# Appendix 65

# Whale Tail Blasting Activities – South Whale Tail Channel Construction Memo Version 1

AGNICO EAGLE

# Memo

**To:** Fisheries and Ocean Canada (DFO)

**From:** Patrice Gagnon, Pier-Eric McDonald

**CC**: Meadowbank Environment

**Date**: September 20th 2019

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**Subject**: Blasting Activities – South Whale Tail Channel construction

## 1. Introduction

Agnico Eagle (Agnico) plans to build the South Whale Tail Channel (SWTC) that is part to the Whale Tail Dike system. The SWTC will convey water to Mammoth Lake to control the water level in Whale Tail South (WTS) at the operational level of Whale Tail Dike. One of the construction activities consists of drill & blasting (D&B) the bedrock or frozen ground portion expected from 2019 field investigation campaign. The drilling and blasting needs will be evaluated based on temperature and foundation condition however, it could be expected that poor bedrock conditions located around 280m from the Mammoth Lake shore be required. Furthermore, most of the excavation is expected to be in the till active layer, however it could be anticipated that frozen till below that active layer (typically 2m depth) be necessary to drill and blast for reaching the proper channel invert elevation. In that case D&B might reach close to either Mammoth or Whale Tail Lake. Since this activity may be close to a water body if blasting is deemed required, Agnico aims to comply with the DFO's Guidelines for Use of Explosives in or Near Canadian Fisheries Waters. In addition to the federal guidelines, condition 2.3.3 of the Fisheries Authorization 16-HCAA-00370 states: '*The Proponent shall develop a blasting mitigation plan in consultation with DFO to ensure effects on fish and fish habitat are minimized, as per Nunavut Impact Review Board Project Certificate No. 008 Condition 22. The blasting mitigation plan shall be submitted to DFO prior to construction for approval, and shall adhere to the guidance provided in the Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies, NWT 2000-2002 (Cott and Hanna, 2005)*'. The recommendations outlined in this document are objects of DFO's most recent recommendations on blast practices close to waterbodies.

This memo presents the proposed monitoring and mitigation measures required for Dike construction works that Agnico has developed to respect the above mentioned guidelines. Those requirements and their underlying mitigations proposed by Agnico are being referred to as a “Blasting Mitigation Plan” which consist of both section 4 and 5 of this present document. This memo will be communicated to all personal involved with drill and blast activities.

## 2. Description of Blasting Activities & Current Site Conditions

### 2.1 Description of Blasting Activities and Associated Computations

Drill and Blast of the SWTC may be required as per the Design Report approved on September 12, 2019 as part of NWB Water License 2AM-WTP1826, in order to get to the proper foundation elevation. Drill and blast activities are planned to be undertaken on an “as needed” basis based on field conditions while respecting the requirements mentioned in Section 3. The blasting activities are planned to occur between September and December so the construction is completed before the thawing season for the construction to meet its design objective. The extent of the blasting area is presented in Appendix D.

The drilling and loading design specific for this blast was performed by Agnico’s drill and blast engineers, it is shown in Appendix D and E. This design was used to compute the setback distance. The instantaneous pressure change threshold is maximum 50 KPa, as recommended by DFO in “Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies”. Those detailed computations are shown in Appendix C and are taken from Appendix II & III of DFO’s document: The Use of Explosives in or Near Canadian Fisheries Waters. It should be noted that Guideline 9 that states that the setback requirement to respect the 13 mm*s-1 from spawning beds is found to be the most stringent guideline regarding setback distances to respect. Also, Appendix B below presents the fish habitats type and it can be seen that the SWTC likely blasting area is in a low risk zone and more than 150m away from the worst case potential blasting area (highest charge combined with closest blast proximity). That worst case distance is either equal or greater than any of the setback distances computed.

## 3. Review of Existing Guidelines and Recommendations

### 3.1 DFO's Guidelines for Use of Explosives in or Near Canadian Fisheries Waters

Agnico intends to comply with the nine (9) guidelines of the document "Guidelines for Use of Explosives in or Near Canadian Fisheries Waters" summarize below. For guideline no 8, Agnico will use a more stringent ICP of 50 kPa as recommended by DFO in the Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies (Cott and Hanna, 2005):

1. *Proponents considering the use of explosives are encouraged to consult the appropriate DFO Regional/Area authorities (Appendix I) as early as possible in their planning process to identify possible alternatives to the use of explosives, the biological resources and their habitats at risk, and/or effective mitigation measures.*

2. *Where provincial or territorial resource management agencies, or aboriginal resource management boards undertake the administration of fisheries, the proponent is encouraged to consult with the relevant authorities.*

3. *The use of confined or, in particular, unconfined explosives in or near Canadian fisheries waters is discouraged, and proponents are encouraged to utilize other potentially less destructive methods wherever possible.*

4. *No use of ammonium nitrate-fuel oil mixtures occurs in or near water due to the production of toxic by-products (ammonia).*

5. *After loading a charge in a hole, the hole is to be back-filled (stemmed) with angular gravel to the level of the substrate/water interface or the hole collapsed to confine the force of the explosion to the formation being fractured. The angular gravel is to have a particle size of approximately 1/12th the diameter of the borehole.*

6. *All "shock-tubes" and detonation wires are to be recovered and removed after each blast.*

7. *No explosive is to be knowingly detonated within 500 m of any marine mammal (or no visual contact from an observer using 7x35-power binocular).*

8. *No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swimbladder of a fish.*

9. *No explosive is to be detonated that produces, or is likely to produce, a peak particle velocity greater than 13 mm•s-1 in a spawning bed during the period of egg incubation.*

### 3.2 Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies (Cott and Hanna, 2005)

Below are recommendations from “Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies”, NWT 2000-2002 (Cott and Hanna, 2005) that Agnico intends to follow.

1. *Seismic exploration should not be conducted under water-bodies not frozen to the bottom in the NWT due to the unpredictability of IPC (Instantaneous Pressure Change) and absence of proven mitigation to suppress the negative effects of a detonated charge.*

2. *Guidelines should be used as intended, as “guidelines”, and be adjusted to site-specific conditions accordingly, not applied as a mitigation.*

3. *Ice profiling on waterbodies should be used as a tool to determine the extent of bottom-fast ice.*

4. *Proven mitigation to minimize the impact on fish from the effects of high IPC should be available on site in the event that an unforeseen event occurs, such as a shallow buried charge.*

5. *For any explosive-based seismic program, a protocol must be developed that clearly indicates what is expected, how monitoring is to be conducted, what and how information is to be recorded, and when the results are to be submitted. The protocol should be designed well in advance of the proposed seismic exploration program, and be a joint effort between industry and regulators.*

6. *Initial testing should be conducted to determine site-specific charge size/burial depth combinations.*

7. *Charge burial depth must be accurately measured and confirmed.*

8. *A maximum threshold of <50kpa should be set for testing and production seismic operations.*

9. *Monitoring equipment should be capable of monitoring at the highest frequency available, currently 65,000s-1 is standard.*

10. *A pre-determined number of production holes should be monitored to confirm the adequacy of the site-specific charge size/burial depth combinations for the entire project area.*

11. *When designing a program to monitor activities of industry, it is important that the requirements be practical and considers the technical and environmental conditions in which the industry is bound to operate.*

## 4. Proposed Monitoring Plan

The Blast Mitigation Plan is outlined in this present section for the monitoring and section 5 for the mitigations. Both section are meant to address the guidelines and recommendations described in the previous section of this memo.

Agnico will monitor blast vibrations with Instantel Minimate™ seismograph monitoring devices to be installed as indicated by the manufacturer at the same location every blast, results could be sent on demand. Note that one station is suggested on each lake, i.e. Whale Tail Lake South Basin and Mammoth Lake. Those locations are to be in a representative area on the shoreline and outside the footprint of channel construction, additionally, they are somewhat equal to the closest possible proximity of a blast to a waterbody as the crow flies in order to be representative. Refer to Appendix A for proposed locations of the existing and new proposed station. Such practices are consistent with the current practices at Meadowbank and Whale Tail and it respects the recommendation 9 regarding the type of equipment to be used that is consistent with industry standards.

The whole blast footprint shall be shot in small sequences as much as practical with limited number of holes quantity per sequence in such a way that after each blast, the recorded values and post-blast visual assessment shall be analyzed and documented by competent personal so adjustments on the next blasting sequences could be brought forward if the guidelines are not respected or exceeded. Lastly, in case of a “no data” event, Agnico will investigate the cause to assess whether the error is human or material and bring corrective measures where applicable.

## 5. Potential mitigation measures

Agnico already has practices that are aligned with some requirements of section 3 regardless if a blast is in proximity to a waterbody or not, for example: holes are backfilled with angular ¾” net gravel, emulsion is used which is not soluble in water, blasters inspect the blast area after each blast, design parameters are optimized, etc.

Although Agnico is confident that actual practices and design will comply with the requirements of Section 3, a handful of potential mitigation measures were identified that could be applied should the first sequence exceeds the requirements. Those are developed from a combination of literature and past experiences at Meadowbank that have proven to be successful, namely:

- Drill on small diameters hole as low as 3” to limit vibrations;
- The explosive charge in each hole (powder factor) shall be reduced to the minimum judged practical in the design phase of the blast and re-adjusted if required after the first sequence;
- Number of holes blasting per delay and blast geometry shall be reduced to a minimum as much as practical in the tying plan produced by the D&B engineer to limit vibrations to respect the computations shown in Appendix C which represent a worst case (highest charge expected compounded with closest possible proximity to waterbody);
- The blasting area might be broken down to smaller blast patterns and more sequences, to be blasted in a chronological manner, starting away from away bodies and moving closer where possible;
- A worker will perform a 2nd visual inspection of the area around the blast after each blast and remove any shock tubes or detonators that might have been projected outside the perimeter. If visual inspection reveals blasting accessories on the iced surface of the

Mammoth lake, the blaster will advise the Agnico personal so that the material is removed via appropriate procedures;

- Quality control by competent personal could be performed after the first blast sequence to ensure that no overloading occurs in such a way that the maximum charge per hole respects the design that was used as in input for the Instantaneous Pressure Change and Vibrations computations for calculating the setback distances;

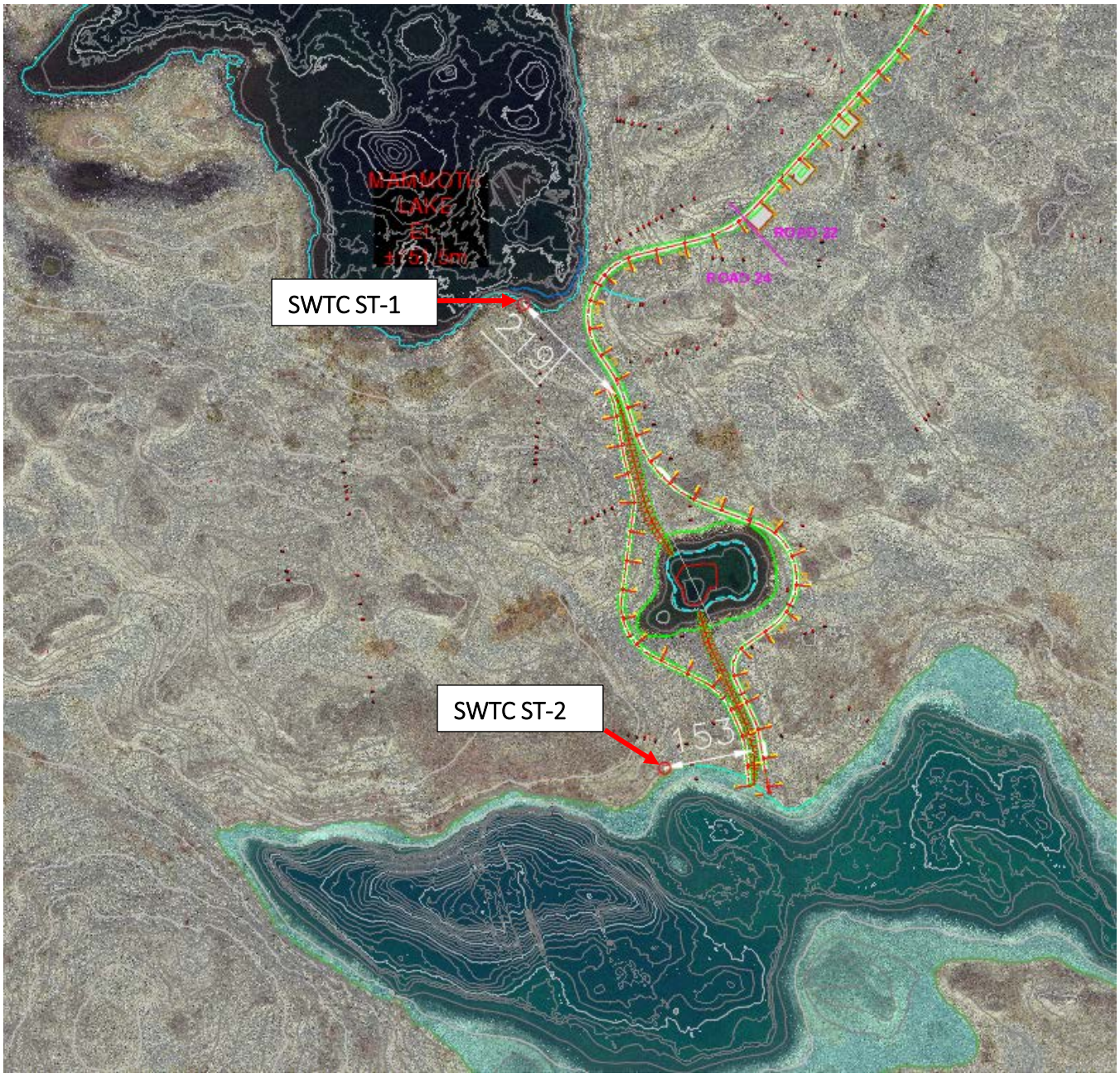
- In the event where projections are judged problematic, blasting mats or geotextile could be applied over the whole blasting sequence with an appropriate amount of aggregates over it in such a way that the energy is kept in the rock mass as opposed to sending projections and deleterious blasting material in the air.

## 6. Closure

This memo communicates Agnico intent's on Drill and Blast activities and the rationale behind it on a construction and design standpoint. It is shown that the closest possible blasting distance is equal or further that the most stringent setback guideline. Also, it is clear that site specific designs are meeting the computational requirements of the guidelines and recommendations that DFO proposes to comply.

Agnico took knowledge of the guidelines and recommendations to comply and then built a monitoring program accordingly. Lastly, Agnico listed realistic and practical mitigations that could be implemented should the first blast sequence show unfavourable results which is also consistent with DFO's guidelines and Cott & Hanna's set of recommendations.

# APPENDIX A – Proposed Blast Monitoring Stations


SWTC ST-1
SWTC ST-2
ROAD 22
ROAD 24
153

# Appendix B: Fish Habitat Type

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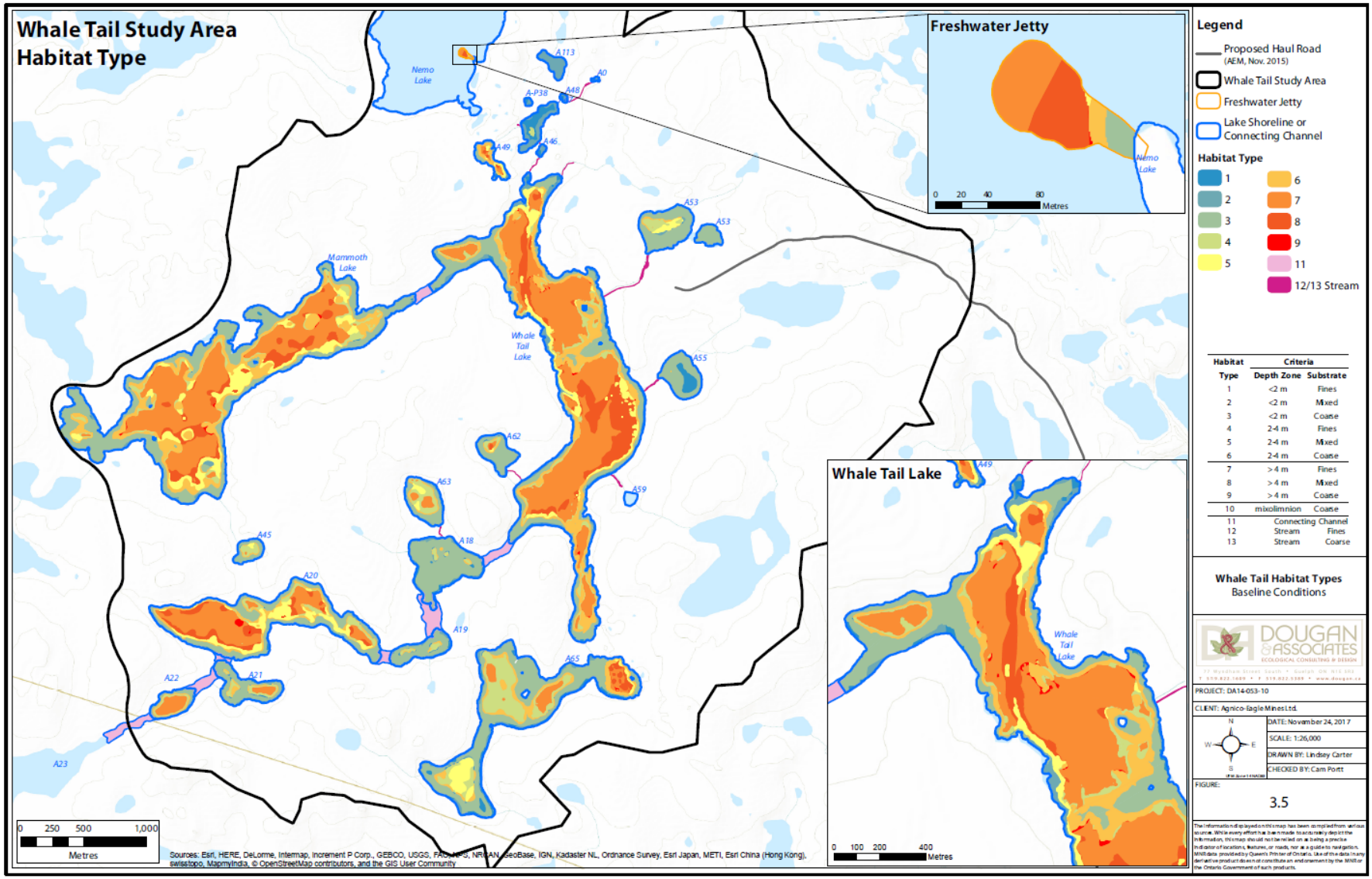

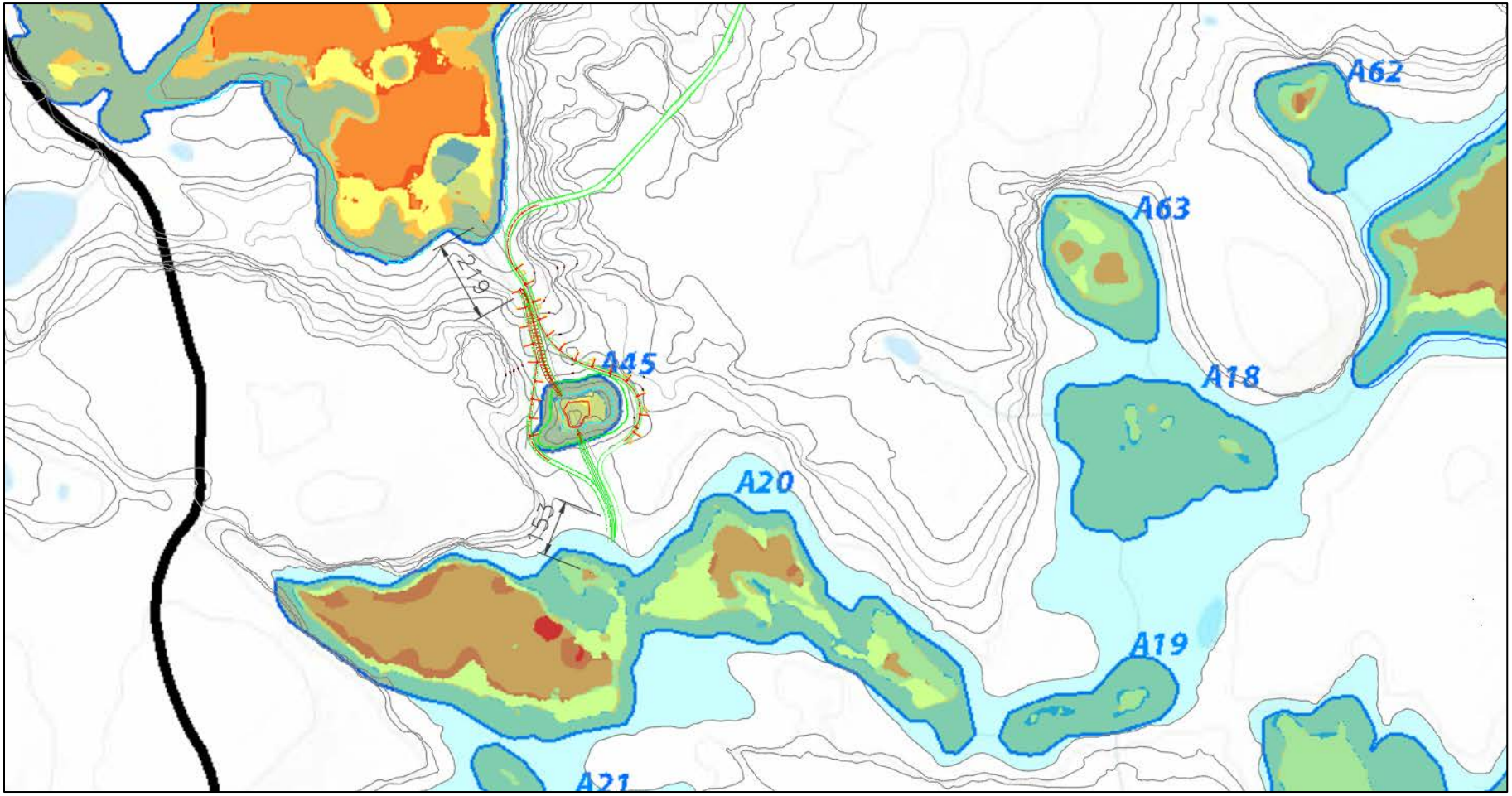
A62
A63
A18
A45
A20
A19
A21
219
53

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Appendix C: Blasting setback distance calculations on 4.5” hole diameter – 50 Kpa requirement

| | | | Guideline 8 | Guideline 9 |
|---|---|---|---|---|
| Hole diameter (in) | 4.5 | **Description** | Instantaneous pressure change over 50 Kpa in the swimbladder of a fish | Peak particule velocity greater than 13mm/s in a spawning bedduring the period of egg incubation |
| Charge Length (m) | 3.2 | | | |
| Explosives Qty (Kg) | 80 | | | |
| | | **Radius to respect (m)** | 64.2 | 147.4 |

## Set back distance required to meet 50Kpa Guideline

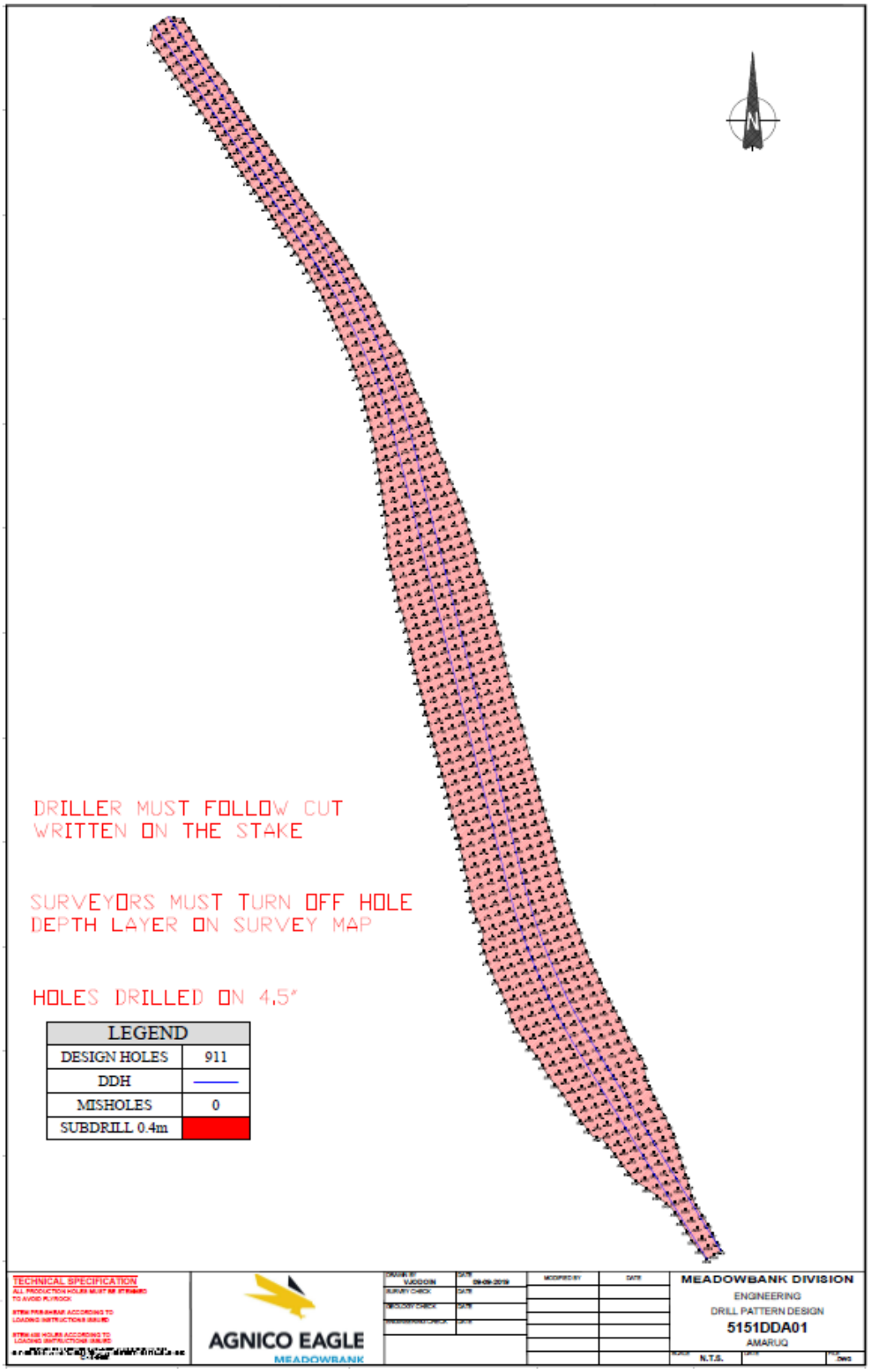
| | | | | |
|---|---|---|---|---|
| Dw | 1 | g/cm3 | Zw/Zr= | 0.249993 |
| Cw | 146300 | cm/s | | |
| Dr | 1.92 | g/cm3 | | |
| Cr | 304800 | cm/s | | |
| Pw | 50 | KPa | | |
| | | | Pw= | 0.399991 *Pr |
| Hole diameter | 4.5 | in | | |
| | 11.43 | cm | Pr= | 125.0027 KPa |
| Emuls. Density | 0.00113 | Kg/cm3 | Pr= | 1250027 dynes (g*cm/s2) |
| Charge per meter | 11.59473 | Kg/m | | |
| Charge length | 3.2 | m* | Vr= | 4.27202 cm/s |
| Explosive Qty | 80 | Kg | | |
| | | | R= | 64.17992 m |

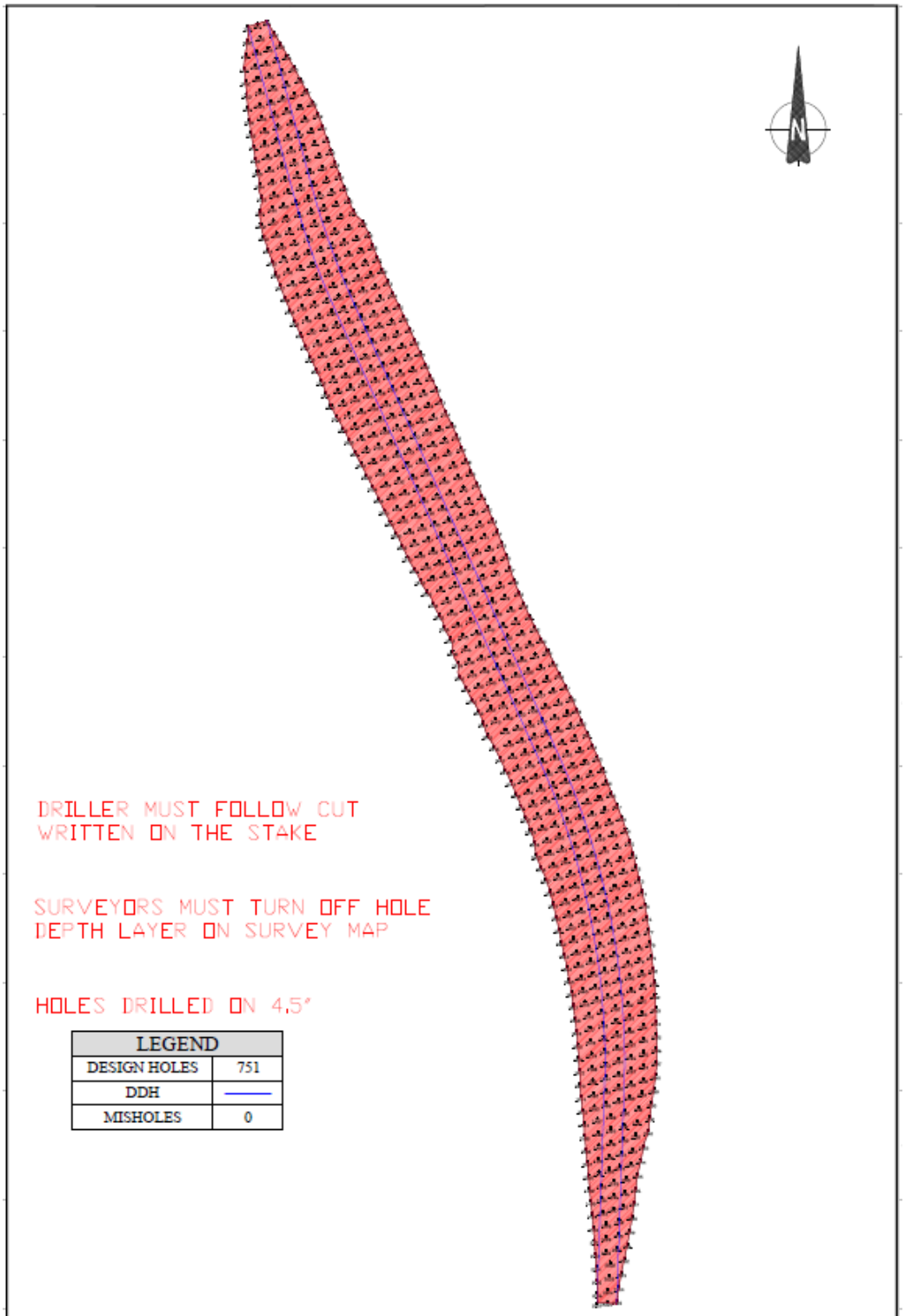
** Using target floor elevation 148.8 with SNC's design highest Natural ground between cut B-B & C-C of 153masl and also considering Loading instructions plans collar Length specified by D&B engineers (1m)*

## Set back distance required to meet 13mm/s Guideline

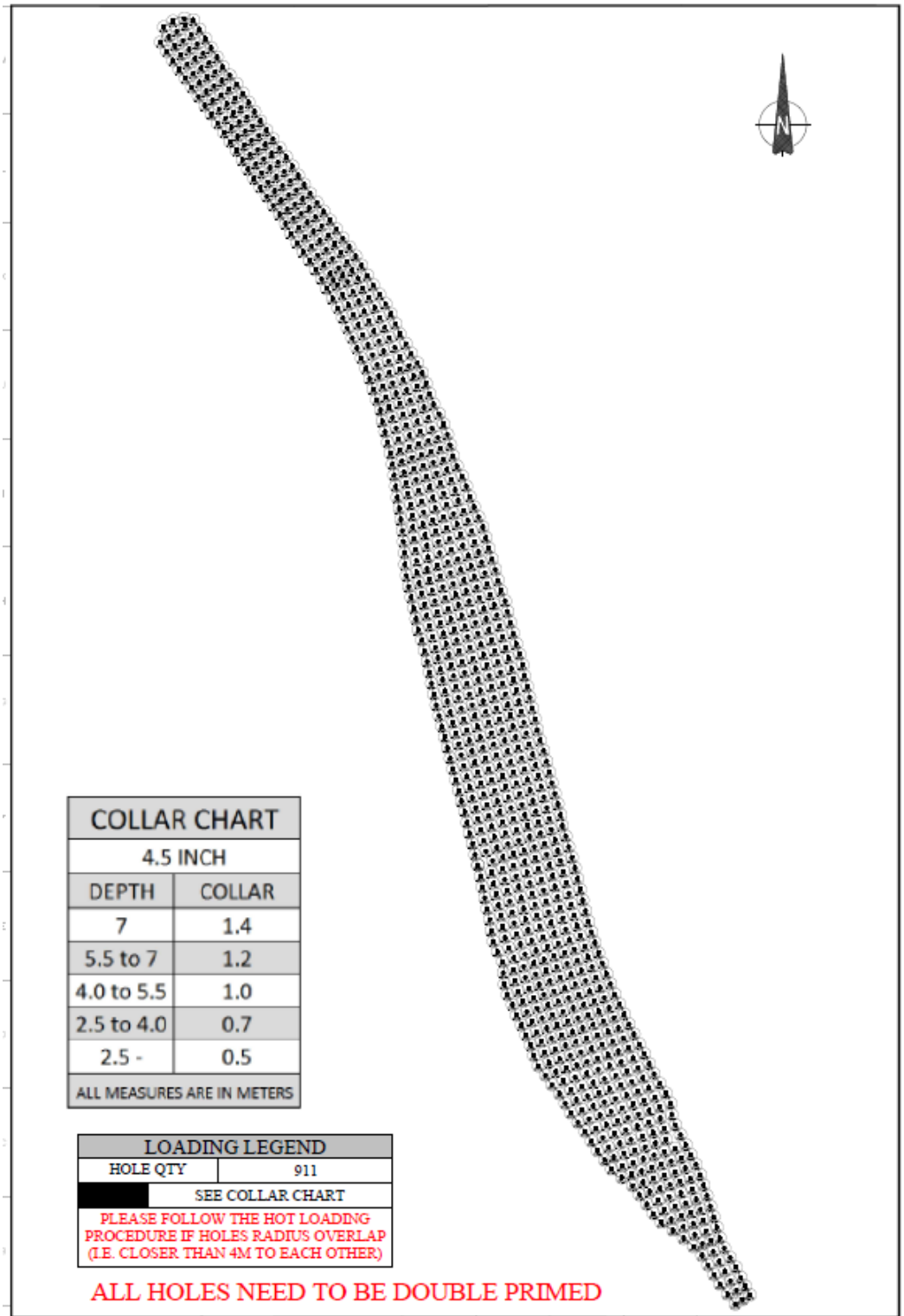
| | | | | |
|---|---|---|---|---|
| Vr | 1.13 | cm/s | R= | 147.3571 m |

# Appendix D: Drilling Design


N
DRILLER MUST FOLLOW CUT
WRITTEN ON THE STAKE
SURVEYORS MUST TURN OFF HOLE
DEPTH LAYER ON SURVEY MAP
HOLES DRILLED ON 4.5'
LEGEND
DESIGN HOLES 911
DDH
MISHOLES 0
SUBDRILL 0.4m
TECHNICAL SPECIFICATION
AGNICO EAGLE
MEADOWBANK
MEADOWBANK DIVISION
ENGINEERING
DRILL PATTERN DESIGN
5151DDA01
AMARUQ
N.T.S.


N
DRILLER MUST FOLLOW CUT
WRITTEN ON THE STAKE
SURVEYORS MUST TURN OFF HOLE
DEPTH LAYER ON SURVEY MAP
HOLES DRILLED ON 4.5'
LEGEND
DESIGN HOLES 751
DDH
MISHOLES 0
TECHNICAL SPECIFICATION
AGNICO EAGLE
MEADOWBANK
MEADOWBANK DIVISION
ENGINEERING
DRILL PATTERN DESIGN
5151DDA03
AMARUQ
N.T.S.

# Appendix E: Loading Design



| COLLAR CHART | |
|---|---|
| 4.5 INCH | |
| DEPTH | COLLAR |
| 7 | 1.4 |
| 5.5 to 7 | 1.2 |
| 4.0 to 5.5 | 1.0 |
| 2.5 to 4.0 | 0.7 |
| 2.5 - | 0.5 |
| ALL MEASURES ARE IN METERS | |

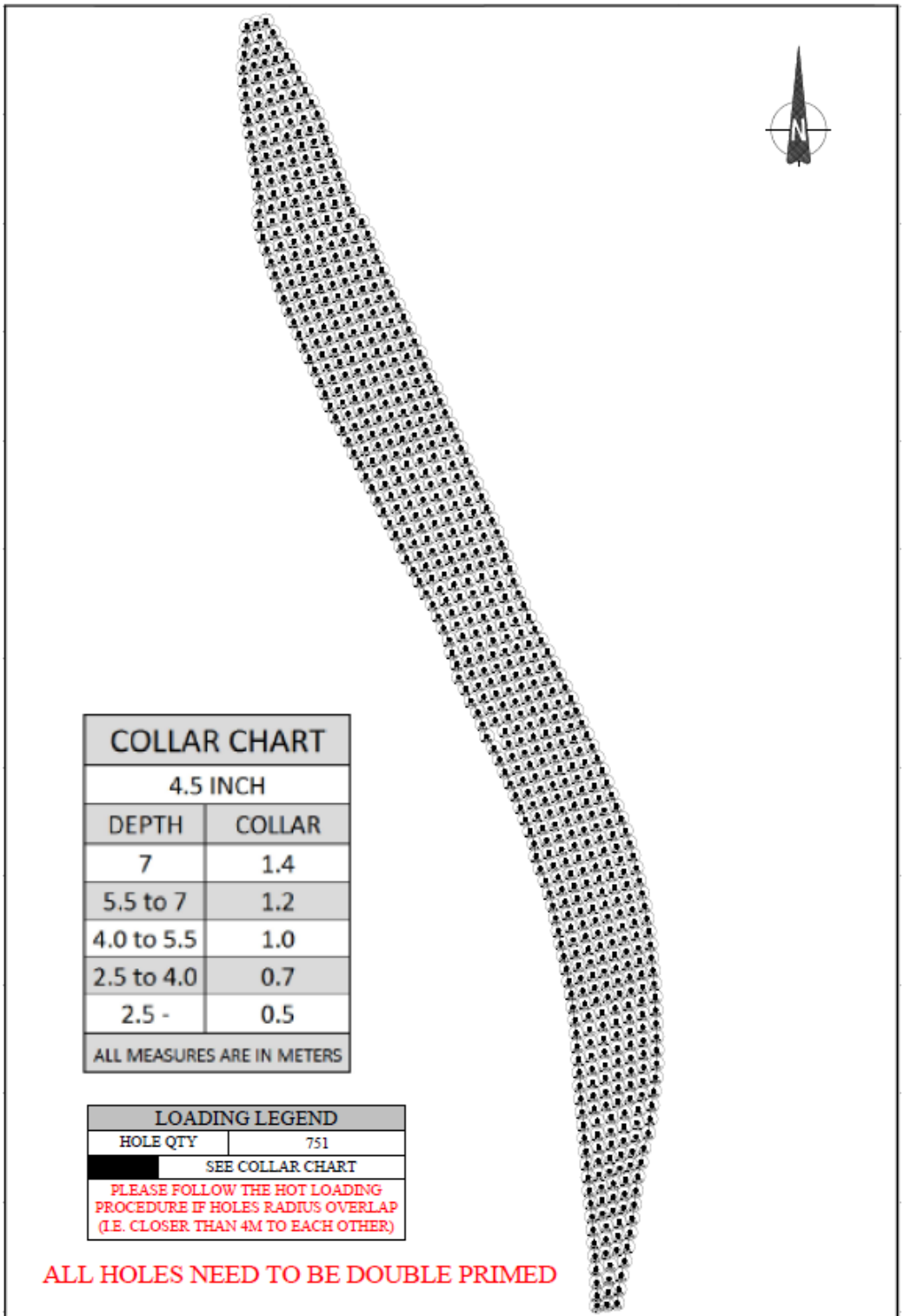
| LOADING LEGEND | |
|---|---|
| HOLE QTY | 911 |
| | SEE COLLAR CHART |
| PLEASE FOLLOW THE HOT LOADING PROCEDURE IF HOLES RADIUS OVERLAP (I.E. CLOSER THAN 4M TO EACH OTHER) | |

ALL HOLES NEED TO BE DOUBLE PRIMED

TECHNICAL SPECIFICATION

AGNICO EAGLE
MEADOWBANK

MEADOWBANK DIVISION
ENGINEERING
LOADING PLAN
5151DDA01
AMARUQ



| COLLAR CHART | |
|---|---|
| 4.5 INCH | |
| DEPTH | COLLAR |
| 7 | 1.4 |
| 5.5 to 7 | 1.2 |
| 4.0 to 5.5 | 1.0 |
| 2.5 to 4.0 | 0.7 |
| 2.5 - | 0.5 |
| ALL MEASURES ARE IN METERS | |

| LOADING LEGEND | |
|---|---|
| HOLE QTY | 751 |
| | SEE COLLAR CHART |
| PLEASE FOLLOW THE HOT LOADING PROCEDURE IF HOLES RADIUS OVERLAP (I.E. CLOSER THAN 4M TO EACH OTHER) | |

ALL HOLES NEED TO BE DOUBLE PRIMED

TECHNICAL SPECIFICATION
ALL PRODUCTION HOLES MUST BE STEMMED TO AVOID FLYROCK
STEM PRIMABAR ACCORDING TO LOADING INSTRUCTIONS (INLINE)
STEM ASE HOLES ACCORDING TO LOADING INSTRUCTIONS (INLINE)

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| DRAWN BY | DATE |
|---|---|
| V.JODOIN | 09-09-2019 |
| SURVEY CHECK | DATE |
| GEOLOGY CHECK | DATE |
| ENGINEERING CHECK | DATE |

| MODIFIED BY | DATE |
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ENGINEERING
LOADING PLAN
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SCALE N.T.S. DATE FILE Dwg