FINAL REPORT

SNOWDRIFT ASSESSMENT
PROPOSED WASTEWATER LAGOON
CLYDE RIVER, NUNAVUT

Project Number: 08-1023

February 29, 2008

SUBMITTED TO: **Mr. Steven Burden**
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Project Manager: Godfrey Holder, B.Sc.
Project Director: Bill F. Waechter, C.E.T.

1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Trow Associates Inc. to conduct a snowdrift assessment for the proposed Wastewater Lagoon in Clyde River, Nunavut. The purpose of this assessment was to qualitatively review the potential for undue snowdrift activity at the proposed lagoon site and on its access road that could potentially have a significant affect on the lagoonís use and access. Where the potential for adverse snowdrifting conditions is anticipated, recommendations have been provided.

2. METHODOLOGY

The review focussed on the proposed wastewater lagoon layout and access road location with respect to prevailing winds, as these design aspects have the greatest impact on snowdrift conditions. An assessment of the local terrain was a critical part of the site review. RWDI has previous snowdrift control site experience in Clyde River, and previously assessed the access road to the existing wastewater lagoon and landfill. Hamlet representatives were also contacted in this assessment to discuss their experience with wind and snowdrift conditions in the vicinity of the existing sewage lagoon and along the access road.

The following information was used to conduct the reviews:

- Design drawings received on January 15, 2008 (Refer to Appendix A);
- Design drawings of four Alternatives received on February 28 (refer to Appendix B);
- An assessment of the prevailing winds in Clyde River;
- RWDIís previous experience with prior visits to Clyde River; and,
- Our engineering judgement.

3. WIND AND WEATHER ANALYSIS

Wind data recorded at the Clyde River Airport for the period of 1952 through 1987 were analysed to determine the wind directions that would most often be associated with drifting snow in this region. The following meteorological conditions were assessed for the winter months (November through April):

- winds greater than 15 km/h;
- winds greater than 15 km/h with snowfall; and,
- blowing snow events.

The movement of drifting snow at low wind speeds is negligible. A threshold wind speed of 15 km/h was therefore used to determine the predominant winds that could be associated with snow movement on and around the study site. The 15 km/h wind speed is measured at the weather stationís anemometer, which is typically located on a mast approximately 10m above the ground. Winter winds with blowing snow represent higher wind speeds often associated with storm events and significant drifting.

The first analysis of the winter winds greater than 15 km/h (see upper left wind rose in Figure 1) indicates that wind blowing from northwesterly sectors occurs most frequently. The second analysis considered winds greater than 15 km/ with snowfall (see upper right wind rose in Figure 1). From these data it is apparent the northwesterly winds are most prevalent. The third analysis considered blowing snow events (see lower wind rose in Figure 1), which also indicates that northwest winds are prevalent. There are no topographical influences of any significance that would alter the wind conditions recorded at the airport, about four kilometres to the east-northeast of the lagoon site. For this assessment, we considered winds from northwesterly sectors (i.e., west-northwest through north-northwest) as the most important.

Environment Canada Normals (1971 to 2000) indicates an annual average snowfall of 203 cm for Clyde River and mean monthly snow depth of between 16 cm and 59 cm. This is a large volume of snow, which, based on experience, indicates a high potential for significant snowdrifts to build-up during severe wind events.

4. ASSESSMENT RESULTS AND RECOMMENDATIONS

For reference, the project drawings and information provided by Trow Associates Inc. for use in this assessment are included in the appendices. An assessment was undertaken using the drawings included in Appendix A (i.e., Assessment A), with a subsequent review conducted on four design alternatives included in Appendix B (i.e., Assessment B).

Clyde River is located on the eastern side of Baffin Island, approximately midway along the islandís east coast. The terrain around the community and in the immediate vicinity of the proposed wastewater lagoon generally consists of rolling land. There are no topographic features nearby that would significantly alter the local wind patterns near the proposed lagoon site and access road (See Image 1). The proposed wastewater lagoon is located in close proximity to the existing lagoon which is approximately one kilometre to the west of the community.

Image 1: Proposed Wastewater Lagoon and Surroundings - Looking West (07/08/97)
Photo Credit: Ansgar Walk

The Works Supervisor (David Arreak) for the Hamlet of Clyde River was contacted to discuss his experience with snowdrift conditions around the existing wastewater lagoon and also along its access road. David indicated that the snowdrift conditions are generally not too bad along the road and are not a problem at the existing wastewater lagoon. RWDI previously conducted a snowdrift audit[1] of drifting problems in Clyde River, which included a review of the access road to the lagoon and landfill. Drifting problems were encountered along the road mainly in two local areas, and were associated with the road surface being too low relative to the immediate surroundings. Snow that accumulated on the road was pushed to the roadside and the piled snow would in turn create further drifting on the road. Photographs from the site visit conducted in the earlier study are included as Images 2 and 3.

Image 2: Drifting Along Wastewater Lagoon Access Road - 06/02/96

Image 3: Drifting Along Wastewater Lagoon Access Road - 06/02//96

Increasing the height of the road surface was considered as one design option at that time. David indicated that the road surface had not been altered. Roadside safety markers that were previously installed on both sides of the road, were, however, removed from one side as recommended in the earlier study. The markers on the south (downwind) side of the road, where snow is piled (see Image 2), had interfered with snow removal operations. We recommend confirming that the single line of markers currently in place is located on the north (upwind) side of the road. During the discussion with David Arreak, he recommended that more road edge markers be installed between the existing markers for safety reasons, to make the road edge more visible during severe blowing snow conditions.

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[1] B. Waechter and C. Williams - RWDI, and J. Neiderkorn - FSC. Clyde River, NWT Snowdrift Abatement Study. Report 96-145F-2CLY. March 27, 1996.

Assessment A (Refer to Appendix A) - The proposed wastewater lagoon is located adjacent to the existing lagoon west of the community. The sloped terrain in this area is not sufficient to create significant drifting problems. The site layout for the proposed lagoon shows a safety barrier along the edge of the existing lagoon as well as around the turn around and transfer area for the new lagoon. Large boulders will be used as safety barriers. Driver safety measures are essential, but it must be understood that the boulders will cause snowdrifts to form around them, and they will also impede snow removal operations. The Hamlet will use a front-end loader to remove snow from the lagoon area, as necessary. Snow should be dumped to the east side of the gravel pad to reduce the potential of the piled snow causing secondary drifting on top of the pad.

Assessment B (Refer to Appendix B) - From an overall snowdrift perspective, Alternatives 1 and 2 are the same (its understood that the berm height differs by 1m). In simple terms a taller embankment will collect slightly more snow within the lagoon, but mainly along northern edges of the lagoon. Because of the shallow sides slopes of the berm, the difference in stored/retained blowing snow will not be significant.

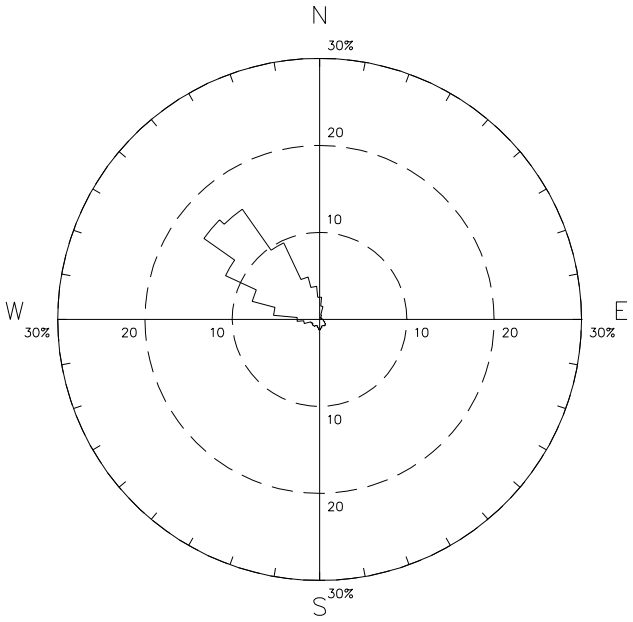
The main difference between Alternatives 3 and 4 is the presence of a second discharge point near the northwest "corner" of the existing lagoon in Alternative 4. The layout of the discharge area at the southeast "corner" of the existing lagoon is no different than the previous scheme we had reviewed, as per our final report you currently have. Those report comments would stand. The "northwest" discharge area is on the windward side of the lagoon. The safety barriers (e.g., boulders) are on the downwind (southeasterly) thus drifting on the traveled surface of the discharge area would be minimal.

Alternative 4 is the best scheme, where the northwest discharge area could be used mainly during the wintertime, therefore reducing the need for any significant snow removal in the area. The southeast discharge area could be left to drift in and used when weather permits. One could question if there is a need for the southeast discharge point at all?

5. CONCLUSIONS

The proposed wastewater lagoon is located in a relatively wind exposed area west of the Hamlet, where drifting snow is not expected to be a major problem. Driver safety barriers (boulders) placed along the edge of the gravel pad around the existing lagoon and the proposed transfer area will collect drifting snow. Recommendations have been provided with respect to snow removal operations and the placement of visual safety markers along the access road from the lagoon site to town. The Hamlet Works Manager indicated that any snowdrifting that occurs on the access road between town and the lagoon site is not problematic and has been manageable. Four design schemes were considered in this assessment. In our opinion Alternative 4 would be preferred.

FIGURES



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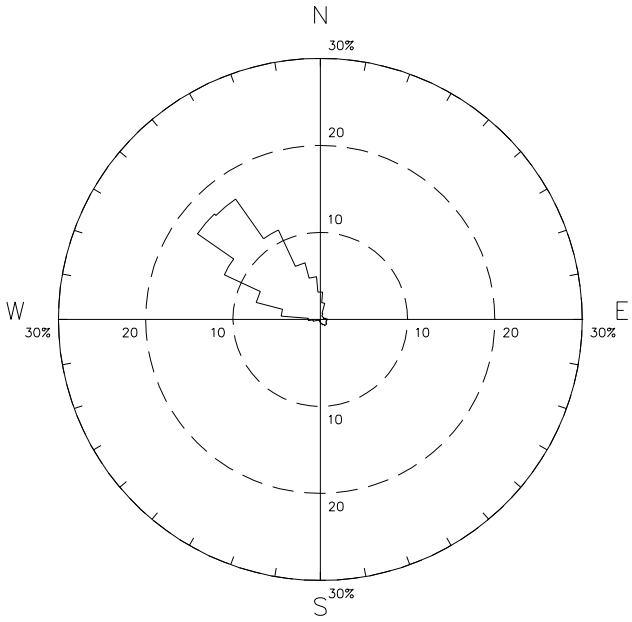
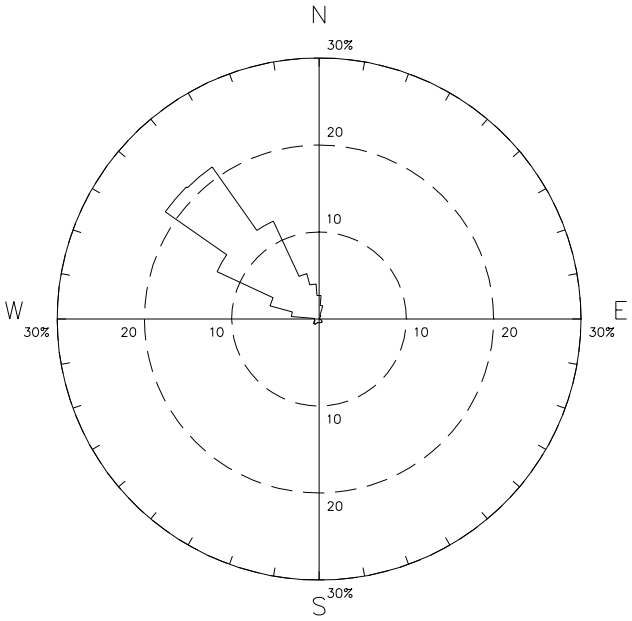


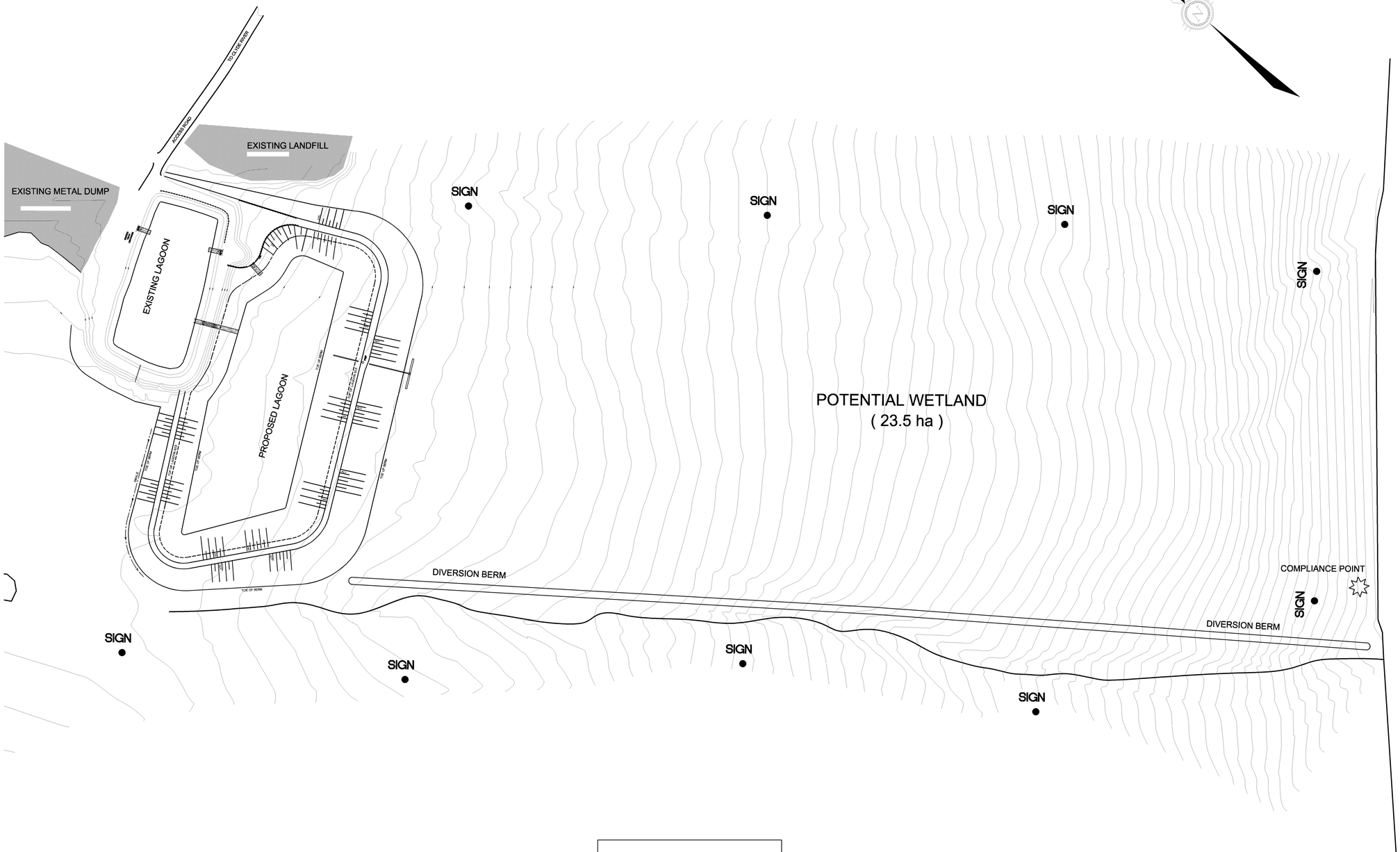
Winter Winds > 15 km/h with Snowfall

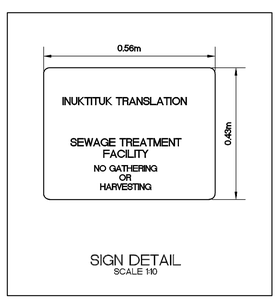


Blowing Snow Events

Directional Distribution of Winds Affecting Drifting Snow **Clyde River Airport, NU (1952 - 1987)** Proposed Wastewater Lagoon - Clyde River, NU Project # 08-1023A	Figure No. **1** Date: Feb. 15, 2008	RWDI

APPENDIX A





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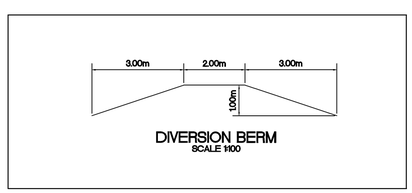

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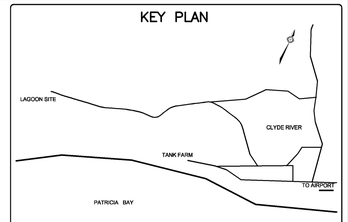
CONTOUR INFORMATION WAS DERIVED BY TROW ASSOCIATES INC.
SURVEY DATED AUGUST 23, 2007.
CONTOUR INTERVALS ARE SET AT 1.00m

KEY PLAN



LEGEND

BENCH MARK

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RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D

REVISIONS

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HORIZONTAL 1:1500

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CLIENT
GOVERNMENT OF NUNAVUT

PROJECT
CLYDE RIVER
WASTEWATER LAGOON

TITLE
OVERALL
SITE PLAN

design by	SAD	project no.	OTCD00019055A
drawn by	MEB	drawing no.	SP-1
checked by	SLB		
date	30/08/2007		
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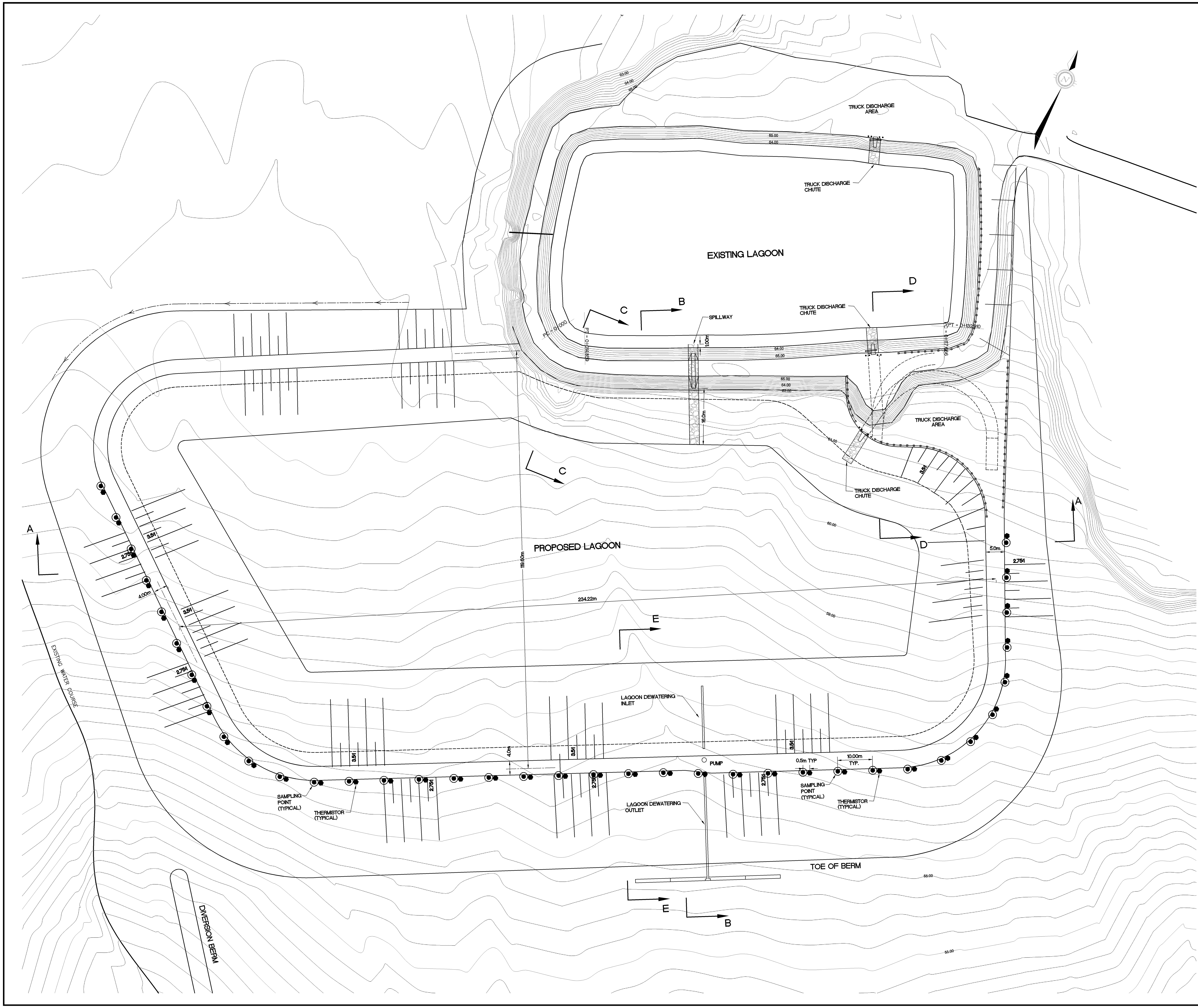

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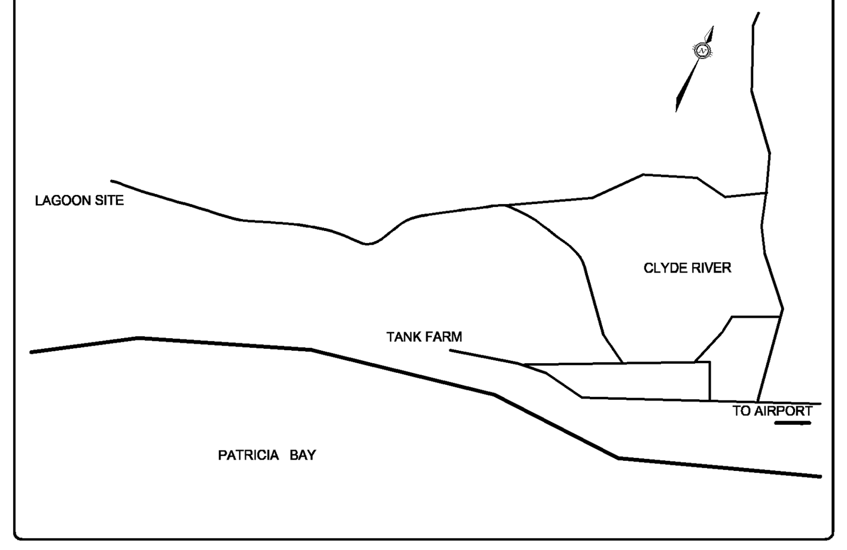

LEGEND

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD, NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D

R E V I S I O N S

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HORIZONTAL 1:500

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GOVERNMENT OF NUNAVUT

PROJECT
CLYDE RIVER
WASTEWATER LAGOON

TITLE
SITE PLAN

design by	SAD	project no.	OTCD00019055A
drawn by	MEB	drawing no.	SP-2
checked by	S.L.B.		
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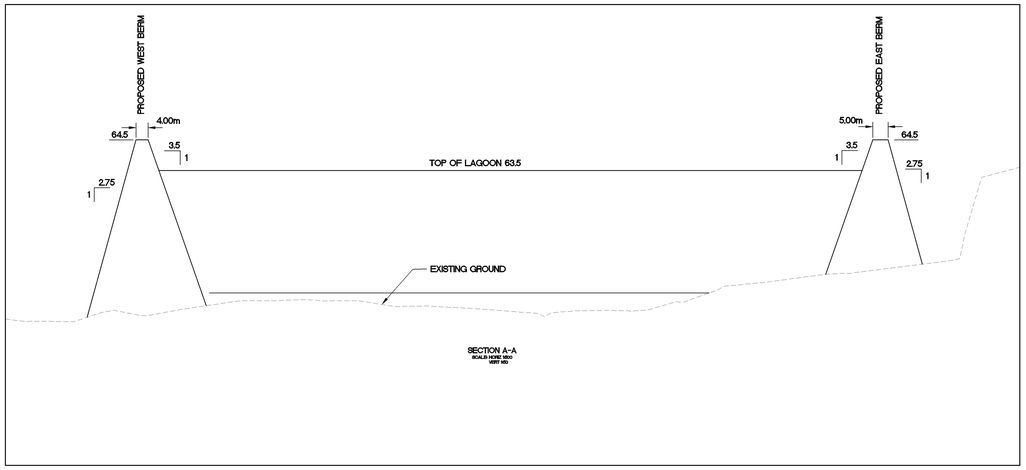

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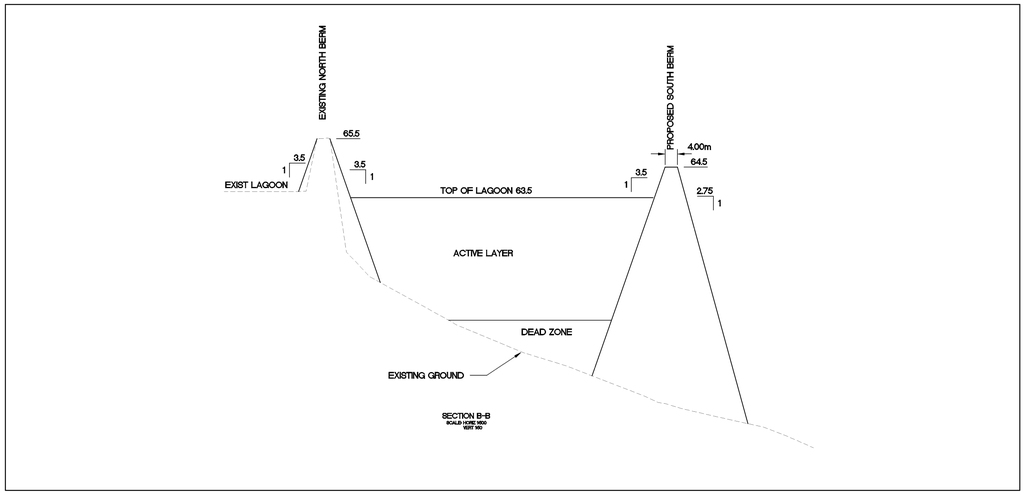

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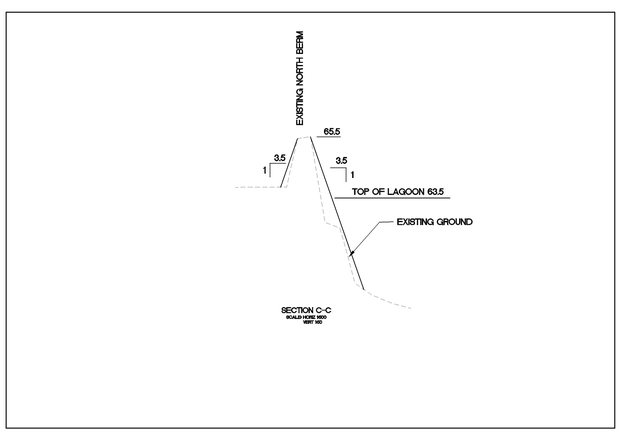

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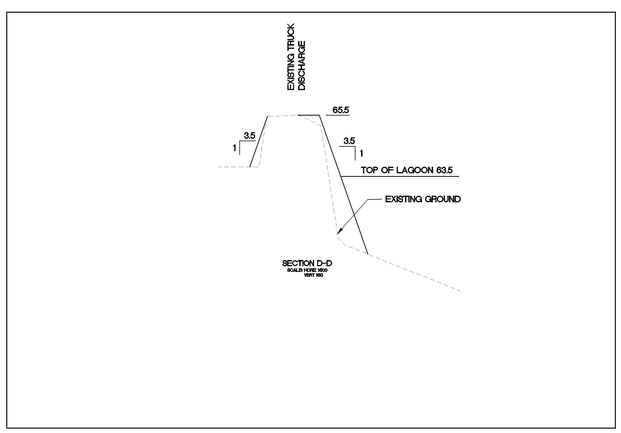

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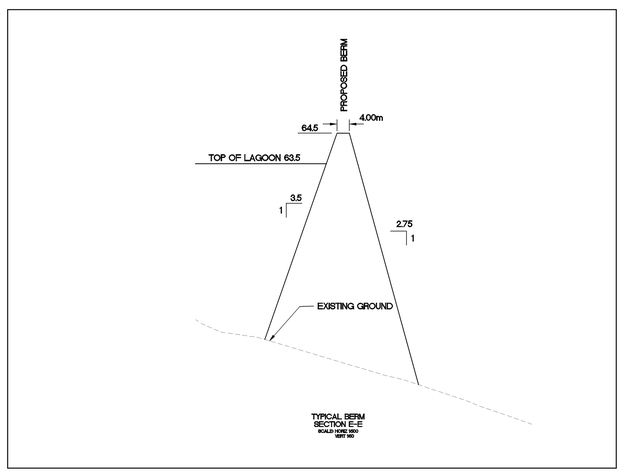

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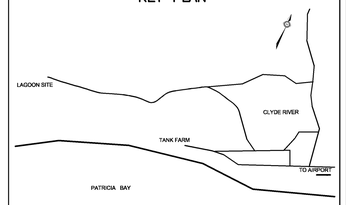
KEY PLAN



LEGEND

BORE HOLE

EXISTING ELEVATION

DIRECTION OF FLOW

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D

REVISIONS

0 5m 10m 20m

HORIZONTAL 1:500

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CLIENT

GOVERNMENT OF NUNAVUT

PROJECT

CLYDE RIVER WASTEWATER LAGOON

TITLE

BERM SECTIONS

design by	SAD	project no.	OTCD000190554
drawn by	MEB	drawing no.	SEC1
checked by	SLB		
date	30/08/2007		
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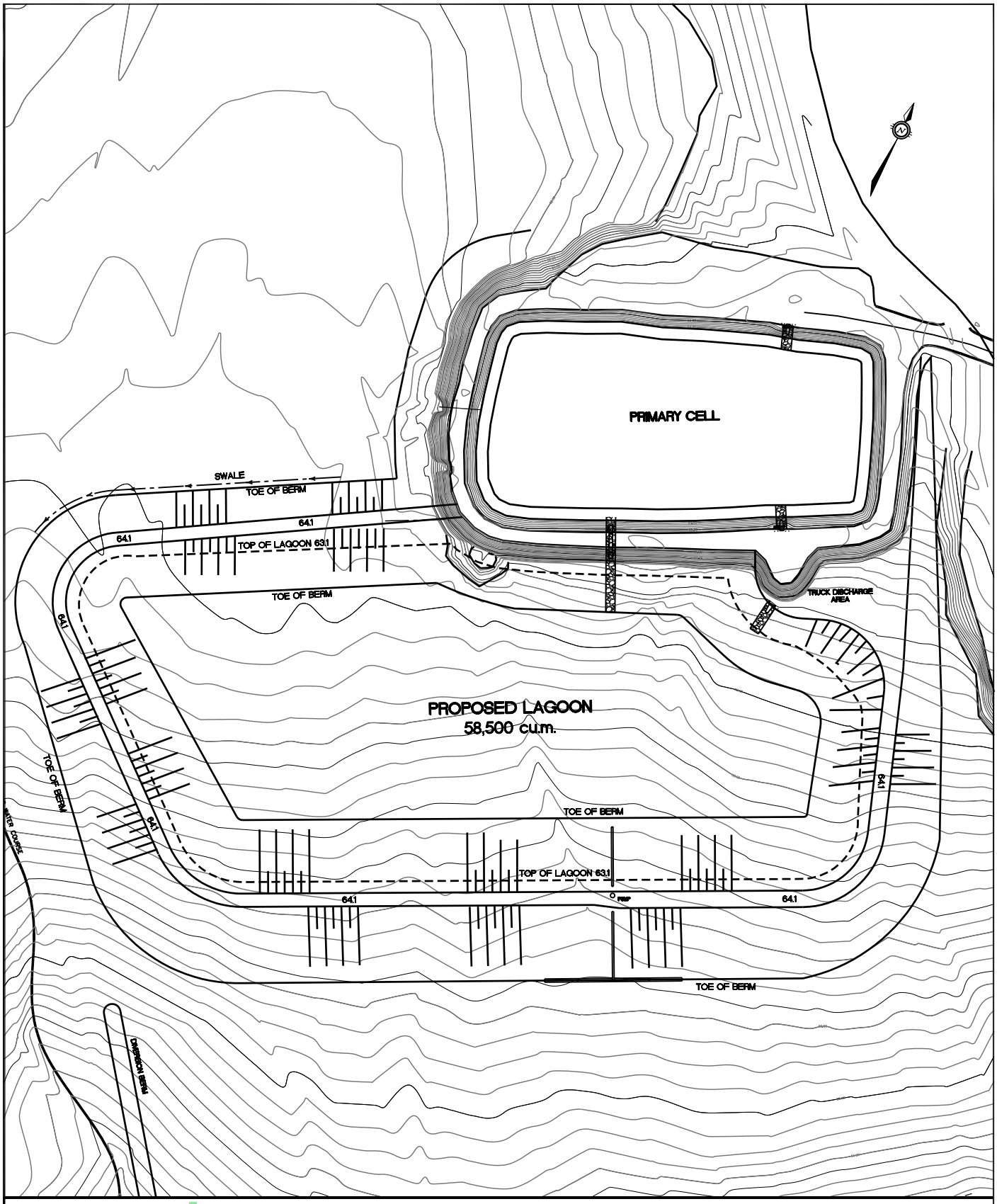
APPENDIX B



Trow Associates Inc.
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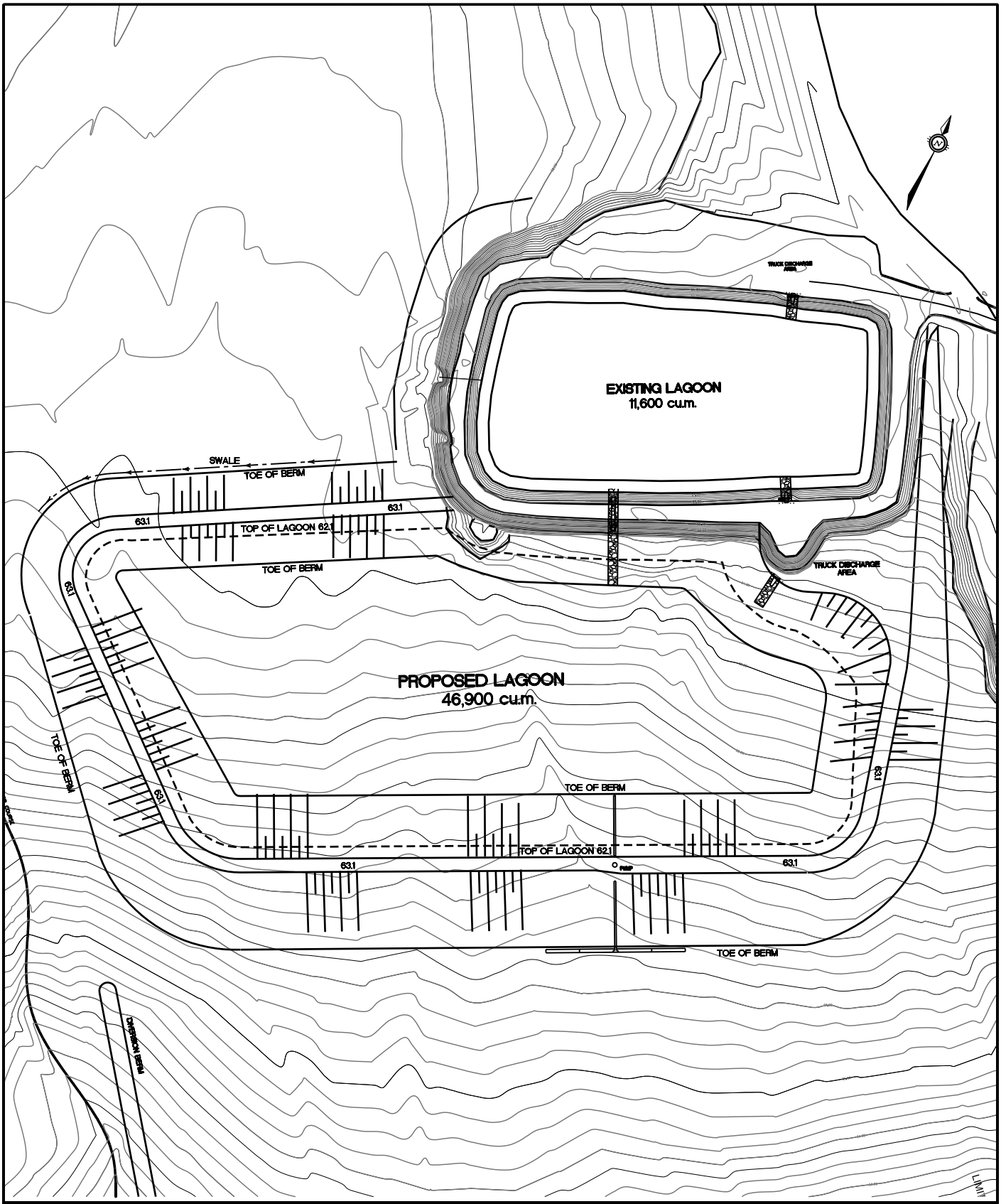

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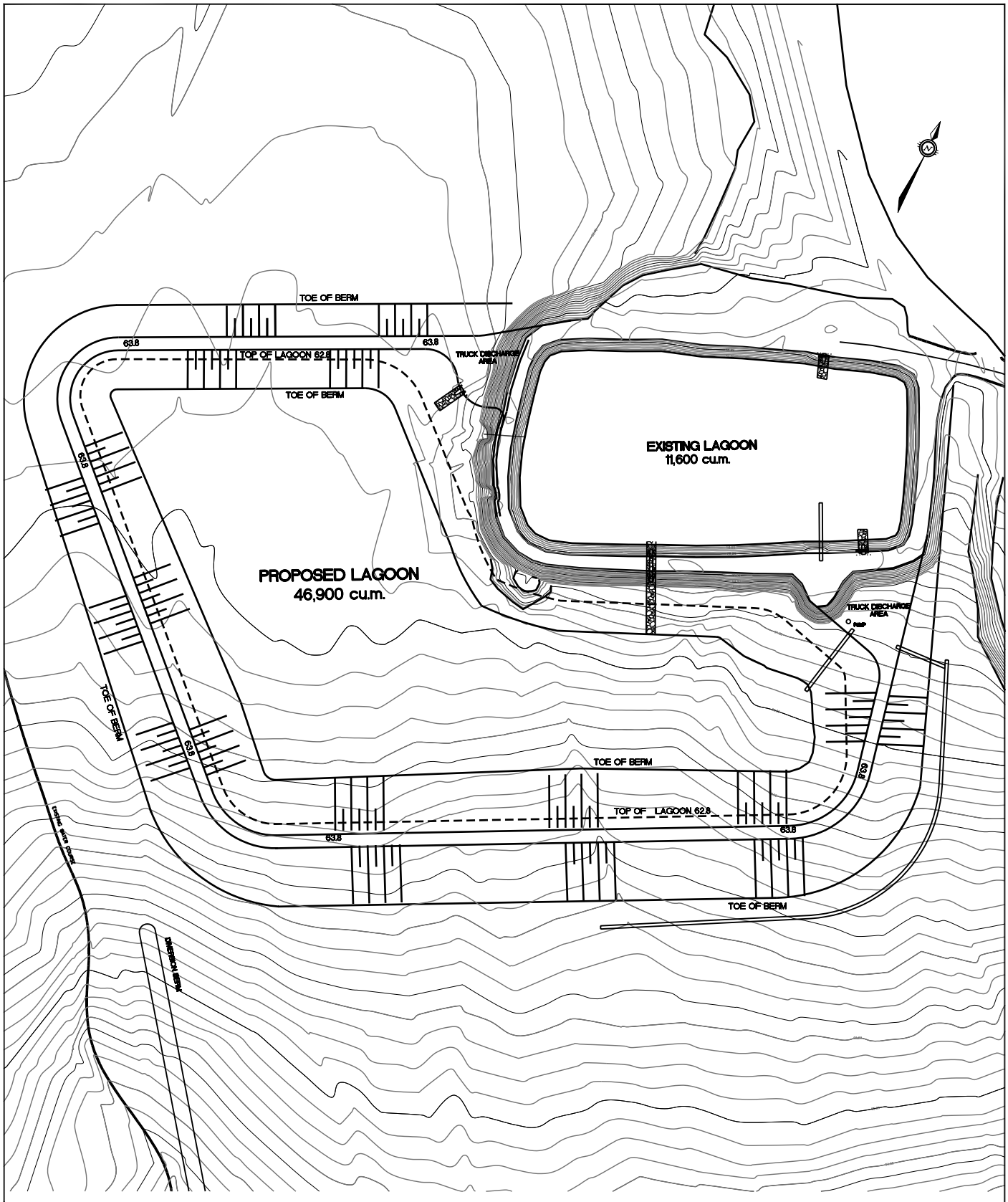

Trow Associates Inc.
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Tel: (613) 225-9940
Fax: (613) 225-7337

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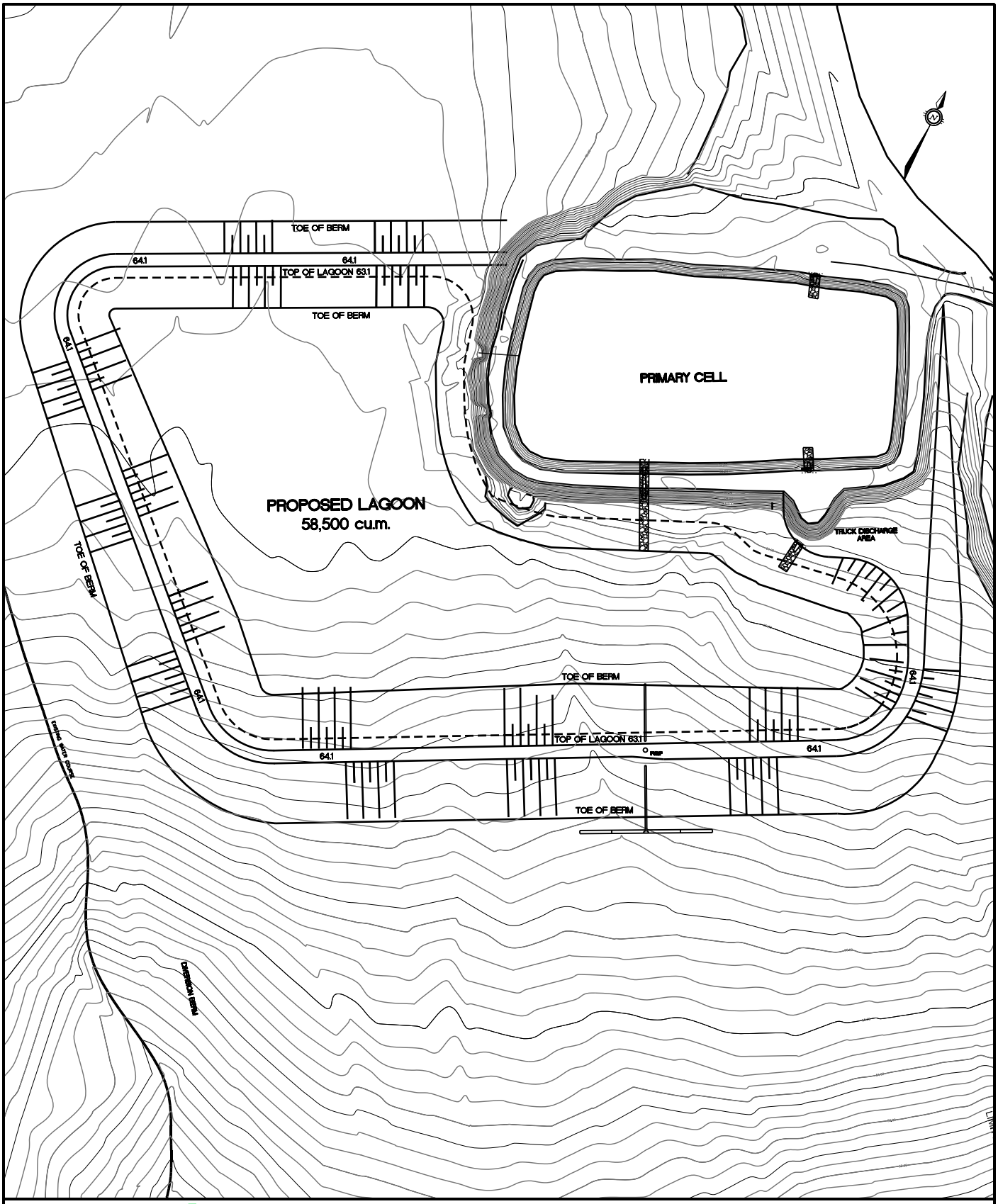

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Tel: (613) 225-9940
Fax: (613) 225-7337

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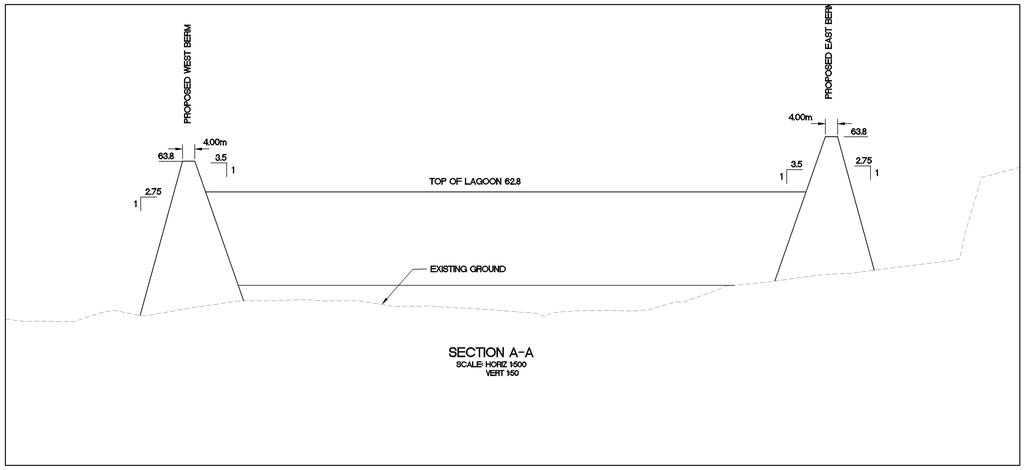

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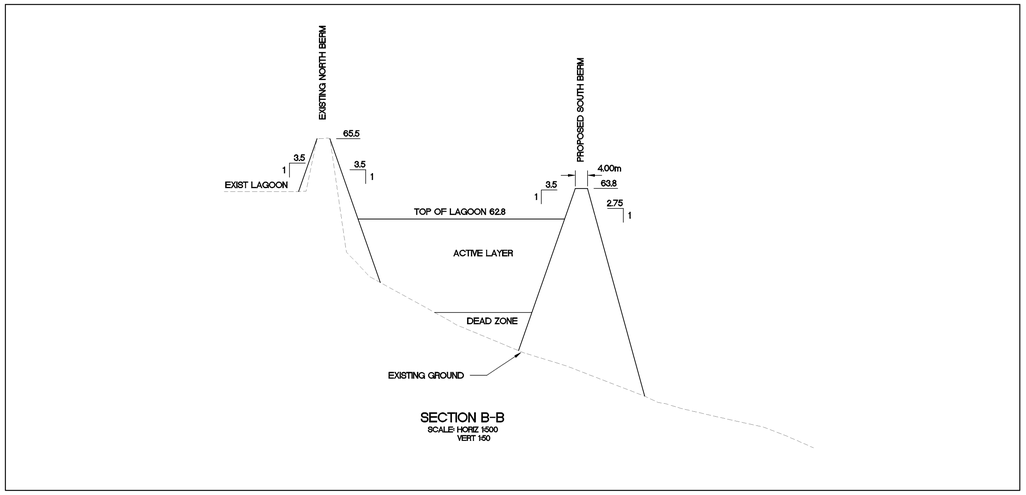

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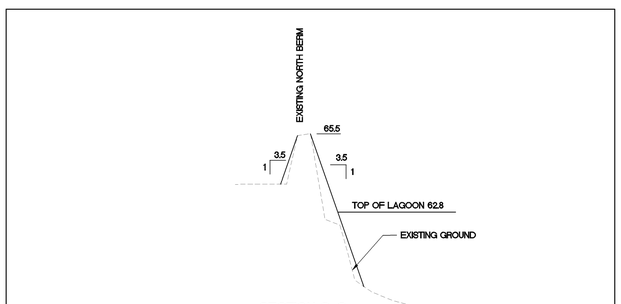

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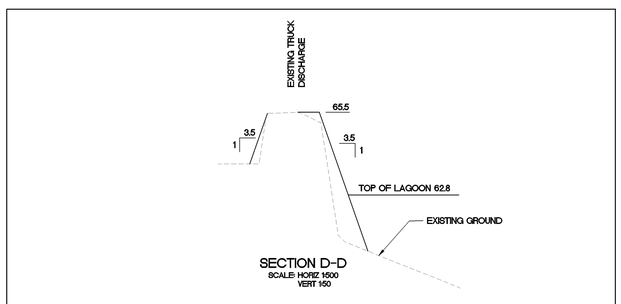

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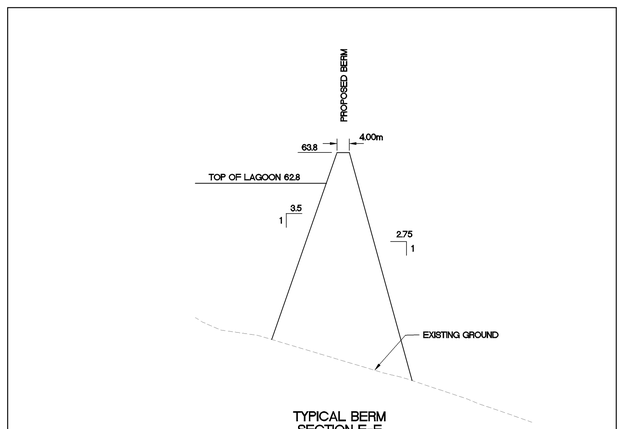

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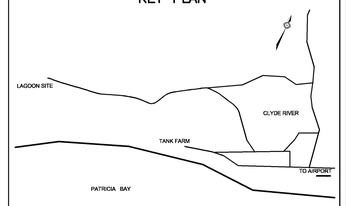
KEY PLAN



LEGEND

BORE HOLE

EXISTING ELEVATION

DIRECTION OF FLOW

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D

REVISIONS

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CLIENT

GOVERNMENT OF NUNAVUT

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TITLE

BERM SECTIONS

design by	SAD	project no.	OTCD00019055A
drawn by	MEB	drawing no.	SEC1
checked by	SLB		
date	30/08/2007		
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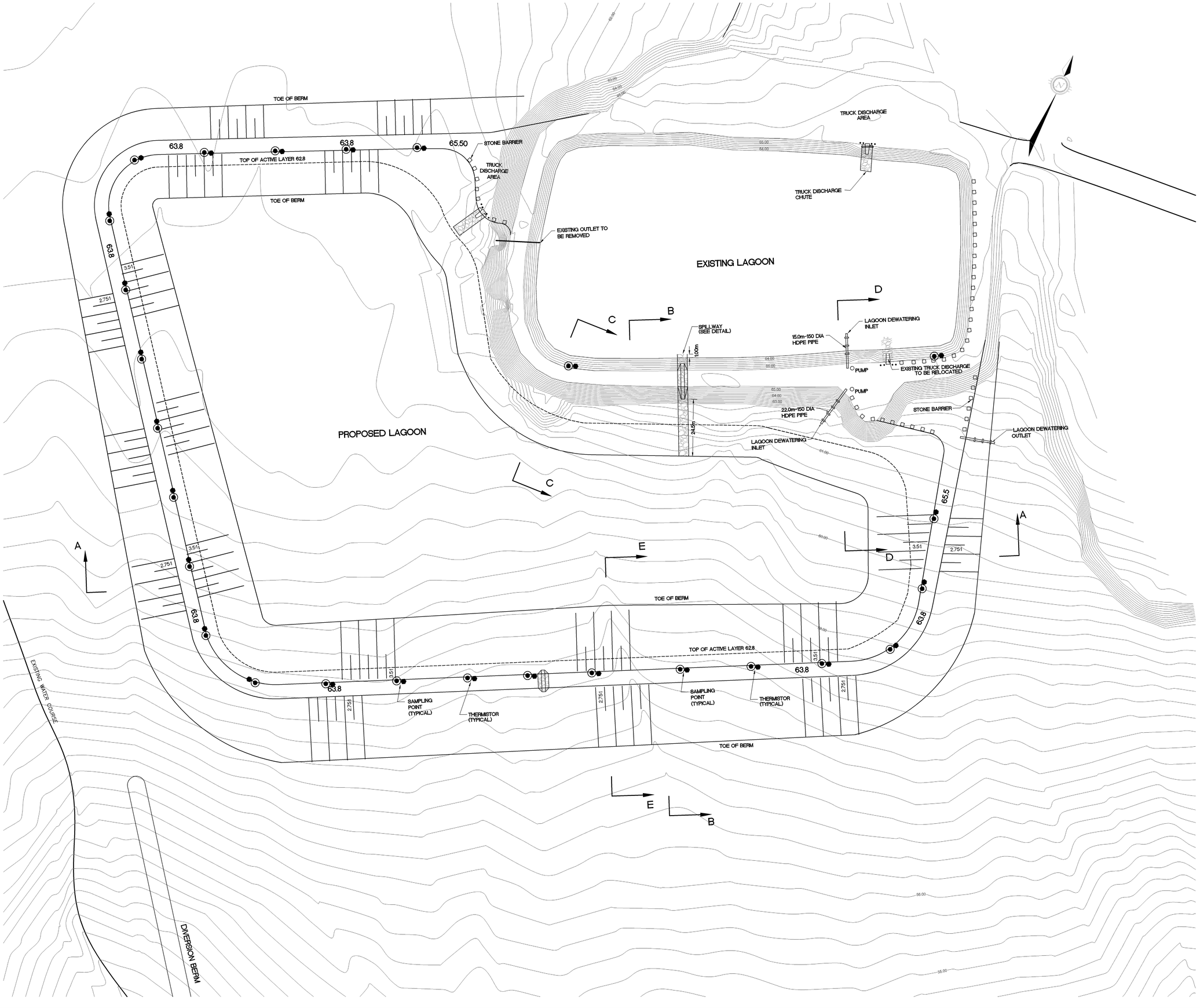

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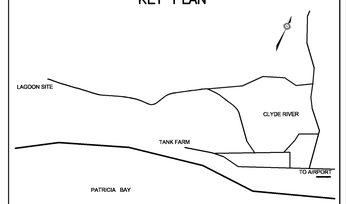

LEGEND

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CLIENT

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CLYDE RIVER
WASTEWATER LAGOON

TITLE

SITE PLAN

design by	SAD	project no.	OTCD000190554
drawn by	MEB	drawing no.	SP–2
checked by	S.L.B.		
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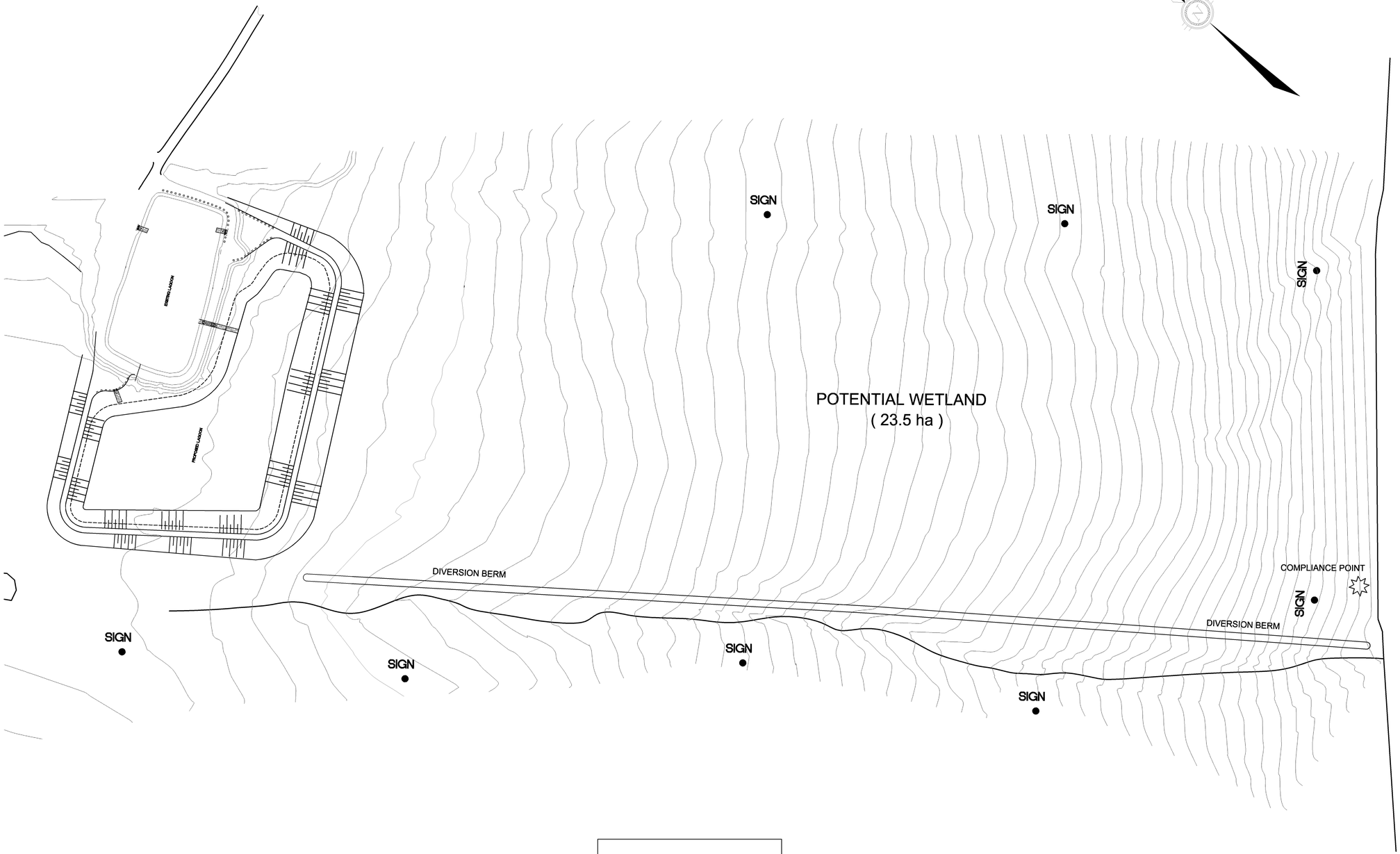
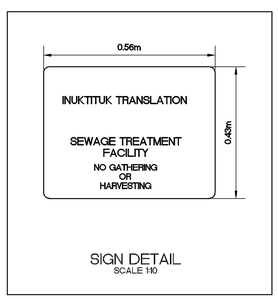
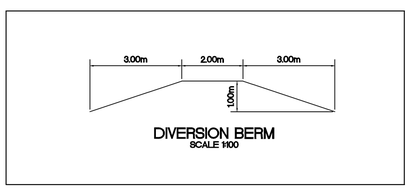




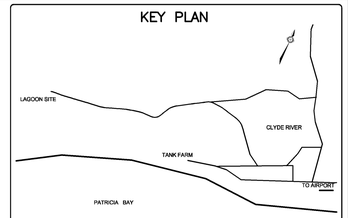
SIGN DETAIL
SCALE 1:10



DIVERSION BERM
SCALE 1:100

NOTES
CONTOUR INFORMATION WAS DERIVED BY TROW ASSOCIATES INC. SURVEY DATED AUGUST 23, 2007.
CONTOUR INTERVALS ARE SET AT 1.00m

KEY PLAN



LEGEND

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D

REVISIONS

Trow Associates Inc.
154 Colonnade Road South
Ottawa, Ont. K2E 7J5
Tel:(613)225-9940
Fax:(613)225-7337

CLIENT
GOVERNMENT OF NUNAVUT

PROJECT
CLYDE RIVER
WASTEWATER LAGOON

TITLE
OVERALL
SITE PLAN

design by	SAD	project no.	OTCD00019055A
drawn by	MEB	drawing no.	SP-1
checked by	SLB		
date	30/08/2007		
scale	HORIZ 1:1500		