolution) for this.

The viewshed analysis was run on an ESRI ArcGIS 10.4.1 platform using the 3D analyst tool – Viewshed. The visibility analysis does not take into account any potential vegetation or any other obstructions (natural/human) that are not part of the bare ground. A viewshed was developed for the existing Meadowbank AWAR, the proposed Whale Tail Haul Road, and the five HOL survey locations.

### Results

The results of the viewshed analysis can be found in Figures 1 to 3, which each show the viewshed from the five HOL survey locations (Figure 1), the proposed Whale Tail Haul Road (Figure 2), and the existing Meadowbank AWAR (Figure 3). All three figures illustrate that with the naked eye, the sightlines from all three sources (HOL, Whale Tail Haul Road, AWAR) range from less than 1 km to greater than 8 km with a range of 3 to 5 km in several different directions from each location. When HOL locations are combined with the Whale Tail Haul Road as a point of observation, the visibility in general for all locations is around 5 km, with several vantage points of greater than 5 km.

A summary of field confirmation details regarding the viewscape analysis at HOL locations includes the following (M. Young, Dougan Associates, 2017, pers. comm.):



## MEMORANDUM

HOL Survey Point	Average Maximum Observable Distance	Comments
1	9.2 km	This site was slightly relocated to improve the visibility of the road. Small blind spots (50 to 100 m wide) facing S and NW
2	7.2 km	Small blind spots facing S, SW, and W
3	9.1 km	Small blind spots facing S, SE, NW, and E
4	8.9 km	Lars Qaqqaq identified this location as a movement corridor for Barren Ground Caribou Small blind spots facing SE, W
5	5.5 km	Road at this section is not currently built. Small blind spots facing SW, NW, NE. SW, and NE blinds spots to be opened up when eskers removed for road construction.

The viewshed analysis is an important component of the overall monitoring program as it provides direction for monitoring locations that best capture caribou movements through the Project area during the spring and fall migration periods. Consequently, the survey locations chosen based on the results of the viewshed analysis will be continually reviewed and updated with the Terrestrial Advisory Group. Additional tasks remaining prior to construction of the Whale Tail Pit and Haul Road include the following:

- Field crews are identifying ideal HOL survey locations and maximum line of sight distances during the summer of 2017, some of this information is incorporated in the table above and some will be compiled into this document at the end of the field season.
- Additional HOL survey location to be added on the west side of the Whale Tail Pit to capture areas not currently covered by survey locations as revealed in the viewshed analysis.
- Selected points along the road may fill in monitoring gaps in the viewshed, these sites have not yet been selected.
- Determine the amount of the landscape covered by height of land survey locations and roadside surveys within an area that buffers the height of land locations by 4 km and the road by 1.5 km to determine if there is sufficient monitoring coverage from the existing surveys.





## MEMORANDUM

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### Closure

We trust this meets your needs, if you have any questions or concerns, feel free to contact the undersigned.

Regards,

**GOLDER ASSOCIATES LTD.**



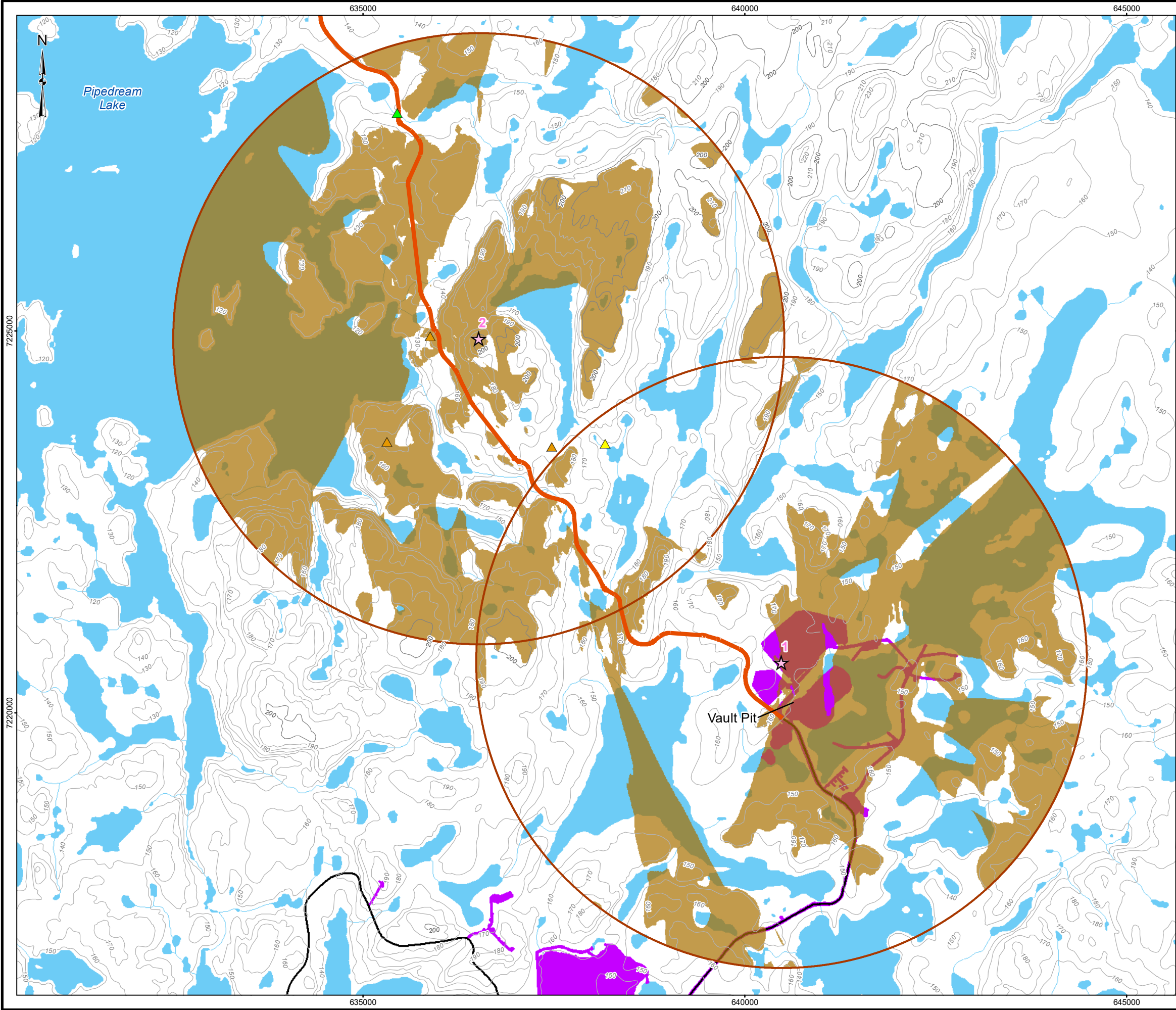
Corey De La Mare, P.Biol.  
Principal, Senior Wildlife Ecologist

### Citation

Young, M.Y. 2017. Landscape Architect, Ecologist. Dougan & Associates – Ecological Consulting & Design, Guelph, ON. E-mail with R. Vanengen (Agnico Eagle). July 2017.

[https://capws.golder.com/sites/1658927RegulatoryAffairs/p3100\\_TEMP\\_and\\_Workshops/TEMP/02\\_Appendices/Appendix H\\_Viewshed/Appendix H\\_Viewshed\\_Analysis\\_June5.docx](https://capws.golder.com/sites/1658927RegulatoryAffairs/p3100_TEMP_and_Workshops/TEMP/02_Appendices/Appendix H_Viewshed/Appendix H_Viewshed_Analysis_June5.docx)

Y:\burnaby\CAD-GIS\Client\Agnico\_Eagle\_Mines\_Ltd\Whale\_Tail\99\_PROJECTS\1658927\_RegulatorySupport\02\_PRODUCTION\3100MXD\Report\1658927\_FIG\_1\_Viewshed\_land\_survey\_points\_20181214.mxd



**LEGEND**

- ★ 2016 HEIGHT OF LAND SURVEY POINT (D&A, JULY 2016)
- BARREN-GROUND CARIBOU<sup>2</sup>**
  - ▲ SIGN
  - ▲ OBSERVATION
  - ▲ CARIBOU TRAIL
- PROJECT DATA AND INFRASTRUCTURE**
  - HAUL ROAD
  - ALL WEATHER ROAD
  - WHALE TAIL PIT
  - MEADOWBANK OPERATION AND INFRASTRUCTURE
  - VISIBILITY ANALYSIS AREA (4 km)
  - AREA VISIBLE FROM PROPOSED HAUL ROAD
- BASE DATA**
  - 10 m CONTOUR
  - 100 m CONTOUR
  - WATERCOURSE
  - WATERBODY

**INDEX MAP**

**KEY MAP**

**REFERENCE**

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg
2. 2015/16 BARREN-GROUND CARIBOU OBSERVATIONS FROM THE GROUND RECONNAISSANCE SURVEYS, WATERBIRD NEST SURVEYS, BREEDING BIRD ROAD TRANSECT SURVEYS & HEIGHT-OF-LAND SURVEYS.
3. CONTOURS, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
4. KEY MAP DATA OBTAINED FROM ESRI.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

1.5 0 1.5  
KILOMETRES

**PROJECT**

**AGNICO EAGLE**

**AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION  
WHALE TAIL PIT PROJECT**

**TITLE**  
**VIEWSHED FROM HAUL ROAD**

PROJECT	1658927	FILE No.
DESIGN	CDM	3 May 2017
GIS	SB	12 May 2017
CHECK	JR	14 Jul. 2017
REVIEW	CDM	14 Jul. 2017

**FIGURE 1A**

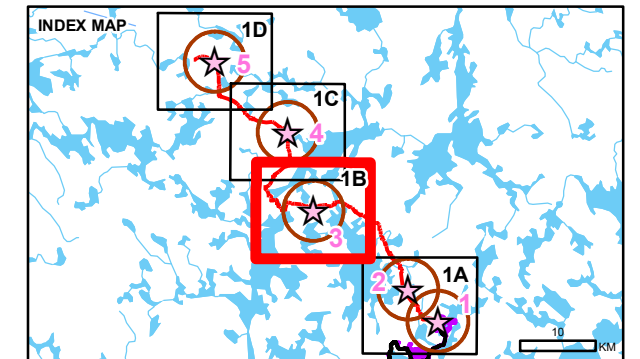


Y:\burnaby\CAD-GIS\Client\Agnico\_Eagle\_Mines\_Ltd\Whale\_Tail\99\_PROJECTS\1658927\_RegulatorySupport\02\_PRODUCTION\3100MXD\Report\1658927\_FIG\_1\_Viewshed\_land\_survey\_points\_20181214.mxd



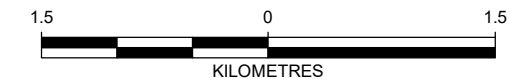
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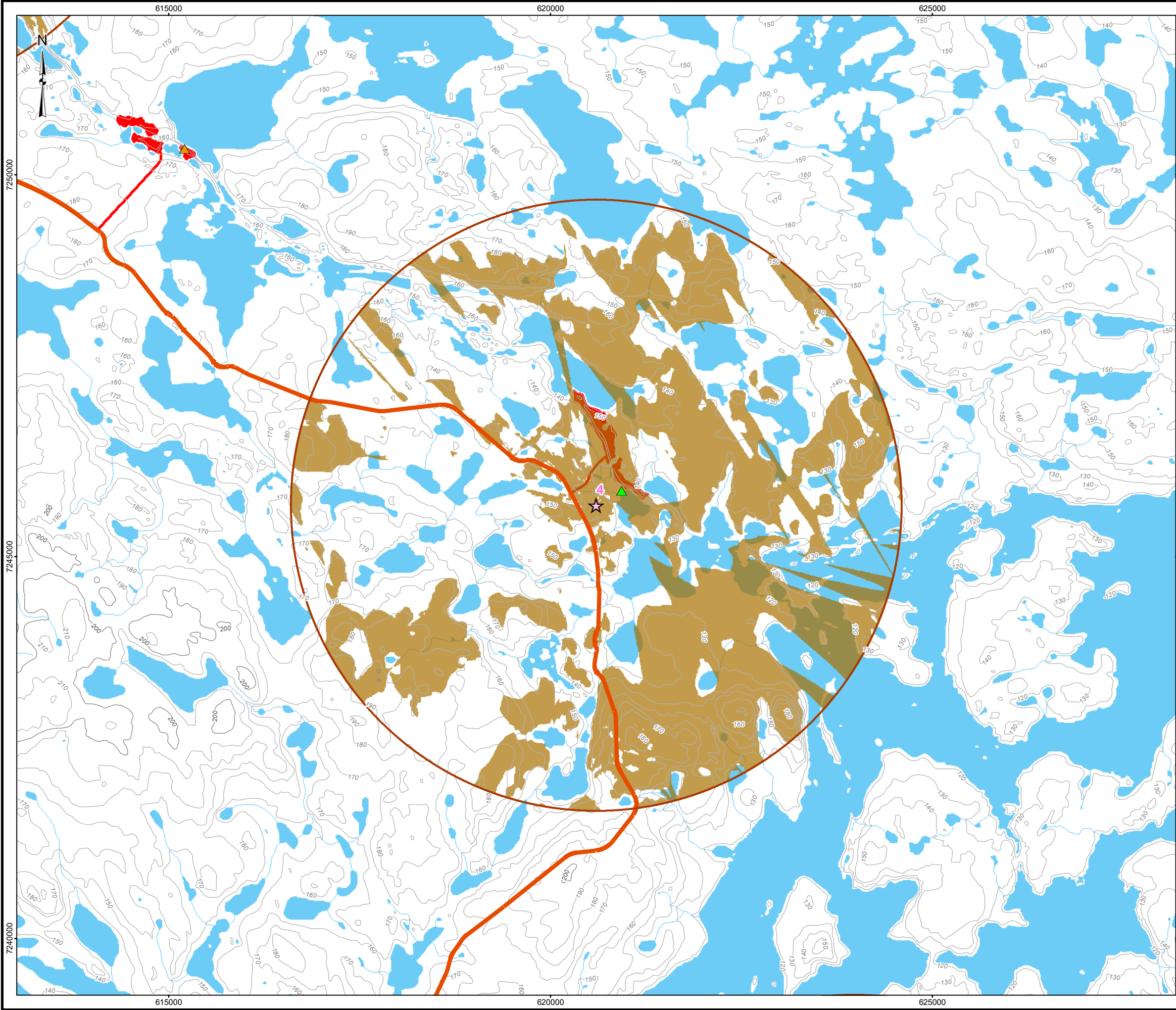
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<b>PROJECT</b>		<b>AGNICO EAGLE</b>		<b>AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION WHALE TAIL PIT PROJECT</b>	
<b>TITLE</b>		<b>VIEWSHED FROM HAUL ROAD</b>			
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	GIS	SB	12 May 2017		
	CHECK	JR	14 Jul. 2017		
	REVIEW	CDM	14 Jul. 2017	<b>FIGURE 1B</b>	



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PROJECT  
AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION  
WHALE TAIL PIT PROJECT

**Golder Associates**

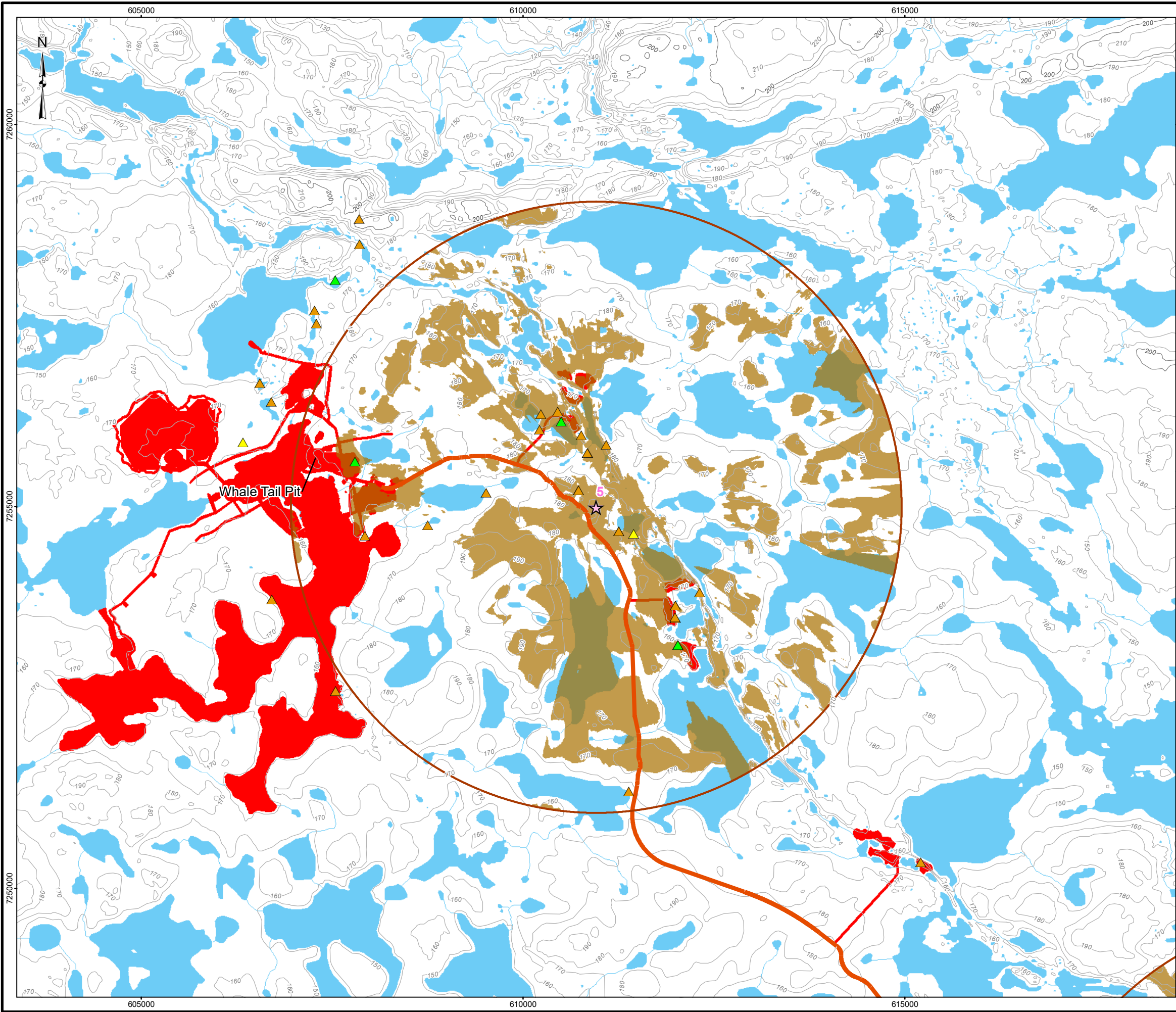
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REVIEW	CDM	14 Jul. 2017	

**FIGURE 1C**

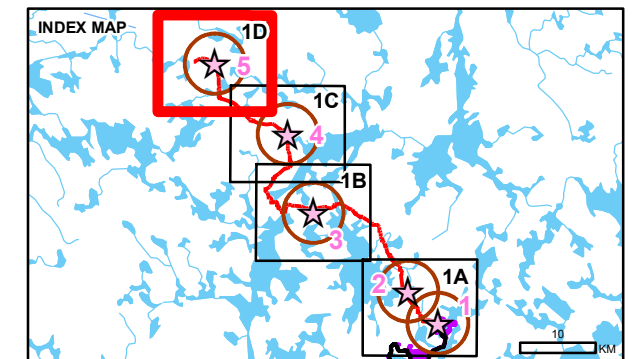


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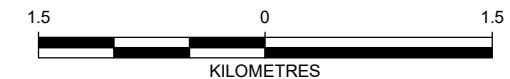
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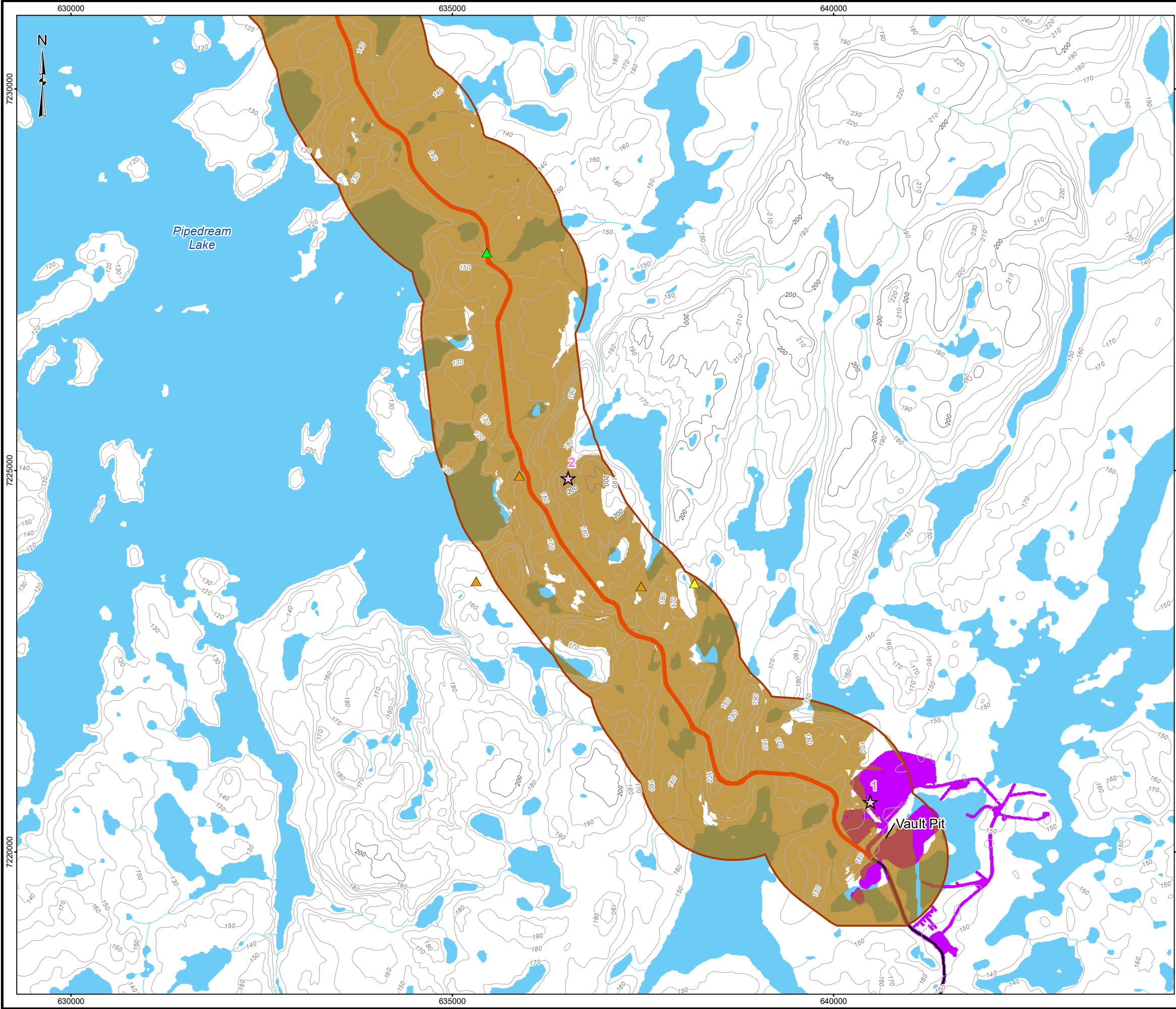


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TITLE						
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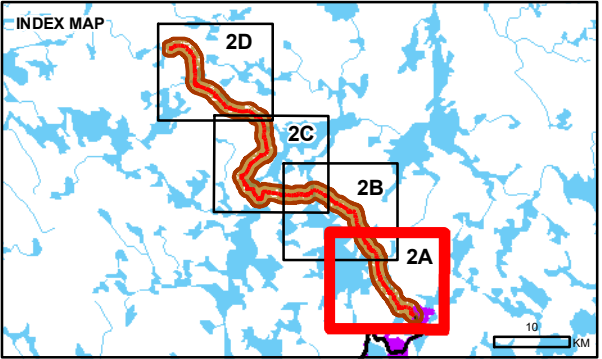


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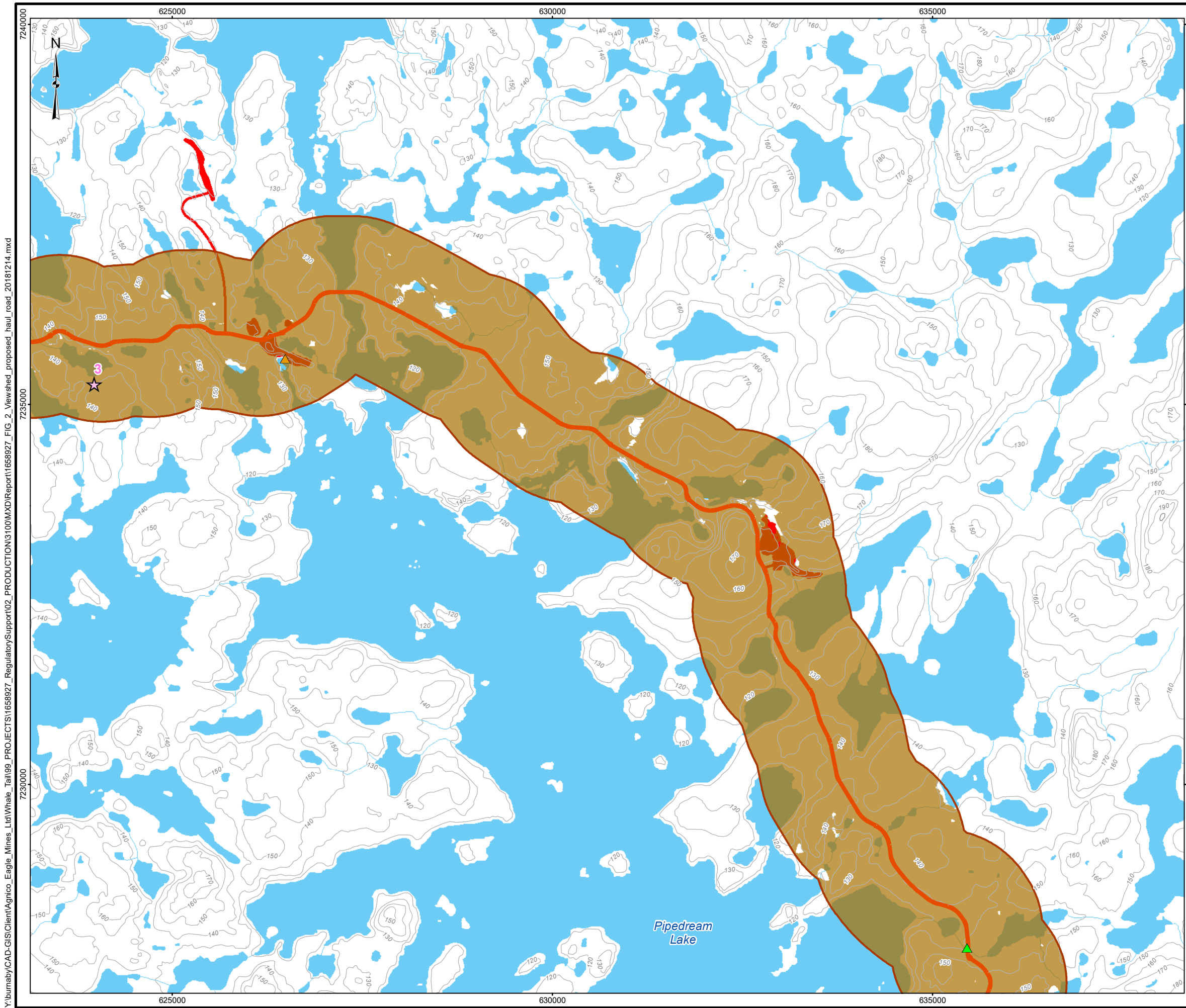
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	DESIGN	CDM	3 May 2017	SCALE AS SHOWN
	GIS	SB	12 May 2017	REV. 0
	CHECK	JR	14 Jul. 2017	
	REVIEW	CDM	14 Jul. 2017	
FIGURE 2A				





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KILOMETRES

**AGNICO EAGLE**

PROJECT

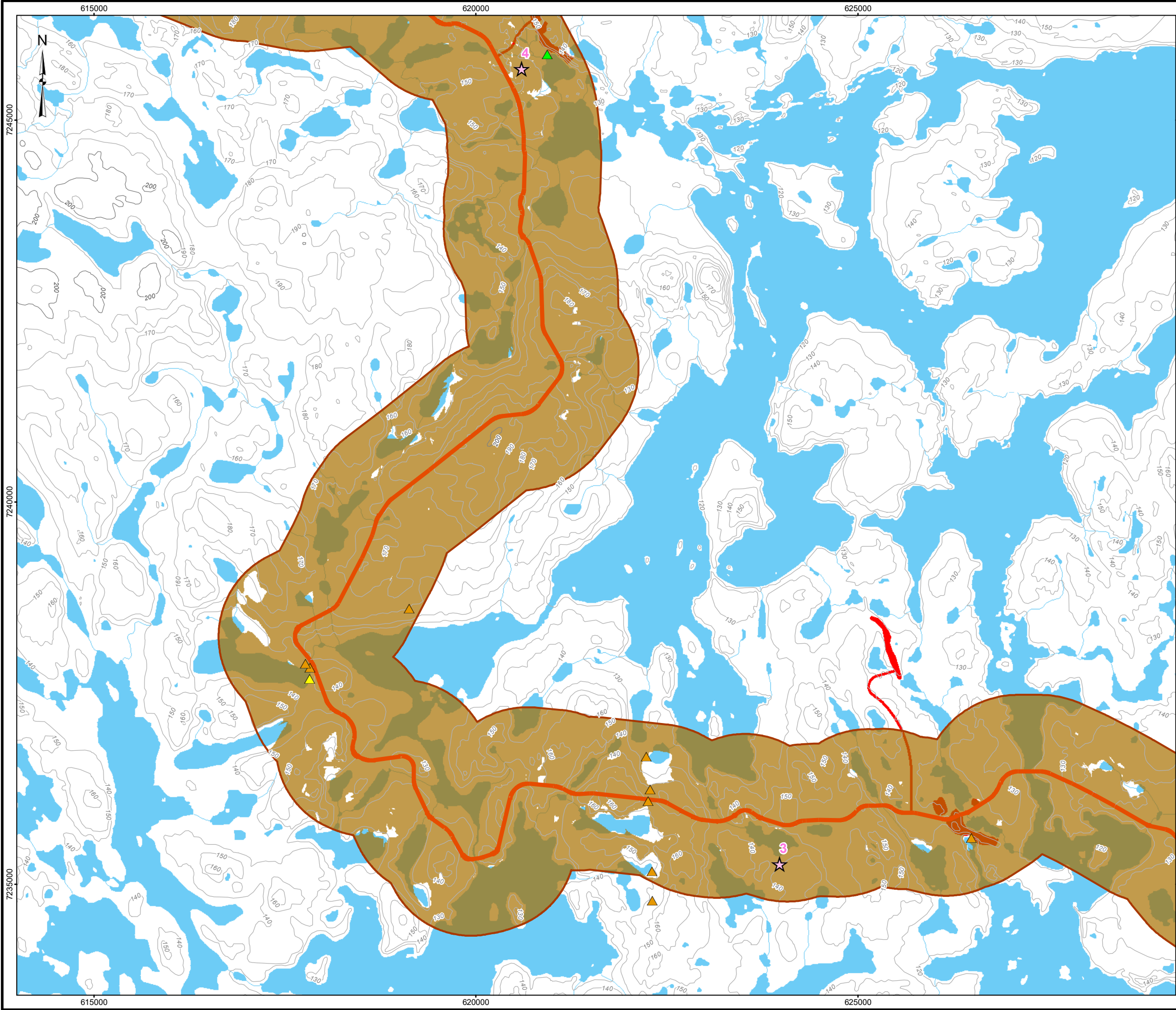
AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION  
WHALE TAIL PIT PROJECT

**Golder Associates**

PROJECT	1658927		FILE No.
DESIGN	CDM	3 May 2017	SCALE AS SHOWN
GIS	SB	12 May 2017	REV. 0
CHECK	JR	14 Jul. 2017	<b>FIGURE 2B</b>
REVIEW	CDM	14 Jul. 2017	



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**LEGEND**

- ☆ 2016 HEIGHT OF LAND SURVEY POINT (D&A, JULY 2016)
- ▲ SIGN
- ▲ OBSERVATION
- ▲ CARIBOU TRAIL

**PROJECT DATA AND INFRASTRUCTURE**

- HAUL ROAD
- WHALE TAIL PIT
- VISIBILITY ANALYSIS AREA (1 km)
- AREA VISIBLE FROM PROPOSED HAUL ROAD

**BASE DATA**

- 10 m CONTOUR
- 100 m CONTOUR
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**PROJECT**

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**AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION  
WHALE TAIL PIT PROJECT**

**TITLE**  
**VIEWSHED FROM HAUL ROAD**

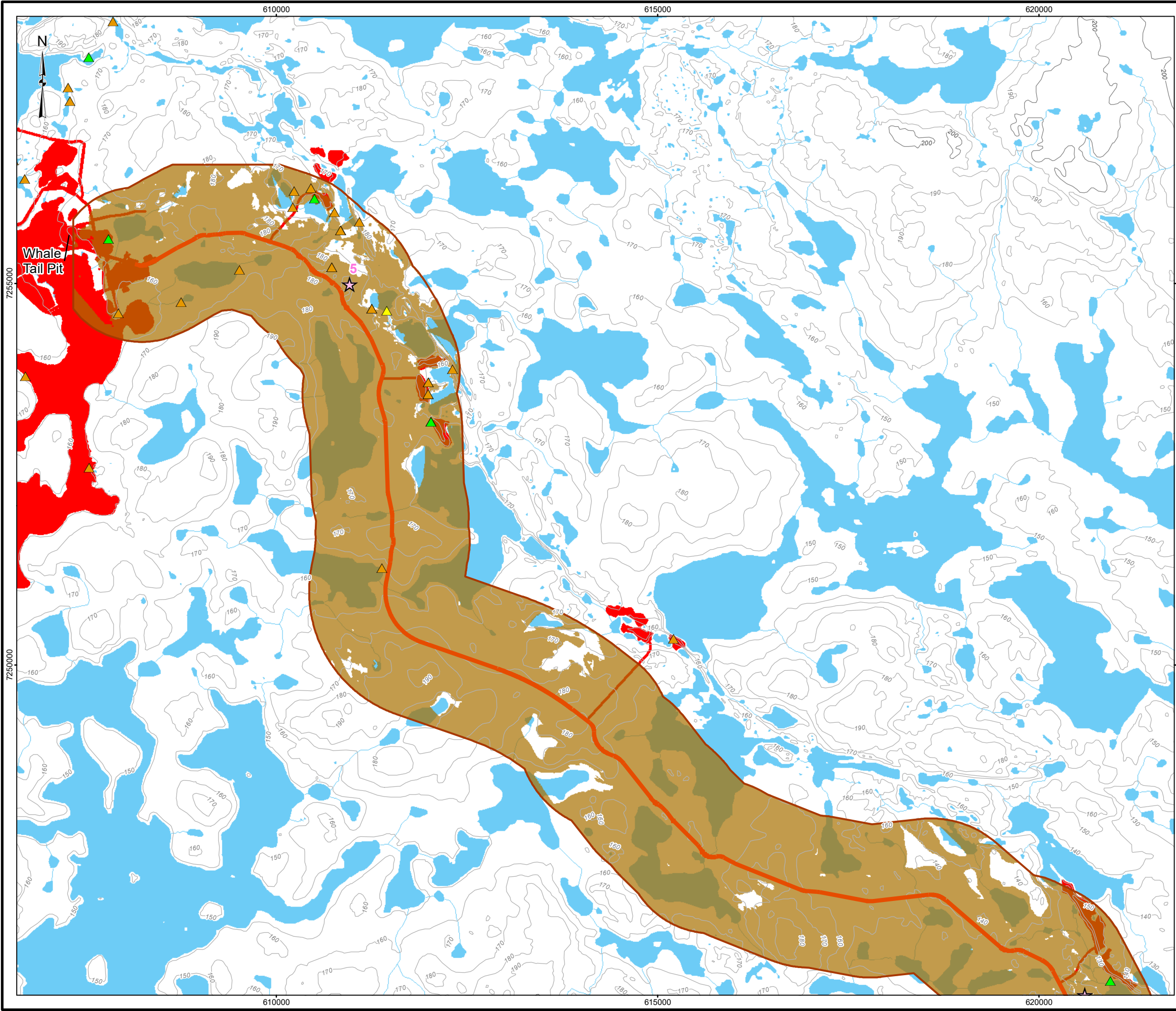
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DESIGN	CDM	3 May 2017
GIS	SB	12 May 2017
CHECK	JR	14 Jul. 2017
REVIEW	CDM	14 Jul. 2017

SCALE AS SHOWN	REV.	0
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**FIGURE 2C**



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  - ▲ CARIBOU TRAIL
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1.5 0 1.5  
KILOMETRES

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**AGNICO EAGLE**

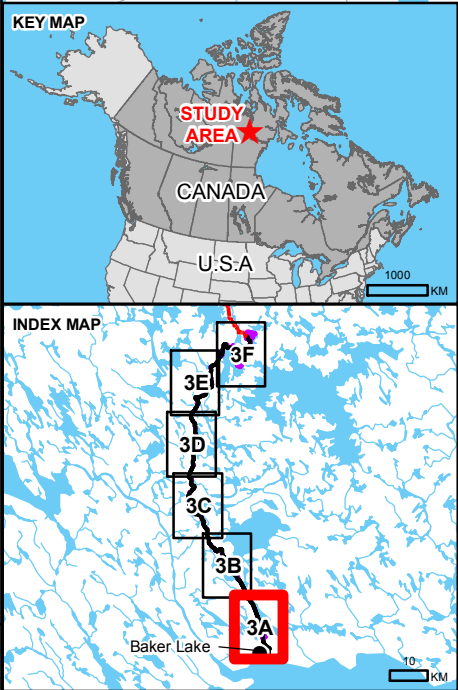
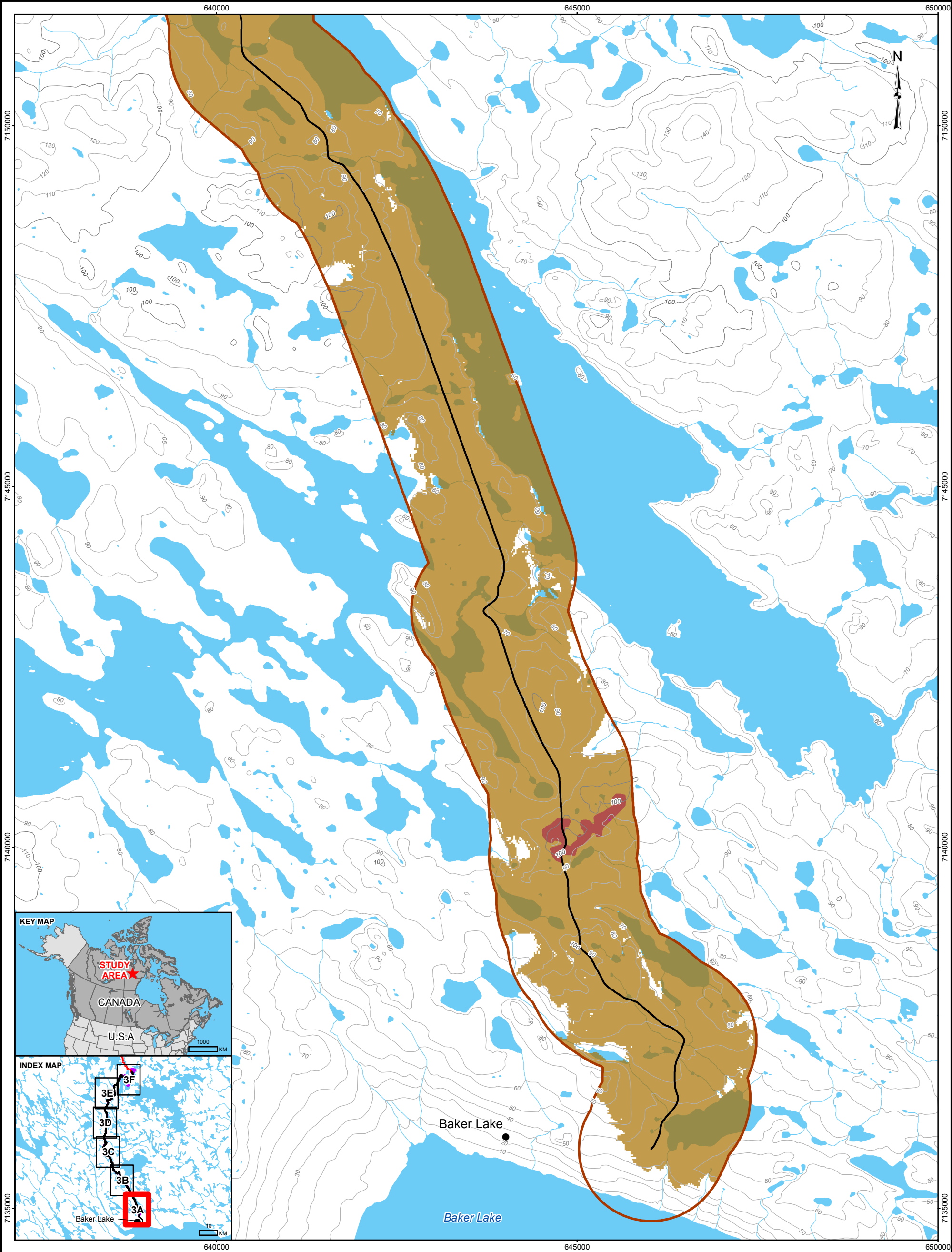
**AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION  
WHALE TAIL PIT PROJECT**

**TITLE**

**VIEWSHED FROM HAUL ROAD**

PROJECT	1658927	FILE No.
DESIGN	CDM	3 May 2017
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**FIGURE 2D**



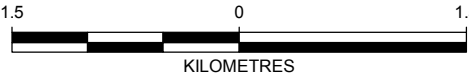
LEGEND

PROJECT DATA AND INFRASTRUCTURE

- ALL WEATHER ROAD
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ALL WEATHER ROAD

BASE DATA

- 10 m CONTOUR
- 100 m CONTOUR
- WATERCOURSE
- WATERBODY

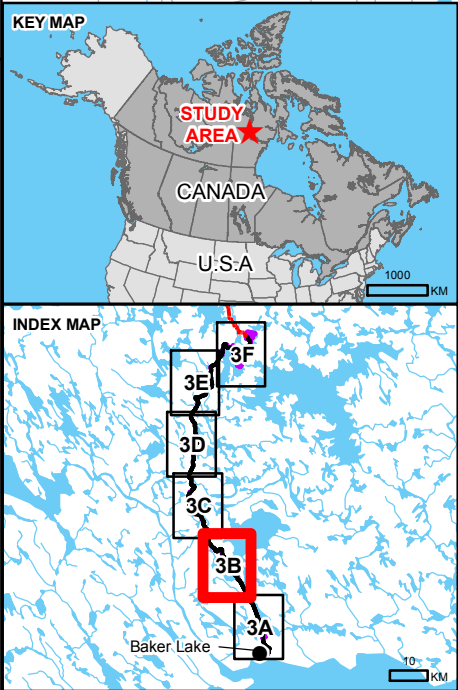
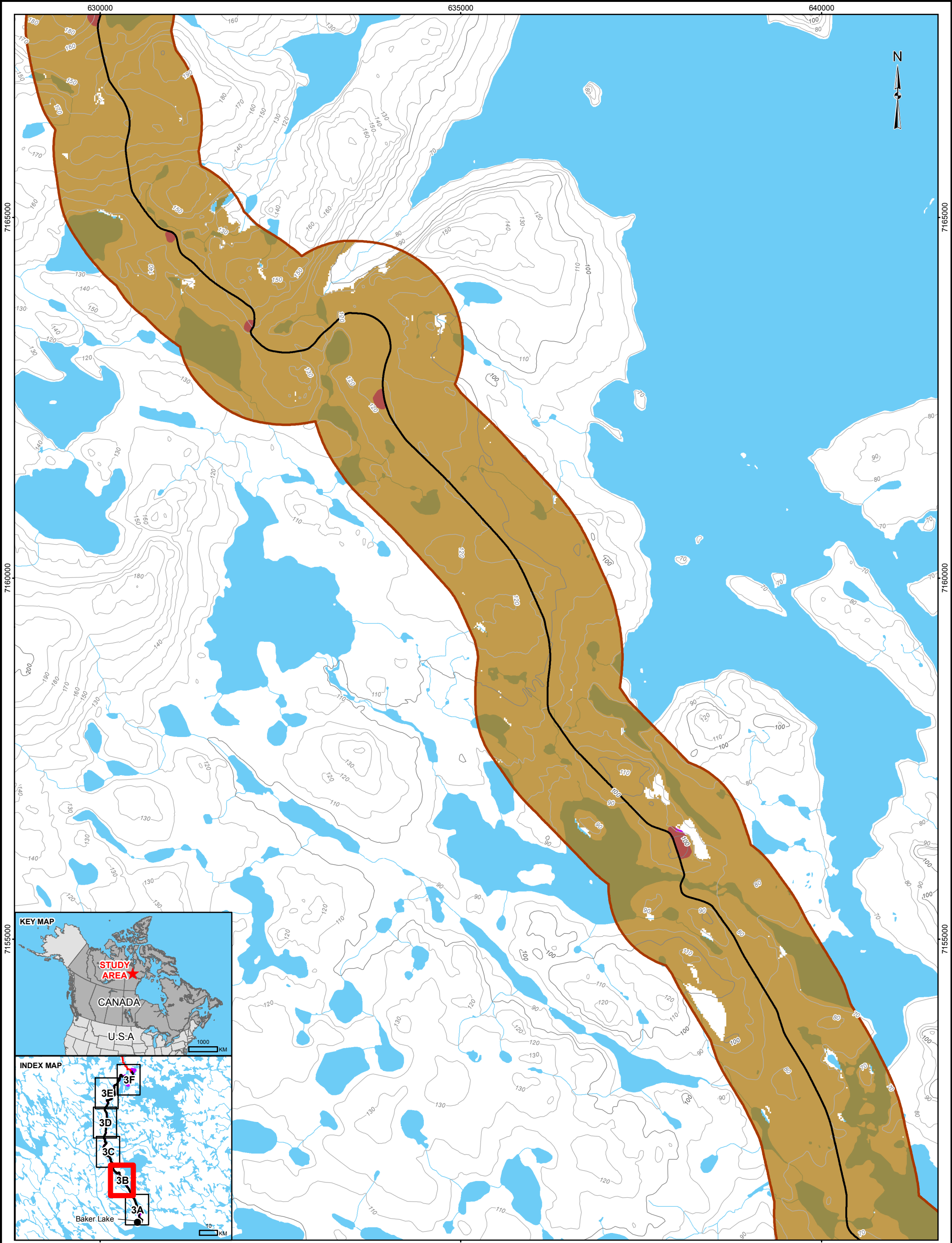


REFERENCE

- HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg
  - 2015/16 BARREN-GROUND CARIBOU OBSERVATIONS FROM THE GROUND RECONNAISSANCE SURVEYS, WATERBIRD NEST SURVEYS, BREEDING BIRD ROAD TRANSECT SURVEYS & HEIGHT-OF-LAND SURVEYS.
  - CONTOUR, WATERCOURSE AND WATERBODY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
  - INSET MAP DATA OBTAINED FROM ESRI.
- DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

PROJECT		AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION WHALE TAIL PIT PROJECT			
TITLE		VIEWSHED FROM ALL WEATHER ROAD			
	PROJECT	1658927		FILE No.	
	DESIGN	CDM	3 May 2017	SCALE AS SHOWN	REV. 0
	GIS	SB	12 May 2017		
	CHECK	JR	14 Jul. 2017		
	REVIEW	CDM	14 Jul. 2017	FIGURE 3A	





LEGEND

PROJECT DATA AND INFRASTRUCTURE

- ALL WEATHER ROAD
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ALL WEATHER ROAD

BASE DATA


- 10 m CONTOUR
- 100 m CONTOUR
- WATERCOURSE
- WATERBODY

REFERENCE

- HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg
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  - INSET MAP DATA OBTAINED FROM ESRI.
- DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14



PROJECT




AGNICO EAGLE

AGNICO EAGLE MINES LIMITED:  
MEADOWBANK DIVISION  
WHALE TAIL PIT PROJECT

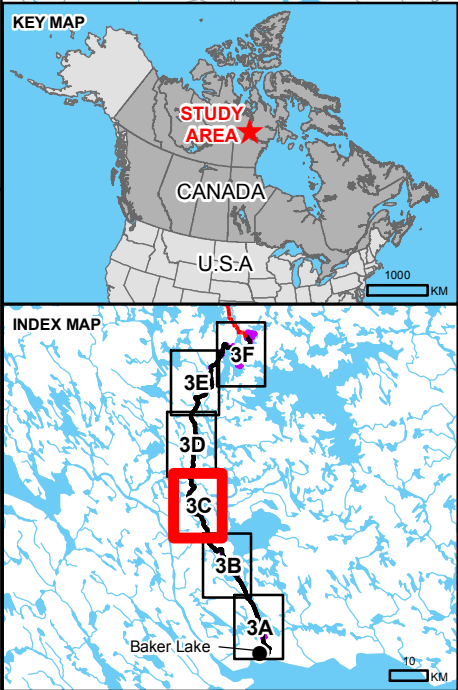
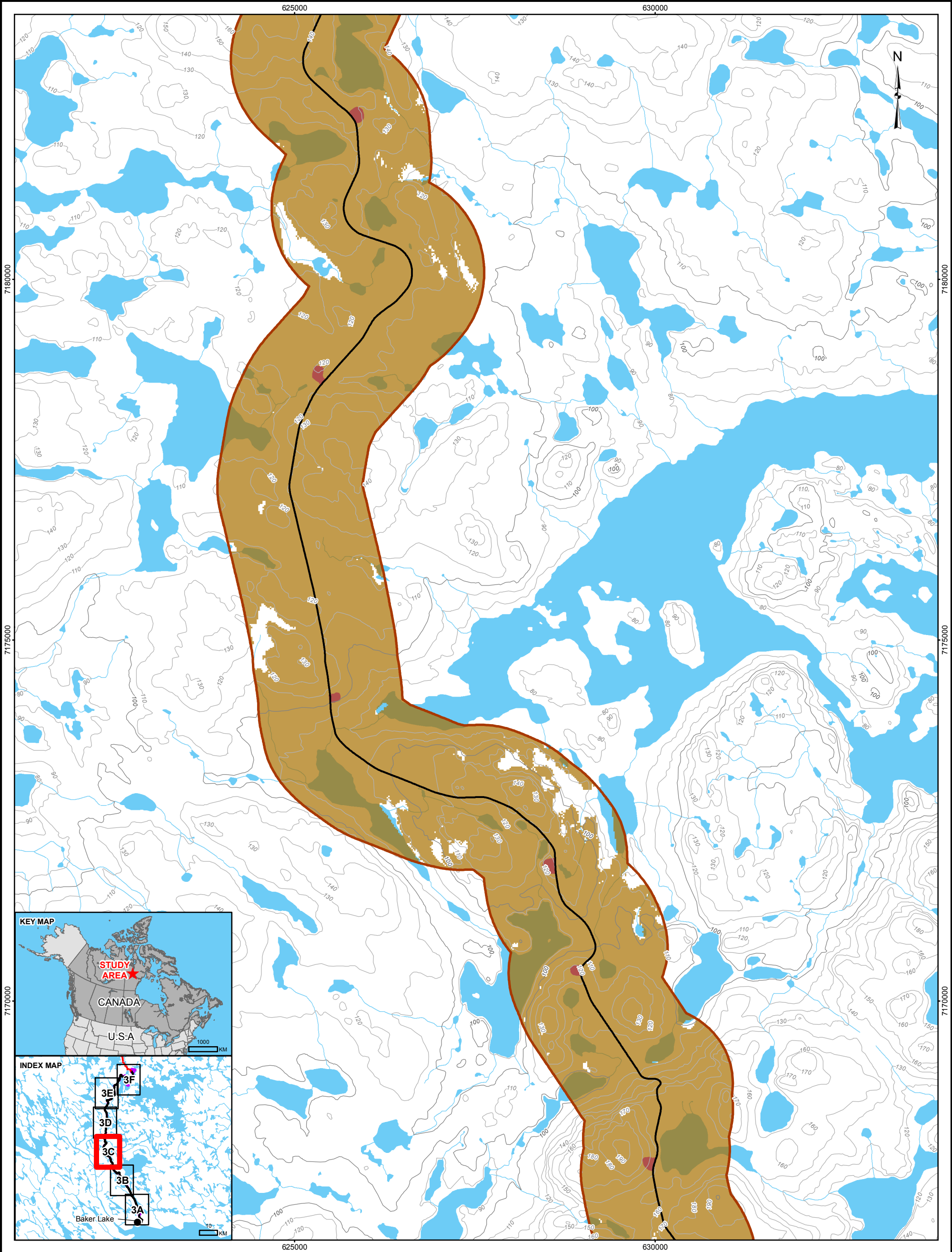
TITLE

VIEWSHED FROM ALL WEATHER ROAD



Golder Associates

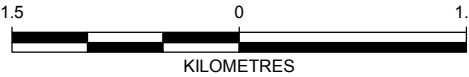
PROJECT			1658927		FILE No.	
DESIGN	CDM	3 May 2017		SCALE AS SHOWN	REV.	0
GIS	SB	12 May 2017		FIGURE 3B		
CHECK	JR	14 Jul. 2017				
REVIEW	CDM	14 Jul. 2017				




LEGEND	
PROJECT DATA AND INFRASTRUCTURE	
	ALL WEATHER ROAD
	MEADOWBANK OPERATION AND INFRASTRUCTURE
	VISIBILITY ANALYSIS AREA
	AREA VISIBLE FROM ALL WEATHER ROAD
BASE DATA	
	10 m CONTOUR
	100 m CONTOUR
	WATERCOURSE
	WATERBODY

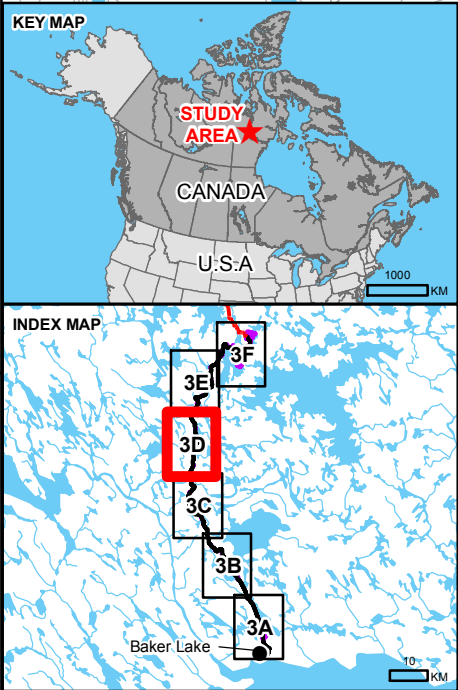
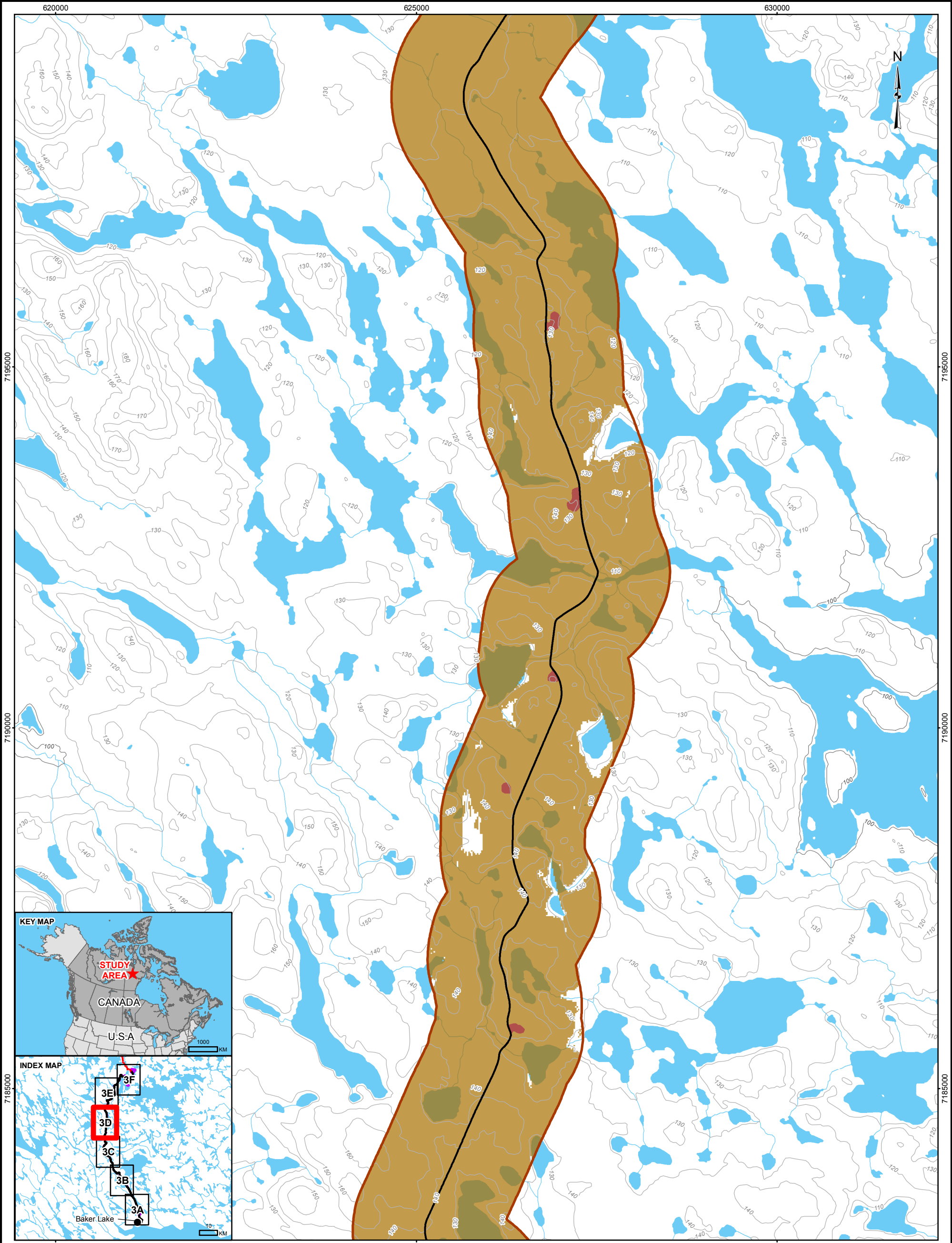
REFERENCE

- HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg
  - 2015/16 BARREN-GROUND CARIBOU OBSERVATIONS FROM THE GROUND RECONNAISSANCE SURVEYS, WATERBIRD NEST SURVEYS, BREEDING BIRD ROAD TRANSECT SURVEYS & HEIGHT-OF-LAND SURVEYS.
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  - INSET MAP DATA OBTAINED FROM ESRI.
- DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14



PROJECT		AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION WHALE TAIL PIT PROJECT				
AGNICO EAGLE						
TITLE						
VIEWSHED FROM ALL WEATHER ROAD						
 <b>Golder Associates</b>	PROJECT		1658927		FILE No.	
	DESIGN	CDM	3 May 2017		SCALE AS SHOWN	REV. 0
	GIS	SB	12 May 2017		<b>FIGURE 3C</b>	
	CHECK	JR	14 Jul. 2017			
	REVIEW	CDM	14 Jul. 2017			





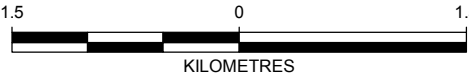
LEGEND

PROJECT DATA AND INFRASTRUCTURE

- ALL WEATHER ROAD
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ALL WEATHER ROAD



BASE DATA

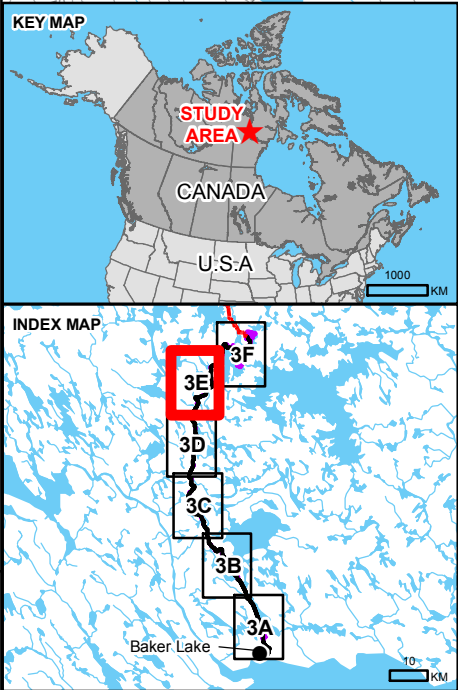
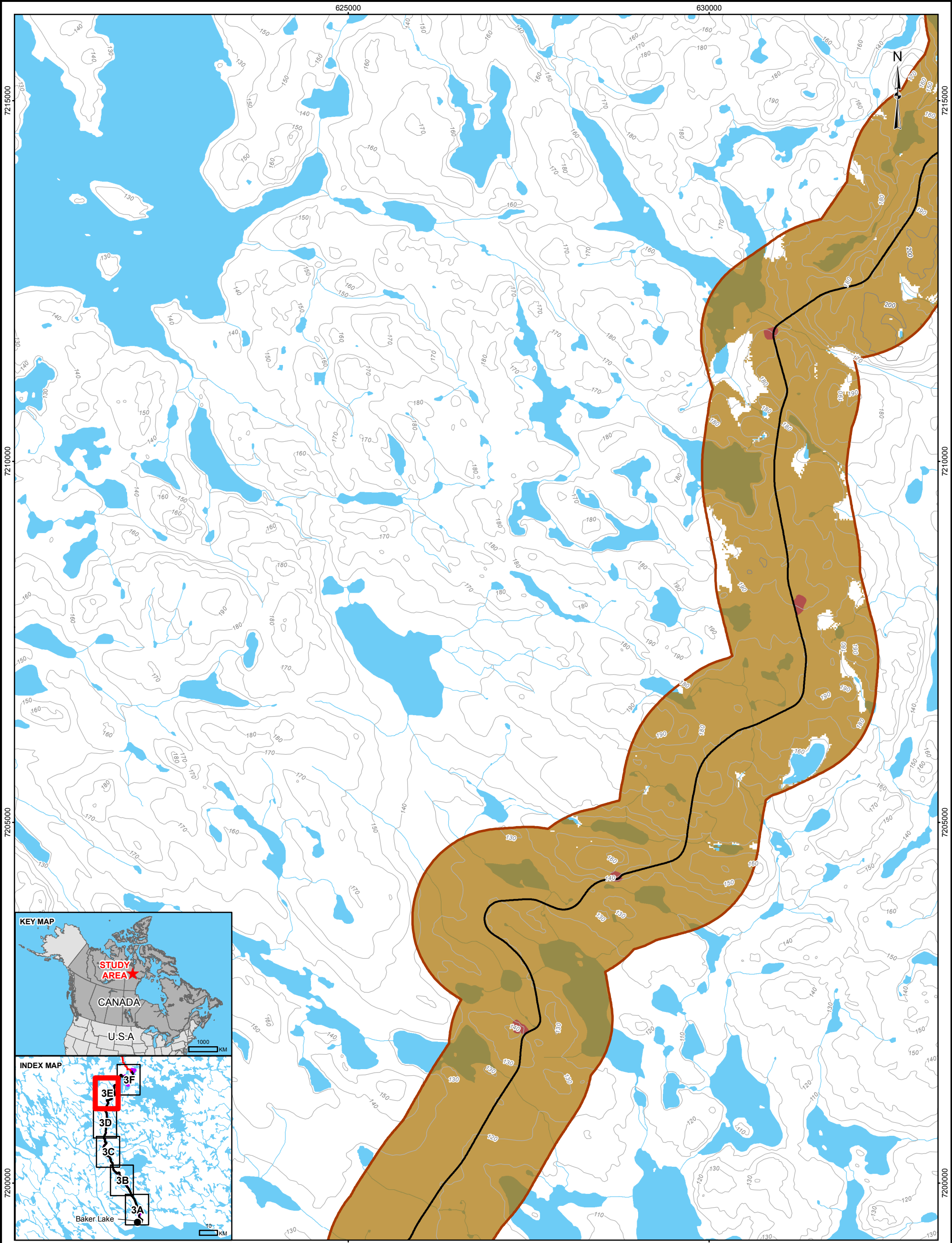
- 10 m CONTOUR
- 100 m CONTOUR
- WATERCOURSE
- WATERBODY



REFERENCE

- HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg
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  - INSET MAP DATA OBTAINED FROM ESRI.
- DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14

PROJECT		 <b>AGNICO EAGLE</b>				AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION WHALE TAIL PIT PROJECT			
TITLE									
<b>VIEWSHED FROM ALL WEATHER ROAD</b>									
		PROJECT		1658927		FILE No.			
		DESIGN	CDM	3 May 2017		SCALE AS SHOWN		REV. 0	
		GIS	SB	12 May 2017		<b>FIGURE 3D</b>			
		CHECK	JR	14 Jul. 2017					
		REVIEW	CDM	14 Jul. 2017					



LEGEND

PROJECT DATA AND INFRASTRUCTURE

- ALL WEATHER ROAD
- MEADOWBANK OPERATION AND INFRASTRUCTURE
- VISIBILITY ANALYSIS AREA
- AREA VISIBLE FROM ALL WEATHER ROAD

BASE DATA

- 10 m CONTOUR
- 100 m CONTOUR
- WATERCOURSE
- WATERBODY

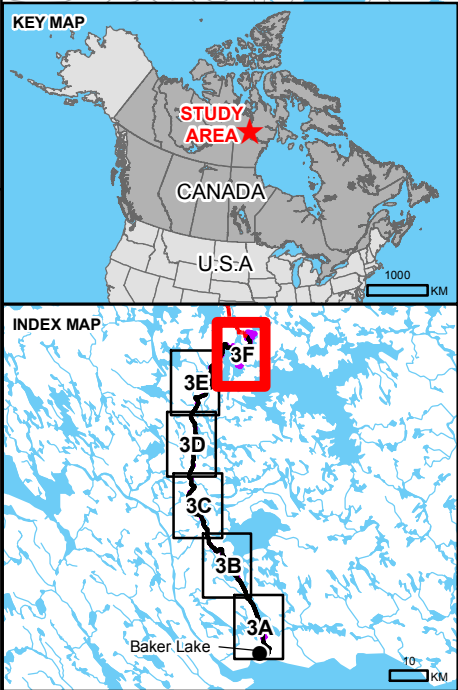
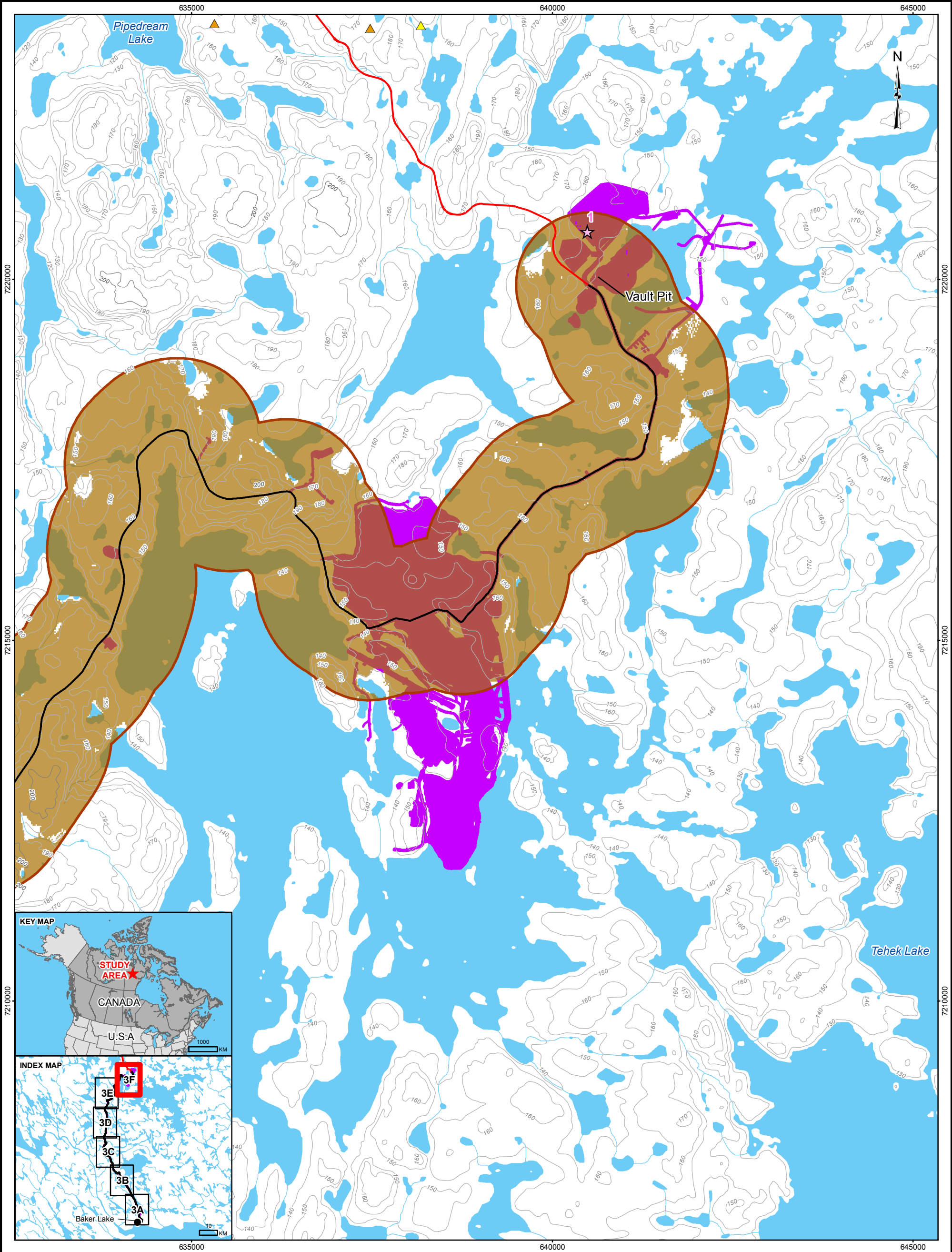
REFERENCE

- HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg
  - 2015/16 BARREN-GROUND CARIBOU OBSERVATIONS FROM THE GROUND RECONNAISSANCE SURVEYS, WATERBIRD NEST SURVEYS, BREEDING BIRD ROAD TRANSECT SURVEYS & HEIGHT-OF-LAND SURVEYS.
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- DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14



PROJECT		AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION WHALE TAIL PIT PROJECT			
TITLE		VIEWSHED FROM ALL WEATHER ROAD			
	PROJECT	1658927		FILE No.	
	DESIGN	CDM	3 May 2017	SCALE AS SHOWN	REV. 0
	GIS	SB	12 May 2017	FIGURE 3E	
	CHECK	JR	14 Jul. 2017		
REVIEW		CDM	14 Jul. 2017		





- LEGEND**

★ 2016 HEIGHT OF LAND SURVEY POINT (D&A, JULY 2016)

**BARREN-GROUND CARIBOU<sup>2</sup>**

  - ▲ SIGN
  - ▲ CARIBOU TRAIL
- PROJECT DATA AND INFRASTRUCTURE**

  - ALL WEATHER ROAD
  - PROPOSED HAUL ROAD
  - MEADOWBANK OPERATION AND INFRASTRUCTURE
  - VISIBILITY ANALYSIS AREA
  - AREA VISIBLE FROM ALL WEATHER ROAD
- BASE DATA**

  - 10 m CONTOUR
  - 100 m CONTOUR
  - WATERCOURSE
  - WATERBODY



PROJECT		AGNICO EAGLE MINES LIMITED: MEADOWBANK DIVISION WHALE TAIL PIT PROJECT			
TITLE		VIEWSHED FROM ALL WEATHER ROAD			
	PROJECT	1658927		FILE No.	
	DESIGN	CDM	3 May 2017	SCALE AS SHOWN	REV. 0
	GIS	SB	12 May 2017		
	CHECK	JR	14 Jul. 2017		
	REVIEW	CDM	14 Jul. 2017	<b>FIGURE 3F</b>	

**REFERENCE**

1. HAUL ROAD OBTAINED FROM AGNICO EAGLE MINES LIMITED. 2015-10-14 FROM 6103-117-230-200\_R0.dwg

2. 2015/16 BARREN-GROUND CARIBOU OBSERVATIONS FROM THE GROUND RECONNAISSANCE SURVEYS, WATERBIRD NEST SURVEYS, BREEDING BIRD ROAD TRANSECT SURVEYS & HEIGHT-OF-LAND SURVEYS.

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4. INSET MAP DATA OBTAINED FROM ESRI.

DATUM: NAD 83 CSRS PROJECTION: UTM ZONE 14