Trow

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Reference: OTCD00019055A

June 3, 2008

Mr. Bhabesh Roy, M.A.Sc., P.Eng.
Municipal Planning Engineer
Community Government Services
Baffin Region, Government of Nunavut
P.O. Box 379, Pond Inlet X0A 0S0

via facsimile:
(867) 899-7328

Sewage Lagoon Failure
Clyde River, Nunavut

Dear Mr Roy:

AS per the request of the Department of Community and Government Services (CGS), Government of Nunavut (GN), Mr Steven Burden, P.Eng. and Mr. Surinder Aggarwal, P.Eng. visit the Clyde River sewage lagoon on the afternoon of May 28, 2008 and the morning of May 29, 2008, to gather information regarding the breach of the lagoon berm and subsequent sewage spill. In addition to the information gathered on site, information regarding the failure of the berms was gathered from Mr. Bhabesh Roy of the CGS and Mr. Bill Buckle, Senior Administrative Officer of the Hamlet of Clyde River.

The information gathered indicates that the berm in the southeast corner of the lagoon was overtopped on May 23, 2008. As a result the berm failed over a distance of approximately 10 metres. Temporary repairs were undertaken by the Hamlet of Clyde River comprising of scraping materials from the surface of the berms in the vicinity of the failure and placing in the failed area. As compaction equipment was unavailable, this material could not be compacted, however, we understand that attempts were made to compact material with a frontend loader with limited success. The failure of the berm resulted in the release of approximately 5,000 m^3 of sewage on to the tundra.

Based on the site visit and information gathered we recommend the following:

Reinforcement of the Repaired Berm

The site visit revealed that the level of the sewage is approximately 1.15 m below the top of berms. It was observed that a crescent-shaped crack had begun to form in the area of the repaired berm. This crack is located approximately 1.5 metres from the edge of the crest of the berm. This is an indication of incipient failure of this portion of the berm. Once this section of the berm fails, the remainder of the berm may be too weak to support the lateral hydrostatic pressures and may also fail. It is recommended that this portion of the berm be immediately reinforced to prevent failure. It is noted that there is no excavator available in the Hamlet and the ground is still frozen. It is understood that the reinforcement of the berm can be undertaken through the placement of sandbags. A source of sand has been identified within the Hamlet and there are approximately 5,000 sandbags available within the Hamlet.

The sandbag reinforcement should be comprised of widening the berm at the crest level by 1.25 metre and sloping at an inclination approximately equal to 2 horizontal to 1 vertical. It is estimated that the reinforcement will require approximately 2,500 sandbags. The placement of the sandbags should be such to ensure that the bags do not have any voids or gaps and that the joints are staggered.

A preliminary sketch has been provided to the Hamlet to allow for the emergency repairs to begin. The final placement of sand bags was accomplished on June 2, 2008. Details of the repairs are provided in the attached sketch SK1.

Remediation of Sewage Spill

During the site visit the extent of the area contaminated by the sewage spill was delineated with a GPS unit and is shown on sketch SK2. The area extended approximately 450 metres from the lagoon to the south east towards the ocean. It appears that the majority of the sewage released has been absorbed into the soil structure. This is evident through the melting of the snow and the soil structure being partially thawed near the surface. A portion of the contaminated area demonstrates discoloured snow and areas where the underlined snow has been melted, leaving a thin layer of ice on the surface. Generally, beneath this snow and ice there is a layer of moist and thawed soil, once again indicating much of the sewage has been absorbed into the natural vegetation and soil structure. The width of the flow path is between 30 and 60 metres, and as previously mentioned, extends approximately 450 metres along the slope.

It is felt that as the majority of the sewage has been absorbed into the soil structure, natural treatment will occur as the wetlands rejuvenates in the spring. To address containment of any contamination in the snow pack, it is recommended that a containment berm be constructed just past the extent of the sewage spill as shown on sketch SK2. This containment berm will be approximately 2-3 feet high and span across the width of the contaminated, details of the containment berm are shown on sketch SK3. The purpose of this containment berm will be to delay the release of the sewage during the spring melt. The containment berm will be located downstream of the spill area and will be constructed out of sandbags.

Sewage Testing and Decanting

It is noted that the lagoon was designed with 1 m of freeboard. As such when the level of sewage raises above the 1 m of freeboard level, the stability of the berms would be vulnerable and the berm might fail at locations of weakness. Therefore it is recommended that the one metre freeboard be maintained for stability purposes. This would require a continuous or regular decanting process. As part of this process it is recommended that a sampling procedure be undertaken to determine the characteristics of the existing sewage and determine if the sewage can be released uncontrolled into the natural environment, or if further containment is required. Samples from the lagoon have been taken and forwarded to a laboratory in Ottawa for testing. Results should be available on June 5th or 6th, 2008.

It should be noted that the sewage would be released to the filterstrip wetlands, downstream of the sewage lagoon which is part of the proposed sewage treatment facility. Upon receiving test results of the strength of the sewage, an assessment of the wetlands' ability to treat the sewage

will be undertaken. If it is determined the wetlands can not treat the sewage to acceptable levels, further containment may be required and would be provided through the use of sand bags.

Detailed design for the construction of the containment berm will be provided if required.

Rehabilitation of Lagoon Berms

As per our Geotechnical Report on the sewage lagoon berms, dated January 2008, the existing sewage lagoon berms have slope stability issues which is further evident from the recent breach. In addition, the 2003 Dillon Report noted seepage from the southwest corner of the sewage lagoon, which again indicates potential weakness in the berm. Due to the recent failure and other reported issues, we recommend that the berms slopes be stabilized as soon as possible. Our Geotechnical Report recommended that the existing sewage lagoon berms be stabilized by flattening the slopes. Details of our recommendations for slope stabilization are included in the Geotechnical Report and detail design drawings prepared for the Clyde River Sewage Lagoon Rehabilitation and Expansion, and as shown in sketches SK 4 and 5.

As previously mentioned, it is critical that the one metre freeboard be maintained to prevent overtopping and potential washout of the berms. It is recommended as part of the rehabilitation of the existing berms that an overflow device be installed to ensure that the one metre freeboard is always maintained. Details of the overflow device are included in the detail design drawings for the Rehabilitation and Expansion of the Sewage Lagoon.

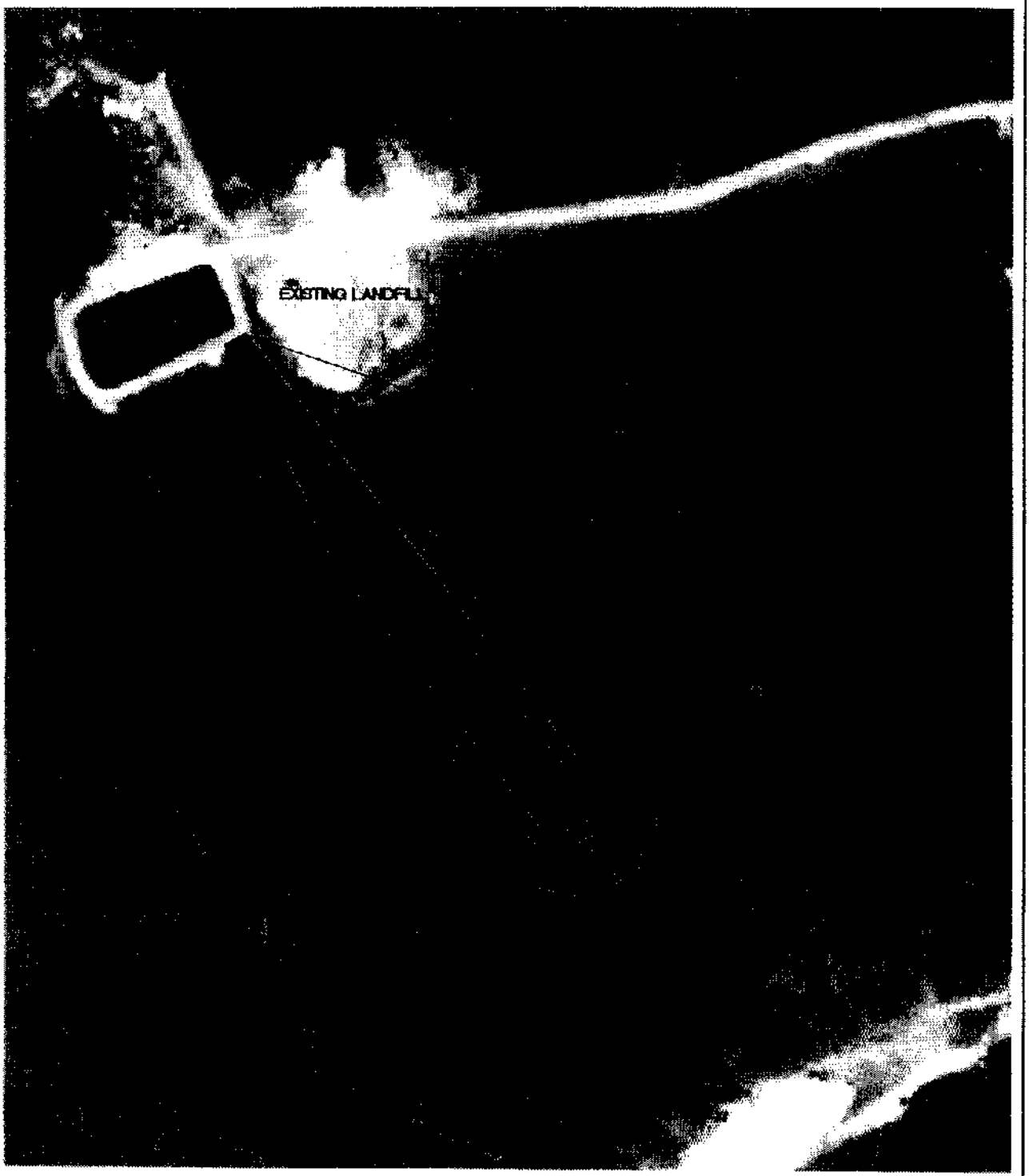
If you have any questions, or require additional information with regards to the findings of our site visit, or the recommendations put forth in this report, please do not hesitate to contact either Steven Burden, P.Eng. or Surinder Aggarwal, P.Eng. at 613-225-9940.

Yours truly,

Trow Associates Inc.

Surinder K. Aggarwal, M.Sc., P.Eng.
Senior Project Manager
Geotechnical & Materials Engineering Services

Steven L. Burden, P.Eng.
Senior Project Manager
Infrastructure Division



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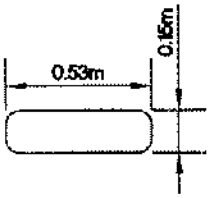
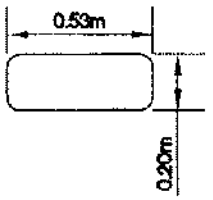
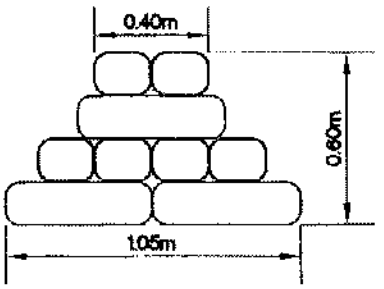
scale: N.T.S.	CLIENT: CGS-GN	project no.: OTCD19055A
date: 02/06/08	TITLE: LIMITS OF SEWAGE SPILL	SK-2
drawn by: MMR		



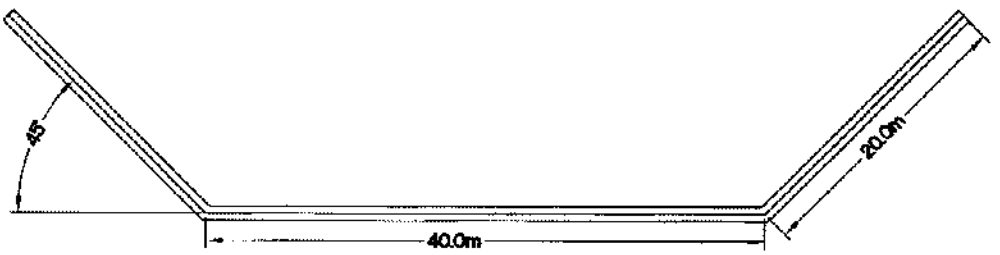
SECTION VIEW
SCALE 1:25



PLAN VIEW
SCALE 1:25



SAND BAGS
SCALE 1:25



SAND BAG BERM
SCALE 1:400

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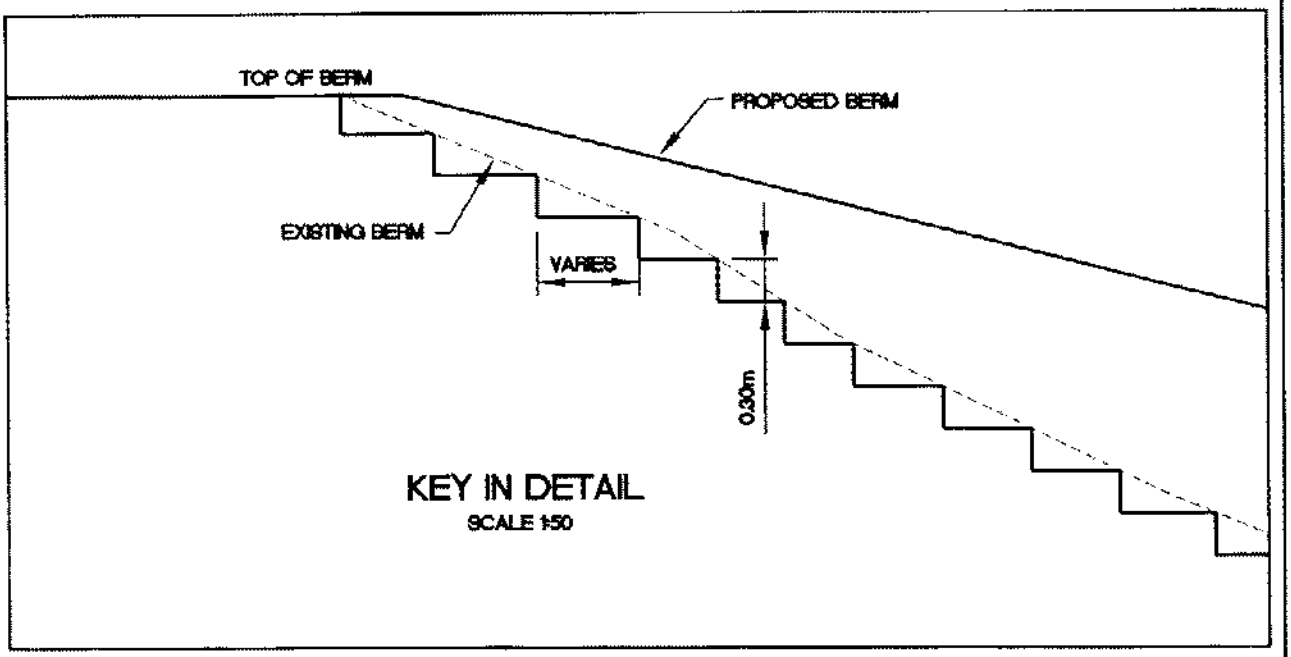
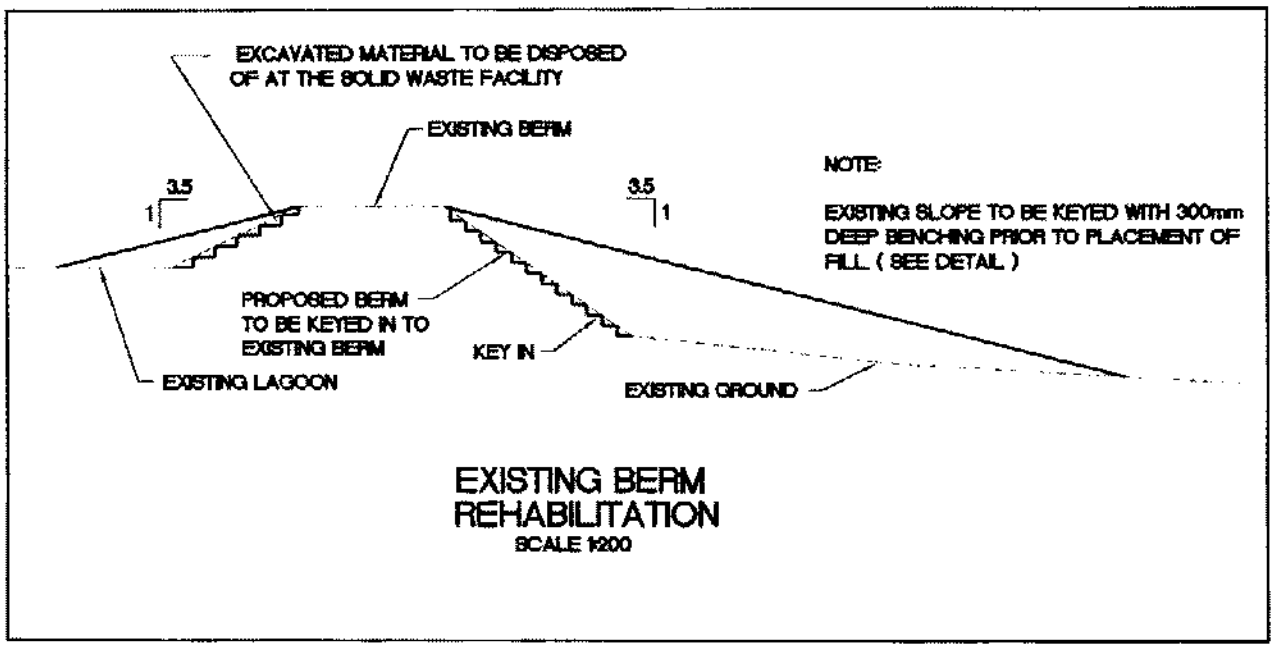
scale: AS SHOWN	CLIENT: CGS-GN	project no.: OTCD19055A
date: 02/06/08	TITLE: SAND BAGS	SK-3
drawn by: MMR		



KEY IN DETAIL
SCALE 1:50



EXISTING BERM REHABILITATION
SCALE 1:200

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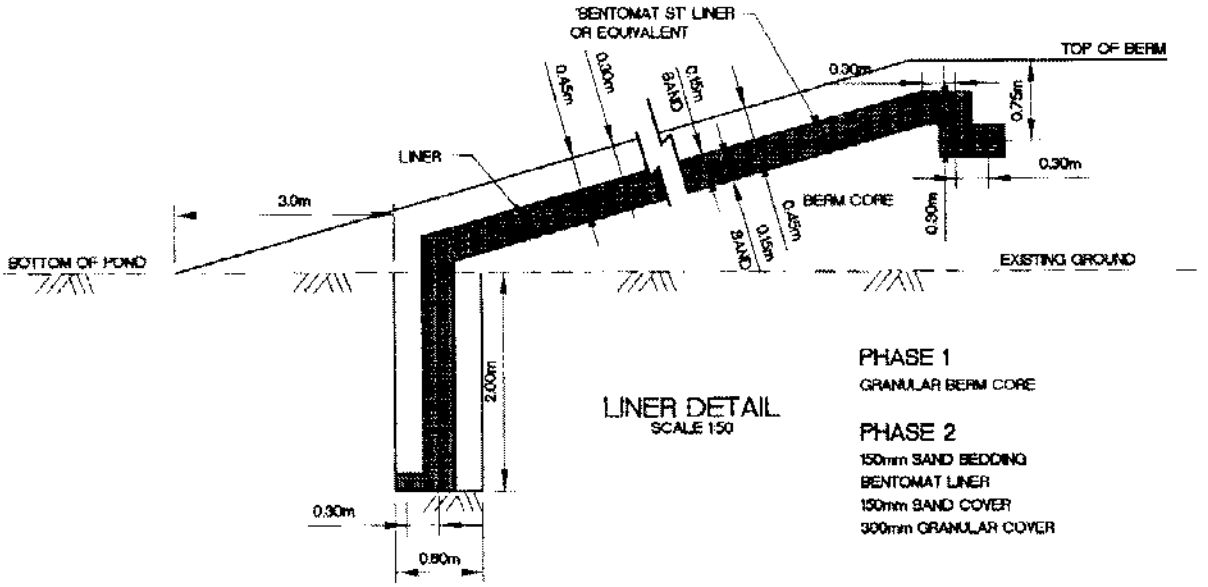
scale: AS SHOWN	CLIENT: CGS-GN	project no. OTCD19055A
date: 02/06/08	TITLE: BERM REHABILITATION	SK-4
drawn by: MMR		



LINER DETAIL
SCALE 1:50

PHASE 1
GRANULAR BERM CORE

PHASE 2
150mm SAND BEDDING
BENTOMAT LINER
150mm SAND COVER
300mm GRANULAR COVER

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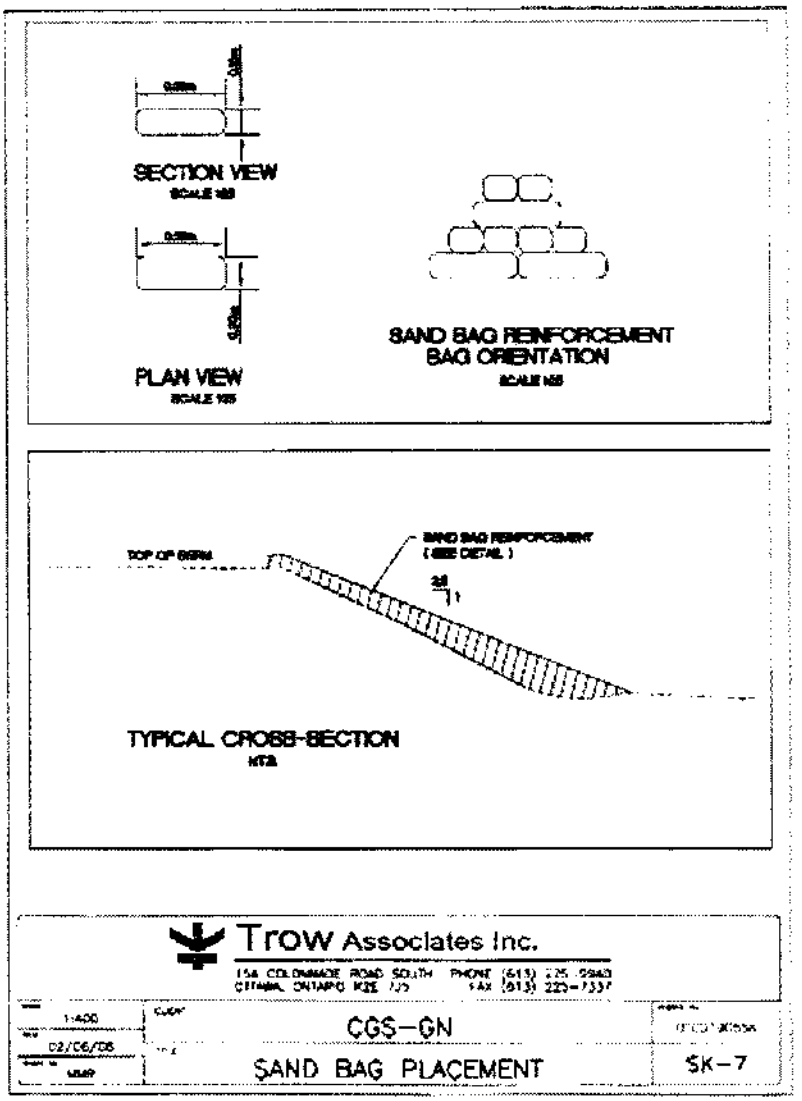
scale: N.T.S.	CLIENT: CGS-GN	project no.: OTCD19055A
date: 02/06/08	TITLE: LINER DETAIL	SK-5
drawn by: MMR		

Appendix A

Figure 1


SECTION VIEW
PLAN VIEW
SAND BAG REINFORCEMENT
BAG ORIENTATION
TOP OF BERM
SAND BAG REINFORCEMENT
(SEE DETAIL)
TYPICAL CROSS-SECTION
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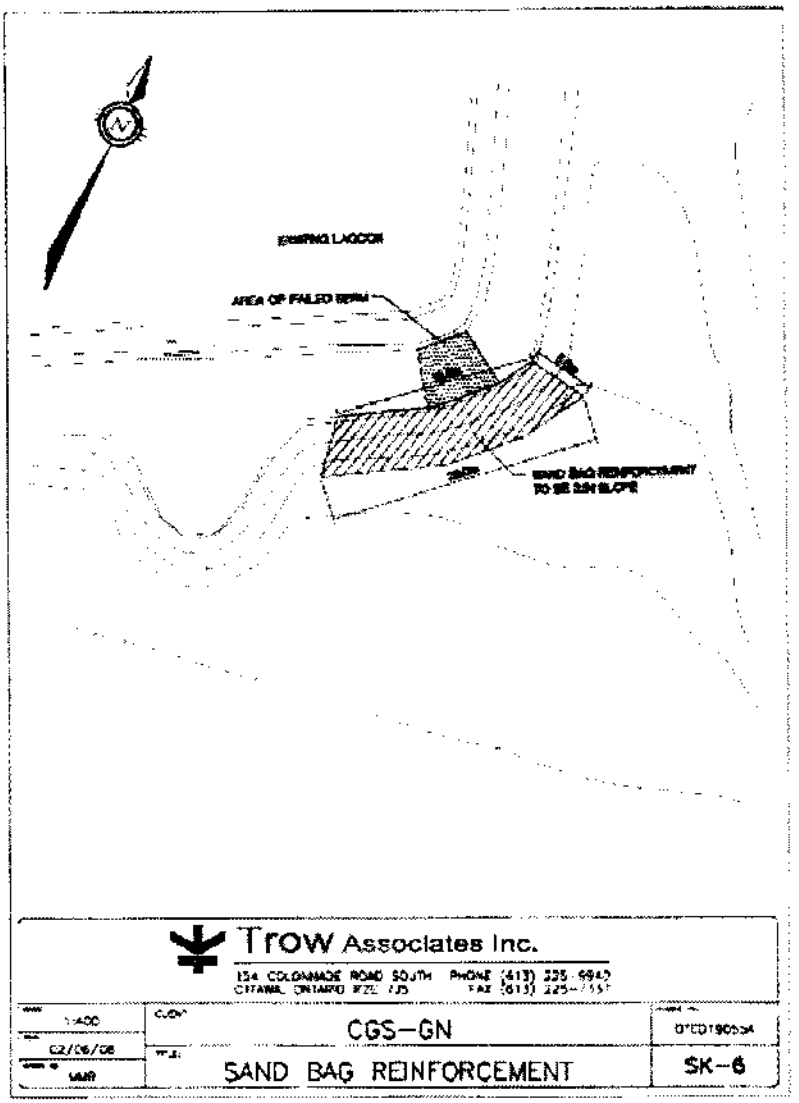
SAND BAG PLACEMENT
SK-7

Figure 2


EXISTING LAGOON
AREA OF FAILED BERM
SAND BAG REINFORCEMENT
TO BE 2.5H:1V SLOPE
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SAND BAG REINFORCEMENT
SK-6

Figure 3

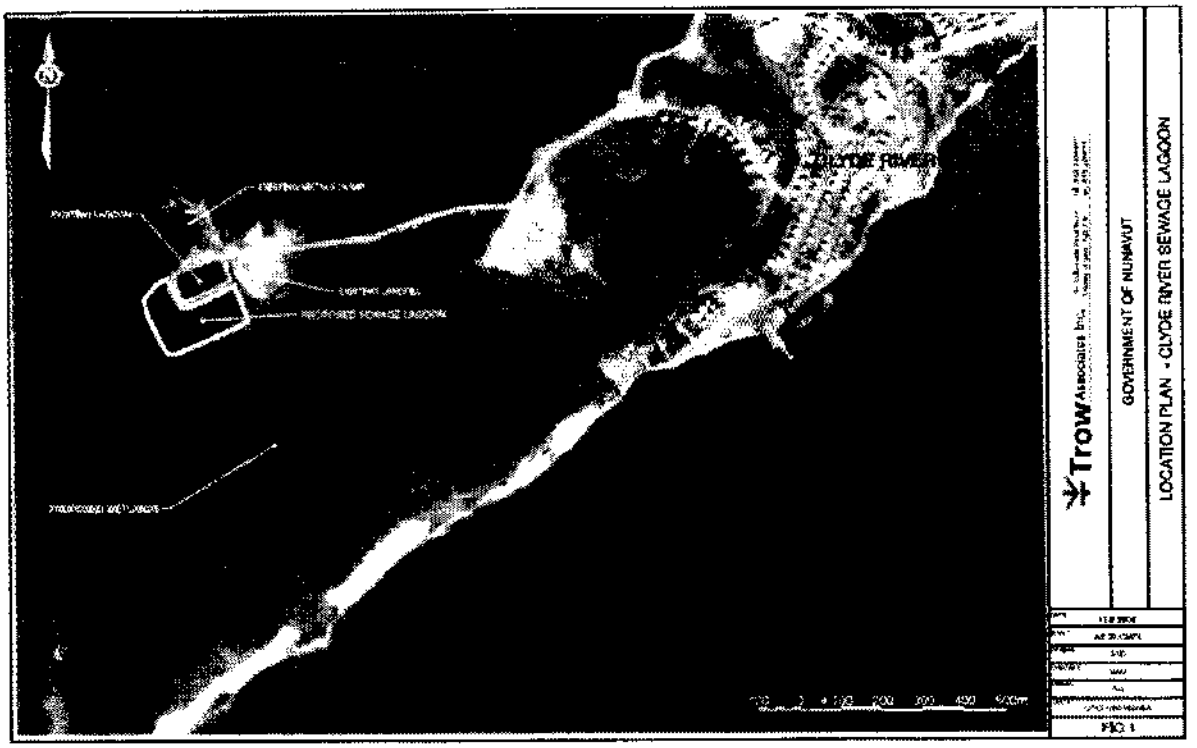

GOVERNMENT OF NUNAVUT
LOCATION PLAN - CLYDE RIVER SEWAGE LAGOON

Figure 4

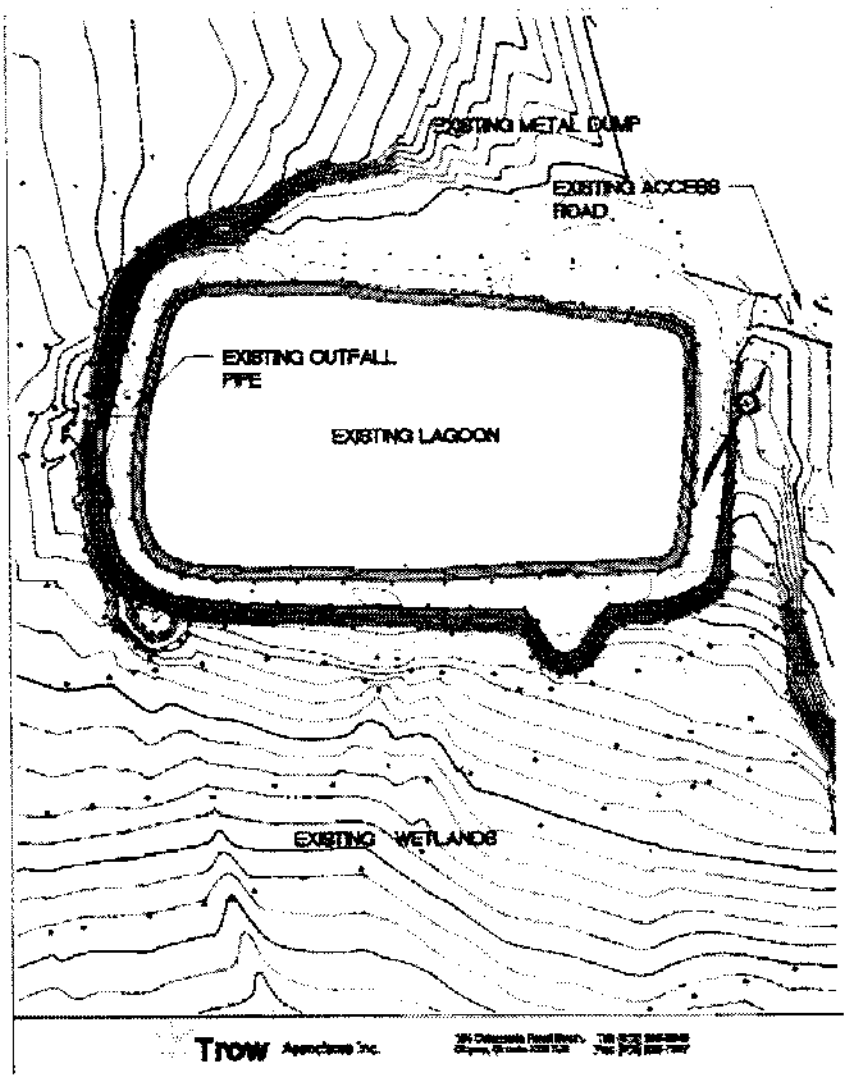
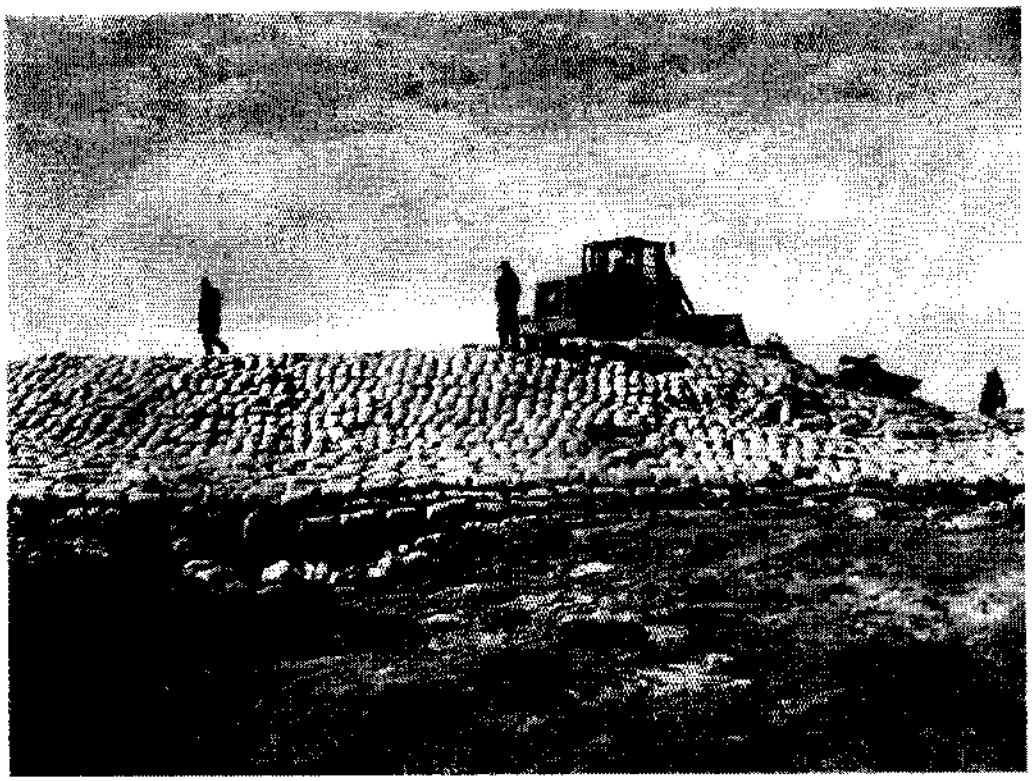
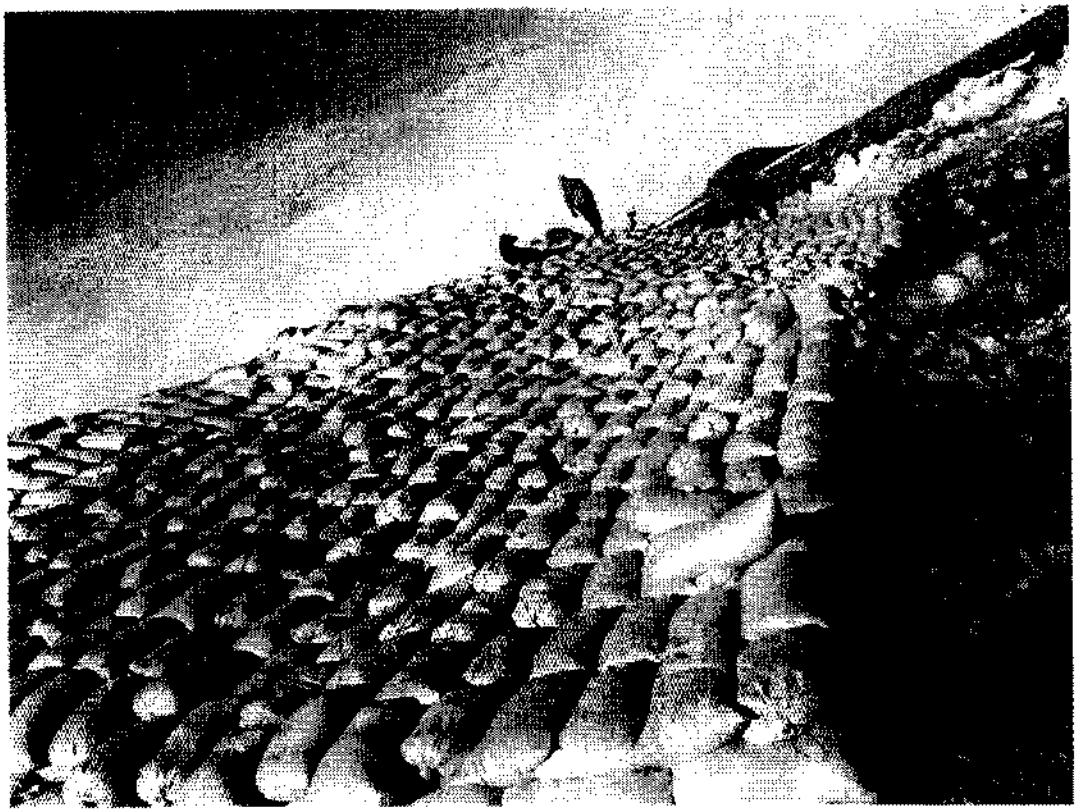

EXISTING METAL DUMP
EXISTING ACCESS ROAD
EXISTING OUTFALL PIPE
EXISTING LAGOON
EXISTING WETLANDS
TROW

Figure 5





Clyde River Sewage Lagoon June 4, 2008