Construction Report
Mount Nansen Seepage Control Dyke and Spillway Upgrading
Department of Indian Affairs & Northern Development
Whitehorse, Yukon

Project No. 0201-00-14618

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EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd. (EBA) was retained by the Yukon Region of Indian and Northern Affairs Canada (DIAND) to complete a dam safety review of the tailings impoundment facility at the former Mount Nansen Mine Site, formerly operated by B.Y.G. Resources Inc. and located 60 km west of Carmacks, Yukon. The work scope was limited to consideration of the physical condition and stability of the tailings dam, and to the adequacy of the associated diversion spillway and seepage control dyke.

During the course of this review, it was determined that urgent upgrading of both the seepage collection dyke and spillway was required. A fast-track design to upgrade the dyke and spillway was developed. This report summarizes the details of the design process, presents conceptual designs of the reconstruction works, and describes the as-built reconstruction of both the seepage collection dyke and diversion spillway.

The existing dyke was originally designed as an earth-fill structure with a geosynthetic clay liner as the primary containment barrier. Seepage rates at the downstream toe of the seepage dyke were reported to be 3.5 L/s to 4.0 L/s in August 2000. Although much of this downstream seepage was thought to be through the abutments, as opposed to through the dyke, it was considered necessary to upgrade the dyke in an attempt to reduce the volume of seepage and improve overall stability.

The upgraded dyke was designed using a geomembrane liner keyed into permafrost soils in the abutments and base, as the primary containment barrier. Horizontal thermosyphon loops, placed in the key trench, were utilized in the design to freeze back the key trench thereby reducing seepage through the key trench. The crest of the dyke was raised 1.0 m to elevation 1131.0 m. The upgraded dyke was designed only to reduce the amount of seepage; it was not intended to be a zero-discharge structure.

The results of a hydrotechnical assessment indicated that the existing spillway would not handle a 20-year storm event without significant physical damage. The upgraded spillway was designed to handle a 200-year storm event. This was to be achieved by re-grading the gravel layer on the bottom of the spillway channel, placing a layer of riprap over the gravel, and adding a series of drop structures along the spillway, with the intent of reducing flow velocities in the spillway channel. However, because of limited onsite availability of acceptable riprap materials, the thickness and areal coverage of the placed riprap was less than recommended. Correspondingly, it was determined that the reconstructed spillway would only be able to handle flows from a 20-year storm event.

1.0 INTRODUCTION

In July 2000, EBA Engineering Consultants Ltd. (EBA) was retained by Yukon Region of Indian and Northern Affairs Canada (DIAND) to complete a dam safety assessment of the tailings impoundment facility at the former Mount Nansen Mine Site, formerly operated by B.Y.G. Resources Inc, and located approximately 60 km west of Carmacks, Yukon. The tailings impoundment facility was constructed in 1996. The work scope included developing a conceptual design to improve the performance of the seepage collection dyke, and providing recommendations to upgrade the diversion spillway.

By August 2000, the results of the safety assessment identified significant physical and environmental deficiencies with the seepage collection dyke and diversion spillway. DIAND determined that these deficiencies warranted immediate corrective action and commissioned EBA to complete fast-track designs to upgrade the dyke and diversion spillway and to provide construction monitoring services for these remediation activities. The fast-track conceptual design was completed in August 2000. Upgrading of the seepage collection dyke was completed by November 2000. Reconstruction of the diversion spillway was substantially complete by August 2001.

This report summarizes the design process and conceptual designs for upgrading the seepage collection dyke and diversion spillway. Highlights of the as-built reconstruction of these two structures are described. Associated reports to be considered in conjunction with this construction report include the Mount Nansen Dam Safety Assessment Report (EBA June 2002) and the Mount Nansen Data Summary Report (EBA September 2002).

For additional information regarding the use of this report, please refer to the General Conditions, included in Appendix A.

1.1 Seepage Collection Dyke

During the initial stages of the dam safety assessment, DIAND determined that the environmental performance of the seepage collection dyke was unacceptable, based on the seepage rates (approximately 3.5 to 4.0 L/s) observed at the downstream toe of the dyke and on the levels of contaminants present in the escaped seepage water. Furthermore, an erosion channel had developed on the south slope of the Dome Creek valley, running just upslope of the tailings dam and crest of the seepage collection dyke and discharging just downstream of the toe of the seepage collection dyke. Runoff water transported along the erosion channel was affecting the integrity of the south abutment of the seepage collection dyke.

DIAND directed EBA to develop a conceptual remediation plan to upgrade the seepage collection dyke. This plan was completed in August 2000. Once reviewed, and accepted, EBA's work scope for the seepage collection dyke expanded from developing a conceptual design to providing detailed design and construction administration services. The detailed design was fast-tracked with the design and tendering being completed by October 3, 2000. Reconstruction of the dyke was completed by November 12, 2000.

The remediation design incorporated a remnant of the existing dyke, placement of a geomembrane liner downstream of this remnant, and the raising of the crest of the existing dyke. The liner was tied into a key trench in permafrost. A layer of sand-bentonite was placed on the base of the key trench to minimize the amount of seepage through the key trench. Horizontal thermosyphon loops were placed in the key trench to freeze the unfrozen key trench backfill and ensure that the geomembrane liner was tied into the natural permafrost soils below the original ground surface. The design relied on the geomembrane liner and nearly-saturated permafrost soils as containment barriers. The erosion channel on the south abutment was filled to protect the dyke from further erosion damage.

1.2 Diversion Spillway

B.K. Hydrology Services Ltd. (BKH) was subcontracted by EBA to carry out a hydrotechnical assessment of the diversion spillway. The scope of work was as follows:

- to conduct a full review of the Designer's (Klohn-Crippen) hydrological assessment for the impoundment;
- to provide recommendations regarding design flows up to the 200-year return storm event;
- to carry out a condition inspection; and
- to provide recommendations for upgrading the spillway so that it could safely handle flows from the predicted 200-year storm event.

The initial assessment was completed in August 2000. The hydrology review, channel capacity and condition, proposed spillway modifications, and final spillway capacity and conditions were summarized in the Dam Safety Assessment Report (EBA June 2002).

By late-August 2000, DIAND and BKH had agreed that the condition of the existing diversion spillway was inadequate and required urgent reconstruction to improve the safety of the facility. Consequently, EBA's work scope was again expanded to include the provision of design and construction administration services to upgrade the diversion spillway.

Upgrading activities for the spillway were initiated out in October 2000 in conjunction with the reconstruction of the seepage collection dyke and substantially completed in August 2001. In October 2001, BKH completed a revised assessment of the spillway.

2.0 DESIGN

This section summarises the design process, design criteria, and conceptual design of the upgraded seepage collection dyke and diversion spillway.

2.1 Seepage Collection Dyke

2.1.1 Design Process

As described in Section 1.1, EBA's scope of work had changed from developing a conceptual plan to upgrade the seepage collection dyke, to providing detailed design and construction administration services. The detailed design was fast-tracked without geotechnical investigations being conducted along the seepage collection dyke centreline. Remediation options were discussed between EBA, DIAND, and Geo-Engineering (acting as reviewer on behalf of DIAND) in August and September 2000. The selected remediation design was carried forward after agreement from all three parties.

Foundation conditions below the seepage collection dyke were estimated based on the following available information:

- geotechnical data provided in Klohn-Crippen's 1995 tailings dam design report;
- observations from a shallow testpitting program conducted by EBA in the vicinity of the seepage collection dyke in August 2000; and
- the results of the 1999-2000 ground temperature monitoring program of the tailings dam and seepage collection dyke conducted by EBA (EBA 2000).

Since there was very limited as-built construction reporting for the existing dyke, as-built conditions were estimated based on dyke design details presented in Klohn-Crippen (1995) and from construction records.

Foundation conditions below the centre of the dyke, based on the borehole log from Borehole DH95-10 (Klohn-Crippen, 1995), consisted of fine to coarse-grained sand, some silt to silty, with some layers of silt, peat and gravel. Ground temperature measurements from a vertical ground temperature cable installed from the dyke crest, Borehole 12861-10 (EBA 2000), showed that the native ground had thawed approximately 1.0 m to 1.5 m below the original ground elevation, but below this depth remained in a permafrost condition, with mean ground temperatures of approximately -0.7°C at approximately 15 m depth below the dyke crest. Ground temperature measurements at the main tailings dam indicated that permafrost temperatures were warmer (approximately -0.2°C) and the active layer was deeper (approximately 4 m) at the north abutment compared to the valley bottom and south abutment (Klohn-Crippen, 1995). This was likely because of the increased absorption of solar radiation on the south-facing slope and the amount of seepage on the north side. Similar permafrost conditions (-0.2°C ground temperature and 5 m deep active layer) were estimated for the north abutment of the seepage collection dyke for remediation design. The permafrost table was expected to be approximately parallel to the ground surface topography.

The existing seepage collection dyke was designed as an earth-fill dam with a geosynthetic clay liner (GCL) as the primary containment barrier (Klohn-Crippen, 1995). The GCL was to be tied 2 m into the permafrost below the upstream toe of the dyke. However, construction records indicated that the GCL was not tied into the permafrost nor was it extended into the abutments. Construction records also indicated that the natural ground surface below the dyke footprint was only stripped to a depth of approximately 0.6 m. Not all of the organics below the dyke footprint were stripped prior to dyke construction.

Excavation and material volumes were estimated based on detailed surveys of the seepage collection dyke area by Yukon Engineering Services (YES) in August 2000.

2.1.2 Design Criteria

The upgraded seepage collection dyke was not designed in accordance with the Dam Safety Guidelines (Canadian Dam Association, 1999) with regards to freeboard design, sizing the dyke for a design inflow flood, and the long-term performance of the dyke (e.g., considering the dyke integrity under extreme warm years or under long-term global warming). The long-term plans for the upgraded seepage collection dyke were not known at the time of fast-track design. DIAND indicated that the upgraded dyke would be required to function for a period ranging from a few years to indefinitely. The design intent of the remedial activities was to reduce the amount of seepage downstream of the dyke; the upgraded dyke was not designed to be a zero-discharge structure. EBA and DIAND agreed that the dyke crest would be raised approximately 1.0 m to a dyke crest elevation of 1131.0 m. The maximum operating level was designed to be at elevation 1130.0 m. It was understood that the operating level of the impounded water would be monitored and regulated by pumping water back into the tailings pond.

2.1.3 Conceptual Design

The design of the seepage collection dyke remediation considered the following:

- construction activities would be carried out over the months of October and November of 2000;
- constructability issues, given the types of existing earthfill and foundation conditions, climatic conditions during reconstruction, seaming of the geomembrane liner, and the variability in permafrost conditions;
- the presence/absence and frozen/unfrozen state of peat and organics beneath the dam footprint;
- full impoundment (to the maximum operating level, el. 1130.0 m) of the seepage collection pond year-round; and

- permafrost foundation and the effectiveness of nearly-saturated permafrost soils as a containment barrier.

The design of the reconstructed seepage collection dyke incorporated the following components:

- *Upstream sump.* Just beyond the upstream toe of the dyke, a trench was excavated to the permafrost table (top of permafrost). Water that collected in the trench was pumped out to ensure that the key trench could be excavated and backfilled in a dry environment and to improve the stability of the slopes of the temporary excavations.

- *Remnant of Existing Dyke.* Given the apparently low seepage flow through the dyke, it was assumed that the existing GCL was in good condition and was providing some form of containment. Therefore, the existing GCL was to be left intact. As much as possible, the existing earth-fill in the dyke superstructure was left intact to minimize excavation and material requirements.

- *Permafrost Foundation.* The dyke foundation was expected to be in a permafrost condition. Ground temperatures were expected to range from –0.2°C to –0.7°C and the active layer thickness was expected to range from 2 m to 5 m. Warmer ground temperatures and a deeper active layer were anticipated at the north abutment, similar to what was observed along the main tailings dam alignment. It is EBA's experience at the diamond mines near Lac de Gras, NT, that nearly-saturated frozen soils have sufficiently low permeability that they can be an effective containment barrier.

- *Downstream key trench.* The existing dyke design required the GCL to be tied into the permafrost below the upstream toe but construction records indicated that this was not the case. Water impounded for an extended period against the upstream slope of the dyke constructed with the original design configuration on permafrost could thaw the permafrost below the upstream toe of the dyke. Therefore, it was

decided that the key trench should be located near the downstream toe to ensure that the liner could be tied into permafrost soils.

- *Sand-bentonite in key trench.* A 0.5 m thick layer of sand-bentonite was placed at the base of the key trench to minimize seepage flow through the base of the key trench and to provide a base for both the liner and the bottom row of thermosyphon loops.

- *38 mil supported Arctic Liner.* Arctic Liner is a PVC liner that was designed to be used for the primary containment. Given the expected subzero ambient air temperatures during reconstruction, Arctic Liner was selected because it remains flexible and can be welded using leistering or hot-wedge techniques under cold temperatures (rated to –15°C by the manufacturer, Layfield Plastics Inc.). It was also the most suitable liner that could be delivered quickly; this was necessitated by the fast-track design and construction process. Supported Arctic Liner has a geotextile mesh sandwiched between the PVC layers; this provides additional tensile strength to the liner, which was considered an important feature considering that the liner was to be placed vertically in a 2 to 3 m deep vertical key trench. The maximum slope of the remnant dyke fill over which the liner could be placed was 2.5H:1V, which was governed by the steepest allowable slope at which the liner could be welded with a hot-wedge welder. The design crest elevation of the Arctic Liner was set at 1130.5 m; since the design maximum operating elevation was 1130.0 m, the dyke was designed with 0.5 m freeboard. Woven geotextile, sewn to the end of the Arctic Liner in the key trench, was incorporated in the design to ensure that the Arctic Liner could be installed vertically in the key trench in the event that the key trench sidewalls were unstable.

- *horizontal thermosyphons.* Since the key trench fill was designed to be placed in an unfrozen state and covered with more unfrozen earth-fill, artificial cooling was required to increase the rate at which the unfrozen key trench backfill would freeze

back and to ensure that the liner was keyed into permafrost soils. Thermosyphons were used to freeze back the key trench backfill.

Thermosyphons are passive heat-removal devices that operate without the need for an external energy source. The above-grade portion of a thermosyphon is termed the condenser (radiator) and the below-grade portion is the evaporator. Thermosyphons use a two-phase working fluid to remove heat from the ground and release it to the ambient air whenever the radiator (air) is colder than the evaporator (ground). Horizontal thermosyphons are a relatively recent development. These units use a loop type evaporator that is typically manufactured using 20 mm steel pipe. The amount of heat extracted from the ground is controlled by climatic conditions, the radiator size, the length and configuration of the evaporator loops, and ground temperatures.

Thermal analyses were carried out to determine the required thermosyphon configuration. The thermal analyses assumed that seepage through the dam was very small such that convective heat transfer caused by flowing groundwater was minimal. The thermosyphons were configured so that the unfrozen key-trench backfill would freeze back by the end of the first winter following reconstruction under mean climatic conditions, and maintain the key trench frozen through the summer (when the passive thermosyphons provide no cooling). Mean ambient air temperatures (estimated to be Carmacks mean minus 3°C, as used in Klohn-Crippen's thermal design of the main tailings dam) were assumed in the thermal design.

The results of the thermal analyses indicated that a total of four thermosyphon loops, each connected to a 19.5 m^2 radiator, were required. The loops were to be installed within the key trench in two rows, as shown on the Contract Drawings (see Appendix C). Since warmer ground temperatures and a deeper active layer were expected at the north abutment compared to the south abutment, the loops connected to radiators at the north abutment were to be shorter than the loops connected to

radiators at the south abutment. The shorter loop length directed more heat flow from the north abutment for the same size radiator.

- *Erosion Channel Repair*. The erosion channel appeared to have developed from disturbance and removal of the natural vegetation cover during past construction activities. The reconstructed channel was designed to stabilize the erosion channel and protect it and the seepage collection dyke from further erosion. The channel was infilled with compacted Zone 1 sand fill, Zone 2 gravel fill, non-woven geotextile and riprap, as shown on the Contract Drawings (Appendix C). Specifications for the Zone 1 sand fill and Zone 2 gravel fill are described in the Contract Specifications (Appendix B). A small swale was incorporated in the design so that runoff water from the south slope of the Dome Creek valley would continue to flow around the south abutment of the seepage collection dyke.

Stability analyses were carried out to ensure that the slopes would be stable both for the short-term, during reconstruction, and in the long term.

2.2 Diversion Spillway

2.2.1 Design Process

In mid-August 2000, BKH reviewed the original hydrologic flows forecast by Klohn-Crippen (1995) and conducted a site visit. BKH predicted instantaneous peak flows in the diversion spillway of 1.2 m^3/s and 3.0 m^3/s from 20-year and 200-year storm events, respectively. Based on the predicted peak flows and the observed condition of the diversion spillway, BHK concluded that the existing diversion spillway section would not even handle a 20 year storm event without significant damage.

Remediation alternatives were discussed in September 2000 between BKH, EBA and DIAND with a design concept resulting from these discussions. Reconstruction

activities for the spillway were timed to coincide with the reconstruction of the seepage collection dyke.

2.2.2 Design Criteria

The spillway was designed to handle the 200-year storm event but not the Probable Maximum Flood (PMF) event. This design criteria was considered satisfactory based on the assumed timeline of 5 years, by which time a decision would be made to either upgrade the spillway to handle the PMF event or to decommission the impoundment facility.

2.2.3 Detailed Design and Specifications

To pass the 200-year storm event, BKH considered two options. The first option was to armour the entire spillway channel with a 1 m thick layer of 400 to 500 mm median-size riprap. The second option consisted of constructing a series of drop structures along the spillway channel to reduce flow velocities, dissipate energies, and limit erosion between any two sets of drop structures. Because of the limited availability of graded riprap on site and the cost associated with each option, the second option was selected.

The recommended modifications to the diversion spillway were implemented in the Contract Specifications and Drawings (Appendix B and Appendix C, respectively) and are summarized below.

The gravel layer should be re-graded to ensure that there would be at least a 0.3 m thickness of gravel in place over the base and sidewalls (up to 1.5 m height above the bottom) of the spillway channel.

All existing riprap located higher than 1.5 m above the bottom of the spillway channel should be moved to the base of the channel, on top of the gravel layer. This rip rap layer should be 0.6 m in thickness. The riprap should have a median size of 300 mm. 80

percent of the riprap should be 200 mm or greater. The size of the riprap should be no greater than 450 mm.

Fourteen drop structures should be constructed along the spillway. Drop structures would be placed at every 2 m drop in elevation along the spillway. The first drop structure would be placed at elevation 1148 m and the last drop structure would be placed at elevation 1122 m.

The width of the channel bottom near the spillway discharge exit should be increased from 3.0 m to a minimum of 5.0 m.

3.0 CONSTRUCTION DETAILS

Pelly Construction Ltd. was the general contractor for the reconstruction works. EBA provided onsite construction administration and quality assurance services. DIAND representatives completed frequent site visits throughout the construction process. While onsite, EBA completed detailed daily construction reports (presented in Appendix D).

3.1 Seepage Collection Dyke

Reconstruction of the seepage collection dyke was carried out between October 17 and November 12, 2000. The following subsections summarize the activities recorded in the daily construction reports.

3.1.1 Erosion Channel

All loose, wet, and slumped organic and inorganic materials from the erosion channel base and sidewalls were excavated and removed from the channel. Zone 1 sand fill was then placed and compacted to achieve the desired grade. All compaction testing completed on this material met or exceeded the specified requirements; results of compaction testing are presented in Appendix E. A non-woven geotextile was placed on

the compacted sand surface and overlain with a 300 mm thick layer of gravel and a layer of 300 mm rip rap.

3.1.2 Dyke Excavation and Foundation Preparation

The excavation of the existing dyke commenced on October 23, 2000. The dyke was excavated to slopes specified by the Site Engineer to provide a smooth and stable base on which to place the liner.

During excavation of the key trench, it was discovered that the thickness of the active layer at the north abutment was much greater than estimated. At the direction of DIAND, construction ceased on the dyke while a series of probe holes were completed to determine the elevation of the permafrost table along the key trench alignment. The elevation of the permafrost table was found to be approximately 1124 m between Stations 0+076 and 0+095, climbing to approximately 1136 m by Station 0+100, and levelling off from this station northwards. The actual permafrost table was up to 12 m deeper than originally assumed. Furthermore, the actual slope of the permafrost table at the north abutment was much steeper, 2.4V:1H, between Stations. 0+095 and 0+100. The deeper active layer may have been a result of permafrost degradation caused by the transfer of convective heat from groundwater flow through the north abutment.

Construction volumes and costs along with design parameters of the liner and thermosyphon systems were reviewed to determine whether the reconstruction could be completed in the autumn of 2000 or needed to be delayed until the following year. It was decided that the reconstruction would recommence and that the liner and thermosyphons would be adapted in the field to the conditions encountered.

3.1.3 Dewatering

Dewatering of seepage water in the north abutment area required significant effort. Several options to control the seepage flows were evaluated. The sump configuration that was eventually used consisted of a geotextile "sock", wrapped around pipe and gravel, and buried in a drainage trench that was excavated into the permafrost. The drainage trench was located upstream of the key trench.

Pumping was maintained throughout construction of the key trench. Water that collected in the sump was redirected into the main tailings impoundment reservoir.

3.1.4 Liner System

Prior to the placement of the Arctic Liner, a levelling course of sand-bentonite material was placed over the base of the key trench excavation. The majority of the sand-bentonite was mixed in the box of a haul truck, using onsite equipment. The base and sidewalls of the key trench were inspected; sharp objects that could damage the liner were removed, where required. Considerable effort was used to clean angular gravel from the upstream face of the key trench. A non-woven geotextile was also placed over the upstream face of the key trench to further protect the liner system.

The liner was installed between November 5 and 10, 2000. Listering was utilized to complete the field seams. Between Sta. 0+095 and 0+100, placement of the liner was hindered because of the steep rise in the key trench up the north abutment.

During field installation, it was determined that the woven geotextile, which was to be sewn to the Arctic Liner and placed in the key trench, was not required.

3.1.5 Horizontal Thermosyphons

The horizontal thermosyphons were installed between November 6 and 8, 2000 by Arctic Foundations of Canada Inc. The as-built thermosyphon configuration accounted for the new geometry of the key trench along the north abutment.

3.1.6 Dyke Fill Placement

The fill was placed as per the contract documents. Compaction testing was completed by EBA on the Zone 1 sand fill. Three of the 38 tests completed did not meet the specified 95% of the maximum dry density. Compaction test results are presented in Appendix E.

3.1.7 Dyke Instrumentation

The installation of the dyke instrumentation was outlined in EBA's letter report 'Drilling/Instrumentation Installation, Seepage Collection Dyke Reconstruction', dated June 21, 2001. This letter report is appended as Appendix F.

3.2 Diversion Spillway

Upgrading of the diversion spillway was initiated in October 2000 during reconstruction of the seepage control dyke. It was intended that existing material stockpiles would be used prior to the onset of winter conditions. However, ice had developed in the spillway channel and spillway reconstruction could not be completed in the fall of 2000. Activities completed in October 2000 included placing the gravel bedding and some riprap cover over the channel base. Construction of the drop structures was initiated but not completed.

In July 2001, reconstruction of the spillway resumed. Prior to resuming construction, a scour and piping failure developed on the south side of the spillway channel near its discharge point. The cause of the failure was not determined but was suspected to be the

result of permafrost thaw initiated by the fall 2000 reconstruction of the seepage collection dyke. During July and August 2001, the failed section was rebuilt, additional riprap was placed in the spillway channel, and the drop structures were completed, excluding Drop Structure #1. This drop structure, located at the spillway discharge point, was not installed due to concerns about icing.

Because of limited onsite availability of riprap material, the placed thickness of riprap was half of the recommended thickness and the riprap covered only 50 to 80 percent of the channel bottom, whereas 100 percent coverage was recommended.

4.0 AS-BUILT CONDITIONS

4.1 Diversion Spillway

In October 2001, Mr. Bernie Kallenbach, P.Eng., of BKH returned to the mine site to inspect the reconstructed spillway. Mr. Kallenbach's site inspection report is presented in Appendix B of the Dam Safety Assessment Report (EBA June 2002).

BKH determined that the channel improvements almost doubled the stable flow capacity that the spillway could handle, from 0.6 m^3/s to nearly 1.2 m^3/s. Consequently, the spillway channel could handle flows up to the 20-year storm event. In order to achieve the design 200-year storm event flow capacity, the rip rap cover would have to be doubled in thickness and extended in areal coverage.

It was also concluded that many of the drop structures required additional work to achieve the design 200-year storm event flow capacity.

The assessment by BKH was further supported by the concerns of EBA in regard to the construction of the spillway channel. EBA's observations during the recent reconstruction and failures suggested that the spillway was not constructed in a

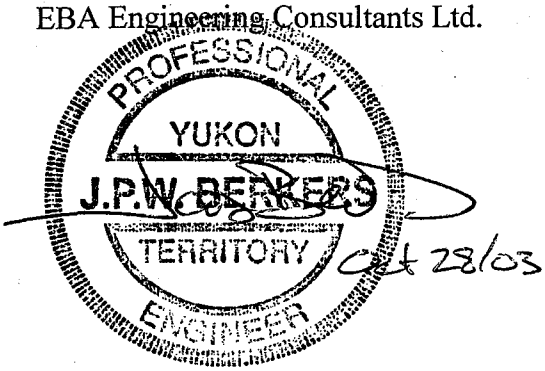
consistent manner: geotextile coverage, filter gravel thicknesses, and rip rap thickness likely varied considerably along the spillway. Therefore, the reliability of the spillway will always be considered suspect unless it is fully reconstructed.

5.0 CLOSURE

EBA trusts that this report meets with your approval. Please do not hesitate to contact the undersigned should you have any questions or comments.

Respectfully submitted,

EBA Engineering Consultants Ltd.



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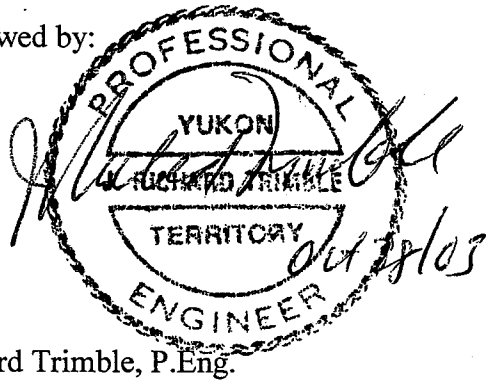
Reviewed by:



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PERMIT TO PRACTICE
Signature
Date Oct 28/03
PERMIT NUMBER: PP003
Association of Professional Engineers of Yukon

REFERENCES

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Klohn-Crippen, 1995. Tailings Impoundment Final Design Report. Mt. Nansen Gold Project. Report submitted to B.Y.G. Natural Resources Inc., Project PM 5314.05.02, August 1995.

EBA 2002. Mount Nansen Summary Data Report. Report submitted to Department of Indian Affairs & Northern Development. Project No. 0201-00-14618, September 2002.

EBA 2002. Dam Safety Assessment. Mount Nansen Tailings Facility near Carmacks, YT. Report submitted to Department of Indian Affairs & Northern Development. Project No. 0201-00-14618, May 2002.

PHOTOGRAPHS

EROSION CHANNEL

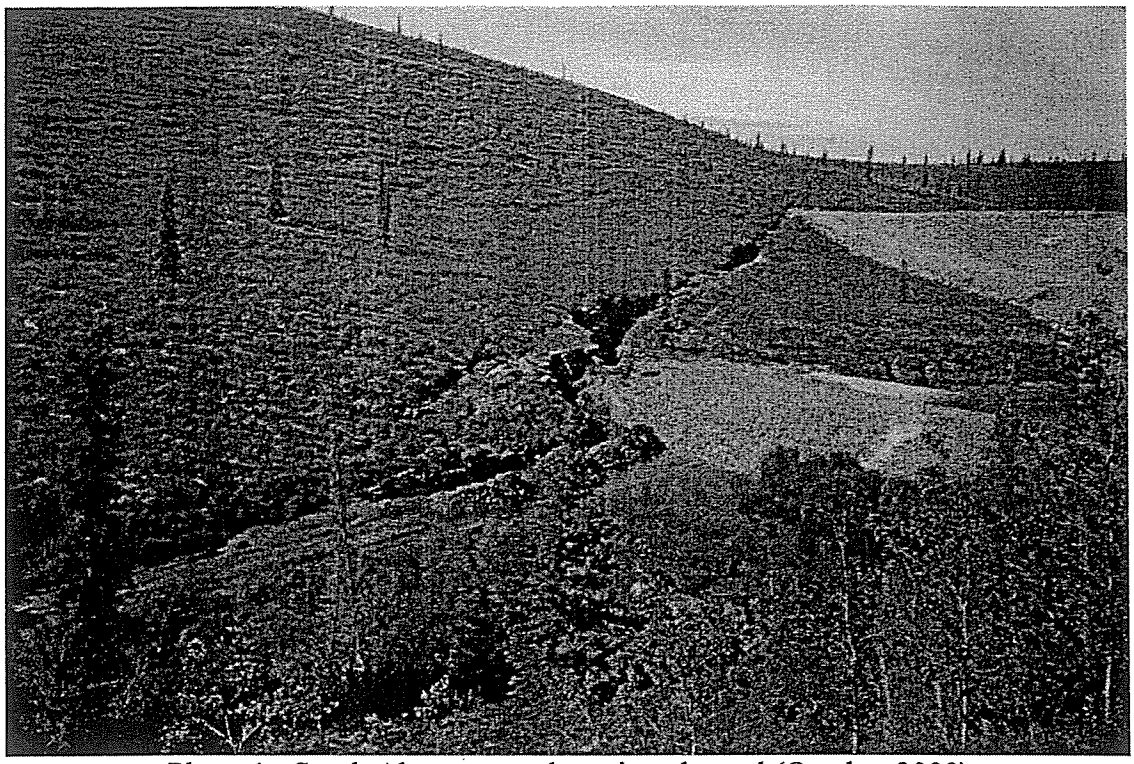

Photo 1: South Abutment and erosion channel (October 2000)

Photo 2: Excavated erosion channel at Sta. 0+75 (October 2000)

Photo 5: Placing gravel in channel

Photo 6: Completed upper portion of channel, still requires swale (October 2000)

SEEPAGE COLLECTION DYKE RECONSTRUCTION

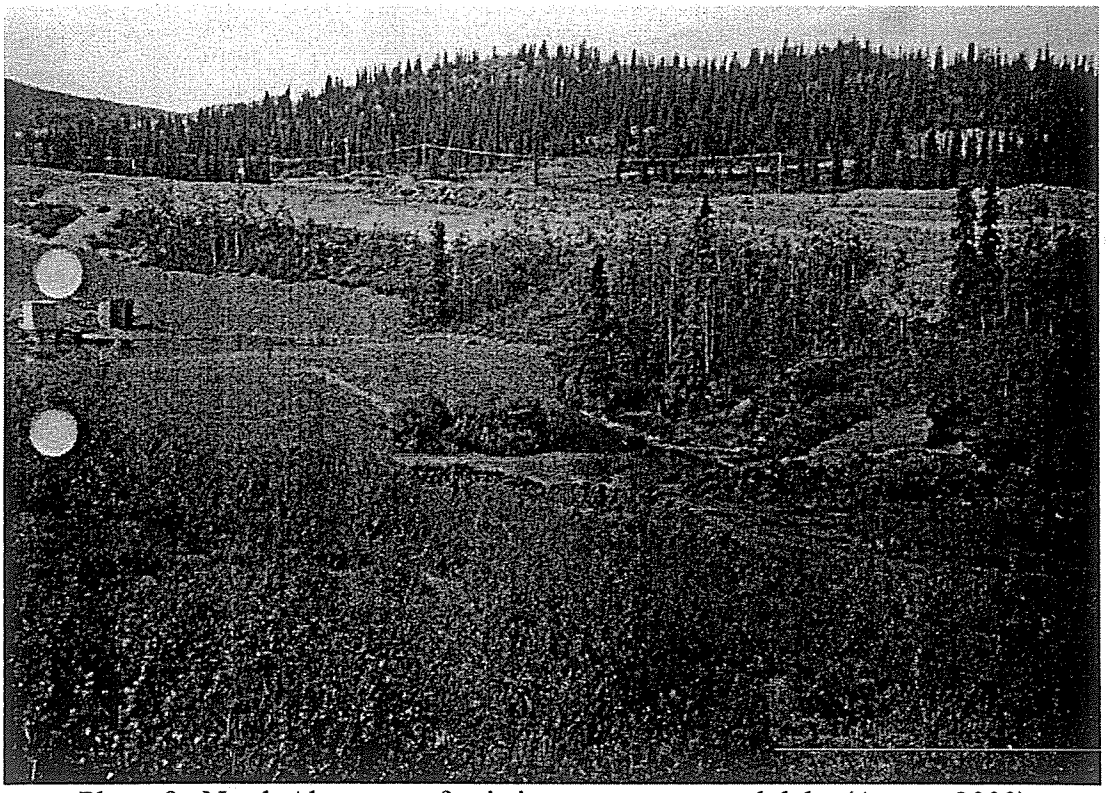

Photo 8: North Abutment of existing seepage control dyke (August 2000)

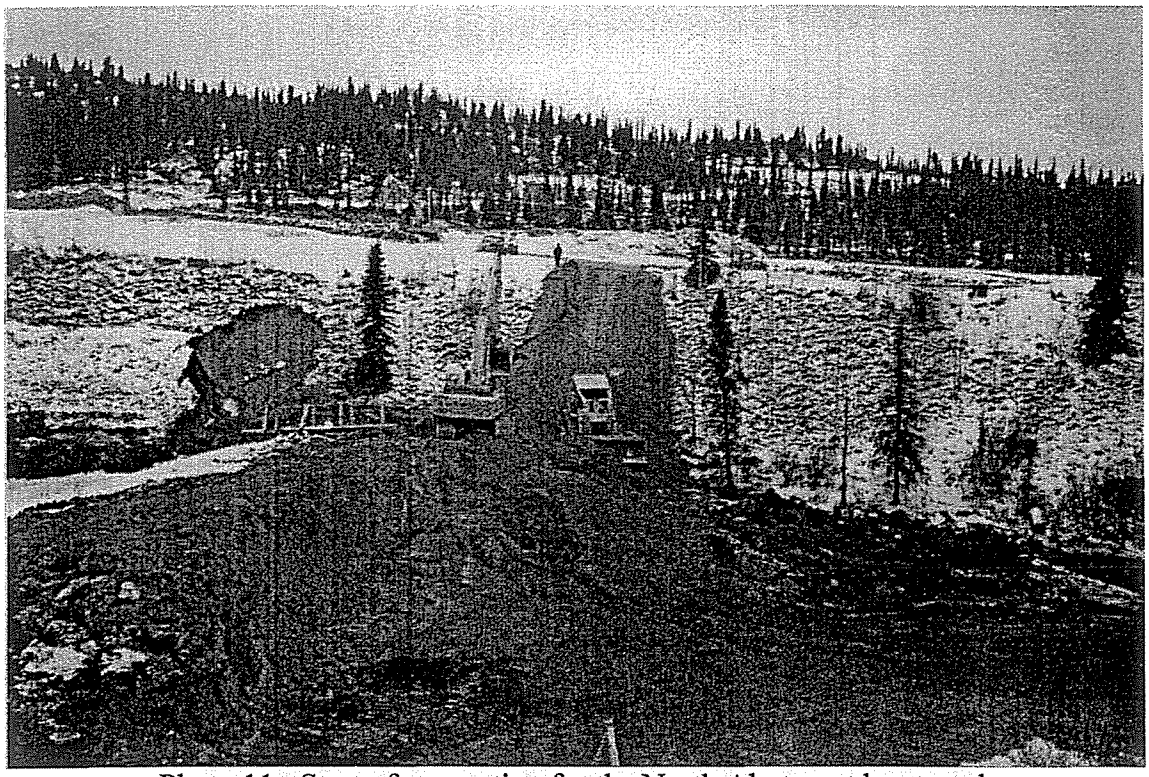

Photo 11: Start of excavation for the North Abutment key trench

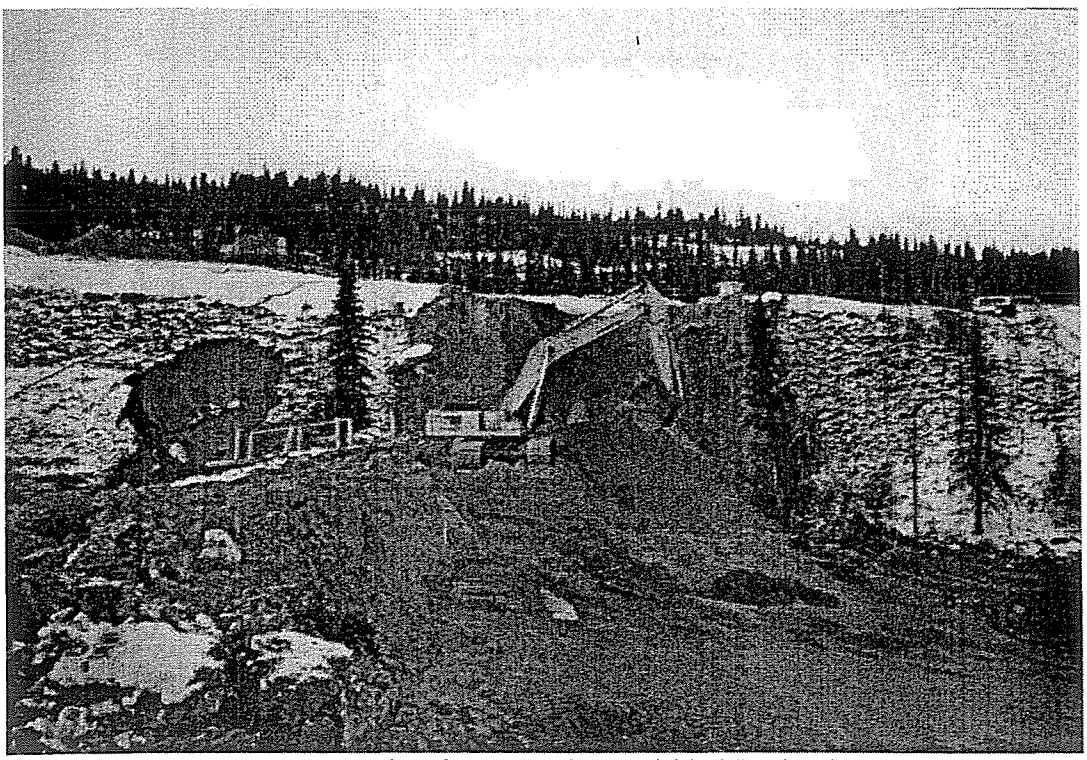

Photo 12: Searching for permafrost within North Abutment

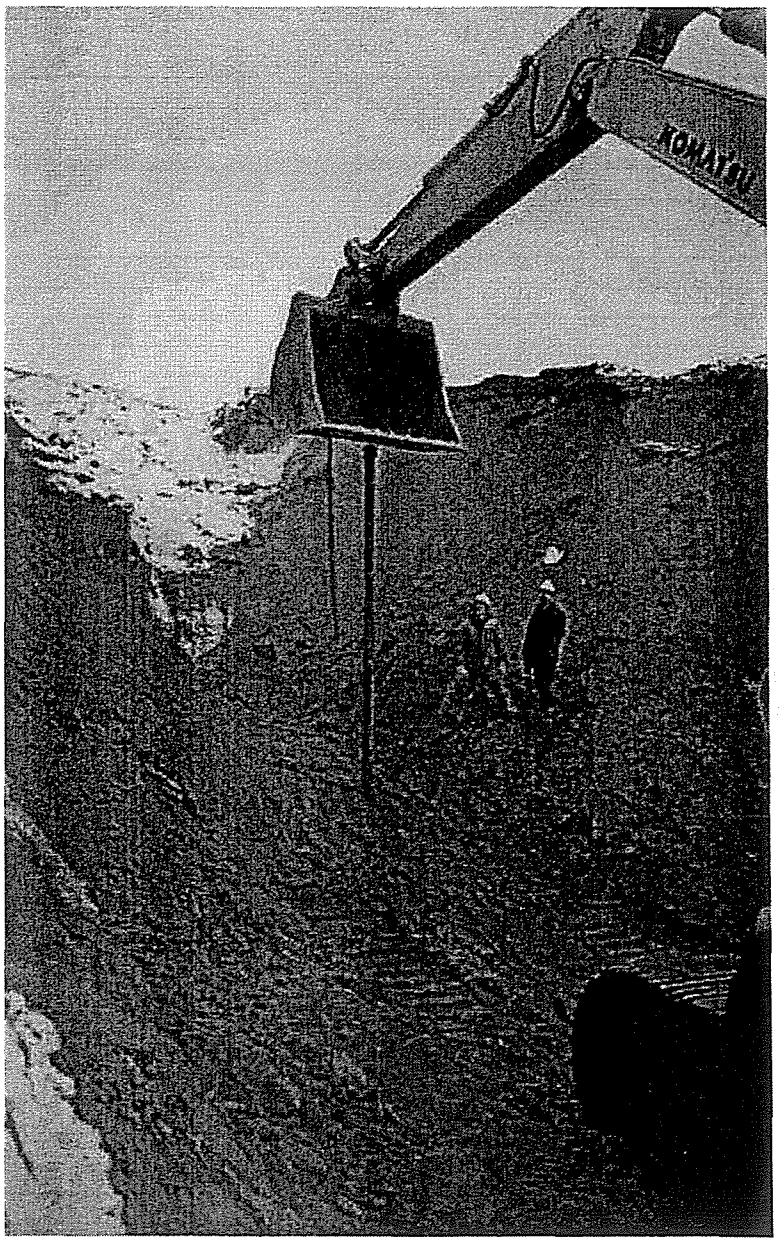

Photo 14: Probing for depth within North Abutment with a 50 mm pipe

Photo 16: Dozer ripping drainage trench on the west side

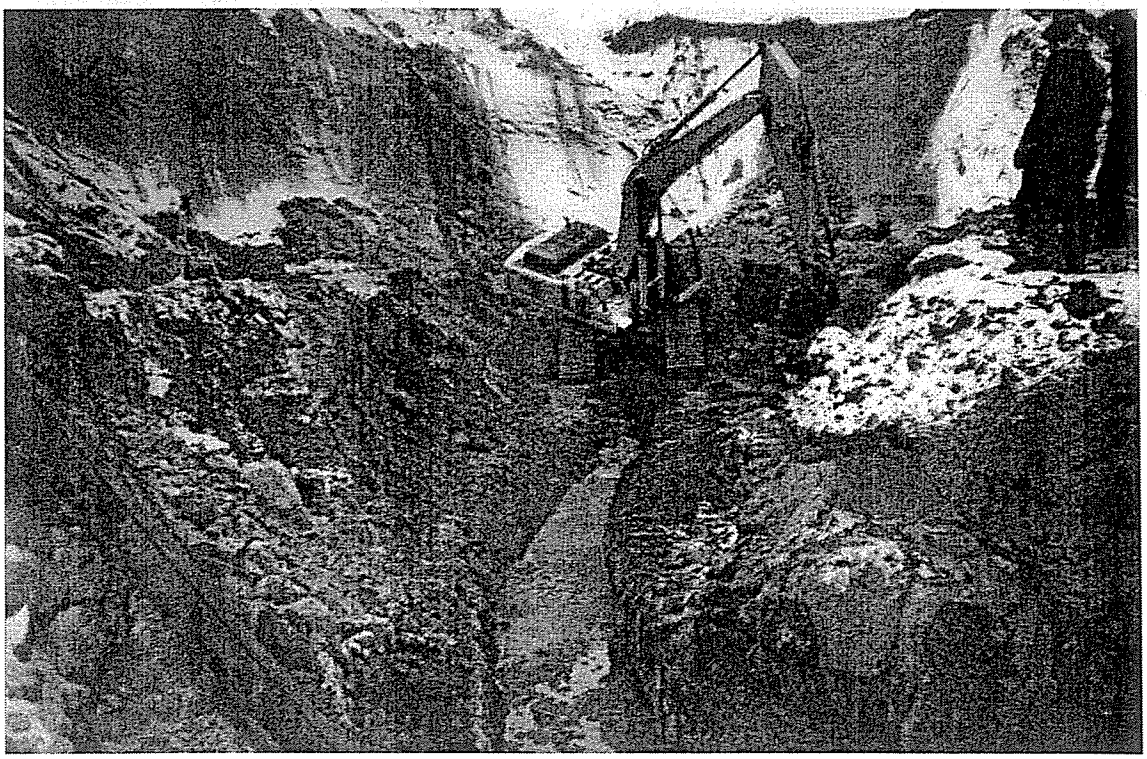

Photo 17: Construction of drainage trench in the North Abutment

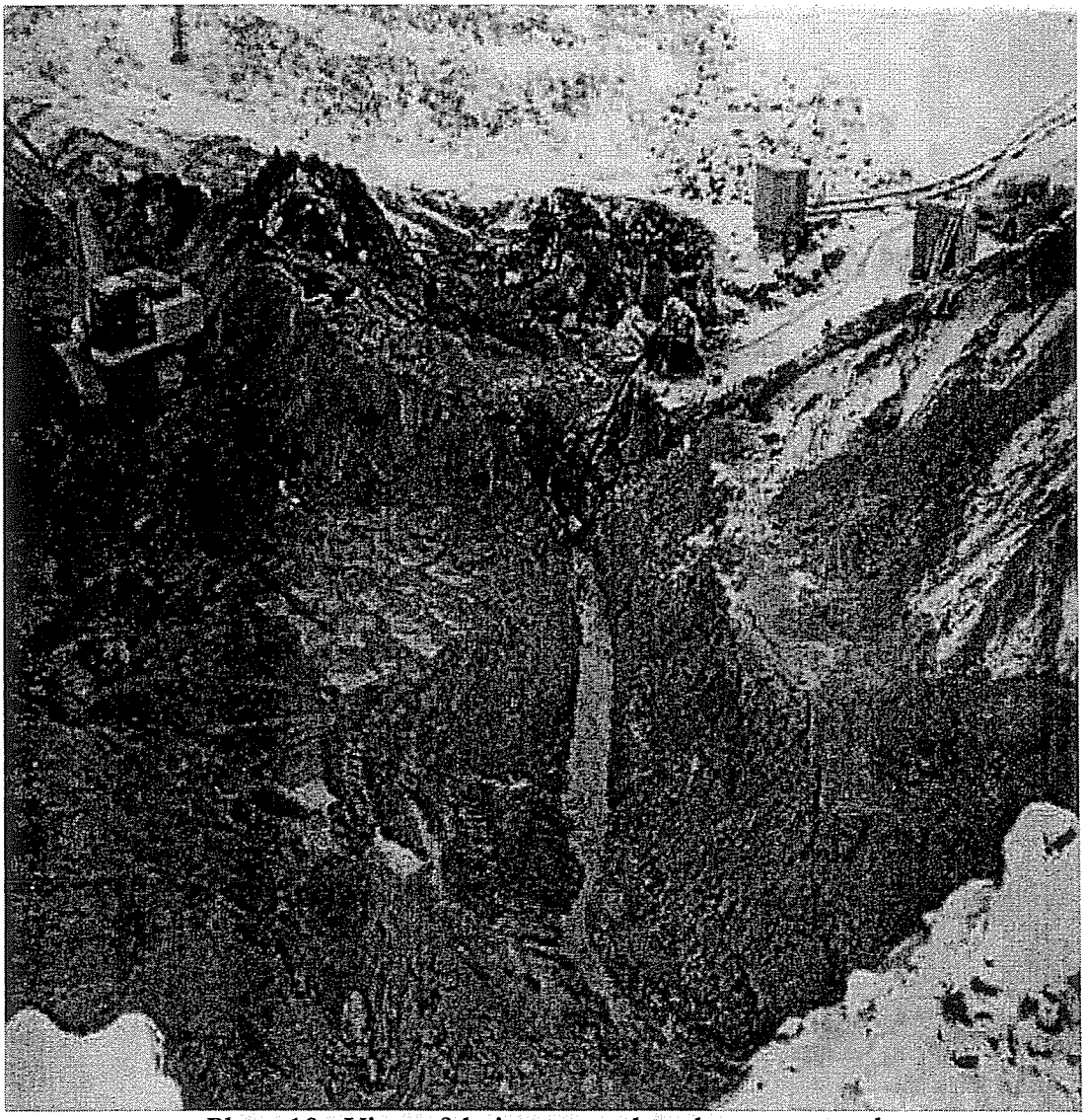

Photo 19: View of drainage trench and seepage pond

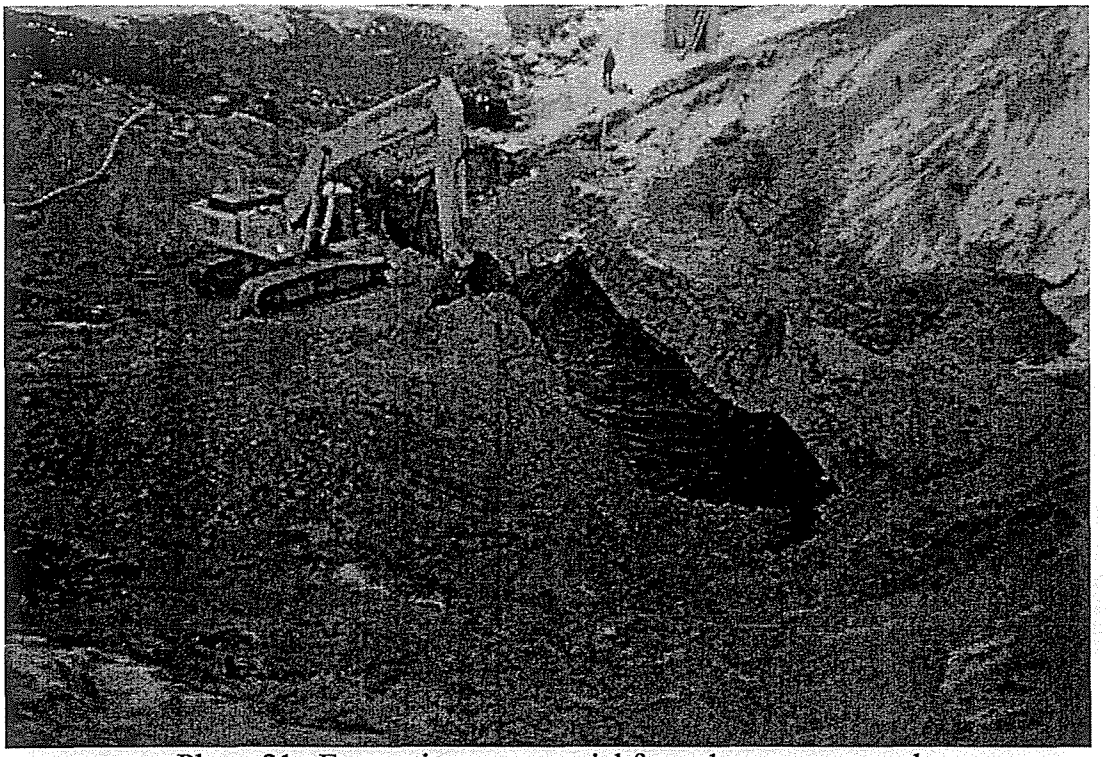

Photo 21: Excavating out material from the seepage pond

Photo 22: Hauling out excavated material from the seepage pond (October 2001)

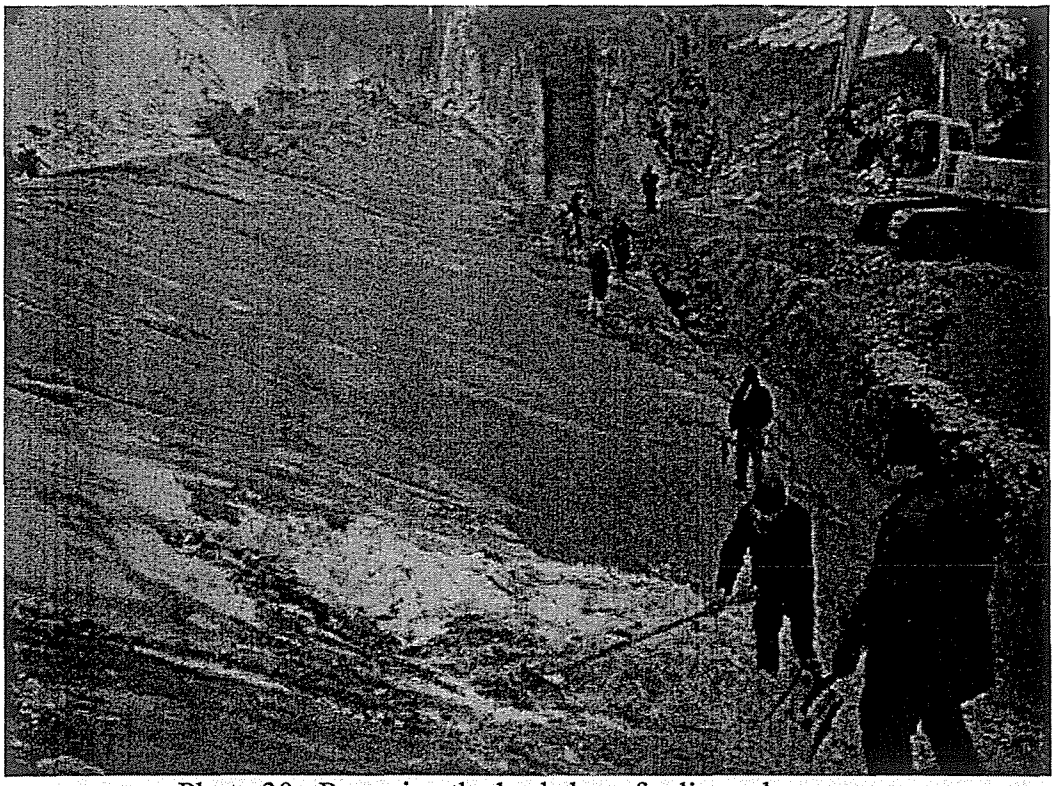

Photo 30: Preparing the backslope for liner placement

Photo 31: Spreading out geotextile over the upstream face of the cutoff trench to protect the liner

Photo 38: View of north end of cutoff trench with both loops and liner in place

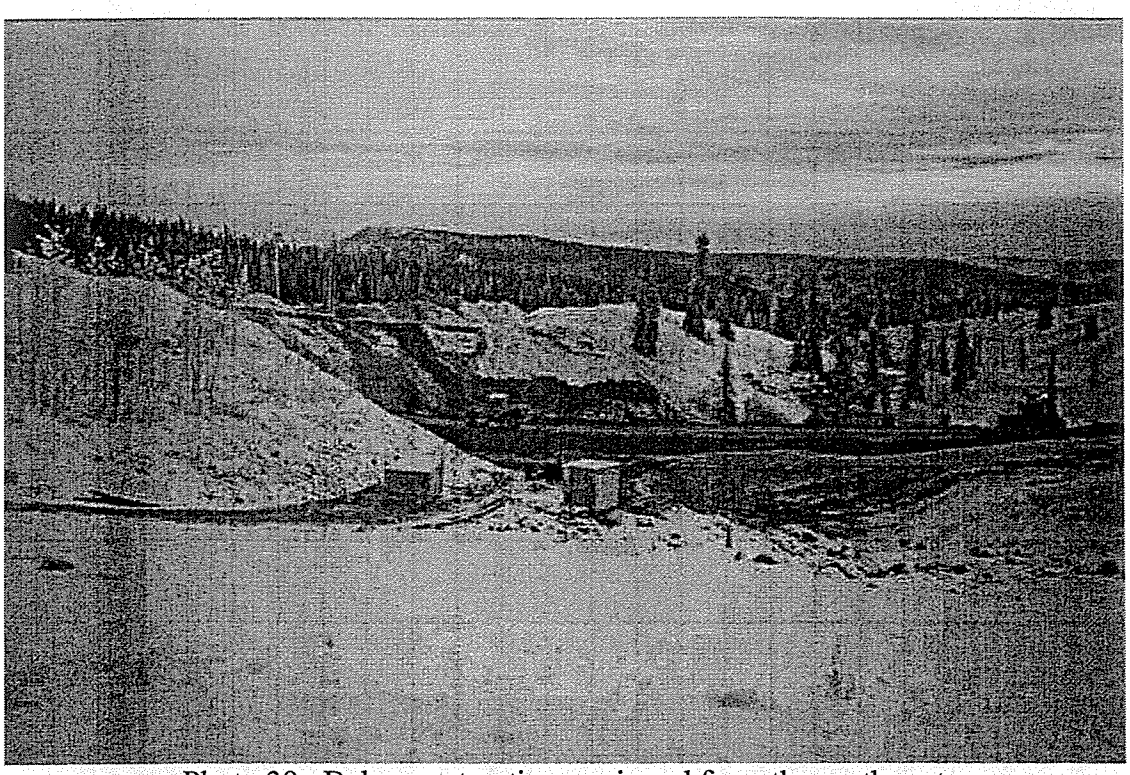

Photo 39: Dyke construction as viewed from the southwest

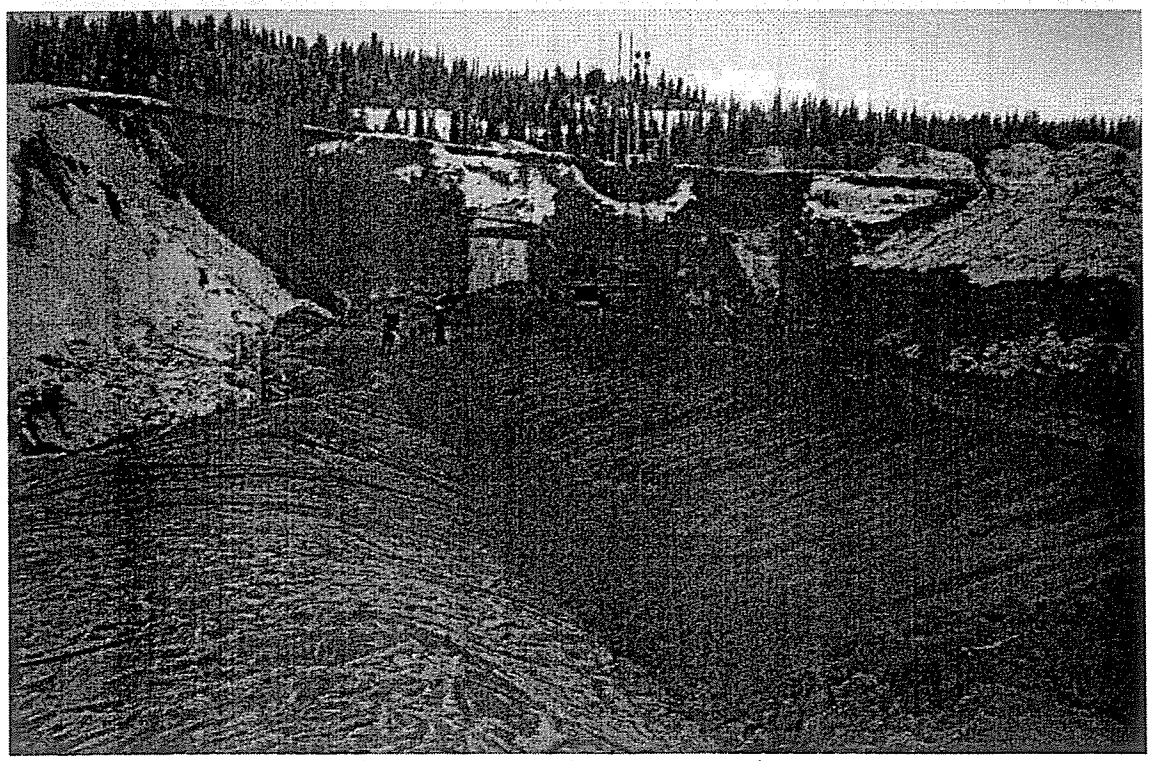

Photo 40: Preparing upstream slope

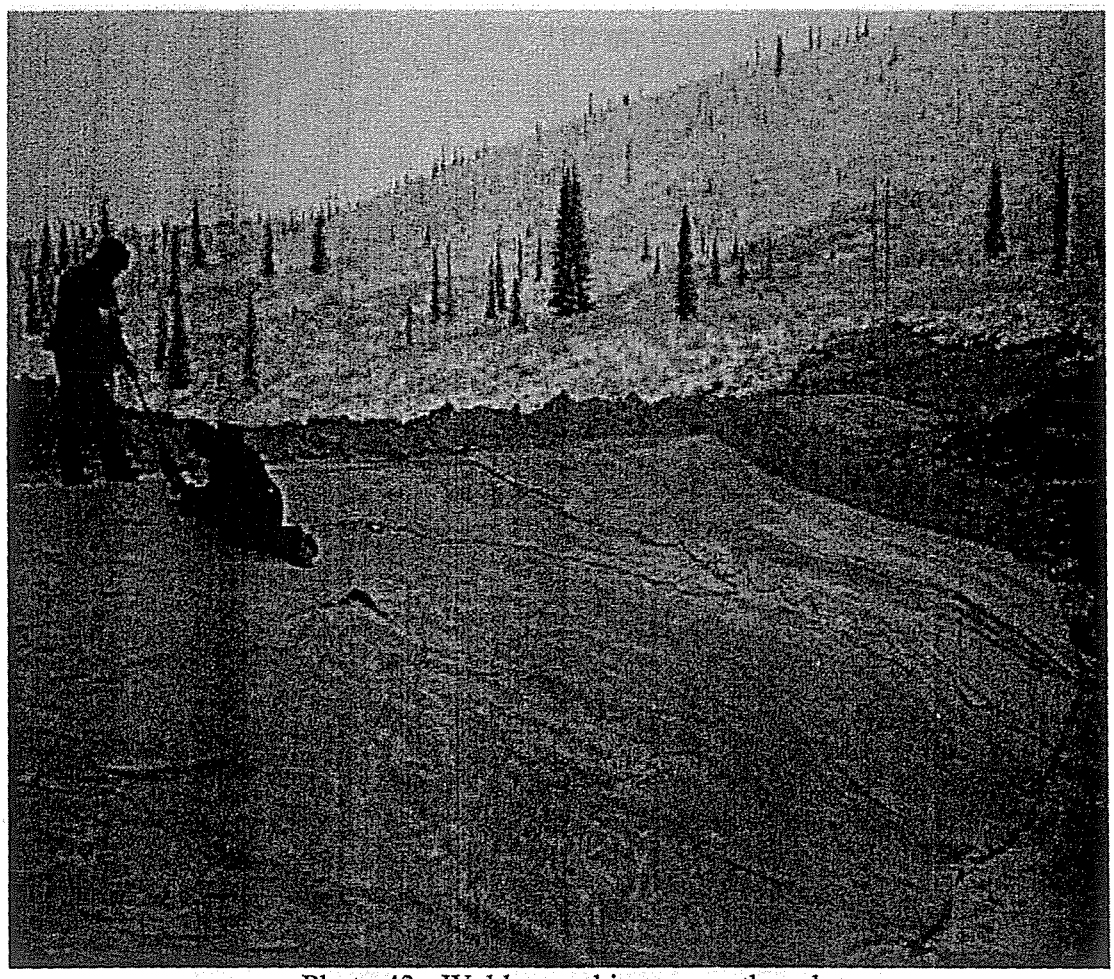

Photo 43: Welder working on north end

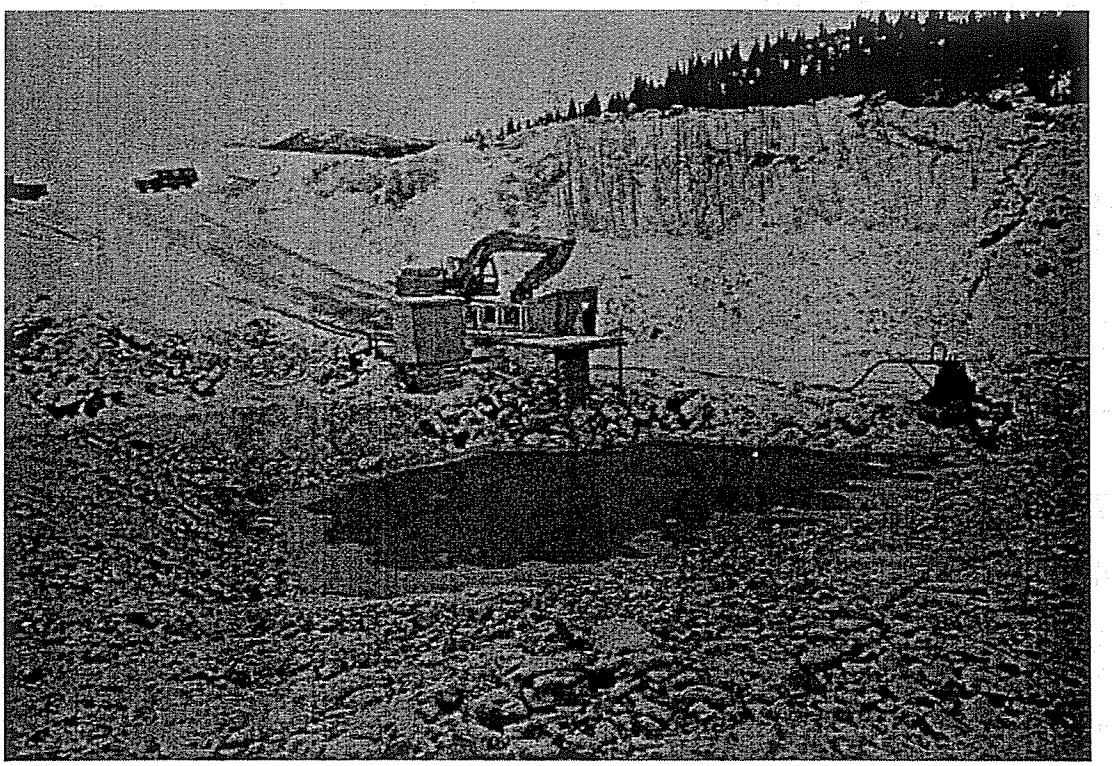

Photo 45: View of the seepage pond, note gravel was placed inside the toe of the pond

Photo 46: Final shaping of dyke

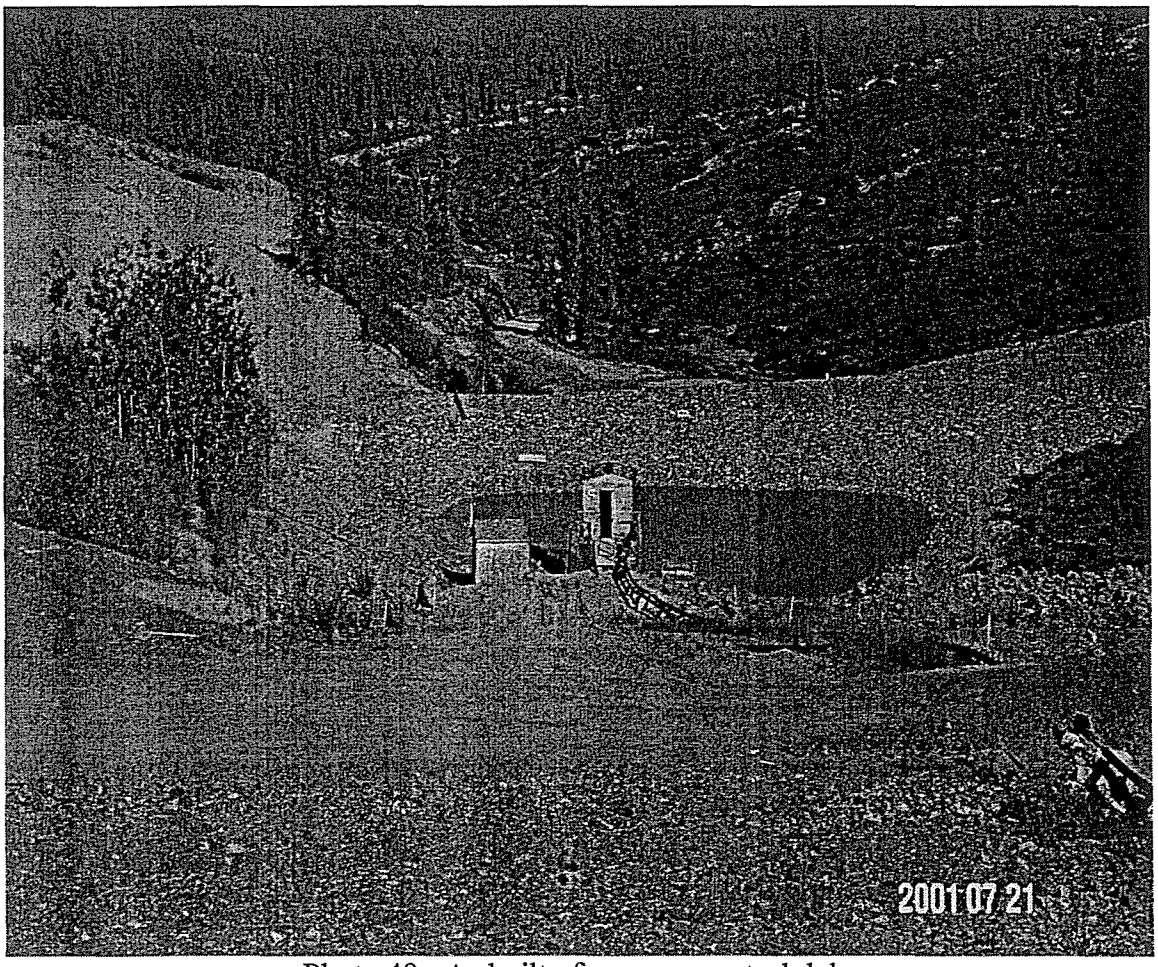

Photo 49: As built of seepage control dyke

SPILLWAY IMPROVEMENTS

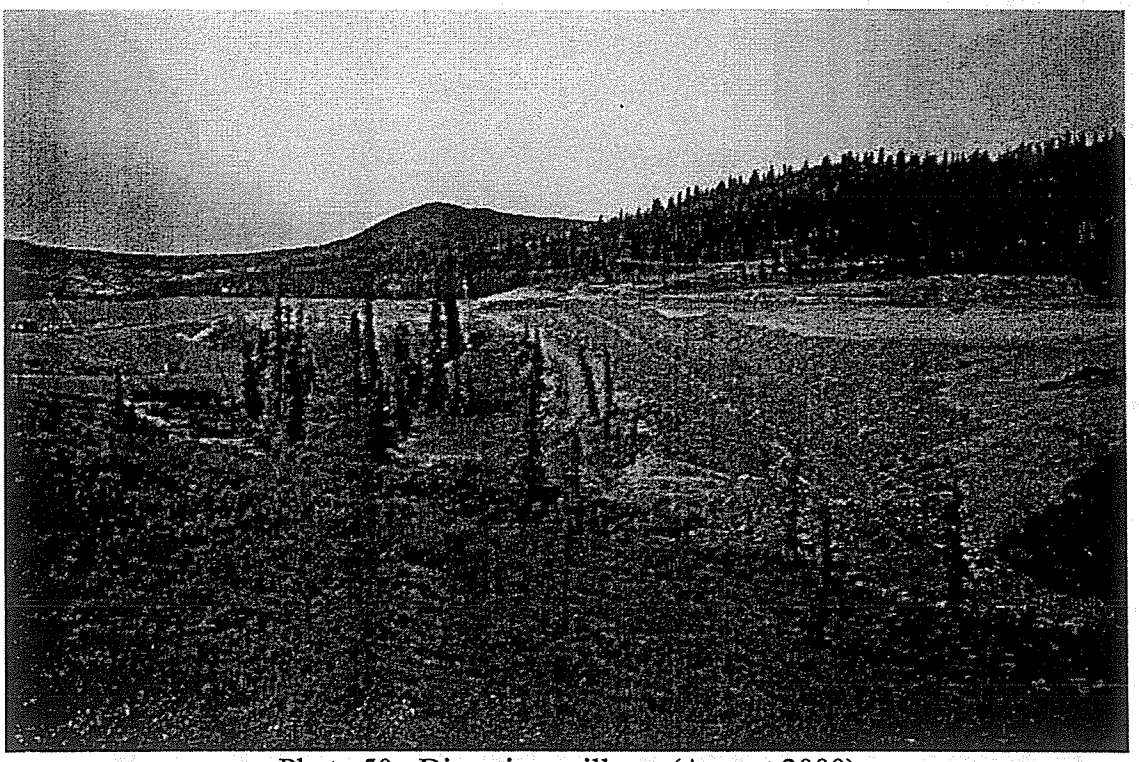

Photo 50: Diversion spillway (August 2000)

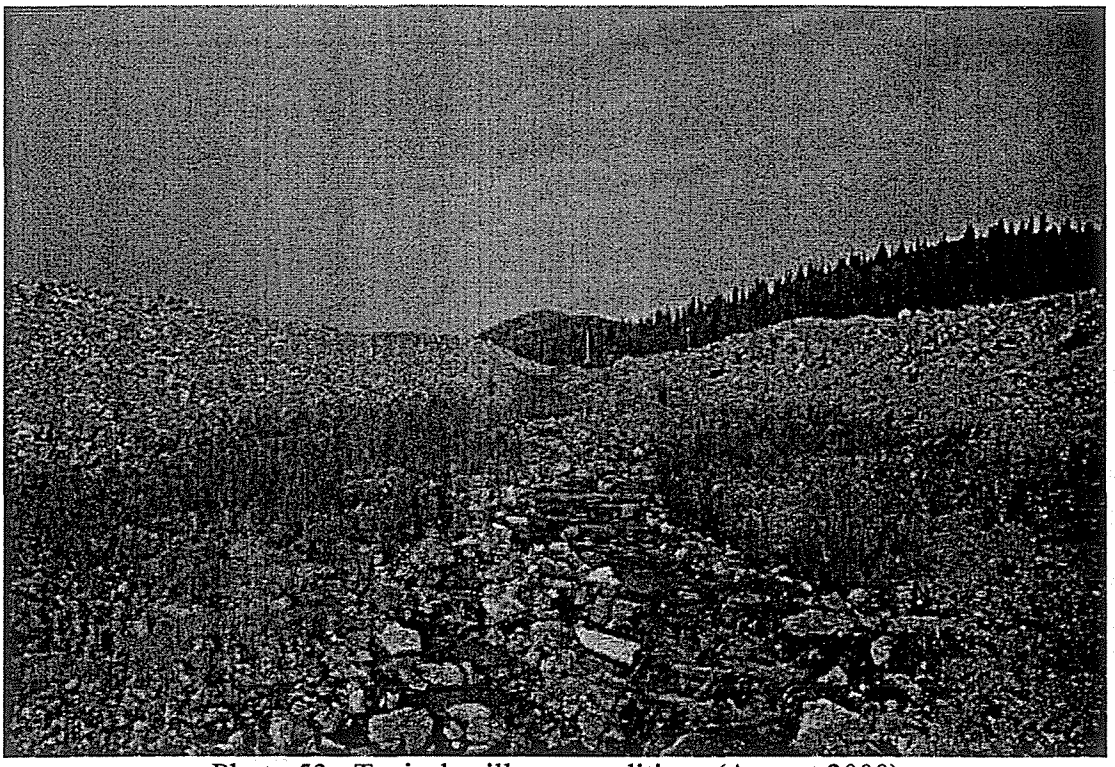

Photo 53: Typical spillway conditions (August 2000)

Photo 54: Spillway with ice and snow pushed off prior to placing gravel (October 2000)

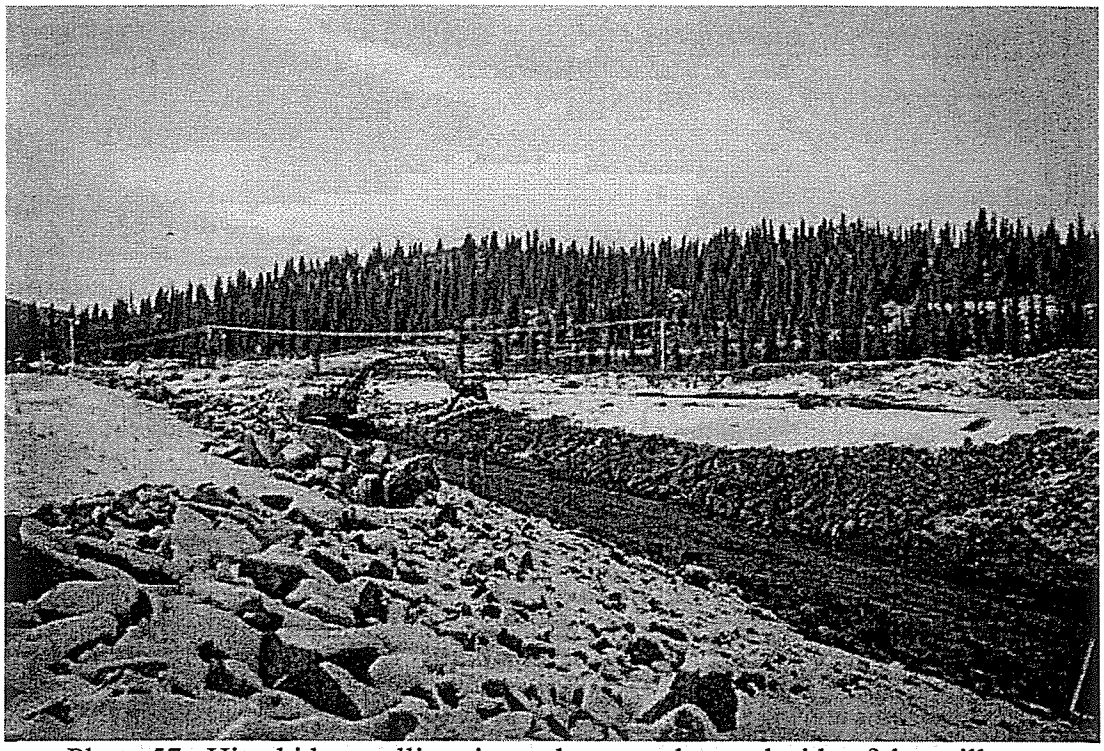

Photo 57: Hitachi hoe pulling riprap down on the north side of the spillway

Photo 58: View of spillway work (pulling riprap down from the sides)

Photo 61: Scour and piping failure near spillway discharge

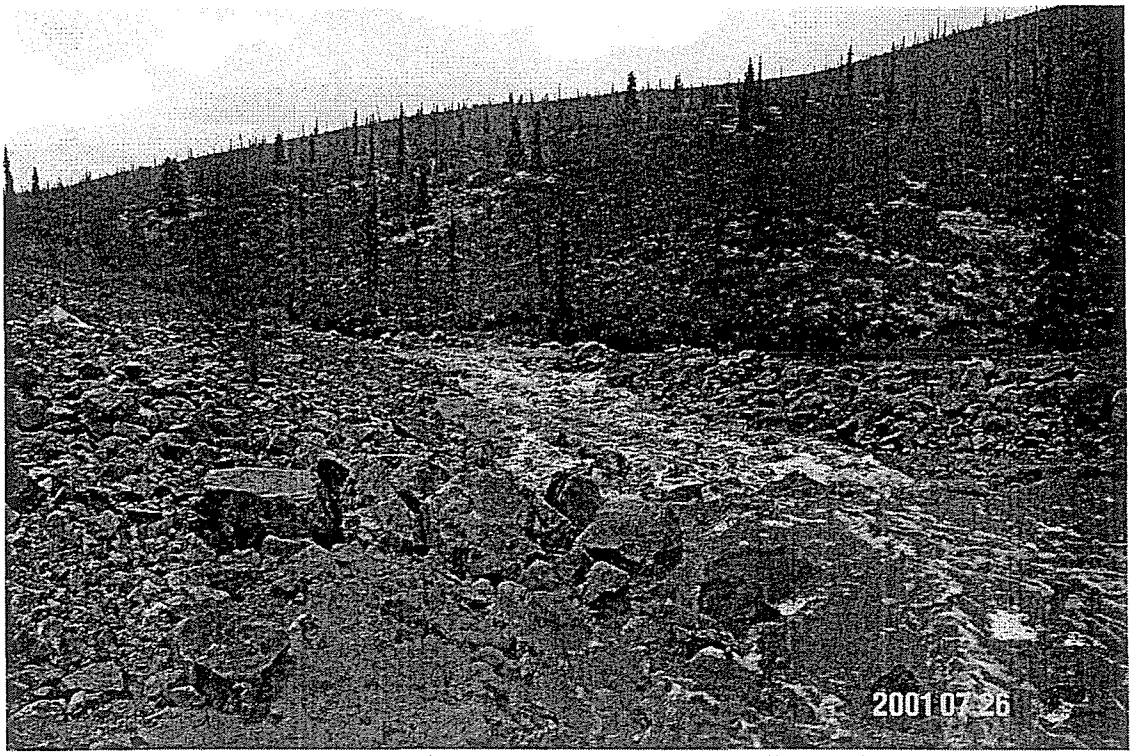

Photo 62: Rerouted channel as temporary remediation for failure

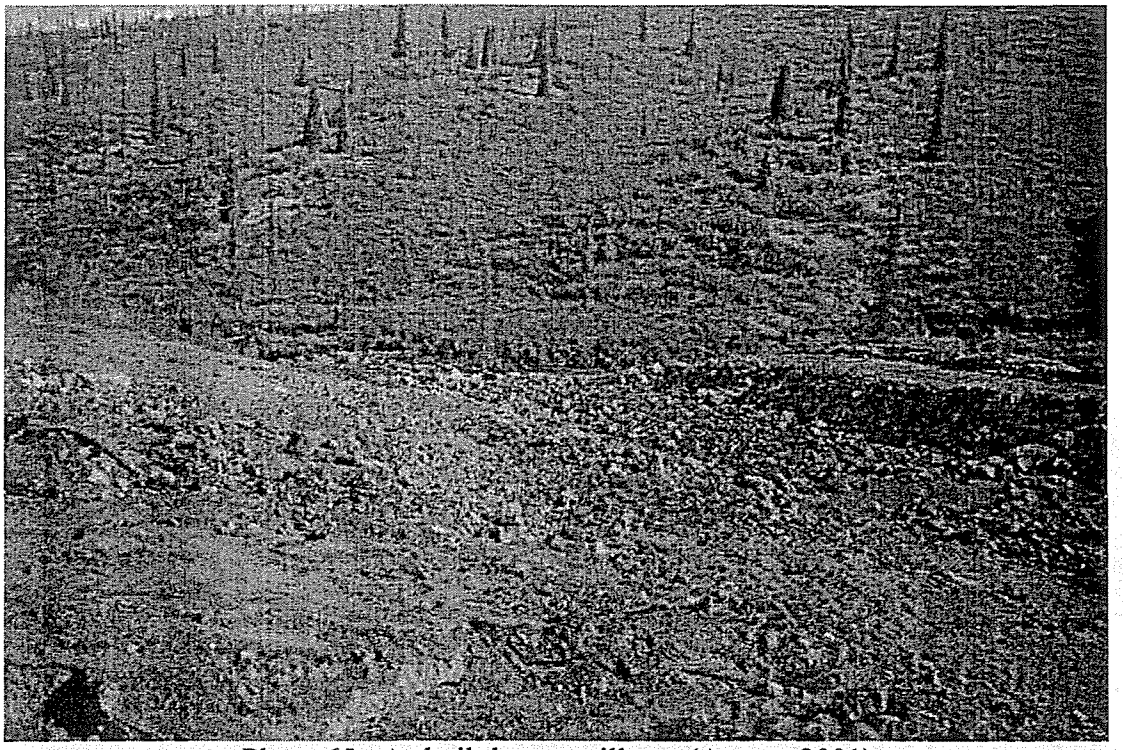

Photo 65: As built lower spillway (August 2001)

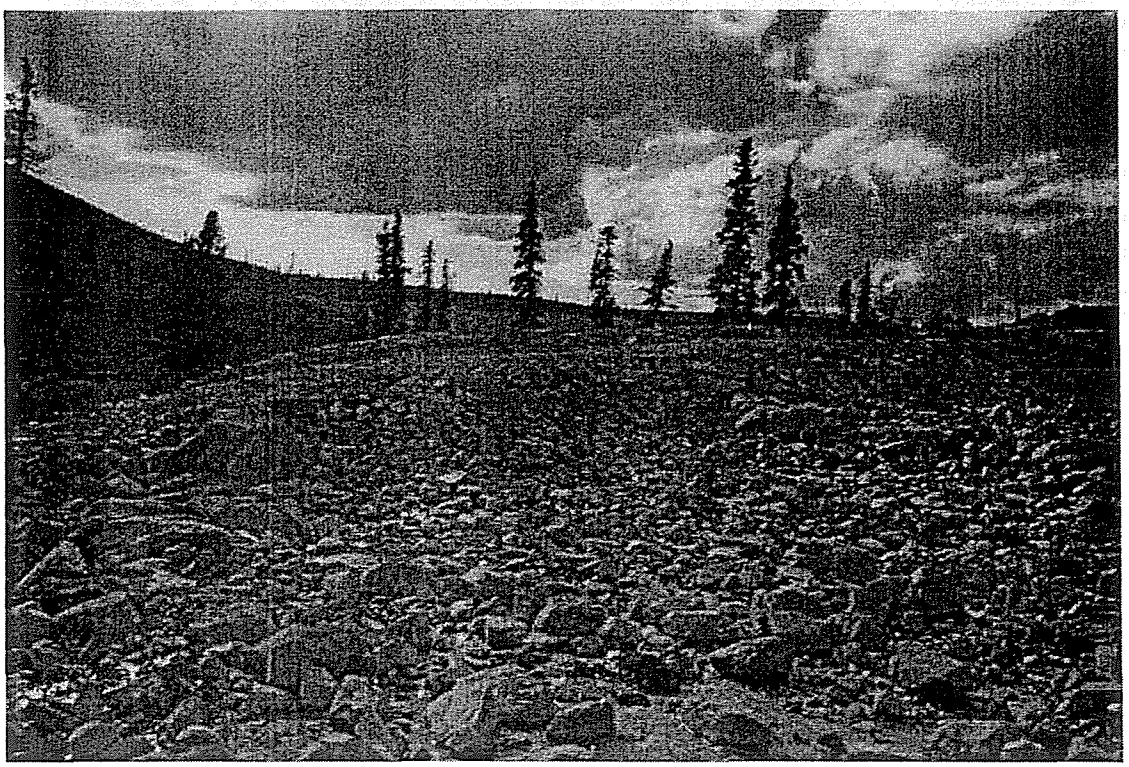

Photo 66: Repaired lower spillway (August 2001)

APPENDIX A

General Conditions

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

2.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

3.0 LOGS OF TEST HOLES

The test hole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

4.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

5.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

6.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

7.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

APPENDIX B

Contract Specifications

MOUNT NANSEN
SEEPAGE DYKE & SPILLWAY IMPROVEMENTS
TECHNICAL SPECIFICATIONS

Submitted To:

WATER RESOURCES DIVISION
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
YUKON REGION
WHITEHORSE, YUKON

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
WHITEHORSE, YUKON

Project No. 0201-00-14618

SEPTEMBER, 2000

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TENDER FORM

(4) WE confirm that the sums herein bid include all sales taxes, royalties, custom duties, foreign exchange charges, transportation, travelling costs, all overhead and profit, all co-ordination fees, insurance premiums, and all other charges.

(5) WE understand and agree to list the names of sub-contractors and suppliers, whose bids have been used in the preparation of this Bid price. The list will be subject to the approval of Owner. "By own forces" will be considered valid and satisfactory only if the Tenderer is recognized as being a "bona fide" contractor or supplier of that particular trade or item.

WE reserve to use the right to substitute other sub-contractors for any trades in the event of any sub-contractor becoming bankrupt after the date hereof. Any such substitution shall be subject to the written approval of Owner and contingent upon satisfactory evidence of bankruptcy.

(6) WE understand and agree that Owner may order changes to the work in the form of additions or deletions.

(7) WE hereby acknowledge receipt of the following addenda:

Addendum No. _____

Addendum No. _____

(8) In order for a Bid to be valid, it must be signed by duly authorized officials and must be received by no later than 1600 hrs Pacific Daylight Saving Time, September 29th, 2000.

SIGNATURE OF BIDDER

Firm Name: _____

Address: _____

_____

_____ CORPORATE SEAL

Signing Officer

TENDER FORM

Project Title and Location: Mount Nansen Seepage Dyke and Spillway Improvements
Mount Nansen Mine site, Yukon.

Tender Submitted by:_____

Schedule C

The Contractor shall provide a contract breakdown of work to be performed in this Tender in the format provided below:

Item	Description	Total
C.1014-1	Labour Hourly Rates	
_____		$_____
_____		$_____
_____		$_____
C.1014-2	Equipment Hourly Rates	
_____		$_____
_____		$_____
_____		$_____
_____		$_____
_____		$_____
_____		$_____
_____		$_____

ALL Rates are Exclusive of G.S.T.

TENDER FORM

Project Title and Location: Mount Nansen Seepage Dyke and Spillway Improvements
Mount Nansen Mine site, Yukon

Tender Submitted by:_____

LIST OF SUBCONTRACTORS

The following is a list of Subcontractors proposed to be used for the Divisions or Sections of work listed hereunder:

DIVISION OR SECTION OF WORK	NAME OF SUBCONTRACTOR

DEFINITIONS

1.0 General

.1 Definitions of terms used throughout the Construction Specifications are presented in this Section.

2.0 Definitions of Terms Used

Drawings – the design drawings as issued for seepage dyke, erosion channel and spillway improvements at the Mount Nansen mine site.

Construction Specifications – this document.

Contractor - the general contractor responsible for constructing the dyke and carrying out the remedial works for the erosion channel and spillway.

Engineer - the EBA Engineering Consultants Ltd. (EBA) representative on site during construction or related activities.

Responsible Authority - Department of Indian Affairs and Northern Development (DIAND), Yukon Region

Site - the area in which dyke construction and remediation of the erosion channel and spillway and related activity is occurring.

Unsuitable- not meeting the requirements stated herein or not receiving the Engineer's approval.

GENERAL

1.0 Background Information

The seepage collection dyke and the spillway at the former Mount Nansen mine site require improvements to meet the original design objectives and the performance criteria of the Water Licence that governs the site. Contaminated seepage is currently passing through and around the seepage collection dyke at an unacceptable rate. In addition, the seepage dyke is being eroded along its south abutment due to an erosion channel that has developed in the natural slope above the seepage collection pond. The spillway has been found to be under-designed and not able to pass the 1:200 year rainfall event without the potential loss of the spillway and the main tailings dam.

Because of these concerns, EBA Engineering Consultants Ltd. (EBA) was retained by Department of Indian Affairs and Northern Development (DIAND) to develop a fast-track plan to make improvements to the seepage dyke and spillway.

This section presents an overview of the existing dyke and spillway conditions, and presents the plans developed to improve both structures. Improvements for both structures are planned to begin in early October 2000. During the month of October, average air temperatures in the area are expected to range between +3°C and –15°C.

.1 Seepage Collection Dyke

.1 The current seepage dyke is approximately 2.5 m in height, 50 m in length, has a 6 to 7 m crest width, and side slopes of between 3H:1V to 4H:1V. A Geosynthetic Clay Liner (GCL) was placed below the upstream face. The dyke was constructed using a sand fill capped with a sand and gravel erosion control layer. According to construction records, the erosion protection layer ranges from as little as 0.3 m in thickness on the upstream face to over 1.0 m in thickness on the downstream face.

.2 The dyke is sited on a former bed of Dome creek approximately 30 m downstream of the tailings dam. Soils underlying the dyke are generally frozen except for an active layer ranging from 0.6 m on the south abutment to over 4 m on the north abutment. Within the main span of the dyke, the active layer downstream of the dyke toe is estimated to be 2 m. Below the active layer, the permafrost occasionally contains some excess ground ice. Mean ground temperatures at the valley bottom and south abutment are estimated to be approximately –1°C. Mean ground temperatures at the

north abutment, with its south-facing slope, are assumed to be warmer -- approximately –0.2°C.

.3 The soil type underneath the dyke is primarily a sand with some silt, a trace of gravel and frequent organic zones. The original soil profile contained interbedded sand and organic layers in the upper 1.5 m of the profile within the Dome Creek channel. Construction records suggest that only 0.5 m of this organic rich zone was stripped from underneath the dyke, prior to construction.

.4 Seepage through, underneath and around the dyke is visible near the south abutment, near the centre of the dyke span, and at the north abutment. Seepage around the dyke through the north abutment is also occurring through the active layer or thaw zone along the toe of the terrace slope that forms the north abutment.

.5 An erosion channel has developed on the south side of the valley along a corridor on the slope that was previously grubbed. A 115 m long section of this corridor starting 50 m below the tailings dam crest has developed into a large erosion channel. This channel currently collects runoff down the hill slope and transports it downstream of the seepage dyke. The channel is impacting the south abutment of the dyke and will need to be filled to protect the dyke from further erosion damage.

.2 Spillway

.1 The spillway at the Mount Nansen site is about 315 m in length and has a grade ranging between 7% and 15%. The channel is trapezoidal in shape with a bottom width ranging from 3 m to 10 m. The side slopes are approximately 3H:1V in slope.

.2 The spillway was built in 1996 and failed during the initial freshet in 1997. It was rebuilt in 1998 by regrading and filling in depressions, spreading geotextile in some areas and covering the channel with a sand and gravel filter and 300 mm nominal riprap. Due to the placement method, the riprap was excessively segregated during reconstruction. This resulted in the channel side slopes containing the majority of the coarse riprap whereas the channel bottom contained only sand and gravel. Erosion within the spillway base has developed since the reconstruction.

.3 Native soils underneath the spillway consist of sand with some silt and a trace of gravel. The soils are frozen below a depth ranging from 2.4 m to 3.6 m.

.4 Hydrologic and hydraulic evaluations of the spillway suggest that the current construction would be unstable for any event greater than the 1:10 to 1:20 year storm.

2.0 Description of Work

.1 Work under this contract covers the following Work at the Mount Nansen mine site:

.1 The installation of a geomembrane liner and thermosyphon system within the existing seepage collection dyke. The dyke crest elevation will also be increased.
.2 The filling and armouring of an existing erosion channel.
.3 The regrading, armouring, and construction of drop structures within the existing spillway.

.2 The approximate location of the Mount Nansen mine site is 62° 3' 00" N Latitude, 137° 7' 00" W Longitude. It is located approximately 63 km by road west of Carmacks, Yukon. It is accessed via the Mount Nansen road starting in Carmacks Yukon.

.3 Specific Work at the site includes, but is not limited to, the following:

.1 Mobilization and demolition of all personnel, equipment, and materials, required to complete the Work.
.2 Dewatering of the work area around and near the existing seepage collection dam.
.3 Stripping and excavation of the unsuitable materials from the footprint of the raised seepage collection dam.
.4 Excavation of a key trench into permafrost within the dam footprint and adjacent slopes.
.5 Excavation of the existing seepage dyke is required to facilitate the installation of the specified liner system.
.6 Installation of the specified liner system.

.7 Installation of the specified horizontal thermosyphon system.
.8 Filling, reconstructing, and raising of the seepage collection dam.
.9 Shaping and cleaning the existing erosion channel.
.10 Filling of the erosion channel with approved materials.
.11 Lining of the partially filled erosion channel with approved geotextile.
.12 Armouring of the infilled erosion channel surface.
.13 Regrading and widening select sections of the existing spillway.
.14 Armouring the spillway using 300 mm median riprap.
.15 Constructing 14 riprap drop structures within the spillway.

3.0 Survey Services

.1 The Engineer shall supply survey services to complete all layout and measurement surveys required for the work completed under this contract.

4.0 Documents Required

.1 Maintain at job site, one copy of each of the following:

.1 Specifications.
.2 Addenda.
.3 Change orders.
.4 Other modifications to Contract.
.5 Water Use Licence QZ94-004 and any other relevant permits, or licences.
.6 A Health and Safety Plan.

5.0 Site Conditions

.1 The contractor is responsible for making themselves aware of the site conditions prior to preparing the bid package.

.2 General information regarding the site conditions are available at the office of EBA Engineering Consultants Ltd. (EBA) in Whitehorse, Yukon.

6.0 Work Schedule

.1 Keep the Engineer advised of planned work activities at least 24 hours in advance of operations.

GENERAL

7.0 Payment

.1 Due to the nature of the Work, it is proposed that this contract use a combination of lump sum payments, and unit rates and cost recoverable payments to remunerate the Contractor.

.2 Where on site measurements or records are necessary, notify the Engineer of planned work activities at least 48 hours in advance of operations to permit required measurements for payment.

.3 Items measured for payment will be paid under Schedule A, Schedule of Unit Prices of the Tender Form. Specific lump sum pay items will be under Schedule B – Schedule of Lump Sum Items of the Tender Form. Cost Recoverable Items will be paid under Schedule C - Schedule of Cost Recoverable Items. All other items, whether specifically defined in specific sections of the Specifications or not, will be paid under Schedule D, Balance of Project Complete, in the Tender Form.

.4 Include costs of any statement of or requirement for work, goods or services required in this section (General) that are not covered by appropriate payment clauses in other sections in Schedule D – Balance of Project Complete, Firm Price, in the Tender Form.

.5 Include all overhead and profit, equipment depreciation, maintenance, fixed costs, and any and all other costs required in the appropriate unit price, or lump sum pay item.

.6 Fixed costs shall include costs for:

.1 Transportation of employees to, from, and at the site as required throughout the Work.

.2 Obtaining and complying with all licences, permits, and authorizations required to comply fully with all laws, ordinances and regulations of the Federal, Provincial, Territorial and local authorities.

8.0 Permits

.1 Water Use Licence QZ94-004 shall govern the completion of all aspects of this Work.

.2 Pay all costs associated with complying with the requirements of permits and licences noted in Clause 7.6.1.

.3 Register, obtain and pay for all required licences and permits for individual tradesmen employed for work of their section.

9.0 Project Meetings

.1 Project meetings will be held on a weekly basis throughout the Work or as requested by the Engineer.

10.0 Site Supervision

.1 Designate a competent and qualified supervisor to be on site as required, to have full authority to make decisions for the Contractor, to be knowledgeable of the requirements of the contract, and to act upon the instructions of the Engineer and/or the Responsible Authority.

11.0 Additional Drawings

.1 The Engineer may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included in these Specifications.

12.0 Materials

.1 The various materials referenced in these specifications are designated on the Drawings. Material quantities have been estimated as shown in Table 2.1.

Table 2.1
Construction Material Quantities

Material	Quantity	Units
Total Excavation	4200	m^3
Zone 1 Sand Fill	4300	m^3
Zone 2 Gravel (Erosion Protection)	450	m^3
Zone 3 Cut-off (Sand/Bentonite Mixture)	100	m^3
Thermosyphon evaporator pipe[1]	420	m
Thermosyphon radiators (each 19.5 m^2) [1]	4	ea
Total 38 mil Supported Arctic Liner[1]	1358	m^2
Total woven geotextile (LP200 or equivalent) [1]	576	m^2
Total non-woven geotextile (LP12 or equivalent) [1]	836	m^2

Note: Thermosyphons, Arctic Liner, and some geotextile material to be supplied by the Responsible Authority.

13.0 Submissions

.1 Upon award notification the Contractor must submit for review:

.1 A Work Schedule:

.1 The work schedule shall be used as a planning tool for the Engineer and will detail the work commitment (in terms of hours and days of operation) of the Contractor for the Responsible Authority's review and approval. It is understood that the schedule will be subject to change due to site conditions, weather, and/or scope changes initiated by the Responsible Authority and the Engineer.

.2 The Work Schedule will include:

.1 The project start-up date.

.2 Estimated project completion date.

.3 Expected hours of daily operation and days of weekly operation for equipment and personnel.

.2 A Health and Safety Plan (H.A.S.P.) which includes, as a minimum, a document outlining the following:

.1 The major hazards that will be encountered on site.

.2 Precautions that will be taken to minimize the hazards (safety protocols, personal protective equipment, etc.).

.3 Medical Emergency Procedures that will be followed by the contractor in case of an accident or incident requiring medical attention, including a contract list of hospitals or nursing stations.

.4 The means of communication in the event of site emergencies.

.5 A complete contact list of persons to be contacted in the event of an emergency including the Contractor's representatives, the Responsible Authority, the Engineer, and a representative of the Yukon Workers Health and Safety Board.

14.0 Indemnification

.1 Indemnify and save harmless the Responsible Authority, the Engineer, the Responsible Authority's or Engineer's employees against liability occasioned in any way through provision of the goods and services of the Contractor. Pay all royalties and fully indemnify the Responsible Authority, the Engineers and the Engineer's employees against all suits or actions arising from the claim of any persons who are, or claim to be, patentees of any apparatus or process used on or in connection with the work.

15.0 Site Maintenance

.1 Keep the site free from the accumulation of waste materials and debris as specified in Section 1004 - Environmental Protection.

.2 Upon completion of the work, clean away and dispose of all surplus material, supplies, rubbish, and temporary works leaving the site neat and tidy to the satisfaction of the Responsible Authority.

16.0 Measurement for Payment

.1 Work under this section will not be measured. Include all costs for the work of this section in Balance of Project Complete in the Tender Form.

SAFETY REQUIRMENTS

1.0 General

.1 Personnel safety, emergency medical capabilities, and reliable communications are of paramount concern due to the distance of the site from medical assistance.

.2 The Contractor shall be responsible for the safety of all persons and property on or about the project and for ensuring that the work is performed in accordance with all applicable safety requirements.

.3 Implement, maintain, and supervise a health and safety plan that meets the standards and requirements of applicable regulatory agencies and to the satisfaction of the Engineer and Responsible Authority. The plan shall be made known to all personnel at the site and shall include specific instructions on actions to be taken in the event of safety violations, accidents, emergencies, personnel injury and sickness. The plan shall also include an effective reporting system to the Engineer on health and safety matters.

.4 Designate a Safety Officer who shall be qualified and authorized to supervise and enforce compliance with the safety plan. The Safety Officer is to be present at the site during the daily working hours.

.5 Supply and maintain, at known places on-site, all required safety equipment necessary for the work being completed, to protect the workers against accident or injury, as prescribed by the governing authorities.

.6 Personnel shall be medically fit for work at locations with limited medical facilities.

2.0 Construction Safety Measures

.1 Observe and enforce construction safety measures required by the latest revisions of: Canada Labour Code, National Building Code of Canada, National Fire Code of Canada, Yukon Workers' Health and Safety Board, the applicable Occupational Health and Safety Regulations, and Territorial and local statutes and authorities.

.2 In event of conflict between any requirements of above authorities, the most stringent requirement shall govern.

SAFETY REQUIRMENTS

3.0 Medical

.1 Provide first aid and medical care facilities for all personnel as required by the following, as applicable:

.1 Statutes of the Occupational Health and Safety Act of Yukon.

.2 Provide an emergency first aid kit sufficient for the maximum number of people at the site, the distance of the site from the nearest medical attention, and the level of care afforded by the nearest medical facilities.

.3 Establish an emergency procedure for the removal of any injured person to medical facilities or a doctor's care in accordance with applicable legislative and regulatory requirements.

4.0 Accidents and Accident Reports

.1 Promptly report in writing to the Responsible Authority and the Engineer all accidents or incidents of any sort arising out of or in connection with the performance of the work, giving full details and statements of witnesses.

.2 If a serious injury or a serious accident occurs, report the occurrence immediately, or as soon as practically possible, to a Safety Officer of the Yukon Worker's Health and Safety Board. Also notify immediately, or as soon as practically possible, the Responsible Authority and the Engineer. In the event of a serious injury or serious accident, the Contractor shall shut the job site down immediately and preserve the accident scene as required by the Yukon Worker's Health and Safety Board or other agency having jurisdiction for the investigation of the event.

.3 If a claim is made by anyone against the Contractor or a Subcontractor on account of any accident, promptly report the facts in writing to the Responsible Authority and the Engineer, giving full details of the claim.

5.0 Communications

.1 The Contractor to provide a reliable, portable communications device capable of making long distance calls to Whitehorse, and Carmacks, Yukon.

SAFETY REQUIRMENTS

6.0 WHMIS

.1 Comply with requirements of workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, and regarding labeling and provision of material safety data sheets acceptable to labour Canada and health and welfare Canada.

.2 Deliver copies of WHMIS data sheets to the Engineer on delivery of materials.

7.0 Handling and Transportation of Dangerous Goods

.1 Observe and enforce all construction measures required by the regulatory agencies including but not limited to Environment Canada, Department of Environment, and Transport Canada.

.2 Most current regulatory Guidelines and Acts will apply to the work.

.3 In the case of any conflict, the more stringent requirements will apply.

8.0 Measurement for Payment

.1 Work under this section will not be measured. Include all costs for the work of this section in Balance of Project Complete in the Tender Form.

ENVIRONMENTAL PROTECTION

1.0 General

.1 Comply with all applicable environmental laws, regulations and requirements of Federal, Territorial, and other regional authorities, and acquire and comply with such permits, approvals and authorizations as may be required.

2.0 References

.1 Ensure that all applicable legislation, regulations and guidelines are followed in carrying out the work. The following lists some of the key regulatory references:

- .1 The Canadian Environmental Protection Act (CEPA).
- .2 The Transportation of Dangerous Goods Act and Regulations.
- .3 The Yukon Waters Act.
- .4 The Territorial Lands Act.
- .5 The Territorial Land Use Regulations.
- .6 The YT Wildlife Act.
- .7 The YT Environmental Protection Act.
- .8 The Spill Regulations.
- .9 Safety Act: Occupational Health Regulations.
- .10 Guidelines for Preparation of Hazardous Material Spill Contingency Plans.

.2 Specific requirements for environmental protection are detailed in Water Use Licence QZ94-004 that governs all work completed under this Contract.

3.0 Submittals

.1 SUBMIT ALL REQUIRED CONTRACTOR SUBMITTALS TO SATISFY ENVIRONMENTAL REQUIREMENTS DIRECTLY TO THE RESPONSIBLE AGENCY.

.2 Submit one complete copy of all submittals and agency approvals to the Engineer.

4.0 Measurement for Payment

.1 Work of this section will not be measured. Include all costs in Balance of Project Complete in the Tender Form.

MATERIALS

1.0 General

.1 This Section describes the specifications for materials to be used in completing the improvements to the seepage dyke, erosion channel, and spillway.

.2 Material quantities are presented in Section 1001 and in the Tender Form.

2.0 Material Sources

.1 No soil or rock material of any type shall be borrowed or excavated without the Engineer's and/or Responsible Authority's prior approval.

.2 The recommended borrow source(s) for sand fill materials are shown on the Drawings. If desired by the Contractor, the Responsible Authority and the Engineer may consider alternative sources. All borrow sources shall be observed by the Engineer throughout construction activities to ensure the borrowed products meets the requirements stated herein.

.3 Sodium Bentonite to be used in the Cut-off Material shall be supplied by the Contractor and shall be CETCO Volclay® CG-50, or approved equivalent.

.4 Arctic liner and woven geotextile materials will be supplied by the Responsible Authority.

.5 A limited quantity of non-woven geotextile will be supplied by the Responsible Authority. Additional geotextile will be supplied by the Contractor.

3.0 Material Specifications

.1 Zone 1 Sand Fill

.1 The Zone 1 sand fill shall consist of native sand material, shall be free of roots, topsoil and deleterious material and, shall met the gradation limits presented in Table 5.1.

Table 5.1
Zone 1
Grain Size Distribution Limits

Grain Size (mm)	% Passing
75.00	100
12.50	95 – 100
5.000	85 – 100
2.000	55 – 100
0.425	30 – 95
0.075	4 – 12

.2 Zone 1 Sand Fill shall be used as common fill in both the seepage dyke and in the erosion channel.

.2 Zone 2 Gravel

.1 The Zone 2 gravel material shall be free of roots, topsoil and other deleterious material and shall have a grain size distribution within the limits presented in Table 5.2.

Table 5.2
Zone 2 Gravel Material
Grain Size Distribution Limits

Grain Size (mm)	% Passing
150	100
75	95 – 100
38	55 – 90
20	40 – 65
5	20 – 40
1.25	7 – 25
.075	0 – 5

.2 Zone 2 Gravel shall be used as an erosion protection layer on the seepage dyke and shall underlie all riprap materials placed in the erosion channel and at the spillway.

.3 Zone 3 Cut-off Material

.1 Zone 3 Cut-off material shall be used in the key trench of the seepage dyke.

.1 Cut-off Material shall consist of a homogeneous mixture of sand and bentonite, with a minimum 15% of its total dry weight being sodium bentonite. Bentonite contents will be confirmed prior to construction. The sand shall be obtained from a borrow source approved by the Engineer, providing it meets the specified requirements herein. The sand component of the mix, prior to introducing the sodium bentonite, shall have a grain size distribution as presented in Table 5.1.

.4 Geomembrane Liner

.1 Geomembrance liner shall be used in the seepage dyke.

.2 The geomembrane liner shall be supported 38 mil Arctic Liner or equivalent. The manufacturer shall provide to the Engineer, prior to shipment of materials, a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 5.3.

Table 5.3
Supported Arctic Liner Properties

Property	Test Method	Units	Value
Thickness (Nominal)	ASTM D1593-91	mm	0.97
Tensile Strength at Break	ASTM D882-91	N	1112
Elongation	ASTM D882-91	%	25
Tear Resistance	ASTM D1004-90	N	267
Low Temperature Impact	ASTM D1790-99	°C	-40
Arctic Liner Minimum Shop Seam Strengths			
Heat Bonded Seam Strength	ASTM D3083-93	N/mm	15.6
Heat Bonded Peel Adhesion Strength	ASTM D413-93	N/mm	3.5
Arctic Liner Minimum Field Seam Strengths			
Heat Bonded Seam Strength	ASTM D3083-93	N/mm	14
Heat Bonded Peel Adhesion Strength	ASTM D413-93	N/m	2.6

.5 Woven Geotextile

.1 Woven geotextile shall be used in the key trench of the seepage dyke and shall be sewn onto the Arctic Liner by the supplier.

.2 The woven geotextile shall have a weight of at least 169 g/m^2. The manufacturer shall provide to the Engineer, prior to shipment of materials, a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 5.4.

Table 5.4
Woven Geotextile – Material Properties

Property	Test Method	Units	Value
Grab Tensile	ASTM D4632-91	N	890
Elongation	ASTM D4632-91	%	15
Trapezoidal Tearing Strength	ASTM D4533-91	N	334
Puncture Strength	ASTM D4833-88	N	445
Mass per unit area	ASTM D5261-92	g/m^2	169

.6 Non-Woven Geotextile

.1 Non-woven geotextile shall be used in the erosion channel improvments.

.2 The nonwoven geotextile shall have a weight of at least 407 g/m^2. The manufacturer shall provide to the Engineer, prior to shipment of materials, a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 5.5.

Table 5.5
Nonwoven Geotextile – Material Properties

Property	Test Method	Units	Value
Grab Tensile	ASTM D4632-91	N	1330
Elongation	ASTM D4632-91	%	50
Trapezoidal Tearing Strength	ASTM D4533-91	N	512
Puncture Strength	ASTM D4833-88	N	800
Mass per unit area	ASTM D5261-92	g/m^2	407

WATER CONTROL/DEWATERING

1.0 General

.1 Water control/Dewatering for the seepage dyke, erosion channel and spillway improvements is described in this Section.

.2 The Contractor is responsible for being fully familiar with all aspects of the current site conditions.

.3 The Contractor shall understand that the water contained within the seepage collection pond and from groundwater seepage originating from the tailings impoundment is contaminated. The Contractor shall meet with a representative of the Federal Department of Indian Affairs and Northern Development to be informed of any health and safety issues that may result from the level of contamination in this water.

.4 The Contractor is responsible for water control and dewatering.

.5 The location and construction of the proposed water control/dewatering system and system elements shall be approved by the Engineer.

.6 The dewatering system shall be installed prior to any excavation at the Work site, excluding excavations required to install the dewatering system.

.7 A minimum requirement for dewatering shall include provisions for dewatering the existing seepage collection pond, the dyke footprint, and the key trench.

.8 The key trench and dam footprint areas shall be dewatered as required to allow for fill placement in a dry environment.

.9 Water Control may be required for activities within the erosion channel and the spillway.

.10 Water Control within the erosion channel and spillway shall be sufficient to allow the Contractor to complete all necessary Works as described in this Specification and on the Drawings.

.8 The dewatering system shall be maintained and operated until the thermosyphon system has been charged and operating for at least two (2) days. At the option of the Responsible Authority and/or the Engineer, the period of dewatering may be extended beyond this time frame for some specified period of not more than 14 days.

.9 Upon the cessation of dewatering, the Contractor shall:

.1 Re-assemble the existing pumpback system for the seepage collection pond and shall ensure that this system is fully functioning to the satisfaction of the Engineer. As part of this task the Contractor shall ensure that the floor level of the existing pumphouse is located above an elevation of 1131 m. If the pumphouse floor level is below an elevation of 1131 m, it shall be raised by the Contractor.

.2 Disassemble the construction dewatering system and its elements including the filling of sumps, and re-establishing slopes and slope protection according to the directions of the Engineer.

.3 Clean up the dewatering areas, including removing built up ice from within the seepage collection pond, and dispose of waste, ice, and debris at locations as directed by the Engineer.

.4 If used, return all borrowed equipment and materials to locations designated by the Engineer.

.10 Damage to any existing structures or to the Work as proposed in this Specification that may result from the failure and/or malfunction of the dewatering system shall be the responsibility of the Contractor and shall be repaired and/or replaced as directed by the Engineer and Responsible Authority at the Contractor's expense

2.0 Dewatering/Water Control

.1 All equipment and materials required for the dewatering system including pumps, piping, insulation, wiring and all other materials and equipment shall be provided by the Contractor.

.2 The Contractor may request to use any existing materials and equipment that may be available at the site. When approved by the Responsible Authority, the Contractor shall use such materials and then shall return the materials to their existing locations in an orderly manner at the end of the Work. Damaged materials are to be replaced by the Contractor at the Contractor's cost.

.3 Construction, operation and maintenance of the sump(s), pump(s), pipe line(s) and all other ancillary elements of the dewatering system are the responsibility of the Contractor.

.4 The dewatering system shall collect all surface water and groundwater that may impact the seepage dyke Work area and shall direct this collected water to the main tailings impoundment reservoir upstream of the Work area.

.5 The water control system shall collect and/or reroute water within the erosion channel and the spillway and shall direct this water downstream of the seepage dyke Work area.

.6 The dewatering system shall ensure that dry working conditions exist for all aspects of the work with the footprint of the dyke and that all excavations and adjacent slopes are stable and not subject to piping erosion during the course of the Work.

.7 The dewatering and water control systems shall be designed to operate during the subzero temperatures that are expected during the Work.

.8 Water collected in the sumps shall be discharged as directed by the Engineer and/or the Responsible Authority. No collected water shall be discharged downstream of the tailings impoundment without written authorization from the Engineer or Responsible Authority. Discharge of water shall not cause erosion.

.2 The geotextile shall be installed in a smooth, taunt manner free of wrinkles and folds.

.5 Zone 2 gravel fill shall be as shown in the Drawings and shall be placed in a single 0.3 m thick lift overlying the geotextile and Zone 1 fill. The placed gravel fill shall be packed using equipment tracks to the satisfaction of the Engineer.

.6 300 mm riprap shall be spread over the filled channel as shown on the Drawings.

8.0 Measurement for Payment

.1 Payment for all aspects of Work completed in this Section will be based on Lump Sum and Unit Prices as defined below. These Prices are included in Schedule A, Schedule of Unit Prices and Schedule B, Schedule of Lump Sum Prices in the Tender Form.

.2 Unit Prices will be used for the following portions of the Work:

.1 Provision, placement, and compaction of Zone 1 sand fill will be paid on the basis of cubic metres (m^3) as measured inplace. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with obtaining and placing of this material. It shall also include the cost of contouring the borrow source(s) to the satisfaction of the Engineer. This will be denoted Item A.1013-1 in Schedule A, Schedule of Unit Prices of the Tender Form.

.2 Provision, placement, and compaction of Zone 2 Gravel fill will be paid on the basis of cubic metres (m^3) as measured by truck count. The volume of each truck used in the haul shall be agreed by the Contractor and the Engineer. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the obtaining and placing of this material. It shall also include the cost of developing and contouring the borrow source(s) to the satisfaction of the Engineer. This will be denoted item A.1013-2 in Schedule A, Schedule of Unit Prices of the Tender Form.

EROSION CHANNEL

.2 Except for approved access routes, all construction traffic must be restricted to a 4 m wide zone on either side of the erosion channel.

.3 If the vegetation cover beyond the limits of the erosion channel is damaged by construction traffic, then Zone 2 gravel fill will be required to repair the disturbed area to the satisfaction of the Engineer. All such repairs will be at the cost of the Contractor.

6.0 Channel Clean Out

.1 The Contractor shall excavation all loose, wet, and slumped organic and inorganic materials from the erosion channel and its sidewalls. The resulting excavation shall provide for a smooth channel free of sharp projections and irregular surfaces.

.2 Spoil materials removed from the trench shall be disposed of within the tailings impoundment at the location designated on the Drawings.

.3 The resulting smoothed channel shall be observed by the Engineer prior to being accepted.

7.0 Channel Filling

.1 Only channel sections observed and approved by the Engineer may be filled.

.2 The channel shall be filled according to details presented in the Drawings that include the placement of Zone 1 sand fill, Zone 2 gravel fill, non-woven geotextile, and 300 mm median riprap.

.3 Zone 1 sand fill shall be placed in lifts with a maximum loose thickness of 450 mm. Each lift shall be compacted to at least 90% of Standard Proctor maximum dry density.

.4 The non-woven geotextile shall be used to separate the sand fill from the overlying fill materials as shown on the Drawings and:

.1 The geotextile shall be overlapped a minimum of 600 mm where overlap joints are required.

EROSION CHANNEL

1.0 General

.1 This Section describes the specifications for filling the erosion channel that lies above the seepage dyke and the seepage collection pond on the south side of the Dome creek channel.

.2 The erosion channel has developed due to the disturbance and removal of the natural vegetation cover during past construction activities. The Contractor's methods for the filling of the erosion channel must prevent similar disturbance from occurring outside of the channel area.

2.0 Reference Standards

.1 ASTM D698-91 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m3).

3.0 Product

.1 See Section 1005 - Materials

.2 The Responsible Authority will supply two rolls (total 1334 m^2) of non-woven geotextile.

4.0 Shipping and Storage

.1 Non-Woven Geotextile

a. Any visible damage to the shipment of geotextile shall be noted on the freight receipt and project records.

b. Storage of geotextile rolls on site shall be in a secure location that will minimize exposure to the elements and physical damage.

5.0 Channel Access and Construction Traffic

.1 The Contractor shall establish access to the erosion channel such that damage to the vegetation cover is prevented. Access route and construction plans shall be presented to the Engineer for review and/or revision. No access route shall be constructed without the approval of the Engineer.

.5 Charging of the thermosyphon system shall be as described by Arctic Foundations.

4.0 Measurement for Payment

.1 Payment for all aspects of Work completed in this Section including all aspects of procurement, freight, hauling, storing, layout, installation, and charging, will be based on Lump Sum Price as defined below. This Lump Sum Price is included in Schedule B, Schedule of Lump Sum Prices in the Tender Form.

.2 A Lump Sum Price will be used for the following portion of the work:

.1 The installation of the horizontal thermosyphon system supplied by Responsible Authority will be paid on the basis of a single lump sum price. The Lump Sum Price to include all equipment, fuel, labour, transportation, or other costs associated with the installation of this system according to the Drawings and Specifications. It shall also include the cost of freight for this material from Whitehorse to the site and storage of the material at the site. Moreover, it shall include the cost of all subcontractors including their mobilization, demobilization, equipment, and standby charges or any other costs associated with subcontractors. This will be denoted Item B.1011-1 in Schedule B, Schedule of Lump Sum Prices of the Tender Form.

HORIZONTAL THERMOSYPHONS

1.0 General

.1 The product and installation specifications for the thermosyphons system to be installed in the seepage dyke are presented in this Section.

2.0 Materials (by Manufacturer)

.1 Thermosyphons shall be two-phase liquid-vapour type thermosyphons charged with carbon dioxide refrigerant.

.2 The thermosyphons shall be constructed with A53B Schedule 40 steel pipe.

.3 Radiators shall be 75 mm O.D. pipe with 32 mm high x 0.012 mm nominal thickness carbon steel fins. Fin density shall be four (4) rows of fins per 25 mm of pipe.

.4 Standard of Acceptance: Thermosyphons as manufactured by Arctic Foundations of Canada Inc., Winnipeg, Manitoba, or an approved equal.

.5 The evaporator and radiator sizes and attachments including concrete footings shall be as shown on the Drawings.

.6 All welds shall meet ASME boiler and pressure vessel codes.

3.0 Installation

.1 Two rows of evaporator pipes shall be placed in the key trench: one row directly on Zone 3 Cut-off material, and the second row 1.5 m above the first row. The Contractor shall ensure that the entire length of the evaporator pipe is supported by the Cut-off material or by Zone 1 sand material placed by hand underneath the evaporator pipe.

.2 The evaporator pipes shall be installed as specified on the Drawings.

.3 The radiators shall be erected plumb and shall be braced to ensure that they are free standing and independent of the dam structure. The foundations and supports for the radiators shall be constructed as shown on the Drawings.

.4 All piping shall be tested prior to burial as detailed in Section 1015.

6 Measurement for Payment

.1 Payment for all aspects of Work completed in this Section including all aspects of hauling, storing, layout, installation, and seaming, will be based on Unit Rate Price as defined below. This Unit Prices are included where applicable in Schedule A, Schedule of Unit Prices in the Tender Form.

.2 Unit Rate Price will be used for the following portion of the work:

.1 Installation of Arctic Liner and woven geotextile will be paid on the basis of square metres (m^2) as measured inplace. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the placing of this material. It shall also include the cost of freight for this material from Whitehorse to the site and heated storage of the material at the site. Moreover, it shall include the cost of all subcontractors including there mobilization, demobilization, equipment, repair costs, and standby charges or any other costs associated with subcontractors. This will be denoted item A.1010-1 in Schedule A, Schedule of Unit Prices of the Tender Form.

f. Stresses imposed while placing backfill on the liner shall be released at the top of the slope during cover placement.

g. The Contractor shall discuss with the Engineer the schedule for liner system and backfill placement. The Engineer shall approve all plans and schedules for backfilling the liner system.

.5 Damage

a. All areas of the liner system requiring repair due to manufacturing flaws or damage during shipping, handling, or placement shall be recorded and surveyed. The Engineer shall prescribe the method of repair to be used for all liner system materials.

a. Damaged sections of geotextile shall be repaired or replaced at the Engineer's discretion.

b. The Arctic Liner is the primary water retention barrier in the seepage dyke. Arctic Liner integrity and quality is absolutely essential for the seepage dyke remediation to fulfill its design intent.

- Defects in the geomembrane panels will include roughness or striations, bubbles, blisters, any local variation in sheet thickness that exceeds +/- 20% or exceeds 150 mm in any direction, undispersed raw material or foreign matter present in either the surface or cross section of the sheet and pinholes, tears, gouges or any other through-thickness defect.

- Any of the defects listed above in the Arctic Liner shall be patched with a piece of the same membrane material. Patches shall be cut with rounded corners and shall overlap the damaged area a minimum of 75 mm. Arctic Liner patches will be applied with a hand held heat gun and roller. The patch and damaged membrane area shall be clean and dry. The heat gun will be inserted between the patch and the membrane liner, heating the surfaces of each to a molten state. Steel roller pressure over a hard surface shall be applied during the heating process in such a way as to smooth out any wrinkles while mating both Arctic Liner membrane surfaces.

b. Care shall be taken when the GCL panels are exposed. Sharp objects, vehicles and equipment shall not contact the material.

c. When the upper liner system of the remediated dyke has been constructed, the GCL shall be folded back over the Arctic Liner, as shown in the Drawings. A minimum of 150 mm thickness of Zone 1 sand material shall be compacted over the GCL prior to covering with Zone 2 gravel for erosion protection.

.5 Backfilling

a. The Contractor shall take the necessary steps to ensure that the integrity of the liner system is not compromised during backfilling. Frozen key trench fill material adhering to the liner system shall not be removed unless repairs are required.

b. The Contractor shall ensure that the integrity of the liner system is not compromised during construction. Precautions the Contractor may take to avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

c. Any damage to the liner system shall be immediately reported to the Engineer. Repair work shall commence as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

d. The liner system shall be temporarily anchored so that movement downslope does not occur during backfilling at any stage of construction.

e. The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system during backfilling. Care shall be taken to avoid any damage to the liner system by making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall be minimized.

of one hundred thousand (100,000) m^2 of Arctic Liner involving the thickness and grade of liner and welding processes required for this project. Furthermore, all geomembrane installation and welding personnel shall have cold weather installation experience applicable to this project.

j. Sufficient temporary anchorage shall be used to hold the geomembrane in place during backfilling. The method of temporary anchorage must not damage the Arctic Liner

.2 Key Trench

a. The liner system (supported Arctic Liner sewn with woven geotextile) to be used in the key trench shall be placed as shown in the Drawings. With the sewn connection at the base of the key trench, the liner system shall be unfolded such that the supported Arctic Liner is lined vertically with the upstream wall of the key trench and the woven geotextile is lined vertically with the downstream wall of the key trench.

b. The upstream face of the vertical key trench shall be smooth and free of localized frozen high points that the Engineer believes may puncture or cause stress to the Geomembrane.

c. Sufficient temporary anchorage shall be used to hold the supported Arctic Liner and woven geotextile in place during placement of the other elements of the liner system and during backfilling. The method of temporary anchorage must not damage the Arctic Liner.

d. The key trench liner system placement shall not be conducted during periods of high wind.

e. During backfilling of the key trench, the temporary anchorage shall be adjusted to ensure that the supported Arctic Liner is not stressed.

.4 Geosynthetic Clay Liner

a. The crest of the existing GCL liner shall be exposed and folded onto the upstream slope, as described in Section 1008, Clause 3.3

b. The liner system placement shall not be conducted during periods of high wind. Panels to be placed in sub-zero temperatures shall be stored in a heated enclosure prior to placement. The air temperature in the heated enclosure shall not be less than 10°C. Panel unfolding and placement must occur immediately after removal from the heated enclosure unless otherwise authorized by the Engineer.

c. Care shall be taken when the Arctic Liner panels are deployed. Sharp objects, vehicles and equipment shall not contact the material.

d. The Arctic Liner shall be placed in a relaxed condition, free of stress or tension. The panels shall be positioned so that there is a nominal 150 mm seam overlap. Any methods used to temporarily bond adjacent rolls shall not damage the geomembrane.

e. The contact surfaces of the two sheets shall be wiped clean to remove all dirt, dust, moisture or other foreign materials.

f. Field seams shall be made by hot wedge fusion welding. Trial seams shall be made and tested to verify the welding temperature, speed of welding and the effects of ambient air temperature. The machine settings shall be adjusted accordingly. Throughout the seaming operation, occasional adjustments of welding temperature and/or speed as the result of changing ambient conditions may be necessary to maintain a consistent seam. A 40 mm nominal seam width is required for single-track welds. Dual track weld should have two 12 mm nominal seams separated by an air test channel.

g. A heated, portable shelter will be required to permit the Arctic Liner panels to be welded. The minimum Arctic Liner temperature in the vicinity of the welder shall be -7°C.

h. All welders will be required to successfully complete a qualification weld, witnessed by the Engineer prior to starting any welding.

i. All welding shall be performed under the supervision of a field supervisor who will remain on site and be responsible for all geomembrane installation. The supervisor shall have installed or supervised a minimum

j. ASTM D413-93 - Standard Test Methods for Rubber Property – Adhesion to Flexible Substrate.

k. ASTM D4643-93 - Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.

l. ASTM D5084-90 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter.

m. ASTM D5321-92 - Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.

3.0 Product

.1 See Section 1005 - Materials

4.0 Shipping and Storage

.1 Arctic Liner & Woven Geotextile

a. Arctic Liner and woven geotextile panels shall be shipped in palletized boxes, which are inspected before leaving the factory. Shipping shall conform to the manufacturer's requirements and shall be conducted in a manner that avoids damage. Any visible damage to the shipment shall be noted on the freight receipt and project records.

b. The Arctic Liner shall remain packaged in dry storage until ready for use. The palletized boxes shall not be stacked.

5.0 Installation

.1 Arctic Liner

a. The area to be lined shall be smooth and free of sharp objects that could puncture the Arctic Liner. All gravel clasts larger than 25 mm shall be removed from the surface to be covered. The installation of the Arctic Liner shall not begin until the base has been approved by the Engineer.

DYKE EXCAVATION AND FOUNDATION PREPARATION

4.0 Dam Footprint

.1 All surficial vegetation, soft and/or wet soils, and organic soils shall be removed from within the limits of construction as shown in the Drawings to expose permafrost soils and/or thawed soils acceptable to the Engineer.

.2 All frozen lumps, ice, or other materials deemed to be unsuitable by the Engineer shall be removed.

5.0 Liner Key Trench

.1 The liner key trench shall be excavated into permanently frozen ground as indicated in the drawings and as determined by the Engineer.

.2 The ultimate depth of excavation shall be determined at the time of construction by the Engineer. The depth of the key trench may be increased in some areas at the discretion of the Engineer to confirm the suitability of the foundation soils beneath the key trench.

.3 The key trench shall be excavated using mechanical techniques. Final cleaning of the key trench shall be conducted with hand excavation, brooms and/or compressed air to remove all loose, broken or altered material from the base of the key trench.

.4 The side walls and base shall be free of any protrusions or sharp projections that in the opinion of the Engineer could puncture or damage the liner that will be placed in the trench.

.5 Any inflow of water into the key trench excavation shall be controlled as specified in Section 1007 in a manner that minimizes thaw and erosion at the key trench base.

.6 The base of the key trench shall be levelled using compacted Zone 3 Cut-off sand/bentonite mixture (see Section 1009).

DYKE EXCAVATION AND FOUNDATION PREPARATION

1.0 General

.1 Specifications for clearing, stripping, and excavation of the existing seepage dyke, the north and south abutment slopes, the dam footprint for the raised seepage dyke, and the liner key trench, are presented in this Section.

2.0 Stripping

.1 All standing vegetation in the areas affected by the construction of the key trench and the foundation for the thermosyphon radiators should be cleared and stripped from the dam footprint and from the north abutment slope. For the north abutment slope the clearing and stripping should extend from 15 m upstream of the existing dam centerline to 15 m downstream of the key trench centerline. The north abutment slope should be cleared and stripped from the toe of the slope to its crest.

3.0 Excavation of Existing Dyke

. 1 The existing dyke shall be excavated as shown in the Drawings.

.2 The Zone 2 gravel used for erosion protection on the existing dyke shall be carefully stripped from the outer shell of the existing dyke and stockpiled for later use to complete construction of the raised dyke and/or of the erosion channel.

.3 Fill on top of the crest of the existing upstream Geosynthetic Clay Liner (GCL) (estimated Elevation 1129.7 m) shall be carefully stripped to expose the GCL. After the crest of the GCL is uncovered, it should be folded back onto the upstream slope so that later, it can overlap the newly-placed Arctic Liner, as shown in the Drawings.

.4 The existing dyke shall be excavated such that the embankment slopes are smooth, stable, and suitable for seaming of the liner system. It is anticipated that slopes as flat as 3H:1V may be required; however, this will be determined by the Engineer during construction.

3.0 Measurement for Payment

.1 Payment for all aspects of Work completed in this Section including all aspects of dewatering will be based on a single Lump Sum Price. This Lump Sum Price will include all equipment, labour, fuel, power, required to install, operate, maintain, disassemble, and clean up after the dewatering activities. It will also include all aspects of disassembling and reassembling the existing seepage pumpback system for the seepage collection pond. This payment item is included as item B.1007-1 in Schedule B, Schedule of Lump Sum Items in the Tender Form.

.2 If the dewatering period is extended in length at the option of the Engineer and/or the Responsible Authority, the Contractor would be paid on the basis of a Unit Rate per day for each day that the dewatering period is extended. This Unit Rate would apply up to a maximum of 16 days following the activation of the thermosyphon system. This Unit Rate Price will include all equipment, labour, fuel, power, required to operate and maintain the dewatering system on a daily basis. This payment item is included as item A.1007-1 in Schedule A, Schedule of Unit Rate Price Items in the Tender Form.

.3 **Installation of** non-woven geotextile will be paid on the basis of square metres (m^2) as measured inplace. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the placing of this material. This will be denoted item A.1013-3 in Schedule A, Schedule of Unit Prices of the Tender Form.

.4 Provision and placement of 300 mm riprap will be paid on the basis of square metres (m^2) as measured inplace. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the production, hauling, and placing of this material. It shall also include the cost of contouring the borrow source(s) to the satisfaction of the Engineer. This will be denoted item A.1013-4 in Schedule A, Schedule of Unit Prices of the Tender Form.

.3 Lump Sum Prices will be used for the following portions of the Work.

.1 All excavation and smoothing of the erosion channel required as described within the Specifications shall be paid on the basis of a single Lump Sum Price. This price shall include all costs associated with this providing access to the channel, excavating materials from the channel, and disposal of the excavated materials. This price shall include all equipment, labour, fuel, and maintenance. This item shall be shall as Item B.1013-1 in the Tender Form.

SPILLWAY IMPROVEMENTS

1.0 General

.1 This Section describes the Specifications for spillway improvements.

.2 Spillway improvements will include widening, increasing the depth, regrading the base, placing riprap, and constructing riprap drop structures.

2.0 Product

.1 See Section 1005 - Materials

3.0 Riprap Source(s)

.1 Riprap to be used in the improvements to the spillway is to be obtained from designated areas on the spillway slopes and from the riprap stockpiles located near the spillway.

.2 If additional riprap is required, the Contractor shall produce and haul this material from the mine waste dump site. The Engineer's authorization will be required before additional riprap is produced and hauled to the spillway site.

4.0 Spillway Widening and Deepening

.1 The minimum spillway width is 5 m and the minimum spillway depth (before riprap placement) is 2.0 m. Where these criteria are not currently met, the Contractor will be required to widen and/or deepen the spillway to achieve these criteria. Such work is expected to be required between Stations 0+40 and 1+00 and between Stations 3+00 and 3+10 (see Drawings for Station locations).

.2 Where the depth of the spillway is not sufficient the Engineer may choose to either excavate the base or built up the sides and will direct the Contractor accordingly.

.3 **Due to the minor nature of these improvements, the Contractor will complete these works under the direction of the Engineer on a Cost Recoverable basis.**

5.0 Spillway Grading & Gravel Placement

.1 The current spillway base contains a variable thickness of gravel fill and is not level from side to side. The Contractor will re-grade the spillway to ensure that at least 0.3 m of gravel is inplace throughout the spillway base and for a height of at least 1.5 m above the spillway base.

.2 The Contractor will also fill in any existing erosion channels present within the spillway and will ensure that the spillway base is level as viewed perpendicular to the spillway centerline.

.3 If required, additional gravel fill will be hauled to the site by the Contractor as part of the regrading operation.

6.0 300 mm Riprap Placement

.1 300 mm median riprap will be placed over the prepared spillway base and spillway side slopes as shown on the Drawings. The completed riprap cover will be at least 600 mm in thickness and will extend at least 2 m above the existing base of the spillway as shown on the Drawings.

.2 Loading, transporting, placing and spreading of the riprap materials shall be carried out in such a manner to avoid segregation. Segregated materials shall be removed and replaced with the materials meeting the requirements stated herein as required by the Engineer.

.3 No riprap shall be placed without the authorization of the Engineer.

7.0 Drop Structure Construction

.1 Fourteen (14) riprap drop structures will be constructed by the Contractor as shown on the Drawings.

.2 Construction of the drop structures will require the individual selection and placement of 400 mm to 600 mm and 900 mm to 1200 mm sized riprap stones as shown on the Drawings.

.3 The drop structures shall be constructed to the satisfaction of the Engineer.

8.0 Measurement for Payment

.1 Payment for all aspects of Work completed in this Section will be based on Lump Sum, Unit Rate Prices, and Cost Recoverable Rates as defined below. These Prices are included in Schedule A, Schedule of Unit Prices, Schedule B, Schedule of Lump Sum Prices and Schedule C, Schedule of Cost Recoverable Items in the Tender Form.

.2 Unit Prices will be used for the following portions of the Work:

.1 Provision, placement, and compaction of Zone 2 Gravel fill will be paid on the basis of cubic metres (m^3) as measured by truck count. The volume of each truck used in the haul shall be agreed by the Contractor and the Engineer. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the obtaining and placing of this material. It shall also include the cost of developing and contouring the borrow source(s) to the satisfaction of the Engineer. This will be denoted item A.1014.1 in Schedule A, Schedule of Unit Prices of the Tender Form.

.2 **Provision of** all of all classes of riprap to the spillway and/or spillway stockpile will be paid on the basis of cubic metres (m^3) as measured by truck count. The volume of each truck used in the haul shall be agreed by the Contractor and the Engineer. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the obtaining and hauling of this material to the spillway. It shall also include the cost of contouring the borrow source(s) to the satisfaction of the Engineer. This will be denoted item A.1014.2 in Schedule A, Schedule of Unit Prices of the Tender Form.

.3 **Placement of** 300 mm medium riprap on the spillway will be paid on the basis of square metres (m^2) of area as indicated on the Drawings. The Unit Rate to include all equipment, fuel, labour, transportation, or other costs associated with the handling and placing of this material on the spillway. The source of the riprap will include the existing spillway slopes, the existing riprap stockpile and riprap produced and hauled to the site from a source developed by the Contractor. This will be denoted item A.1014-3 in Schedule A, Schedule of Unit Prices of the Tender Form.

SPILLWAY IMPROVEMENTS

.3 Lump Sum Prices will be used for the following portions of the Work.

.1 Regrading and levelling of the spillway required as described within the Specifications shall be paid on the basis of a single Lump Sum Price. This price shall include all costs associated with this levelling and regrading the spillway as well as spreading additional gravel as required to fill low areas. This price shall include all equipment, labour, fuel, and maintenance. This item shall be shall as Item B.1014-1 in the Tender Form.

.2 The construction of 14 drop structures along the spillway as indicated in the Drawings and described in the Specifications will be paid on the basis of a single Lump Sum Price. This price shall include all costs associated with this handling, hauling, and placing the required riprap to form the drop structures. The source of the riprap will be the riprap stockpile unless this is exhausted. This price shall include all equipment, labour, fuel, and maintenance. This item shall be shall as Item B.1014-2 in the Tender Form

.4 All aspects of widening and/or increasing the depth of the spillway where required by the Engineer will be paid on the basis of Cost Recoverable hourly rates for Equipment and Labour. The rates will be provided by the Contractor in Schedule C, Schedule of Cost Recoverable Items in the Tender Form.

QUALITY ASSURANCE

1.0 General

.1 The quality assurance testing required by the Engineer is described in this Section.

.2 The quality assurance testing will be conducted by the Engineer.

2.0 Reference Standards

.1 American Society for Testing Materials.

a. ASTM D2216-92 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.

b. ASTM D4437-84 – Standard Practice for Determining the Integrity of Field Seams used in Joining Flexible Polymeric Sheet Geomembranes.

c. ASTM D3083-89 – Standard Practice for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal and Reservoir Lining.

d. ASTM D413-82 – Standard Test Methods for Rubber Property – Adhesion to Flexible Substrate.

.2 Canadian Standards Association

a. CSA Can 3-A23.2-6C – Density, Yield and Cement Materials Factor for Plastic Concrete.

.3 Geosynthetic Research Institute

a. GRI Test Method GMG – Pressurized Air Channel Test for Dual Seamed Geomembranes.

3.0 Fill Testing Requirements

.1 Zone 1 Sand Material

a. The density of the Zone 1 sand fill shall be evaluated by in situ density testing. The required tests and testing frequency is presented in Table 15.1. Additional testing may be required at the discretion of the Engineer.

Table 15.1
Zone 1 Sand Backfill Testing and Frequency

Test	Test Frequency of Mixed Material	Test Frequency for Placed Material
Moisture Content	One per 500 m^3	2 per day
Placed Bulk Density	-	2 per day

.2 Zone 2 Gravel

a. Samples of the Zone 2 gravel will be evaluated from time to time during placement to ensure that the produced and placed gradation meets the specification stated herein. The required tests and testing frequency for the Zone 2 gravel material is presented in Table 15.2. Additional testing may be conducted at the discretion of the Engineer.

Table 15.2
Testing and Frequency During Placement of Zone 2 Gravel Material

Test	Test Frequency
Grain Size Analysis	One per 2 days

.3 Zone 3 Cut-off Material

a. Table 15.3 summarizes the required tests and testing frequency for the Cut-off sand bentonite mix. Additional testing may be conducted at the discretion of the Engineer.

Table 15.3
Zone 3 Cut-off Sand/Bentonite Mix Testing and Frequency

Test	Test Frequency of Mixed Material	Test Frequency for Placed Material
Moisture Content	One per day	One per day
Placed Bulk Density		One per day

.4 Fill Testing Methods

a. Moisture content is defined as the ratio of the weight of water to the weight of dry soil. Moisture content testing shall be conducted according to ASTM D2216.

b. The Engineer shall obtain in situ density measurements of the Zone 1 sand and the Zone 3 cut-off sand/bentonite mix using a nuclear densometer.

4.0 Arctic Liner Testing Requirements

.1 General

a. The Contractor is responsible for obtaining mill certificates from the manufacturer and forwarding them to the Engineer.

b. The Contractor shall record all seam parameters (i.e. time, date, operator, welding speed and temperature) on the liner.

c. The Engineer will conduct a limited program of testing on seam welds.

d. The Contractor shall be responsible for completing the vacuum box testing and fusion seam pressure testing. The Contractor shall mark the test number and parameters on the liner.

e. The Contractor shall supply a field tensiometer for testing liner seams for shear and peel strength. The tensiometer shall be available for the Engineer's use.

f. Qualifying seams will be tested by the Engineer.

g. The Contractor is responsible for maintaining testing records.

h. All coupons and test specimens remain the property of the Responsible Authority.

.2 Preliminary Qualification

a. At the start of liner installation, the Contractor shall remove a sample and submit it to the Engineer for audit testing if required. Samples shall consist of a strip 750 mm wide cut across the full width of one roll, which was not sampled at the factory. If all rolls were sampled, then one roll shall be picked at random by the Engineer.

QUALITY ASSURANCE

b. At the start of liner installation, the Contractor shall submit to the Engineer a 1 m long sample of each type of seam to be used in the installation. The test seams will be fabricated from a sheet used in the installation by a welder working on the installation. Test seams will be used to evaluate the welding procedures used by the Contractor. Evaluation of welding procedures will involve destructive testing, as described in this specification, for each type of weld. Test values obtained during this procedure will not be considered as "bench mark" values for any subsequent evaluations.

.3 Qualifying Welds

a. Qualifying seams shall be conducted on fragmented pieces of material at the following times:

- At the start of each shift of production seaming, and at 4 hour intervals during production seaming,
- When a new operator or new machine starts welding,
- When a machine is restarted after repairs,
- When welding is stopped for sixty (60) minutes or more,
- When there is a change in the ambient conditions, and
- At the discretion of the Engineer.

b. Qualifying seams shall be 1 m long, and shall be subject to shear and peel testing. The test seam shall meet the minimum requirements stated herein for seam strength, when tested on a field tensiometer. If a qualifying seam fails, the seaming procedure shall be reviewed and the test shall be repeated.

.4 Non-Destructive Testing

a. Test all welded seams over their full length using a vacuum unit or air pressure test (for split-wedge fusion process).

- Seam intersections will also be subject to vacuum box testing, regardless of seaming method employed.

- The Contractor shall supply all apparatus and personnel for this type of test.

- The tests shall be witnessed and documented by the Engineer.

b. Clean all seams to permit proper inspection.

c. Repair any seams which fail non-destructive testing in accordance with this Specification. Repairs shall be fully documented by the Contractor.

.5 Destructive Testing for Production Seams

a. Cut-out coupons shall be taken at a minimum frequency of one (1) per 150 m of seam, or once per seam. Coupons shall be cut by the Contractor at the location directed by the Engineer. Coupons shall generally be taken from a location that does not affect the performance of the liner. All cut-outs shall have rounded corners. Care shall be taken to ensure that no slits penetrate the parent liner.

b. All holes left by cut outs shall be patched immediately.

.6 Testing of Repairs

a. All repairs shall be tested using the Air Lance or Vacuum Box in accordance to test method ASTM 4437-84.

.7 Seam Acceptance Criteria

a. Seam and adhesion tests will be performed according to ASTM D3083 and ATSM D413.

b. Seam and adhesion strength acceptance will be based on five (5) samples in each coupon, which shall meet or exceed the minimum value specified. No individual sample may have a seam shear strength less than the minimum value specified in Table 5.3 of Section 1005.

c. If a coupon does not meet the acceptance criteria, two (2) additional coupons shall be cut from the seam within three (3) metres to each side of the failed coupon, and tested. This shall continue until the extent of the unsatisfactory seam has been defined.

.8 Seam Strength Acceptance

a. All seams shall meet or exceed the seam strength and adhesion criteria presented in Table 5.3 of Section 1005.

.9 Vacuum Box Testing and Fusion Seam Pressure Testing

a. No leaks shall be permitted. Leak testing shall be conducted using vacuum box testing and fusion seam pressure testing.

b. If a vacuum box test cannot be carried out on a particular area a pick test and air lance test shall be performed on the area.

.10 Air Pressure Testing

Air pressure tests shall be conducted for seams made with split wedge welding. The split wedge welder prepares welds with two bonded areas separated by an unbonded channel. This channel can then be sealed at each end and air pressure applied to determine the integrity of the seams. Air pressure testing shall be carried out according to GRI Test Method GM6, Pressurized Air Channel Test for Dual Seamed Geomembranes.

5.0 Thermosyphon Testing Requirements

.1 All evaporator piping shall be tested for leaks using a helium detecting mass spectrometer prior to burial. Final above ground joints on the risers shall be checked for leaks with a leak detection system once the unit has been charged. No leaks are permitted.

6.0 Measurement for Payment

.1 Work of this section will not be measured. Include all costs in Balance of Project Complete in the Tender Form.

PROJECT TITLE: **Mount Nansen Seepage Dyke and Spillway Improvements**
Mount Nansen Mine Site, Yukon

EBA PROJECT NUMBER: **0201-00-14618**

ADDENDUM NUMBER: 1

SCOPE OF THIS ADDENDUM

1. Tender Closing

a) The closing date of tender as shown on Page 2 of the Tender Form should be read: **"no later than 1600 hrs Pacific Daylight Saving Time, October 2nd, 2000"**

2. Drawings

b) A clarification drawing of Cross Section K-K from Drawing 14618-07 – "Erosion Channel Plan View and Cross Sections" is attached as "Figure 7 Addendum". This drawing represents no change to Drawing 14618-07, but provides the cross section K-K in larger scale.

3. Tender Form

a) A revised Schedule A of the Tender Form is attached to this Addendum. Note that this revised Schedule contains a change in the quantities for Items A.1013-1, Channel Sand Fill and A.1013-2, Channel Gravel.

4. Section 1002 General

a) Clause 12.0 – "Materials" Table 2.1, delete the Note following table and replace with:

"Note: Thermosysphons, Arctic Liner, and geotextile material to be supplied by the Responsible Authority."

5. Section 1005 Materials

a) Clause 2.0 – "Materials Sources" delete item .5 and replace with:

".5 Non-woven geotextile to be supplied by the Responsible Authority."

6. Section 1009 Dyke Fill Placement

a) Clause 4 – "Zone 3 Cut-Off Material" delete item .5 and replace with:

".5 The Zone 3 Cut-off material shall be compacted to at least 95% of the maximum dry density as determined by the test method ASTM D698-91 (Standard Proctor)."

b) Clause 6.0 – "Zone 2 Gravel Material" add item .2:

".2 Zone 2 gravel shall be packed using tracked equipment to the satisfaction of the Engineer."

7. Section 1011 Horizontal Thermosyphons

a) Clause 2.0 – "Materials (by Manufacturer)" change clause title to read:

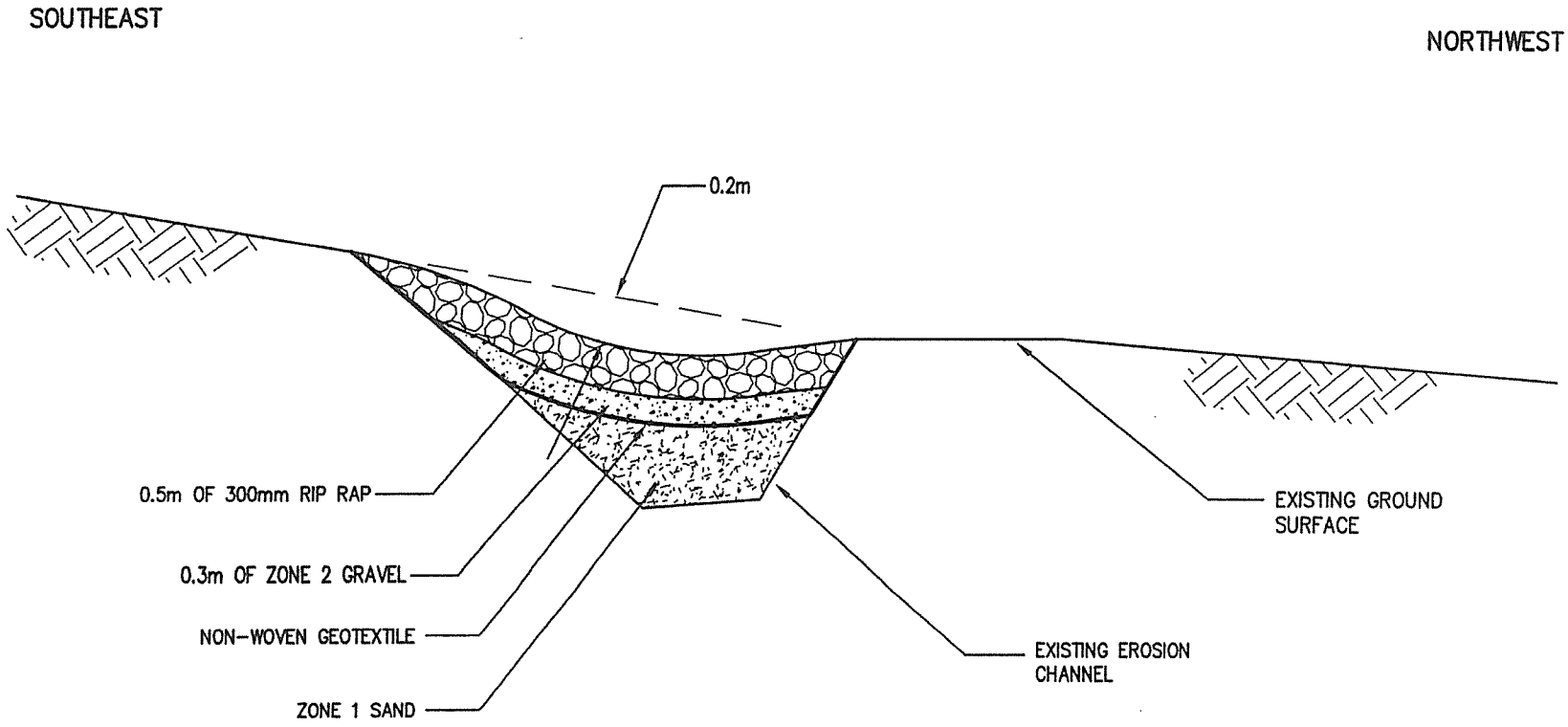
"2.0 Materials"

b) Clause 2.0 – "Materials" add item .7 to read:

".7 Concrete footings to be supplied by the Contractor and to be either cast-in-place or precast 20 MPa unreinforced footings as shown on the drawings."

END OF ADDENDUM

Enclosures



CROSS-SECTION K-K (K / 02) (K / --)

Figure 7 Addendum

Erosion Channel
Cross-Section K - K

14618 Figure 7 Section K-K.dwg

TENDER FORM

Project Title and Location: Mount Nansen Seepage Dyke and Spillway Improvements
Mount Nansen Mine site, Yukon.

Tender Submitted by:_____

Schedule A

The Contractor shall provide a contract breakdown of the equipment and labour proposed to complete the work in this Tender in the format provided below:

Item	Description	Unit	Unit Price	Quantity	Total
A.1007-1	Daily Water Control	days	$_____	5	$_____
A.1008-1	Excavation	m^3	$_____	4200	$_____
A.1009-1	Zone 1 Sand Fill	m^3	$_____	4300	$_____
A.1009-2	Zone 2 Gravel Fill	m^3	$_____	450	$_____
A.1009-3	Zone 3 Cut Off Fill	m^3	$_____	100	$_____
A.1010-1	Liner Installation	m^2	$_____	1934	$_____
A.1013-1	Channel Sand Fill	m^3	$_____	800	$_____
A.1013-2	Channel Gravel	m^3	$_____	200	$_____
A.1013-3	Geotextile Install	m^2	$_____	836	$_____
A.1013-4	Channel Riprap	m^2	$_____	720	$_____
A.1014-1	Spillway Gravel	m^3	$_____	100	$_____
A.1014-2	Riprap Supply	m^3	$_____	750	$_____
A.1014-1	300 Median Place	m^2	$_____	6600	$_____
				GST	$
	TOTAL SCHEDULE A				$

APPENDIX C

Contract Drawings

Department of Indian Affairs & Northern Development

MOUNT NANSEN DAM REMEDIATION
MOUNT NANSEN, YUKON

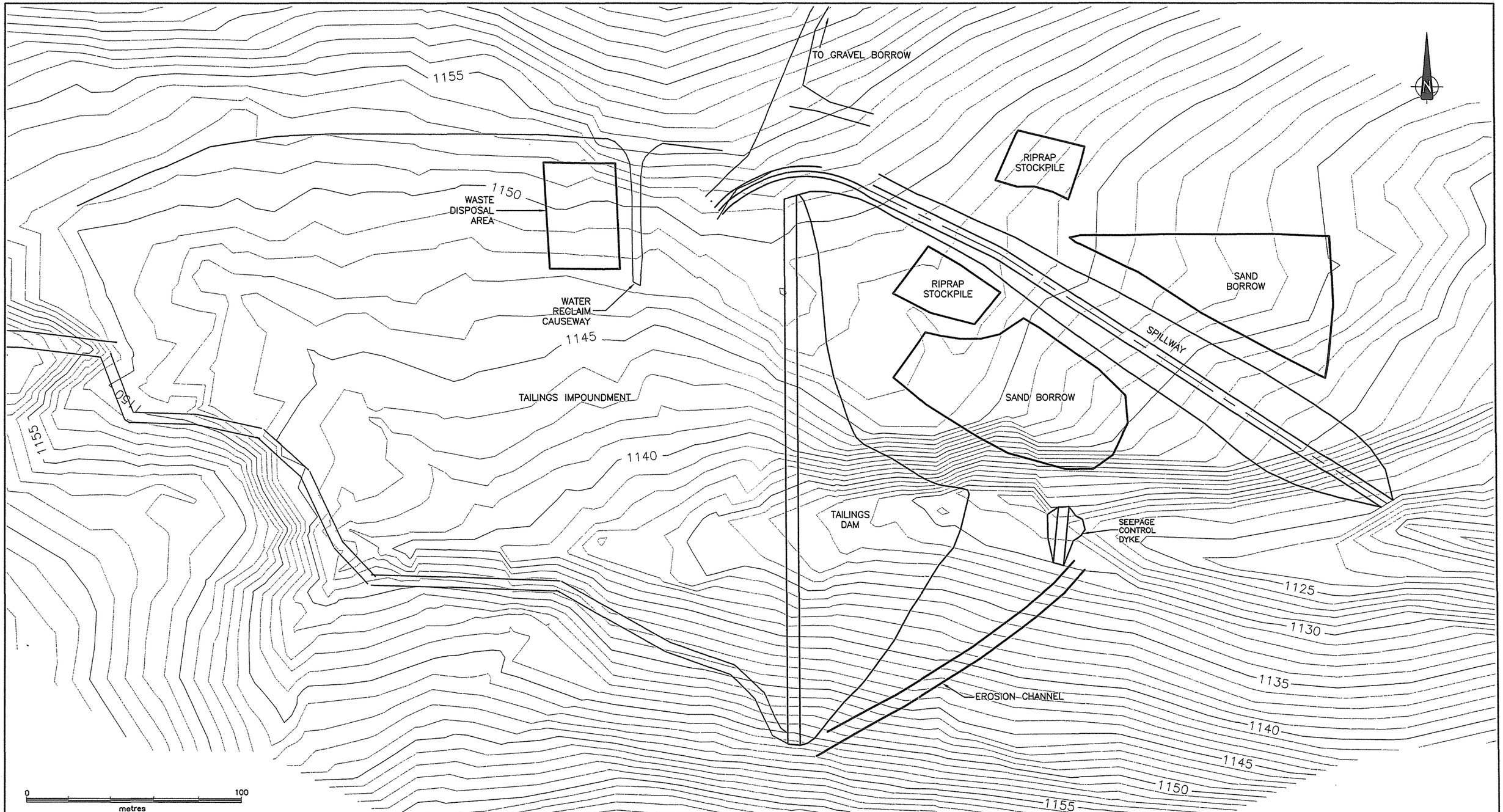
SEEPAGE DYKE & SPILLWAY IMPROVEMENTS

CONSTRUCTION DRAWING - INDEX

Drawing Number	Drawing Title
14618-01	TAILINGS DAM KEY PLAN
14618-02	SEEPAGE DYKE - PLAN VIEW, KEY TRENCH AND DAM LAYOUT
14618-03	SEEPAGE DYKE - PROFILES A-A AND B-B
14618-04	SEEPAGE DYKE - CROSS-SECTIONS C-C, D-D, E-E, F-F AND G-G
14618-05	SEEPAGE DYKE - PLAN AND PROFILE, THERMOSYPHON AND INSTRUMENTATION LAYOUT
14618-06	SEEPAGE DYKE - TYPICAL THERMOSYPHON DETAILS
14618-07	EROSION CHANNEL - PLAN VIEW AND CROSS-SECTIONS
14618-08	SPILLWAY - PLAN VIEW OF SPILLWAY AND LOCATION OF DROP STRUCTURES
14618-09	SPILLWAY - SPILLWAY PROFILES
14618-10	DROP STRUCTURE - PLAN VIEW AND CROSS-SECTIONS A-A', B-B'

EBA Engineering Consultants Ltd.

CONSTRUCTION DRAWINGS
SEPTEMBER, 2000



	DD/MM/YY		0	ISSUED FOR CLIENT REVIEW	17/05/00	XXX
DRAWING TITLE	DATE	REV	No.	DESCRIPTION	DATE	APPROVED
REFERENCE DRAWINGS			REVISION			

EBA Engineering Consultants Ltd.

DESIGNED BY:	JTCS/KWJ
DRAWN BY:	B. RICHMOND
DATE:	09/09/00
SCALE:	AS SHOWN
PROJECT No.:	0201-00-14618
ACAD FILENAME:	14618 Figure 1.dwg

SEAL

DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT

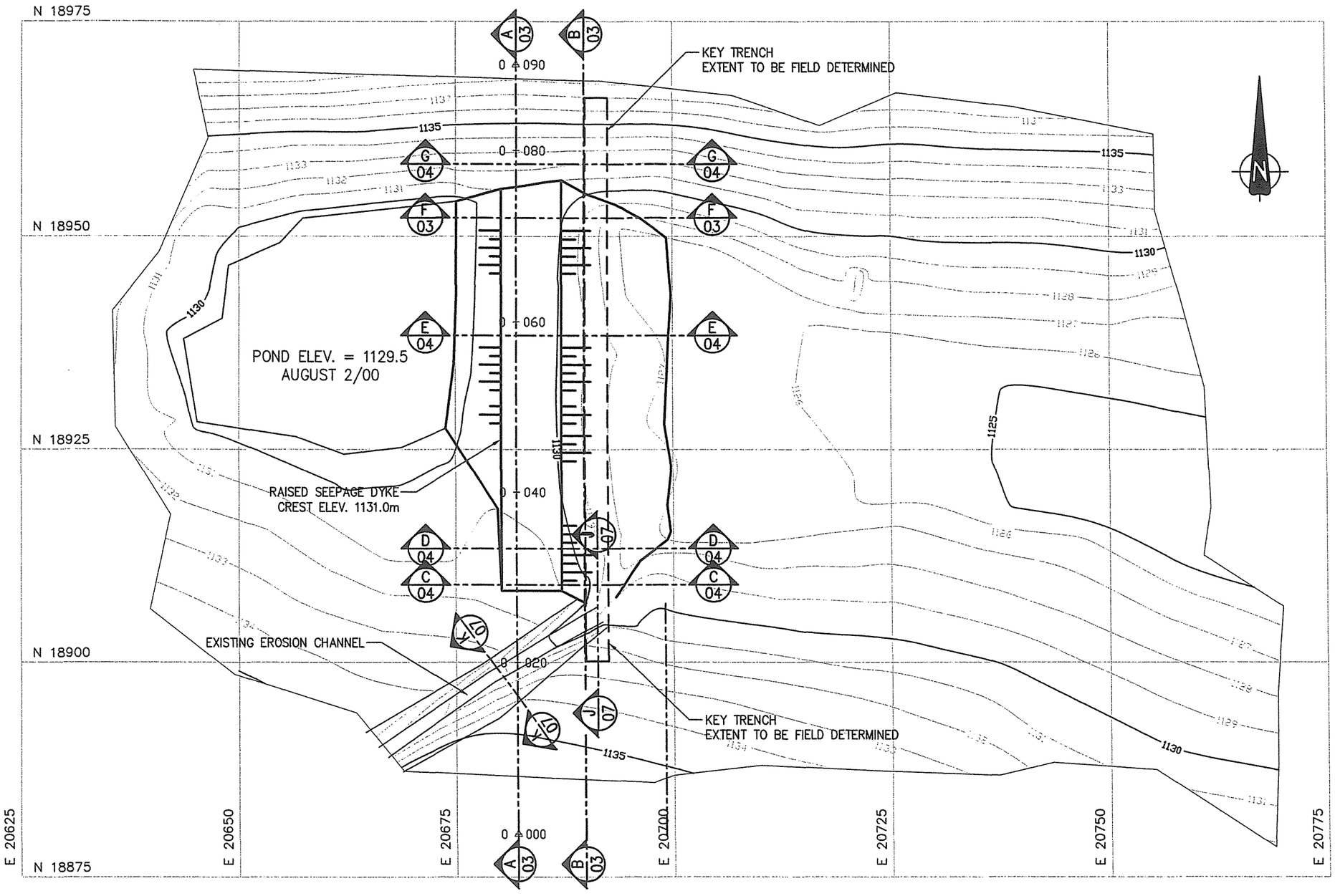
MOUNT NANSEN SEEPAGE DYKE AND SPILLWAY IMPROVEMENTS – MT. NANSEN, YT.

TAILINGS DAM

KEY PLAN

REVISION ISSUE 0

DRAWING No. 14618-01



DRAWING TITLE	DATE	REV	No.	DESCRIPTION	DATE	APPROVED
	DD/MM/YY		0	ISSUED FOR CLIENT REVIEW	17/05/00	XXX
REFERENCE DRAWINGS			REVISION			

EBA Engineering Consultants Ltd.

DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT

MOUNT NANSEN SEEPAGE DYKE AND SPILLWAY IMPROVEMENTS – MT. NANSEN, YT.

SEEPAGE DYKE

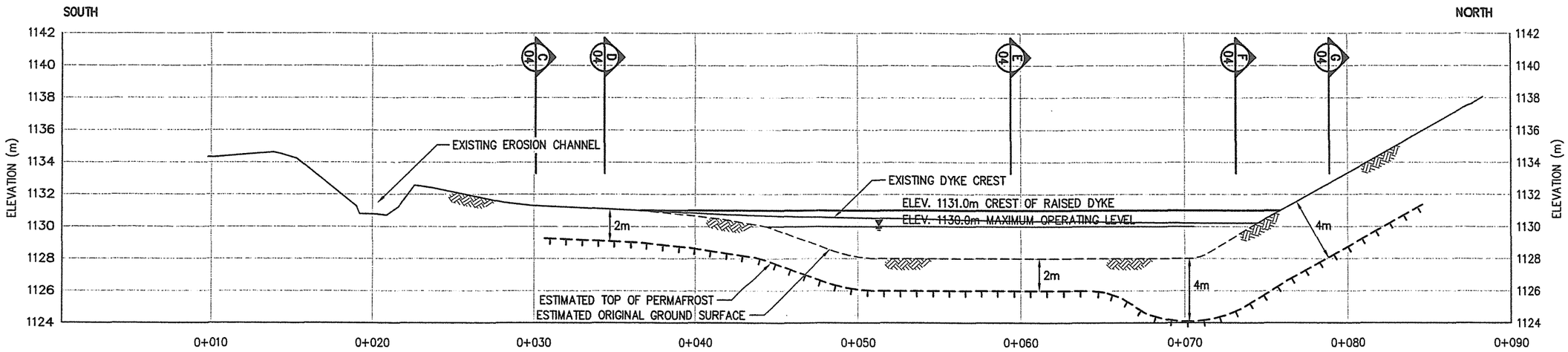
DESIGNED BY:	JTCS/KWJ
DRAWN BY:	B. RICHMOND
DATE:	09/09/00
SCALE:	AS SHOWN
PROJECT No.:	0201-00-14618
ACAD FILENAME:	14618 Figure 2.dwg

SEAL

PLAN VIEW, KEY TRENCH & DAM LAYOUT

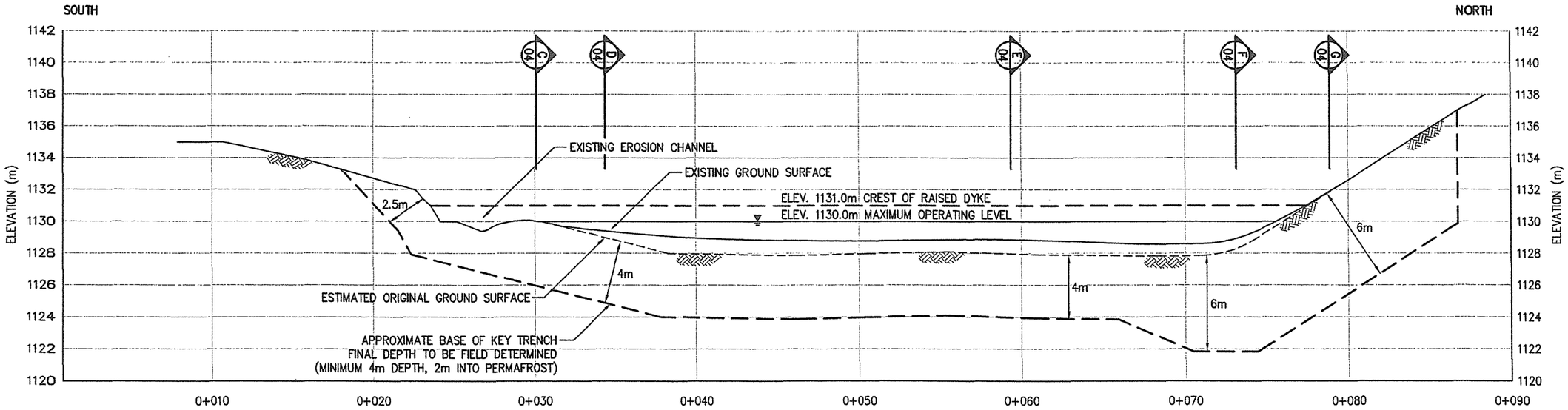
REVISION ISSUE: 0

DRAWING No.: 14618-02



LONGITUDINAL PROFILE, DAM CENTRELINE

PROFILE A – A (A / 02)



LONGITUDINAL PROFILE, KEY TRENCH EXCAVATION

NOTE: ORIGINAL GROUND SURFACE, PRIOR TO SEEPAGE DYKE CONSTRUCTION

PROFILE B – B (B / 02)

0 10
metres

DRAWING TITLE	DD/MM/YY	REV	No.	DESCRIPTION	DATE	APPROVED
REFERENCE DRAWINGS			0	ISSUED FOR CLIENT REVIEW	17/05/00	XXX
				REVISION		

EBA Engineering Consultants Ltd.

DESIGNED BY: JTCS/KWJ
DRAWN BY: B. RICHMOND
DATE: 09/09/00
SCALE: AS SHOWN
PROJECT No.: 0201-00-14618
ACAD FILENAME: 14618 Figure 3.dwg

SEAL

DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT

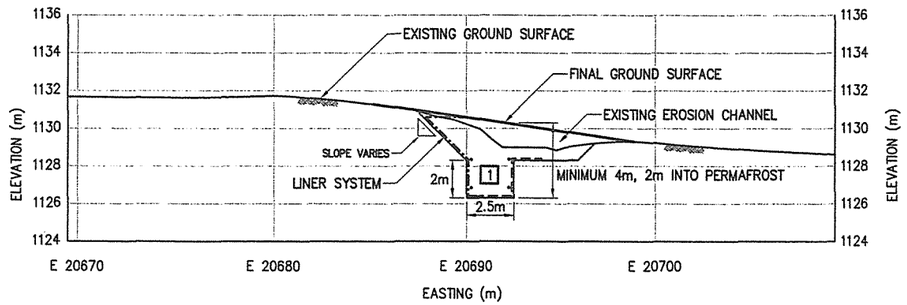
MOUNT NANSEN SEEPAGE DYKE AND SPILLWAY IMPROVEMENTS – MT. NANSEN, YT.

SEEPAGE DYKE

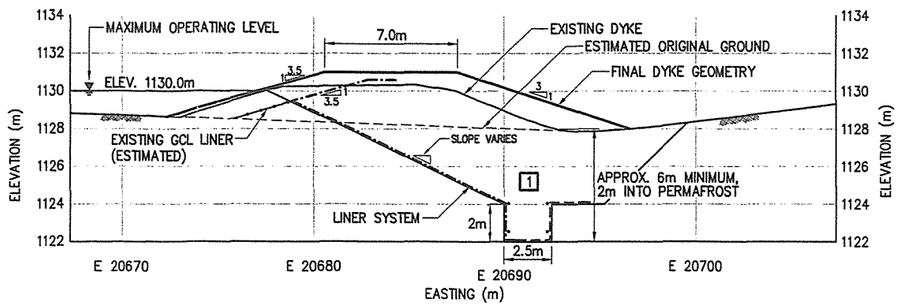
PROFILES A–A and B–B

REVISION ISSUE: 0

DRAWING No.: 14618–03



CROSS-SECTION C-C (C/02)



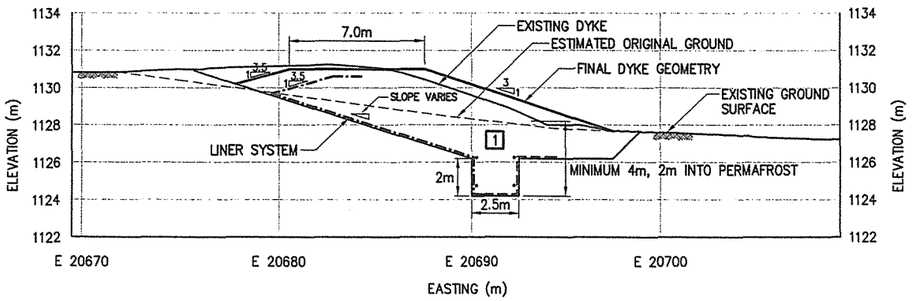
CROSS-SECTION F-F (F/02)

NOTES:

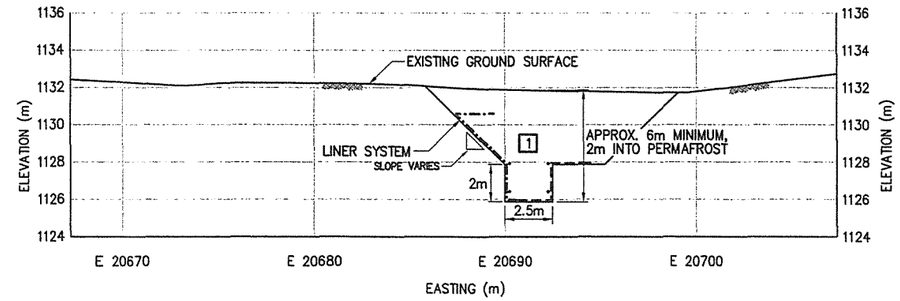
1. COORDINATES BASED ON LOCAL MINE GRID.
2. EXISTING DYKE GEOMETRY BASED ON DATA PROVIDED BY YUKON ENGINEERING SERVICES, AUGUST, 2000 SURVEY.

MATERIALS

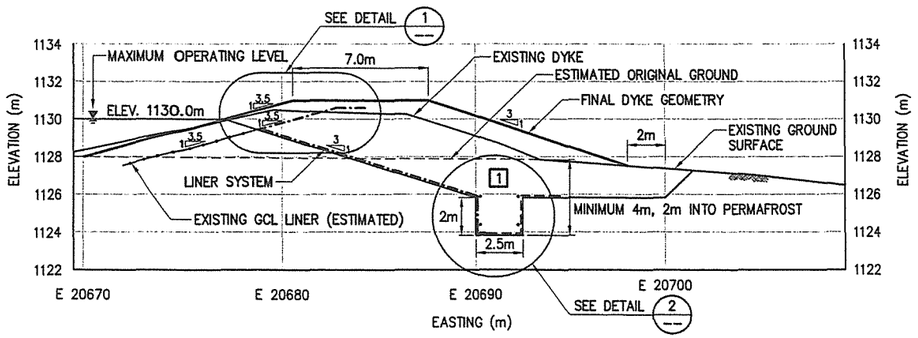
1 ZONE 1 SAND
2 ZONE 2 GRAVEL
3 ZONE 3 CUT-OFF SAND/BENTONITE



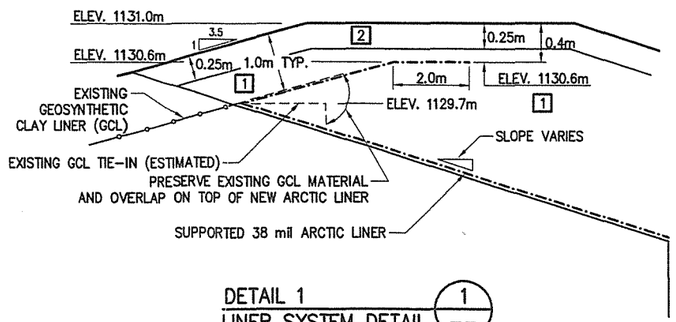
CROSS-SECTION D-D (D/02)



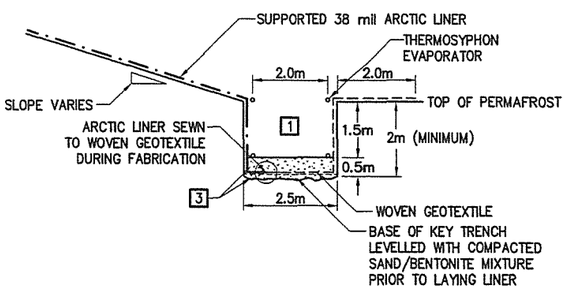
CROSS-SECTION G-G (G/02)



CROSS-SECTION E-E (E/02)



DETAIL 1
LINER SYSTEM DETAIL (1/--)
NOT TO SCALE



DETAIL 2
KEY TRENCH DETAIL (2/--)
NOT TO SCALE

DRAWING TITLE	DATE	REV	No.	DESCRIPTION	DATE	APPROVED
	DD/MM/YY		0	ISSUED FOR CLIENT REVIEW	17/05/00	XXX
REFERENCE DRAWINGS				REVISION		

EBA Engineering Consultants Ltd.

DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT

MOUNT NANSEN SEEPAGE DYKE AND SPILLWAY IMPROVEMENTS - MT. NANSEN, YT.

SEEPAGE DYKE

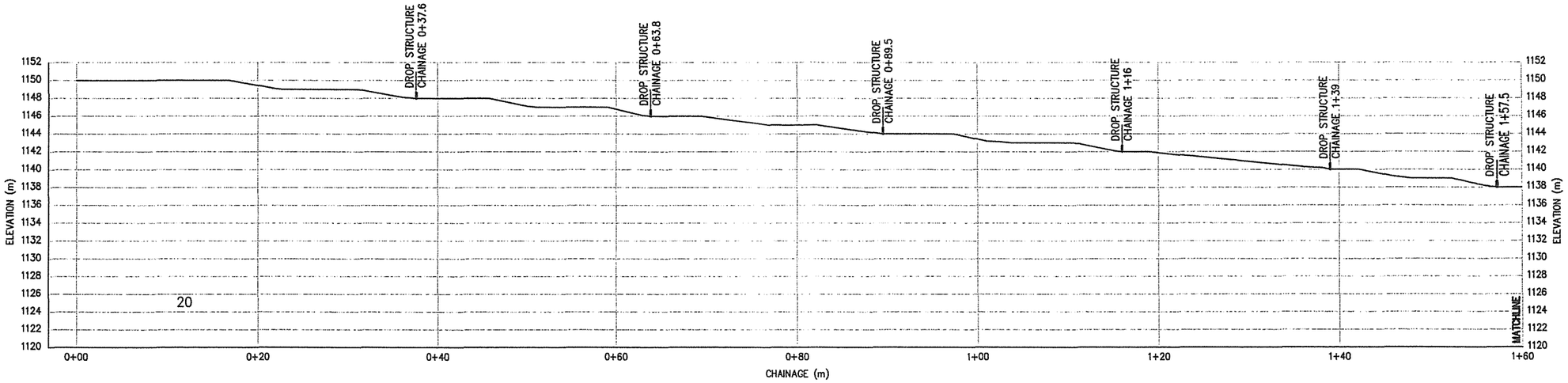
DESIGNED BY:	JTCS/KWJ
DRAWN BY:	B. RICHMOND
DATE:	09/09/00
SCALE:	AS SHOWN
PROJECT No.:	0201-00-14618
ACAD FILENAME:	14618 Figure 4.dwg

SEAL

CROSS-SECTIONS C-C, D-D, E-E, F-F and G-G

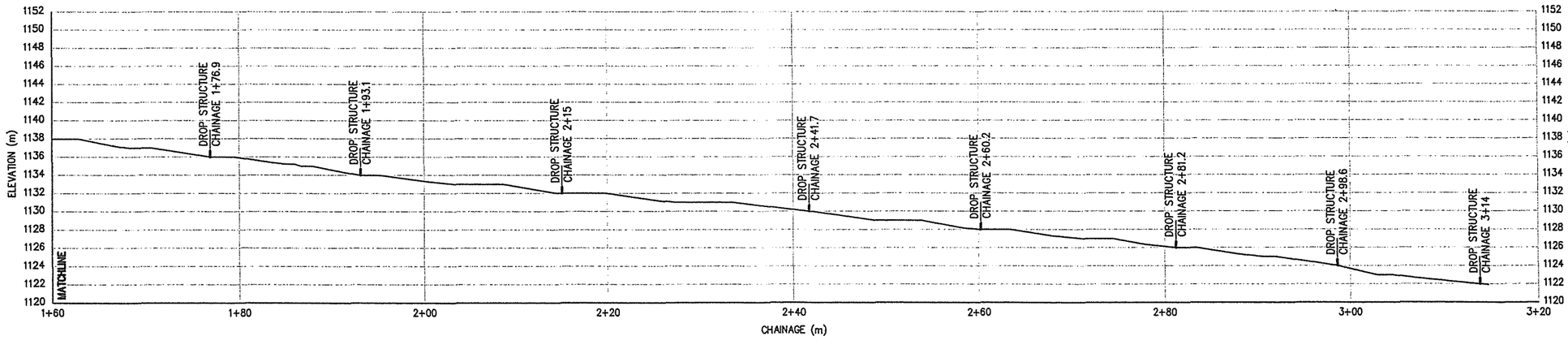
REVISION ISSUE: 0

DRAWING No.: 14618-04



LONGITUDINAL PROFILE L–L (L/08)
CHAINAGE 0+00 TO 1+60

0 20
metres



LONGITUDINAL PROFILE L–L (L/08)
CHAINAGE 1+60 TO 3+20

0 20
metres

DRAWING TITLE	DD/MM/YY		0	ISSUED FOR CLIENT REVIEW	17/05/00	XXX
	DATE	REV	No.	DESCRIPTION	DATE	APPROVED
REFERENCE DRAWINGS			REVISION			

EBA Engineering Consultants Ltd.

DESIGNED BY: JTCS/KWJ
DRAWN BY: B. RICHMOND
DATE: 09/09/00
SCALE: AS SHOWN
PROJECT No.: 0201-00-14618
ACAD FILENAME: 14618 Figure 9.dwg

SEAL

DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT

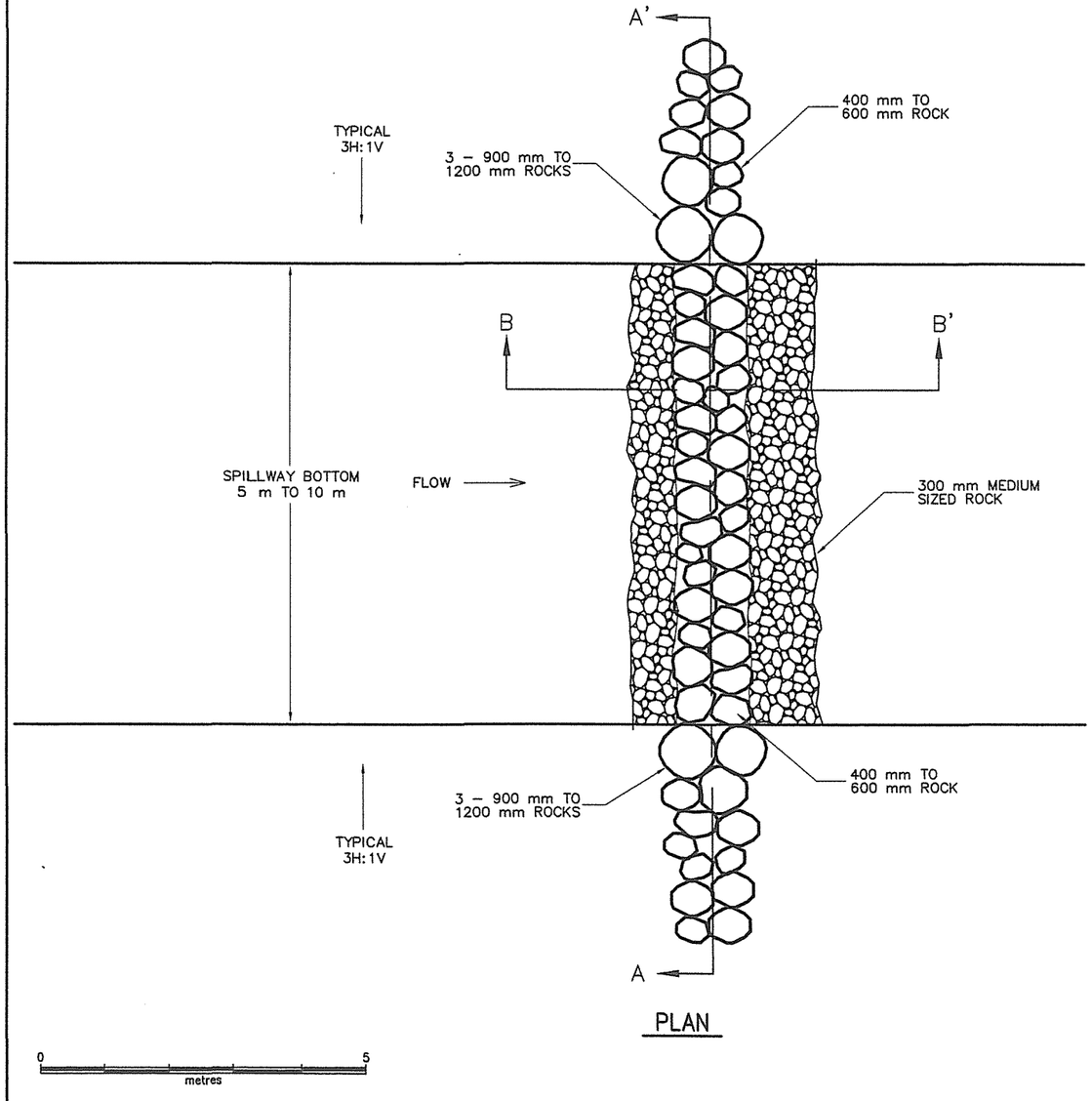
MOUNT NANSEN SEEPAGE DYKE AND SPILLWAY IMPROVEMENTS – MT. NANSEN, YT.

SPILLWAY

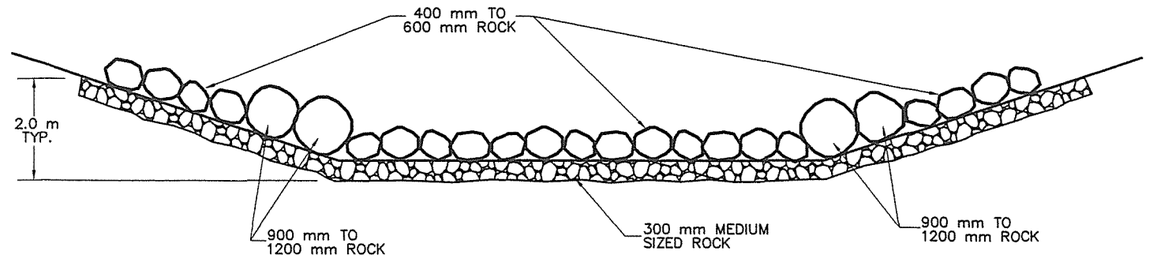
SPILLWAY PROFILES

REVISION ISSUE 0

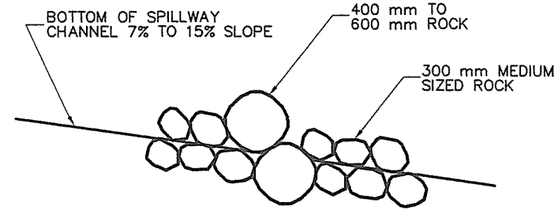
DRAWING No. 14618-09



PLAN



SECTION A – A'
N.T.S.



SECTION B – B'
N.T.S.

	DD/MM/YY		0	ISSUED FOR CLIENT REVIEW	17/05/00	XXX
DRAWING TITLE	DATE	REV	No.	DESCRIPTION	DATE	APPROVED
REFERENCE DRAWINGS			REVISION			

EBA Engineering Consultants Ltd.

DESIGNED BY: JTCS/KWJ
DRAWN BY: J.BUYCK
DATE: 09/09/00
SCALE: AS SHOWN
PROJECT No.: 0201-00-14618
ACAD FILENAME: 14618 Figure 10.dwg

SEAL

DEPARTMENT OF INDIAN AFFAIRS & NORTHERN DEVELOPMENT

MOUNT NANSEN SEEPAGE DYKE AND SPILLWAY IMPROVEMENTS – MT. NANSEN, YT.

DROP STRUCTURES

PLAN VIEW
X-SECTIONS
A-A', B-B'

REVISION ISSUE: 0

DRAWING No.: 14618-10

APPENDIX D

Daily Construction Reports

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 24**

- A subcontracted Hitachi UR9 hoe from the Carmacks Development Corporation arrived last night after work hours.
- 0730 hrs, Pelly out to start equipment and offload Hitachi excavator; Komatsu 400 completing ramp from southeast side of dyke to northeast corner of dyke.
- Bud McAlpine on site; new driver arrives for Pelly (crew up to 7 including Don Pilsworth who is operating the Hitachi excavator).
- A second haul truck arrived after shutdown last night, second truck is a Moxy MT30.
- 0900 hrs, 400 Excavator is working on inside of seepage pond, enlarging the existing sump and moving it further out into the pond, a side trench is excavated from the north east corner and an attempted tie in to the north slope is conducted.
- Pelly discontinued tie in due to extensive sloughing from the hill side, they plan on completing a bulk cut into the North slope around the cutoff trench in order to determine conditions there and remove most of the material; sand that is excavated from above water table can be stockpiled for re-use; wet sand is taken to the tailings impoundment.
- Hitachi excavator used to excavated larger sump downstream of the seepage pond and then spent most of afternoon sorting large rock from the riprap stockpile. @ 1600 hours Hitachi is finished sorting and starts on mucking out sand that has filled in the Dome Creek diversion ditch. The ditch mucking is work contracted directly to DIAND through Ketza and not part of the Seepage Dyke and Spillway contract.
- Bud McAlpine leaves site in early afternoon.
- In early afternoon, bulk cut starts by removing the ramp on the north east corner of the seepage dyke and proceeds into the hillside. The D8K dozer is used to push down the slope

DAILY CONSTRUCTION REPORT

Project: Seepage Dyke and Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor: Pelly Construction
EBA Representative: CRH
EBA Project Number: 0201-00-14618
Date: 2000 10 26

- @ 0730 hrs CRH, Bud McAlpine, Milos Stepanek, and Jessie met to discuss possible job shut down; it was decided that Pelly's truck drivers would stay in site at this time pending completion of the probing exercise at the north abutment cut.

- CRH discussed situation with EBA Frontier group to develop idea's regarding the dewatering of the excavation, CRH conveyed that the technical problem to be overcome was the dewatering of the thawed sand wedge in the north slope. In addition there are logistical problems to be overcome including getting additional materials (liner and thermosyphon piping), layout of the liner, staging of construction, placement of thermosyphons, etc. Finally it is important for EBA to review the design concept to ensure that the changed conditions are still conducive to the success of the design. Frontier group will look into these issues.

- Note that EBA does not believe that the thermosyphons will function unless a positive cutoff into the permafrost is completed.

- @ 1000 hrs, CRH et al, are at the north slope cutoff and are conducting a probing exercise using 75 mm pipe and 100 mm pipe – the pipe is pushed and/or pounded into the ground to refusal with refusal being assumed to be the permafrost table. Six locations were probed using both the 75 mm and 100 mm steel pipe. Generally, the pipe was able to easily be pushed into the sand until near the permafrost table (within 1 m). The 100 mm pipe sounding were typically 0.6 m or more lower than the 75 mm pipe soundings. A trial hole was also conducted with the 100 mm pipe out in an area of the Dome Creek channel where the permafrost is known to be 2 m – the sounding confirmed this depth. The soundings indicated the permafrost table had a depth in the range of 1124 m to 1125 m within most of the north abutment cut. The distance back to a permafrost level of 1130 m was approximately 18 m from the slope face (@ the 1130 m level).

- @1330 hours, CRH completed calculations using the determined permafrost levels to estimate possible excavation volumes. The volume of the required excavation was estimated in the order of 5500 m^3 without allowances for additional volume for dewatering.

- The results of the volume calculations were conveyed to EBA personnel, the contractor and DIAND.

- CRH contacted EBA Edmonton to discuss the new volume estimates and to determine the progress with dewatering evaluations – according to EBA the use of well points was the recommended method, large diameter vertical wells was not believed to be a reasonable option.

- @1500 hrs, CRH, Bud and Milos held a meeting with the contractor to discuss findings and to determine the costs of resuming the seepage dyke work, the issue of dewatering was also discussed. Jessie Jewel committed to reducing the cost of excavation on the seepage dyke to \$11 per m^3, this would apply to "dry" excavation above water table. He would still want the bid rate of \$12.50/m^3 for the contract amount of 4200 m^3 plus an additional 15% or 630 m^3. Jessie also noted that Pelly would consider a further reduction to \$10/m^3 if cycle times were low on the excavation.

- Dewatering options were discussed and sinking culverts was an idea that was felt (by EBA and DIAND) to have some potential merit, the contractor was directed to attempt to sink a culvert for dewatering at the location of the existing upstream cutoff – this would be an exercise to see the effectiveness and practically of sinking culverts within the open cut for dewatering.

- CRH used the contractor's cost for excavation to check scenario's for completing the work with an allowance for dewatering benches on either side of the trench location. The result was an expected cost in the order of \$60 000 to \$70 000 for such an excavation.

- CRH visited the spillway site at 1700 hrs and work has progressed well, riprap was in place over most of the sideslopes of the spillway, although some sand sections were visible and would require more riprap cover. The 400 excav. and Hitachi were working on this item. The contractor expected to complete the spillway work tomorrow.

- The culvert exercise at the upstream cut off was modestly successful but required some additional work tomorrow and its effectiveness would be evaluated at that time. A 1.2 diameter culvert was sunk about 2.4 m and still needed to be cleaned out.

- CRH completed some rough survey measurements on the existing north slope cut. This was in order to try a rough calculation of volume.

- @ 1930 hours, CRH met with Bud and Milos to discuss the options to proceed or not proceed with the seepage dyke work. CRH argued that work should resume and that a bench cut sufficient for a well point system or other dewater system should be installed at an expected excavation cost of \$65 000. Prior to mobilizing a well point contractor, EBA would direct Pelly to try to construct a drain system using available materials and imported drain pipe. Should this not be successful then a decision would be made as to when or whether a well point system should be implemented. CRH suggested that the southern portion of the dyke could be reconstructed to a convenient station (0+70?) and the construction of the north side

resumed at some appropriate point in the future (if Pelly can not dewater and a well point contractor is either excessively expensive or delayed to the point of being impractical during the current year). Milos queried these recommendations and ultimately suggested with Bud that the cost of a wide cut that could be used for a determined attempt at putting in a horizontal drain was the best option. It was agreed to seek additional funding to resume the work and to try to complete the project in the current season.

- Jessie of Pelly was informed that Bud would be going through DIAND channels to approve an extra cost item for this work and he hopes to have the decision tomorrow. In the meantime Jessie has indicated that he will resume working on the cut at his own risk on the assumption that a go ahead will be received.

- CRH completed quantity estimate based on rough survey of existing north slope cut, the volume estimate is 1500 m^3.

- Cost estimate for work completed or certain of being completed is about 50% of contract amount, this includes completion of spillway and erosion ditch, and shaping of north slope cut and backfilling existing cut on the seepage dyke without a cut off trench, liner or thermosyphons.

- Survey of water levels by CRH and Bud McAlpine using a survey rod and hand level and assuming top of existing dyke at 1130 m yields estimate groundwater levels in the upstream cut off at 1128 m and in the north slope cut (cut off trench location) of 1127.7 m. these are believe to be accurate with ±0.45 m.

- Force account and standby charges for this date include:

Standby:	haul trucks 10 hrs @ 60% of $180/hr
Force Account:	Foreman, 7 hours @ $50/hr
	400 Excavator, 6.5 hrs @ $275/hr

  Total Standby and force account work at $4800 on this date.

- Hours 0730 to 1300; 1330 to 1900; , 1930-2300, Total: 14.5 hrs

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 27**

- As per discussions of yesterday, Pelly is starting on extended cut on north slope on the speculation that additional funding will be provided; CRH provided direction as where the cut would be if approved.

- CRH informed Contractor that estimated volume of cut on north slope removed up to this date was 1500 m^3, the Contractor was in agreement with this amount.

- Bud McAlpine has secured additional funding on the order of $100 000 if required; EBA will direct the Contractor's forces in completing additional work with the desire to stay within this amount. Bud McAlpine and Milos Stepanek will remain on the site and provide continued input.

- Additional materials now required for the north slope section of the seepage dyke have been estimated by EBA and include 50 m of thermosyphon piping and a 15x20 m and 16x7 m piece of arctic liner. The order of bentonite is believed to be to adequate for the sand bentonite mixture on in the cut off trench.

- Jack Seto is looking after material issues out of EBM, it is appears that liner materials will be fabricated on the weekend and shipped on Monday. Arctic Foundations is believed to have access to the additional piping and will confirm with the contractor later today.

- Work on the spillway is progressing and will continue through out the day, the Hitachi hoe is conducting riprap placement. CRH observed work and believes that channel base and drop structures need additional effort. Channel base work from Station 2+60 to 3+15 does not have complete coverage of riprap. Drop structures # 11 to #14 also need some improvement. CRH discussed with Jessie Jewel of Pelly and he agreed that more work was necessary and would correct any problems.

- Hitachi Hoe pulled off spillway @1700 hrs to sort more riprap for base.

- The 400 excavator and both haul trucks and the dozer are involved in the north slope cut.

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- Perforated pipe (HDPE 10") has been ordered by Pelly and should on site by Monday. The Contractor may try to use alternative materials if the drain location is available prior to the pipe being on site. Jessie indicated that such an attempt would be at the Contractor's cost if it was not successful and needed to be repeated when the perforated pipe arrives. The cost of the pipe is estimated by Pelly at $3000 for 40 m of pipe.

- Sand excavation continued throughout day; Pelly's load count for the day was 10 loads of organics (stripping) and 142 loads of sand.

- 1.2 m diameter culvert sunk into sand in the Northeast corner of the seepage pond is cleaned out by jetting and pumping using the 4" pump and the Honda flight pump. Work completed as much as possible by Pelly. 4" sump pump set up in culvert, strong flow is observed coming up through bottom of culvert.

- Hours 0730 to 1200; 1230 to 1900 Total: 11 hrs

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 28**

- Pelly moves to an earlier start to (0730 hrs) to increase sand cut production; 400 excavator, Moxy haul trucks and Dozer all resume working on sand cut on north slope. Dry sand is being stockpiled on the terrace above the seepage pond, wet sand is being hauled to the impoundment disposal area. The dozer is leveling both areas as required.

- Hitachi excavator resumes spillway work; CRH reviews work quality and it is still not adequate; Jessie agrees and will use 400 excavator to "dress up" finished product later in the project.

- Dewatering from main sump in seepage pond and from the 1.2 m culvert sunk in the northeast corner of the pond is continuing.

- Bud McAlpine and Milos Stepanek leave the site today to travel to Faro, will return later today or early tomorrow.

- After lunch CRH and Jessie Jewel evaluate size of cut, it appears large enough to try a dewatering technique. Pelly excavates trench along west side of cut and fills in trench excavation with ripped bedrock (residual bedrock). 16 loads of gravel are placed in the trench which runs from the permafrost wall at the north west corner of the cut to the former culvert sump area in the northeast corner of the impoundment.

- During excavation of the trench the wet sand sloughs significantly and the trench is placed in short sections to account for the sidewall sloughing. Excavation requires use of Hitachi excavator for 1 hour and the 400 excavator from 1400 hrs until 1915 hrs. Both haul trucks and the loader are also used from 1400 hrs to 1915 hrs.

- The 1.2 m culvert is removed during the "gravel" placement and a new sump down to permafrost is excavated in the north east corner of the seepage pond. The 6" pump and line are relocated to this new sump location.

- The Hitachi excavator continued working on the spillway base and drop structures, completes up to Station 0+60, but reworking will be required for much of the placed base material.

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- Bud and Milos back on site @ 1900 hrs

- Trench work by Pelly is to be paid on the basis of the gravel placement, when asked by CRH no force account costs are requested by Jessie Jewel. Bulk cut completed to 0.5 to 1.0 m above water table has dimensions of 31 m wide at the slope interface and 19 m wide at the back (north end) of the cut. CRH estimates volume is between 5000 m^3 and 5500 m^3.

- During set up of new sump, Pelly switches to frost bucket on 400 excavator to sink sump into permafrost, excavation of the frost appears to be very difficult and slow. Jessie believes that he may need to rip the cut off trench with the D8K Dozer and/or get a ripper for the 400 excavator.

- Hours 0800 to 1200; 1230 to 1930; 2000 to 2100 Total: 12 hrs

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PRECONSTRUCTION MEETING

Project: Seepage Dyke and Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor: Pelly Construction
EBA Project Number: 0201-00-14618
Date: 2000 10 11

Present:

Cord Hamilton, EBA
Keith Byram, Pelly Construction Ltd.
Jessie Jewel, Pelly Construction Ltd.
Bud McAlpine, DIAND
Kurt Dieckmann, YWOH& S

- Pre-construction meeting held at Pelly's Office on 2000 10 11.
- Discussed progress of arranging a contract between Pelly and DIAND's agent Ketza Construction, contract is still being prepared but Pelly is confident that there is no problem with this arrangement between Ketza and Pelly.
- Pelly introduced Jessie Jewel as the project manager for this work, he replaces Ken Gauld. Jessie has more liner experience and is acceptable to EBA and DIAND. CRH was introduced as the EBA's site representative and Bud McAlpine will be the responsible authorities representative.
- CRH reviewed the various elements of the project (erosion channel, seepage dyke and spillway). Pelly understands the work scope. Jessie will be heading into the site as soon as possible to review the conditions and will phone CRH if he has any questions.
- CRH notes that liner delivery has been delayed due to the need to sew on the woven geotextile to the bottom piece. This delay can be reduced if the woven geotextile is eliminated. EBA has no objection to eliminating the woven portion of the liner as it is only required to assist the contractor. Keith indicates that they have no objection to deleting the woven geotextile. CRH indicates that this will reduce the liner installation quantity, Keith accepts this.
- EBA will direct Layfield's to eliminate the woven portion of the liner.

- Pelly is still trying to find a welder for the liner installation, Layfields is not available but EBA has provided some alternatives for Pelly to consider and Pelly is trying their own contacts as well. CRH discussed Layfield's suggestion about Listering instead of wedge welding. Pelly does not have experience with this technique and will try to find a wedge welder instead.

- CRH and Pelly discussed layout requirements needed for Pelly to start construction. Layout will be consist of staking of cutoff trench and 3:1 upstream cut, and staking of top of riprap along spillway and location of drop structures along spillway. Layout will be completed by YES and will be done on Monday October 16th, 2000. This timing is acceptable to Pelly.

- Pelly is planning on mobilizing into the site starting on Friday. Crew size will be five and work hours will be around 12 hrs per day. Work should start at the site around October 16th or 17th and should be completed by November 1st, 2000.

- Safety issues were discussed with Pelly and Kurt Dieckmann of YWOH&S. Pelly will bring an ambulance to the site and will prepare medivac plans with a helicopter company. Pelly will check with Ketza as to whether first aid can be supplied through them. If not Pelly will have first aider's on site. Bud McAlpine discuss the contaminants at the site and indicated that they are not a great safety of health hazard unless ingested. All required personal safety gear will be used by Pelly personnel. Cyanide kits will be brought to site. Pelly will have a site phone (satellite phone # 600-700-5104). Kurt wanted further details about the excavations at the site and will require a letter regarding the permafrost stability. Ladders will be required to enter the cutoff trench. Care will be required around any open water and dewatering stations.

- CRH discussed payment items and survey requirements for payment. Measurement surveys will be conducted by YES. Jessie indicated that some surveys may not be necessary if we can agree to quantities at the site.

- CRH noted that erosion ditch work must be confined to within 4 m on either side of the channel and any disturbed areas will need to be repaired.

- CRH indicated that dewatering is critical to the success of the project. Pelly understands this and will be using 6" pumps at the site and has access to larger pumping systems if required.

- CRH will stay in touch with Pelly and will be at the site as soon as required to monitor the work.

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

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EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 19**

- CRH prepares for, loads, and mobilizes to site and arrives at 1500 hrs

- Contractors crew at site consisted of three personnel include the project manager. Pelly had already mobilized to the site starting on 2000 10 17. Some work had already been completed to prepare the haul road down to the seepage dyke.

- Activities completed today consist of continuing the access road to the seepage dyke (route is along the south crest of the spillway down to Dome Creek and then up a bench along the north side of Dome Creek to 20 m below the seepage dyke).

- Contractor has also taken a dozer and walked along the erosion channel to widen and straighten out the channel. This has cut the sides and filled in the bottom of the channel. The dozed channel is now about 5 m wide and has a depth of between 2 and 0.5 m. the contractor plans on using the widened channel as the access route for the channel work and will not be working off the area outside of the channel.

- Contractor will start installing the dewatering system tomorrow morning.

- Equipment on site consists of:
  Komatsu 400 excavator
  Moxy MT36 haul truck
  CAT D8K Dozer
  Komatsu WA 45 loader
  2 pickup trucks and an ambulance
  one 6" pump

- Hours 0800 to 1230; 1230 to 1800, Total 10

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DAILY CONSTRUCTION REPORT

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Date:	**2000 10 20**

- 0730 hrs Pelly off to warm up equipment, crew of three on site, no equipment changes
- During morning hours Contractor working on haul road to seepage dyke and erosion channel; hauling weathered bedrock to access road.
- After Lunch, Bud McAlpine arrives on site; Pelly starts to set up for dewatering sump.
- A small sump is placed in the seepage pond between the electrical shed and the pump shed; a 6" pump with 3" pressure line is used; pressure line belongs to DIAND and is used for the pond evaporator in the summer. Pelly has problems with 6" pump and needs to shut it down for repairs. It was able to draw down the pond to the sump level; seepage into the sump is noticeable from the north side where a strong clear seepage emerges from underneath a weathered rock fill pad in the northwest corner of the seepage pond. Seepage from the dam toe on the south side of the sump is also visible.
- Spoil from the sump excavation is hauled off to the west end of the tailings pond.
- Bud McAlpine leaves about 1600 hrs
- @ 1700 hrs, Pelly starts removing the piping from the spillway; the 3" HDPE line is hauled out and left along the tailings impoundment access road (along the diversion ditch road), the 4" line can not be fully removed until an excavator with a thumb is on site, it is left in place after a series of attempts to pull it out fail.
- CRH informs Pelly where the contaminated spoil dump location is by the pump causeway in the tailings impoundment. Existing electrical lines in this area are removed to avoid being buried.
- Hours 0730 to 1200; 1230 to 1900; Total 11

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 21**

- In morning Pelly is excavating from the Erosion Channel; CRH initially concerned about the approach was leading to excess quantity, however, this turned out not to be a valid concern. Excavation was completed using the 400 excavator, the D8K dozer and the single Moxy 36MT haul truck.

- Erosion channel cleaned out to CRH's satisfaction by early afternoon, spoil from excavation is placed initially in the impoundment (4 loads) and then on a location north of the spillway that was approved by CRH, roughly 19 loads of spoil were removed.

- Following excavation CRH completed a cross section of the shaped channel, this was done with the assistance of Jessie Jewel of Pelly. Jessie agreed that taping the channel was sufficient and that a formal quantity survey was not necessary. Estimated total volume was 1134 m^3 but this will be confirmed with a cross check using Pelly's load count. Some wall heights in the shaped channel were in excess of 3.3 m and sloping so the estimate should not be any more accurate than ± 15%.

- After cross sectioning was completed, Pelly began hauling sand fill into the channel, a full lift of 0.45 m to 0.6 m as authorized by CRH was placed over the channel and compacted using the Dynapac vibratory roller.

- Sand is being obtained from an existing stockpile on the north terrace. Moxy 36MT haul truck, Komatsu loader and D8K Dozer are used in the operation.

- Hours 0730 to 1200; 1230 to 1900; 1930 to 2030 Total 12

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project: Seepage Dyke and Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor: Pelly Construction
EBA Representative: CRH
EBA Project Number: 0201-00-14618
Date: 2000 10 22

- Contractor resumes sand haul into erosion channel @0800 hrs; D8K Dozer is clearing snow.
- By 0900 hours dozer is ripping gravel from first existing pit on dam access road.
- Sand is being placed in a wedge (north-south) in the east-west aligned channel because it is up to grade on the lower side (north side) over the first 50 m of the channel. Therefore, angled or sloped lifts are being placed to bring the south side near grade for the sand layer. The Contractor will not be able to fully reach grade with the sand as this would create too steep a cross fall (north-south) for the packer to run. The shortage will be may up by using more "gravel".
- Second lift is in place by 1100 hours; lift is packed from 1120 hrs to 1200 hours
- Additional 6" pump and parts for existing pump arrive from Whitehorse; liner material also arrives; liner is off loaded at the dam site but will be moved to the mill for heated storage.
- A fourth crew member arrives for Pelly Construction.
- Contractor is repairing existing pump and preparing new pump (line reducers etc.).
- CRH tested sand fill in channel; all tests are over 95% compaction.
- Contractor will not place any more sand between Station 0+50 and 0+00; sand is at grade on the north side and nearly at grade on the south side; the fall across the trench is too steep for any further sand placement to bring the grade up on the south side.
- Next lift is placed below Station 0+50; lift completed and packed by 1530 hours.
- CRH completing cross sections on channel; stopped at station 0+20 because Contractor is placing geotextile prior to bringing in gravel fill over the sand.

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- Placed most geotextile; will require some additional coverage tomorrow to cover some areas of the channel side slope. Geotextile starts at Station 0+91.5 (13.5 m from the centreline of the cutoff trench).

- Geotextile stopped at 0+91.5 because any further could be damaged during the subsequent excavation for the cutoff trench.

- CRH completes cross sections using pacing for chainage.

- Dozer and excavator used to prepare a ramp at the bottom of channel for hauling of gravel. Existing dyke is excavated on its southeast corner to provide some fill for the haul ramp into the channel. This ramp will be wasted during the excavation for the cutoff trench.

- Gravel placement starts at 1700 hrs; about four loads placed. Some gravel placed before geotextile to help truck get up into channel.

- New 6" pump is placed at sump and started at 1600 hrs.

- Geotextile used is Armtec200/15/300; two rolls are used (836 m^2)

- Contractor would like to replace riprap with gravel material and fill in remainder of trench with gravel material. This is a reduced cost to DIAND and Contractor would like to reset gravel price to account for lower overall cost of work. CRH suggested a gravel cost of $14 per m^3. Contractor is agreeable but this must be confirmed with Bud McAlpine of DIAND.

- Contractor has counted a total of 34 loads of sand that have been placed in the erosion channel; this amount is greater than estimated based on CRH's cross sectioning – represents a 20% change. Note that one load was returned to the borrow on 2000 10 20, and several loads have been used in the area of the channel that is included in the seepage dyke quantities, so perhaps 30 loads were placed.

- CRH estimates each sand load consists of six 3.5 m^3 buckets for a total of 22 m^3 per load

- Contractors load count of channel gravel was 11; note that two of these loads are in the ramp area at the entrance to the channel and were for providing access to the channel.

- Hours 0730 to 1200; 1230 to 1900; 2000 to 2200, Total 13

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 23**

- Contractor resumes gravel haul into erosion channel;. Equipment in use includes loader, Dozer and Moxy truck.

- 6" pump in place at sump located adjacent to the pumphouse. Pump was active all night without freezing; seepage still visible below the seepage dyke. Contractor will be disconnecting the electric pump downstream of the seepage dyke later today as it will interfere with work at the dyke.

- CRH reviews estimate of quantities and calls Bud McAlpine to discuss change in use of gravel for riprap in the erosion channel; CRH will negotiate a price change due to the elimination of the riprap and replacement with gravel. Bud would like to see a lower price than $\$14/m^3$.

- CRH ensures that remaining geotextile is place ahead of gravel. Roughly 2.5 to 2.75 rolls of geotextile have been used todate.

- Gravel spread to end of channel area by 1130 hrs; remaining loads will be spotted along the high side of the channel to match existing ground levels. Excavator will used to shape the remaining loads on the high north side of the trench.

- 19 loads gravel loads placed by 1200 hours.

- After lunch shaping of channel required another 9 loads of gravel for a total of 28 to complete the channel to station 0+91.5.

- A swale is still required down the centre of the channel; otherwise the channel is complete except for the interface with the cutoff trench and dyke. The sacrificial gravel and other fill placed between the cutoff trench and Station 0+91.5 fill will have to be cut out later to tie into the end of the geotextile.

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- A fifth crew member from Pelly Construction arrived after lunch and will be onsite for the remainder of the work.

- Pelly has made arrangements with Ketza's crew to move the liner materials to a heated shop for storage.

- Starting after lunch, Pelly used the Dozer to begin ripping the seasonal frost from the seepage dyke.

- The thermistor cable on the seepage dyke could not be salvaged; the metal casing was salvaged.

- Around 1400 hrs, the erosion channel work was completed and the Komatsu 400 excavator was moved to the seepage dyke to start making a box cut along the downstream face of the dyke, starting at the south side.

- Materials removed from the seepage dyke were wasted within the impoundment waste area.

- The existing downstream electrical pump was removed in order to allow Pelly to work on the seepage dyke, considerable seepage water is accumulating downstream of the dyke between the dyke toe and the haul road that crosses the creek bed.

- Bud McAlpine is onsite at 1300 hrs; Bud has indicated that seepage collecting downstream of the dyke must be pumped back to the seepage pond and not allowed to discharge downstream. Some allowances may be made during critical portions of the work if it is not feasible to return this seepage to the seepage pond.

- A testpit was completed on the cutoff trench centreline to observe permafrost depth and groundwater conditions, the permafrost was at approximately 2 m as predicted; heavy seepage from downstream was observed in the testpit as witnessed by Jessie Jewel of Pelly.

- Pelly has arranged to have more pumps shipped to the site including a 4" trash pump and several flight pumps. One or more of these will be used for the downstream seepage.

- Installation of the main upstream cutoff will be undertake tomorrow as soon as the initial cut on the downstream face of the existing dyke is completed and a ramp is built to provide access for hauling of waste from the sump cut. Bud McAlpine will remain on site to witness this activity.

- A heating system was constructed for the main 6" pump in order to allow the pump to work through colder weather.

- The seepage pond has been drawndown all day, strong clear spring flows are visible entering the sump location from the south side of the dam toe, the north side of the dam toe and from the northeast corner of the seepage pond area. The seeps existing downstream of the seepage dyke do not seem to have been reduced as a result of the draw down of the seepage pond.

- At EBA and DIAND's request, Pelly has walked the D8K Dozer down the spillway to remove as much built up ice as possible. This was witnessed by CRH and Bud McAlpine. It was clear that the plan to level the base of the spillway is not practical at this time as the base is substantially frozen out side of the minor flow channels.

- CRH and Bud discussed the best approach to level the spillway base and fill in the gullies that have developed. It was decided to plan a minimum of 150 mm of gravel fill over the base using the dozer, this would ensure that the gullies are filled.

- Bud would like Pelly to clear out the flow gullies (remove ice and slush) prior to placing the gravel fill down the spillway. Pelly has indicated that they will clear the ice on a daily basis using the Dozer until the gravel fill is in place. CRH will work out the new gravel quantity for the spillway, assuming a 4.5 m width (dozer blade) and a 150 mm average thickness.

- CRH discussed cost adjustment for use of gravel in erosion channel in lieu of riprap; Jessie was agreeable to gravel at $12 per m^3, will confirm later this week when we meet to finalize quantities. CRH discuss the wasted loads at the access ramp and Jessie agreed that some credit loads would be required to complete the channel after the dyke is filled. Therefore Pelly would provide three more sand loads (already included in the sand volume of 644 m^3) and five gravel loads (already in gravel volume of 740 m^3).

- Hours 0730 to 1200; 1230 to 1900; , 1930-2100, Total: 12.5 hrs

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 29**

- First morning with -20°C temperatures; difficulties pumping last night as screen on end of suction line was freezing up. Pelly felt that flow has increased significantly as a result of the yesterday's rock drain that spanned the width of the north abutment cut. Bud and Milos on site, they tried to measure the flow and estimated it was in the range of 5-6 l/s which is consistent with pervious day's.

- Contractor will attempt to increase sump size this morning and clean up around the top edge of the cut to control safety hazard, will also try to construct a full drain downstream of the rock drain.

- During the morning, Pelly experiences operational problems with their equipment due to fuel problems. It appears that water in the fuel is freezing up. This problem had been experience throughout the project (three filters already used on the 400 excavator); however, this mornings -20°C temperatures it has become a significant problem. @ 1000 hrs, Pelly decides to stop work while the fuel issue is dealt with. Jessie Jewel will be trying to get a new fuel tanker into the site as it is believed that moisture in the current fuel tanker is the source of the problem. He has also sent a runner into town to get some methyl hydrate. In the mean time the equipment is being gathered at the seepage dyke and fuel tanks are being heated.

- Prior to the shut down, Pelly had been bulk cutting from the remain portion of the seepage dyke (between stations 0+40 to 0+70). This was done using the loader and both haul trucks. The 400 excavator was trying to enlarge and deepen the new sump in the northeast corner of the seepage pond but it did not appear that the frost bucket and ripper teeth was able to excavate into the permafrost. After that attempt the 400 exc. Switched to its clean out bucket and was going to try to excavate a new drain beside the rock drain installed yesterday.

- CRH discussed the communication lines between DIAND and Pelly with Bud and Milos. CRH indicated that the contractor is how entering into portions of the work where challenges were to be expected. Therefore it is important that the contractor be able to work through these challenges. CRH suggested that advice from DIAND or Geo-engineering be provided to EBA to be given to the contractor should that be advisable.

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- Pelly has supply truck arrive at site @ 1200 hrs, still waiting for methyl hydrate to arrive via hotshot out of Whitehorse. Supply truck delivered bentonite, 4" perforated piping, two rolls geotextile and two concrete buckets for sand bentonite mixing. Jessie expects to resume work around 1430 hrs. Given length of day left at that time, Pelly will not try to open up the planned drainage trench. Pelly will complete force account subcutting of sand out of the seepage pond and continue bulk cut of original seepage dyke.

- @ 1445 hrs, CRH at site and Contractor is not yet able to resume work, some equipment is able to operate but they are still waiting for methyl hydrate and other additives to treat the fuel. The 6" pump has also stopped work and has some major mechanical problems resulting from the fuel problem. Pelly tried pumping the sump using the 4" pump but it is not sufficient to lift the effluent over the dam crest. Another 4" pump is available from the mill but it is not set up for 3" line. Therefore, Pelly will cannibalize their backup pump (6") which means they will take parts form its motor and use it with the engine of the other 6" pump. It is expected to take 3 hrs to get this combined pump set up and working. In the meantime no further work is continuing. The sump system that exists in the former seepage pond has sufficient volume for at least 12 hours without pumping.

- Pelly's 400 excavator has spent at least 20 minutes today subcutting the seepage pond.

- CRH and Bud McAlpine discussed the spillway work, CRH noted that Pelly recognized that the channel base work was not adequate but they had agreed to rework sections later to bring it up to standard. Unfortunately, icing is developing throughout the spillway and it seems unlikely that Pelly will be able to improve the current work. CRH suggested to Bud that it may be required that Pelly return to the site in the spring/summer of 2001 to correct any spillway deficiencies. CRH will discuss this with Pelly after they try to improve the spillway work later in the project.

- 6" pump back on line by about 1745 hrs; 400 excavator working on mucking out the seepage pond (force account work). Excavator has taken the pond down to permafrost in the centre of the pond (a 10 m by 10 m area). Other areas have been cut down about 0.6 to 1.0 m. the toe of the dam can not be reached at this time and will be left for later. CRH will likely have some of the muck replaced in the seepage pond centre to add some insulation over the permafrost. Other equipment is ready to run as well (fuel issues have been dealt with), but Pelly will wait until tomorrow before restarting the work (other than the seepage pond mucking).

- Milos Stepanek expresses great concern about the potential for pumping failure during subsequent more critical portions of the work, such as when the cut off trench is open. He indicates that the Contractor should have a new functioning backup pump on site. CRH noted that the Contractor is responsible for dewatering but will advise the Contractor that a backup pump should be readily available at all times. Jessie Jewel of Pelly indicated that a new backup pump is being obtained and that in the meantime the two existing pumps and insulated lines from the original pumpback system for the seepage pond can be brought back on line with very little effort.

- Force account charges for this date:
  Komatsu 400 Excavator 1.5 hrs @ $275 per hour.
  Labourer 9 hours
  Pick-up 9 hrs

- Hours 0800 to 1200, 1300 to 1900 Total: 10 hrs

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DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 30**

- CRH contacted Jack Seto at EBA to arrange for shipping of the liner materials; Jessie Jewel believes that they will be needed on site on Thursday. CRH also asks that Jack try to contact Arctic Foundations to arrange for the additional 40 m of piping required for the work.

- This AM Pelly will finish mucking out the seepage pond and will turn to install an open drain system from immediately east of the gravel drain that runs through the north slope cut.

- 400 excavator, loader and both haul trucks working on mucking out seepage pond and advancing dewatering trench north to the north side of the north slope cut. Two loads of "gravel" hauled down for trench support. 400 excavator is able to peel off permafrost using the clean out bucket and is also able to rip through the frost using the frost bucket. Work on trench and mucking is force account work. Note that Pelly can either be paid for force account or volume and CRH will discuss this with Jessie at end of shift to see how they wish to account for it. The dewatering trench is on the order of 7 m wide at the top and 4 to 5 m wide on the bottom. It runs northeast for 15 m and then turns north to meet the permafrost wall (an other 7 m). A considerable volume has been removed from the work area by the dewatering trench.

- Prior to lunch Pelly started keying the dewater trench into permafrost and ensuing a positive slope down to the sump in the seepage pond, this key will be the width of the frost bucket.

- The sump in the northeast corner of the seepage pond has been deepened into the permafrost about 1 m. During lunch Pelly set up the 4" pump and drained the large downstream sump into the seepage pond (and into the 6" pump sump).

- Jack Seto indicated to CRH that the liner pieces will arrive in Whitehorse on Wednesday between 1000 hrs and 1200 hrs on Northwest Freight to Pelly's shop. Jack also confirmed that the additional 10 m of length for the north thermosyphon loops was still acceptable for the design. Tie into the nearly vertical permafrost wall should be at least 1 m and the liner should be wrapped around in the tie in. The location of the radiators should be subcut at least 1 m below the existing permafrost table to control future settlements.

- After lunch Pelly continued advancing the drainage trench towards the north wall of the north cut. The work required the use of the 400 excavator and the dozer to rip a drainage ditch into

the permafrost. The Hitachi excavator was also used for a few hours to help trench across the seepage pond towards the south slope thereby ensuring a completed valley cutoff keyed into permafrost. The Hitachi was also use to maintain the sump and move the suction line for the 6" pump.

- The overall excavation completed was in the order of 600 to 700 m^3, but this was not measured, it will be when the excavation is complete. The drainage trench has a general bottom width in the order of 6 m and a top width of over 10 m. The depth ranges up to 3 to 3.5 m. Within this general excavation a bottom drainage trench about 1.5 m wide and up to 1 m deep has been ripped into the permafrost. The loader and haul trucks were stopped early due to the tight quarters and soft conditions, also ripping the permafrost was not producing large volumes of spoil for hauling.

- At the end of the shift it was not clear that a positive drainage channel was completed but permafrost was encountered along the entire drainage route, it will be pumped tonight and evaluated tomorrow. The downstream sump will also be pumped tonight.

- Tomorrow after the channel has been reviewed to prove positive drainage geotextile and drainage piping will be buried in the channel using gravel to form the final drain.

- Note that work completed today consists of both unit rate and force account charges, the contractor wanted force account costs for bailing out the seepage pond and hauling it away using the loader, haul trucks and excavator. Force account was also requested for excavating the drainage trench but the hauling will be based on volume (due to double handling of material). This seemed a reasonable compromise to CRH.

- Pelly also commented that the original dewatering budget was being stressed and that they may want to discuss this. CRH indicated that this could be discussed when Pelly so desires.

- Force Account Charges for today:

  400 excavator 10.5 hrs @ $275/hr
  Dozer 1 hrs @ $210/hr
  2 Haul trucks 4.0 hrs each @ $180/hr
  Loader 4 hrs @ $ 125/hr

- Hours 0730 to 1200, 1230 to 1845, 1900 to 2045 Total: 12 hrs

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 10 31**

- By 0815 hrs, Pelly has ripped the drainage trench again using the Dozer ripper and is mucking out the trench. Haul trucks are down and drivers are on standby labour rate; loader is sanding roads.

- Labourer's assembling materials for drain – geotextile, and piping.

- Drainage trench runs from northeast corner of seepage pond on a northeast diagonal for 22 m and then runs 4 m due north into the permafrost wall. CRH set up level to check on relative elevations along trench. Initially trench is flat from the end of the diagonal to the sump (± 30 mm). At the 22 m "corner" or end of the diagonal the trench is at the permafrost level and at the sump the trench is up to 0.8 m below the permafrost table. The trench needed to be ripped down further.

- To lower trench Pelly has to lower the permafrost bench above the trench on the south side in order to allow the Dozer ripper to reach deeper. This is done and about 4" of fall from the 22 m corner to the sump is established. This is to close for long term success, so it is decided to bulk cut from the northeast corner of the north cut and from the south side of the drainage trench in order to provide access to lower the trench further.

- CRH discussed yesterday's charges (volumes and force account agreement with Pelly) and Bud agrees to the compromise.

- 400 excavator resumes mucking out of seepage pond while dozer is ripping frost; mucks out the west side of the pond. CRH was concerned about removal of organic rich material and discusses with Bud McAlpine, Bud wants to continue and would like to advance closer to the dam toe and to rebuilt the toe cut to a new backslope with gravel fill. He hopes this controls "icing" or glaciation in the pond over the winter.

- @ 1030 haul trucks and loader are running at seepage dyke, haul muck from pond to start with and then bulk cut material from the north cut.

- CRH establishes temporary bench mark (boulder) on north side of pond (near electrical shed), elevation ≈ 1130.99 ±0.05 m (TBM #1).

- After lunch Pelly continues the bulk cut and switches to using the 400 excavator for this work (changes to clean out bucket at 1345 hours). Both Haul trucks and 400 excavator working on bulk cut. Dozer tries to finish pond mucking but the pond base is to soft for dozer.

- CRH observed the pipe delivered to site for Pelly, consists of 10" rigid IPEX PVC perforated sewer pipe, 10 lengths of 4 m long pipe. Pipe only has two rows of holes (not four) and is bell ended. Pelly also has 6" Big "O" flexible perforated pipe, it is coiled up so the length is difficult to estimate.

- By 1700 hrs the valley bottom and north cut from Station 0+60 northward is cleaned out down to permafrost. The permafrost surface steps down from Station 0+60 in rolls (smooth ridges and valleys) with the high point near 0+60 and the low point near the north end of the north abutment cut. 400 excavator switches over to frost bucket to grade in the drainage trench bottom (force account work).

- CRH advised Pelly and Bud McAlpine that the east wall of the north slope excavation will require further cutting to lower the slope angle for safety. This must be done before the cutoff trench is started in this area.

- Also @ 1700 hrs Jessie runs the loader at the gravel borrow and trucks haul down 7 loads of gravel for use in building the drain.

- CRH establishes another TBM on a boulder near the 6" pump. TBM#2 has elevation 1129.9 m.

- Surveying of the permafrost surface and trench grades by CRH and Bud McAlpine determines that the low point in permafrost within the north cut is located within a few metres east of the "corner" of the drainage channel. The low point has an elevation (top of permafrost) $\approx$ 1124.6 m. The "corner" of the drainage trench is 1124.7 m. East of the low point the permafrost tends to rise.

- Surveying of the sump elevation when the bulk cut is completed yielded an elevation of $\approx$1124.6 m, so the trench is flat between the low point and the sump. Therefore, Pelly is asked to lower the sump elevation. This proves difficult as the sump is set into permafrost with abundant angular gravel clasts. Surveying of the sump after further excavation yielded an estimate depth of 1124 m giving a total of 0.6 m of fall from the low point; however the corner location of the drain was lowered by about 0.3 m as well so the fall from the corner to the sump is about 0.4 m. It was agreed to leave the sump overnight to allow some thaw to deepen the trench. It will be cleaned out tomorrow and the drain assembled and buried.

- Level survey of north cut shows that original bulk bench cut was to an elevation of $\approx$1128.6 m, and that permafrost depths are similar to those predicted by the probing exercise on 2000 10 26. One notable exception is that the lip of permafrost just inside the slope is higher than expected. The permafrost rises to an elevation of over 1126.4 m before dropping down to an elevation of 1124.6 m.

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project: Seepage Dyke and Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor: Pelly Construction
EBA Representative: CRH
EBA Project Number: 0201-00-14618
Date: 2000 11 02

- In AM Pelly using 400 excavator and both haul trucks to sand out east side of north cut (material pushed down by dozer yesterday). Dry material is moved to the terrace and will be used to backfill the slope.

- Dozer starts to rip cutoff trench from south side to about Station 0+65; Bud McAlpine is concerned about the rough edge that the trench may have. CRH will look at this when the trench is mucked out. Jessie of Pelly will use 400 excavator to clean upstream edge later.

- Tony Gaw of YES arrives at 1000 hrs; CRH works with Tony until 1700 hrs to pickup cut topography through the north and south sides of the project. CRH and Tony also layout 1129.5 m elevation stakes for the "fold" in the liner. Tony checks CRH's TBM #2 and determines a level of 1129.84 m; CRH was using 1129.9 m. Tony and CRH also pickup as-built of mucked out seepage pond.

- Arctic foundations required rough length estimate for piping; CRH and Tony chain off from south to north end (radiator to radiator location). Length following the lay of land is 96 m; CRH informs Bill Watt of Arctic foundations. Arctic Foundations has 490 m of pipe on site so there should not be a problem with the length. Arctic foundations starts assembling piping for thermosyphons. Bill inquires about depth of bury for base of radiators, current length for burial is 7'. CRH believes burial of base will be about 10' but we will fill up to level to allow for the 7' length of the radiators.

- In PM Pelly has north end cleaned and it appears to have sufficient room for cut off trench. 400 excavator moves to dressing up slopes south of Station 0+65 using sand fill; smoothes slopes for placement of liner.

- Note that for volume Pick up CRH will add in volumes for sump, cutoff trench and radiator notches.

- CRH and Tony set alignment for cutoff trench, it is essentially unchanged from design but may vary due to accuracy limitations in constructing the trench.

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- Dozer moved over to ripping drainage trench along east side of north cut at 1600 hrs; Bud and Milos concerned about drainage trench coming into the cutoff trench. CRH talks to operator, later clean out shows that the drainage trench did not come into the cutoff trench.

- After 1630 hrs, Pelly starts building the backslope on the north side; Dynapac packer, two trucks dozer and hoe are used. CRH tests compaction and it is good. Fill placement continues until 1915 hrs.

- Force Account Charges for today:

  Dozer 1.0 hrs

- Hours 0730 to 1215, 1245 to 1915, 1945 to 2030 Total: 12.0 hrs

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH**
EBA Project Number:	**0201-00-14618**
Date:	**2000 11 03**

- Pelly switches to frost bucket 0815 hrs; 400 excavator set up to start cleaning and excavating the cut off trench starting from the south side.

- @ 0830 hrs, Pelly switches 400 excavator over to the east drainage trench which had been ripped using the dozer yesterday. 400 excavator establishes drainage along this ditch leading to the downstream sump. The spoil from the excavation was hauled away using the haul trucks, roughly 1hr was spent on this item.

- CRH measures out location for overlay of thermosyphon loops, north loop will be 44 m, south loop will be 54 m; CRH informs Bill Watt of Arctic Foundations and Jessie Jewel of Pelly. Jessie is planning on completing the thermosyphons and liner in two sections starting with the south section.

- Pelly will be setting up a electric pump for the downstream sump and will have a operator/pump person working night shifts starting tonight. This is to ensure that the pumps run well and to continue excavating the permafrost cutoff trench.

- By 0930 hrs the 400 excavator is working on the cutoff trench excavating from the south end working north. The pad or notch for the south thermosyphon radiators is completed to an depth of about 2.5 m when filled back to original ground/vegetation level. CRH informs Bill Watt of depth and suggests that Bill view the pad. Pelly is using a 0.6 m diameter metal disk (idler from a D10 Dozer) as the base for the thermosyphons, Arctic Foundations is aware of this.

- Cutoff trench excavation proceeds slowly but Pelly is able to achieve 2 m depth; upstream face of the trench is quite rough and will need to be smoothed prior to placing the geotextile. Pelly is aware of this and has some ideas as to how it can be done.

- Bud McAlpine suggested that any extra thermosyphon piping be used to extend the length of overlap between the North and south loops with a view to addition thermal loading capacity to the north side. CRH checks this with Jack Seto and Jack does not believe that this would have any significant impact on the thermo-design. CRH is also concerned that Pelly would ask for significant standby extra's if this change is implemented. CRH discusses with Bud McAlpine and he agrees to withdraw the idea.

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- Bud and Milos are both concerned that the east side drain in the North cut is not yet completed to a final product. Milos is concern that the current shallow ditch will freeze and stop draining. CRH had discussed this with Jessie Jewel and Jessie would be willing to stop work to complete this item in any form acceptable to Bud and Milos; however, he would be charging for all costs and for standby of other forces due to lack of production on the cutoff trench. CRH discusses this with Bud and Milos and notes that *until Pelly moves to open ground that is currently effected by the backflow seepage in the northeast corner* EBA has no concern about this seepage and believes that the seepage does not impact the ultimate quality of the work. As soon as Pelly wishes to work in this area, then the drainage issue will need to be properly dealt with.

- Proper handling of the northeast corner seepage will require removal of additional sand from the slope above the northeast corner and further excavation and deepening of the current drainage ditch. Piping etc will also be required and CRH has discussed this with Jessie Jewel of Pelly.

- 400 excavator and one truck working on cutoff trench until 1520 hrs; 400 excavator stops to clean washed in sand out of the 6" pump sump; dozer rips a portion of the cutoff trench while excavator is cleaning sump.

- @ 1555 hrs 400 excavator resumes cutoff trench work; stops at 1630 hrs to change over to clean out bucket and bulk cut sand from the northeast corner of the north cut. Sand removal is to allow for construction of a drain. Cut requires removal of 21 loads of sand using both trucks. Cut completed by 1630 hrs and 400 excavator refuels and changes over to frost bucket for night shift.

- Note that sand loads will not be included in YES's quantity survey so they must be added by CRH. YES provide preliminary numbers for the north cut, they have estimated a volume of 6350 m^3 ±3%. This seems reasonable to CRH (expecting at least 6000 m^3). YES wants to completed the detailed calculations before announcing the amount to the Contractor.

- Night shift operator (Ken Gould) will be cut in east side drain and resuming excavation of the cutoff trench. Day shift had completed to about Station 0+50 to 0+55.

- Close observation of the cutoff trench completed by the day shift was completed by CRH, Jessie, Bud and Milos. All agree that the sharp rough edges of the cut will damage the liner material. Jessie does not believe that these edges can be fully removed mechanically, he is considering other options to solve this problem. CRH and Jessie both believe that geotextile will provide some protection but it is not certain that this is enough. Bud and Milos initial agree with geotextile option in combination with hand cleaning of the sides to remove as many projections as feasible. Bud later suggests a sand alternative that needs to be discussed (sand bentonite wedge on upstream edge).

- CRH calls Jack Seto in evening to discuss cutoff trench up the north wall. Jack feels that while depth can be modified the width should be held at 2.5 m. CRH informed Jessie of Pelly.

- 400 Excavator is repaired and ready for use for night shift. Night shift will end after tonight.
- Force Account Charges for Today:

  Labourer - 1.5 hrs
  Dozer – 5.5 hrs
  Komatsu 400 – 1.5 hrs
  Haul trucks – 1.5 hrs
  Loader – 1.5 hrs

- CRH Hours 0730 to 1145, 1215 to 1830, 1900 to 2100 Total: 13.0 hrs

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**CRH/JSB**
EBA Project Number:	**0201-00-14618**
ate:	**2000 11 10**

Night shift (JSB):

- Final repairs to Komatsu tracked hoe bucket is complete around 1930 hrs, Hoe used to remove water and submersible pump from the south end sump. Also, clean-up of the south end of trench is completed.
- Liner pieces being attached by worker from 1900 – 2030 hrs.
- Placement of geotextile and pipe started at 2000 hrs, and back filled with coarse gravel fill. Back fill complete at 2300 hrs with 9 gravel loads.

Day Shift (CRH/JSB):

- In AM, Pelly completing welding of north section of flipped liner and infilling the main sump.
- 8 gravel loads placed in the main sump, work on sump completed between 0800 hrs and 1100 hrs.
- 400 excavator completing sand cover over liner and upstream slope during morning as well.
- After lunch, JSB takes over dayshift and meets with CRH and Bud McAlpine and David Sherstone to review work to date and remaining items to be completed. Bud and David arrived at site around 1230 hrs and leave around 1500 hrs; CRH leaves site around 1700 hrs. JSB remaining to complete job.
- CRH indicated to Bud that instrumentation will not be installed for several weeks.
- After lunch Pelly placing gravel on completed sections of the dyke and mucking out additional areas in seepage pond as per the request of Bud McAlpine.
- Bud also indicated that additional work on the spillway should be completed, this was conveyed to CRH and JSB and will be explained to Pelly.

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- CRH and Jessie Jewel will meet in Whitehorse on Saturday (November 11th) to prepare a progress payment for about $400 000. This was acceptable to DIAND.

(JSB entry)

- Sand cover placed over liner from 1300 hrs to 1400 hrs. Gravel cap placed on seepage dyke and on slope of the seepage pond side from 1400 hrs to 1500 hrs.

- Sand pushed over embankment with loader from 1400 hrs to 1500 hrs.

- Excavation and clean-up of seepage pond area conducted as per Bud McAlpine instructions. This task took place from approximately 1600 to 1700.

- Sand hauling for south end of seepage dyke from 1700 hrs to 1730. Hauling rock from 1730 to 1800 hrs.

- Crew done hauling for the day. Some time spend fueling equipment to about 1815 hrs.

- Force Account Charges for Today:

  Komatsu 400 – 1.5 hrs
  Loader – 1 hr

- CRH Hours 0730 to 1145, 1215 to 2000 Total: 13.0 hrs
  JSB Hours 1900 to 2330, 1300 to 1800; Total 9.5 hrs.

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**JSB**
EBA Project Number:	**0201-00-14618**
Date:	**2000 11 11**

Day Shift (JSB):

- In AM, Meet with Pelly rep. Ken Peacock to go over list of construction items to be addressed. Ken provided JSB with order of tasks he will attempt to accomplish.
- 2 truckloads of large boulder delivered to the seepage pond for the culvert sump installation.
- 4 truckloads of rock hauled for the seepage pond sidewalls, and placed with the Komatsu hoe. Excavated sump was back filled by Pelly while completing rock armor placement around Seepage pond, as well culvert set in place.
- Total 2.0 hrs. to complete the remainder of the erosion ditch. Swale excavated and geotextile placed and covered with rock armor. From near top of the upstream side of the seepage dyke, to near the bottom of the natural downside slope where the creek daylights, 14 loads were required to cap the erosion ditch.
- Don Pilsworth placing boulders around culvert sump in seepage pond. Started at 10:00 am completed by Noon.
- Shaping downstream slope of seepage dyke, approximately 0.5 hr.

In PM

- Approximately 1.5 hours to place 2 bags of Bentonite around thermosyphon piping, and 2 bags mixed with sand placed on seepage dyke adjacent to wall and on top of liner.
- Komatsu hoe used to push and place material over embankment for 2.0 hours.
- 1 Moxy truck loaded by Komatsu hoe used to haul material from east embankment to dump over the central area of the embankment. 25 loads hauled in total.
- Seepage Pond - Hitachi hoe used for setting up sump, sump shack and piping from the tailings dam shut down at 1600. Approximately 5.0 hours of operational time.

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- Dozer utilized to push material from the west embankment towards the central area. 1.5 hours of operational time.

- 1 – 2 workers have been working throughout the day, cleaning up, returning hoses and pumps to Ketza's shop

- Force Account Charges for Today:

  Dozer – 1.5 hrs
  Komatsu 400 – 4.5 hrs
  Haul trucks – 1 hr (total)
  Loader – 0.5 hrs

JSB Hours PM 7:30 to 12:00, AM 12:45 to 1800 Total 10.0 hrs.

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Seepage Dyke and Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	**Pelly Construction**
EBA Representative:	**JSB**
EBA Project Number:	**0201-00-14618**
Date:	**2000 11 12**

Day Shift (JSB):

- In AM, Meet with Pelly reps. Ken Peacock and Ken Gould to go over list of construction items to be addressed.
- 6 truckloads of gravel hauled to the upper portion of the spillway. 30 – 40 minutes. Spillway cleared of snow, and rock spread out with Komatsu tracked hoe later in the day. 1 hour.
- 1 truckload of gravel hauled for a low area of the side slope of the diversion ditch.
- 34 truckloads of sand hauled from east slope and end dumped over embankment on north end of seepage dyke. 3 – 3 ½ hours. 7 full hoe buckets are required to fill Moxy truck box.
- 7 truckloads of gravel hauled for the down stream slope of the seepage dyke. 50 minutes to haul and place.
- Down stream sump partially filled with sand.
- Dozer leveling terrace and pushing excess material and end dumped sand over embankment. Approximately 4 – 5 hours of dozer time utilized for the terrace and embankment work required.
- 2 truckloads of large boulders loaded and hauled to the end of the spillway (20 minutes) for later placement with Komatsu hoe.
- 3 truckloads of coarse rock hauled from stockpile located on terrace and placed in area just up from "Ford" (15 minutes). Later spread and placed with Komatsu hoe, approximately 15 minutes.
- Dozer leveled waste pile, approximately 35 minutes.

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- Komatsu hoe used to excavate, place and shape terrace, embankment, and slope up from sump. 1.5 hours.

- Force Account Charges for today:

  Dozer – 5 hrs
  Komatsu 400 – 1.75 hrs
  Haul trucks – 1 hr (total)
  Loader – 0.5 hrs

JSB Hours PM 7:15 to 12:00, AM 12:45 to 1800 Total 10.0 hrs.

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project: Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor:
EBA Representative: JPB
EBA Project Number: 0201-00-14618001
Date: 2001 07 26

JPB mobilized to site along with a backhoe contractor to complete temporary repairs to the end of the spillway.

JPB onsite at 12:00. Don Pilsworth was just unloading the hoe at this time. The hoe was used to construct a berm upstream of the main erosion channel to help divert the water from flowing into through this area. Riprap from the sideslopes and base of the channel was used to fortify the berm. The erosion channel was then backfilled with existing material from the immediate vicinity of the channel. Upon completion of the work, the channel was completely backfilled and the majority of water diverted from the area. Numerous photos were taken during the temporary repairs.

JPB left site at 18:00

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	
EBA Representative:	**JPB**
EBA Project Number:	**0201-00-14618001**
Date:	**2001 08 11**

JPB arrived onsite at 12:00. Two tandems and a loader hauling material down to the diversion ditch from the borrow area. Hoe dressing up borrow on the northeast side. After launch had the hoe haul its cleanup bucket and an abandoned roll of GCL down to the diversion ditch to commence reconstruction.

Two labourers (Stuart and Roger) showed up to site at 14:30. Their driver (Darren) worked for one hour before heading back to Carmacks. Both labourers work the remainder of the day till 19:00 at prep. The liners and exposing the existing geotextile near the drop structure at 0+285.

Hoe was used to help exposed the existing geotextile and commence excavating the material bailed into the failure region two weeks ago.

For additional information, see field notes.

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project:	**Spillway Upgrading**
Location:	**Mount Nansen, Yukon**
Contractor:	
EBA Representative:	**JPB**
EBA Project Number:	**0201-00-14618001**
Date:	**2001 08 12**

Two tandems and a loader continued hauling material down to the diversion ditch from the borrow area until 15:30 at which time the majority of the stockpiled borrow material was hauled away. The two tandems completed some unassociated Ketza work before heading back to Carmacks. The loader came down to the diversion ditch and commenced stockpiling material closer to the excavation.

Hoe and labourers completed exposing the existing geotextile, the tie in was completed and the area was backfilled. Two layers of geotextile and a layer of GCL was installed.

Two labourers (Stuart and Roger) completed the day at 18:30 and Stuart was sent down to Carmacks with the truck drivers.

For additional information, see field notes.

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EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project: Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor:
EBA Representative: JPB
EBA Project Number: 0201-00-14618001
Date: 2001 08 13

The loader continued to haul the stockpiled material to the current excavation throughout the day while the hoe continued with the excavation and backfilling operations. The loader is the slowest part of the operation with the hoe having to wait for material at times. However, while waiting the hoe is able to do cleanup work and continue excavation.

Geotextile and GCL was installed as required.

Bud McAlpine was onsite at 13:00. Roger (the remaining labourer) was sent back to Carmacks with Bud at 16:30.

For additional information, see field notes.

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DAILY CONSTRUCTION REPORT

Project: Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor:
EBA Representative: JPB/CRH
EBA Project Number: 0201-00-14618001
Date: 2001 08 14

The loader continued to haul the stockpiled material to the current excavation throughout the day while the hoe continued with the excavation and backfilling operations. The loader is the slowest part of the operation with the hoe having to wait for material at times. However, while waiting the hoe is able to do cleanup work and continue excavation.

Geotextile and GCL was installed as required.

CRH arrived at site at 1630 hrs; JPB left @ 1730 hrs.

Loader and Hoe continued working on building up south side until 1900 hrs.

For additional information, see field notes.

EBA Engineering Consultants Ltd.

DAILY CONSTRUCTION REPORT

Project: Spillway Upgrading
Location: Mount Nansen, Yukon
Contractor:
EBA Representative: CRH
EBA Project Number: 0201-00-14618001
Date: 2001 08 18

- In AM loader continues hauling and placing large key stones at DS's that need to be improved, excavator spreading riprap in channel from previous placed piles
- Loader completed hauling key stones and placed some additional riprap at ford area; loader completed work @ 1000 hrs.
- Excavator spreading riprap and rebuilding low DS's from 0930 hrs, should be completed by 1500 hrs, operator will call in to CRH to let him know the time.
- CRH left site @ 1300 hrs

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APPENDIX E

Compaction Test Results

EBA Engineering

DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus : Nuclear Machine No: 4004

Soil Description: SAND - trace of gravel, trace to some silt

Temperature Air: -10.0 °C Soil: 0.0 °C

Specified Compaction: 90

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: **1721**

Optimum M.C.: 14.0

Date Tested: **2000.10.22** By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
1/200	Erosion Channel Sta. 0 + 020 m	1.0	5.8	1685	97.9
2/200	Erosion Channel Sta. 0 + 35 m	0.8	4.6	1705	99.1
3/200	Erosion Channel Sta. 0 + 50 m	0.8	4.6	1730	100.5
4/200	Erosion Channel Sta. 0 + 80 m	1.0	6.9	1623	94.3

Remarks:

Reviewed By: _____ P.Eng.

c.c.
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EBA Engineering

DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus : Nuclear Machine No: 4004

Soil Description: SAND - trace of gravel, trace to some silt

Temperature Air: 0.0 °C Soil: 0.0 °C

Specified Compaction: 95

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: **1721**

Optimum M.C.: 14.0

Date Tested: **2000.10.22** By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
5 /200	Seepage Dyke Sta. 0 + 85 15 m W of Centreline 1127.0 m	4.0	5.5	1740	101.1
6 /200	Seepage Dyke Sta. 0 + 75, Centreline 1126.7 m	4.3	5.0	1700	98.8

Remarks:

Reviewed By: _____ P.Eng.

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DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus : Nuclear Machine No: 400-4

Soil Description: SAND - trace of gravel, trace to some silt

Temperature Air: 0.0 °C Soil: 0.0 °C

Specified Compaction: 95

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: 1721

Optimum M.C.: 14.0

Date Tested: 2000.11.02 By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
7/200	Seepage Dyke Sta. 0 + 85 15 m W 1129.5 - 2 m	2.5	4.7	1685	97.9
8/200	Seepage Dyke Sta. 0 + 70 20 m W. -2.5	2.5	6.0	1693	98.4

Remarks:

Reviewed By: _____ P.Eng.

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DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus : Nuclear Machine No: 4004

Soil Description: SAND - trace of gravel, trace of silt

Temperature Air: 0.0 °C Soil: 0.0 °C

Specified Compaction: 95

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: **1721**

Optimum M.C.: 14.0

Date Tested: **2000.11.06** By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
9 /200	Seepage Dyke Sta. 0 + 044 from S. end of Trench	0.5	3.9	1645	95.6
10 /200	Seepage Dyke Sta. 0 + 032 from S. end of Trench	0.5	3.9	1688	98.1
11 /200	Seepage Dyke Sta. 0 + 042.5 from S. end of Trench	1.0	4.1	1647	95.7
12/200	Seepage Dyke Sta. 0 + 030 from S. end of Trench	1.0	4.0	1679	97.6
13 /200	Seepage Dyke Sta. 0 + 018 from South end of Trench	1.0	4.4	1563	90.8
14 /200	Seepage Dyke Sta. 0 + 85 Cut off Trench	0.7	6.1	1654	96.1
15 /200	Seepage Dyke 10 m East of Centre line 1126 m Station 0445	1126	5.0	1678	97.5
16 /200	Seepage Dyke Sta. 0 + 076 Centreline of trench	1.0	6.3	1607	93.4
17 / 200	Seepage Dyke Sta. 0 + 060 Centreline of trench	1.5	5.3	1653	96.0
18/200	Seepage Dyke Sta. 0 + 038 10 m East of Centreline	1126.	6.4	1690	98.2

Remarks: Test 13 was a check of density before compaction.

Reviewed By: _____ P.Eng.

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EBA Engineering

DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus : Nuclear Machine No: 4004

Soil Description: SAND - trace of gravel, trace of silt

Temperature Air: 0.0 °C Soil: 0.0 °C

Specified Compaction: 95

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: **1721**

Optimum M.C.: 14.0

Date Tested: **2000.11.07** By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
19/200	Seepage Dyke Sta. 0 + 013 10 m East of Centreline	1128.	4.5	1623	94.3
20/200	Sta. 0 + 016 7 m East of Centreline	1128.	4.6	1682	97.7
21/200	Sta. 0 + 029 9 m East of Centreline	1127.	5.4	1659	96.4
22/200	Sta. 0 + 018 6 m East of Centreline	1128.	4.4	1688	98.1
23/200	Sta. 0 + 038 6 m East of Centreline	1128.	6.0	1630	94.7
24/200	Sta. 0 + 028 10 m East of Centreline	1127.	4.5	1663	96.6

Remarks:

Reviewed By: _____ P.Eng.

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EBA Engineering

DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus : Nuclear Machine No: 4004

Soil Description: SAND - trace of gravel, trace of silt

Temperature Air: 0.0 °C Soil: 0.0 °C

Specified Compaction: 95

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: **1721**

Optimum M.C.: 14.0

Date Tested: **2000.11.08** By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
25/200	Sta. 0 + 20 Centreline	1131	5.2	1635	95.0
26/200	Sta. 0 + 75 15 m East of Centreline	1127	6.8	1642	95.4
27/200	Sta. 0 + 85 10 m East	1125.	5.2	1720	99.9
28/200	Sta. 0 + 50 4 m East	1127.	4.7	1689	98.1
29/200	Sta. 0 + 90 4 m East	1127	6.2	1653	96.0
30/200	Sta. 0 + 35 2.5 m East	1128.	4.8	1647	95.7
31/200	Sta. 0 + 55 8 m East	1128.	5.4	1681	97.7
32/300	Seepage Dyke North End	-2.0	4.9	1678	97.5
33/300	Seepage Dyke Center	-2.0	5.2	1689	98.1
34/300	Seepage Dyke North End	-1.6	4.4	1704	99.0
35/300	Seepage Dyke North Centre	-1.6	4.6	1711	99.4
36/300	Seepage Dyke South Centre	-1.6	5.2	1701	98.8
37/300	Seepage Dyke South End	-1.6	4.8	1756	102.0+

Remarks:

Reviewed By: _____ P.Eng.

c.c.
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EBA Engineering

DENSITY TEST RESULTS

ASTM Designation D2922 & D3017, or D1556

Project No: **0201-00-14618**

Project: Seepage Dyke Spillway Improve.
Mount Nansen, YT

Client: **DIAND**

Att'n: **MR. BUD MCAPLINE**

Test Apparatus: Nuclear Machine No: 4004

Soil Description: SAND - trace of gravel, trace of silt

Temperature Air: 0.0 °C Soil: 0.0 °C

Specified Compaction: 95

Compaction Standard: Standard Proctor

Minimum Dry Density:

Maximum Dry Density: **1721**

Optimum M.C.: 14.0

Date Tested: **2000.11.09** By: CRH

Test No./ Probe Depth	Location	Elevation	% Moisture Content	Dry Density Kg/m^3	% Compaction
38/300	Sta. 0 + 90 2 m East Centreline	1130	5.0	1736	100.9
39/300	Sta. 0 + 75 12 m East	1129.	6.1	1712	99.5
40/300	Sta. 0 + 65	1130	4.5	1693	98.4
41/300	Sta. 0 + 50 3 m East of Centreline	1129.	5.0	1666	96.8
42/300	Sta. 0 + 35 2 m East of Centreline	1130.	4.2	1704	99.0

Remarks:

Reviewed By: _____ P.Eng.

c.c.
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FILE COPY

APPENDIX F

Instrumentation Installation Report

June 21, 2001 EBA File: 0201-00-14618

Government of Canada
DIAND – Yukon Region
Water Resources
310-300 Main Street
Whitehorse, Yukon
Y1A 2B5

Attention: Mr. Bud McAlpine

Subject: **Drilling/Instrumentation Installation**
Seepage Collection Dyke Reconstruction
Mount Nansen Mine Site, Yukon

This letter summarizes the instrumentation installation completed by EBA Engineering Consultants Ltd. (EBA), to provide future monitoring of the newly reconstructed seepage collection dyke at the mine site at Mount Nansen, Yukon. The purpose of this program was to install PVC standpipes for ground water monitoring, and thermistor cables for ground temperature monitoring along the downstream side of the new seepage collection dyke. These instrumentation installations are to assist in future monitoring of the effectiveness of the seepage dyke construction. This report presents a description of the site work completed, and provides details of the instrumentation installations.

Authorization to proceed with this program was received from Mr. Bud McAlpine of the Government of Canada (Water Resources Division – DIAND, Yukon Region).

1.0 FIELDWORK

The fieldwork commenced on January 18, 2001 and was completed on January 20, 2001. The six boreholes were drilled with a Schramm air-rotary drill rig contracted from Midnight Sun Drilling Co. Ltd. of Whitehorse, Yukon. Where possible, samples were obtained from the cone discharge and logged accordingly. However, the priority of the drill program was to install the

instrumentation, which consisted of three 50 mm PVC monitoring wells into the water table, and three ground temperature thermistor cables, into at least 1.0 m of permafrost soils, along the downside toe of the seepage dyke berm. The locations are shown on Figure 1, attached.

Installation of the thermistor cables was accomplished by air-rotary drilling, determining the depth to permafrost, and then drilling approximately 1.0 m into the permafrost. The standpipe depths were pre-determined by EBA based upon ground water levels obtained during construction of the seepage dyke. These levels were confirmed during the installation and drilling program. Standpipe and thermistor instrumentation was installed in the same manner, by being lowered into the casing while simultaneously retracting and filling the casing with "frac" sand or drill cuttings where applicable. A steel protective pipe with locking cap was placed over each of the monitoring wells and thermistor cables.

All boreholes were advanced along the toe of the seepage dyke crest, to varying depths. A thermistor cable and standpipe were installed in Boreholes 14618-BH01and -BH02, respectively. These boreholes are located on the upper bench located east of and adjacent to the north end of the seepage dyke. A thermistor cable was also installed in Boreholes 14618-BH03, and -BH04, along the toe of the seepage dyke. A standpipe was installed in each Borehole 14618-BH05 and –BH06, also located along the east side of the seepage dyke. Detailed instrumentation installation details are shown on the corresponding borehole logs, attached.

All boreholes were drilled in locations previously approved by Mr. Bud McAlpine of the Government of Canada (Water Resources Division – DIAND, Yukon Region). Table 1 summarizes borehole, permafrost and instrumentation details for each borehole.

Table 1
Borehole, Permafrost and Instrumentation Summary

Borehole	Borehole Depth	Permafrost Depth	Instrumentation - Depth
14618-BH01	13.1 m refusal	12.2 m	Thermistor Cable # 1385 – 12 m string, 16 points, starting at 0.5 m, 3 m lead.
14618-BH02	7.6 m refusal	n/a	50 mm standpipe – 8.3 m
14618-BH03	10.0 m refusal	9.4 m	Thermistor Cable # 1383 – 10 m string, 16 points, starting at 0.5 m, 2 m lead.
14618-BH04	10.4 m	9.0	Thermistor Cable # 1384 – 10 m string, 16 points, starting at 0.5 m, 2 m lead.
14618-BH05	3.0 m	n/a	50 mm PVC standpipe.
14618-BH06	3.0 m	n/a	50 mm PVC standpipe.

Notes: Figure 1 shows the borehole locations, and instrumentation details are shown on the attached logs.

2.0 INSTRUMENTATION READINGS

Initial thermistor readings were obtained by EBA, after installation, to confirm that the cables were working. It is understood that mine personnel will be obtaining all future readings from the thermistors and standpipes.

3.0 CLOSURE

The report has been prepared for the exclusive use of the Government of Canada (Water Resources Division – DIAND, Yukon Region).

We trust this report satisfies your requirements at this time, however, if you have any questions, or require additional information or assistance from EBA, please contact the undersigned.

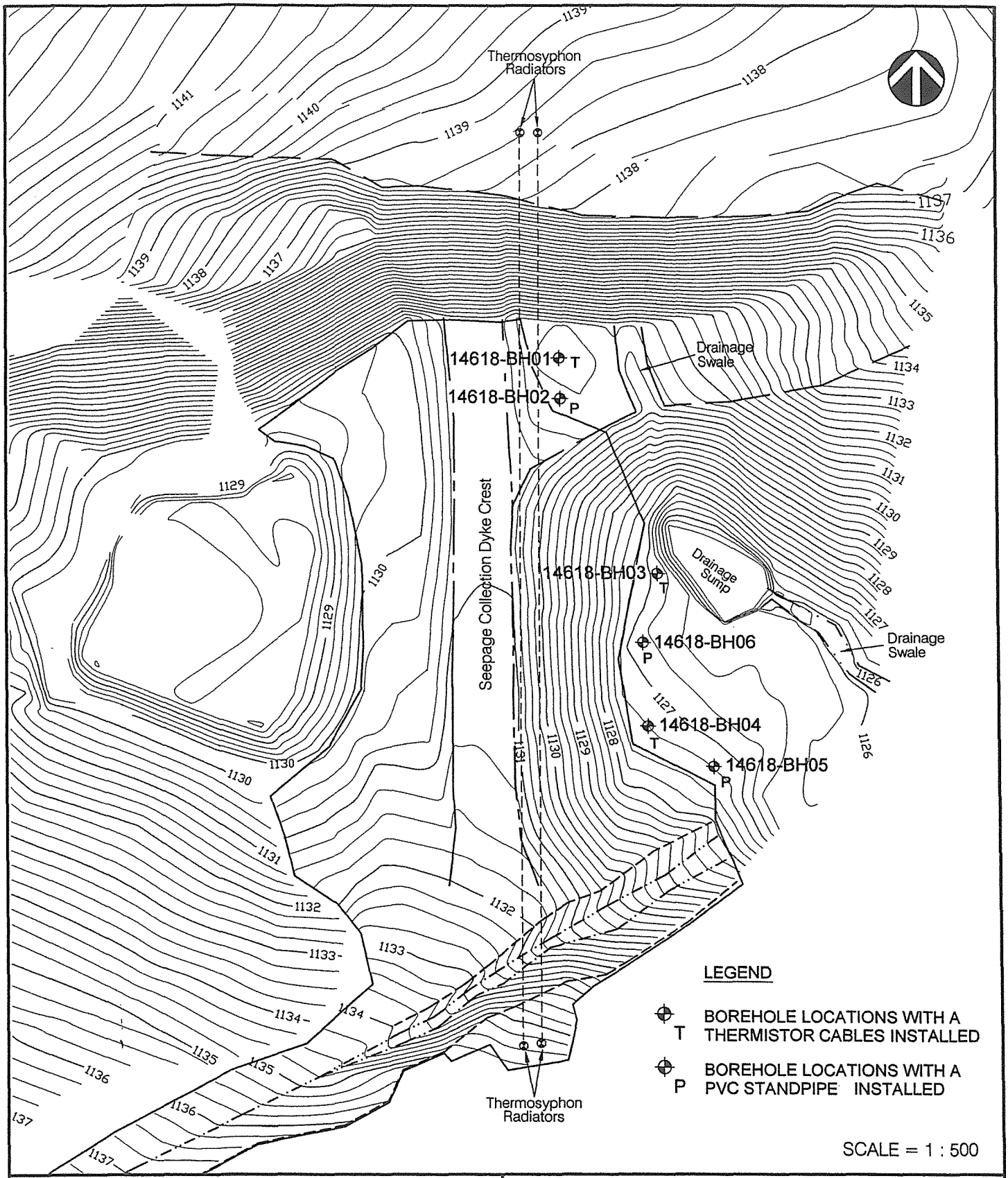
Yours truly,
EBA Engineering Consultants Ltd.

James S. Buyck
Engineering Assistant
(Direct Line: (867) 668-2071, ext. 26)
(e-mail: jbuyck@eba.ca)

J. Richard Trimble, P.Eng.
Senior Geotechnical Engineer
Project Director, Yukon Region
(Direct Line: (867) 668-2071, ext. 22)
(e-mail: rtrimble@eba.ca)

JSB/jsb

Attachments: Site Plan (1 page)
Borehole Logs (6 pages)
Thermistor String Calibration Sheets (3 pages)



EBA Engineering Consultants Ltd.			PROJECT	DRILLING/INSTRUMENTATION INSTALLATION SEEPAGE COLLECTION DYKE RECONSTRUCTION MT. NANSEN MINE SITE, YUKON	
CLIENT DIAND YUKON REGION			TITLE SITE PLAN SHOWING BOREHOLE AND INSTRUMENTATION LOCATIONS		
DATE JUNE 2002	DWN. JSB	CHKD. JRT	FILE NO. 0201-00-14618		DRWG. FIGURE 1

Drilling/Instrument Installation	CLIENT: DIAND – Yukon Region	BOREHOLE NO: 0014618-BH01
Mount Nansen Mine Site,	DRILL: Schramm Air Rotary	PROJECT NO: 0201-0014618
Carmacks, YT	UTM ZONE: 8 N – E –	ELEVATION: 1130.75 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	SAMPLE TYPE	RUN NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	STANDARD PENETRATION 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	PERCENT GRAVEL 20 40 60 80 / PERCENT SAND 20 40 60 80 / PERCENT SILT OR FINES 20 40 60 80 / PERCENT CLAY 20 40 60 80	ELEVATION(m)
0.0					SAND (FILL) – trace of silt, fine to medium grained, light brown, dry			1130.0
1.0								
2.0								
3.0								1128.0
4.0								
5.0					–becomes silty at about 4.5 m –color changes to a dark grey around 4.5 m			1126.0
6.0								
7.0								1124.0
8.0								
9.0								1122.0
10.0								
11.0								1120.0
12.0					–frozen at approximately 12.2 m			
13.0								1118.0
14.0					END OF BOREHOLE 13.1 m –water table at 4.5 m –thermistor cable #1385 installed			

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB
REVIEWED BY: JRT

COMPLETION DEPTH: 13.1 m
COMPLETE: 18/01/01

02/06/21 03:51PM (NANSEN T)

Drilling/Instrument Installation	CLIENT: DIAND – Yukon Region	BOREHOLE NO: 0014618-BH02
Mount Nansen Mine Site,	DRILL: Schramm Air Rotary	PROJECT NO: 0201-0014618
Carmacks, YT	UTM ZONE: – N – E –	ELEVATION:

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	SAMPLE TYPE	RUN NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					SAND (FILL) – trace of silt to some silt
4.5					– becomes silty at 4.5 m – water encountered at about 4.5 m
7.3					END OF BOREHOLE @ 7.3 m

STANDARD PENETRATION 10 20 30 40

PLASTIC M.C. LIQUID 10 20 30 40

PERCENT GRAVEL 20 40 60 80

PERCENT SAND 20 40 60 80

PERCENT SILT OR FINES 20 40 60 80

PERCENT CLAY 20 40 60 80

ELEVATION(m): 0.0, -2.0, -4.0, -6.0, -8.0, -10.0, -12.0, -14.0

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: 7.3 m
REVIEWED BY: JRT	COMPLETE: 18/01/01

02/06/21 03:51PM (NANSEN T)

Drilling/Instrument Installation	CLIENT: DIAND – Yukon Region	BOREHOLE NO: 0014618-BH03
Mount Nansen Mine Site,	DRILL: Schramm Air Rotary	PROJECT NO: C201-0014618
Carmacks, YT	UTM ZONE: 8 N – E –	ELEVATION: 1126.8 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	SAMPLE TYPE	RUN NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	STANDARD PENETRATION 10 20 30 40	PLASTIC M.C. LIQUID 10 20 30 40	PERCENT GRAVEL 20 40 60 80	PERCENT SAND 20 40 60 80	PERCENT SILT OR FINES 20 40 60 80	PERCENT CLAY 20 40 60 80	ELEVATION(m)
0.0					GRAVEL – sandy, silty							1126.0
1.0					SILT – sandy, wet, dark brownish black							
2.0												
3.0												1124.0
4.0												
5.0					– becomes moist at about 4.5 m							1122.0
6.0												
7.0					SAND – trace of gravel, trace of silt, medium to coarse sand, fine grained gravel, loose, moist, light yellowish brown							1120.0
8.0												
9.0					– sand becomes fine grained below 8.5 m – becomes silty below 8.5 m – colour changes to medium grey at about 8.5 m							1118.0
10.0					– frozen below 9.4 m END OF BOREHOLE @ 10.0 m – thermistor cable #1383 installed							
11.0												1116.0
12.0												
13.0												1114.0
14.0												

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB
REVIEWED BY: JRT

COMPLETION DEPTH: 10 m
COMPLETE: 20/01/01

02/06/21 03:56PM (NANSEN T)

Drilling/Instrument Installation	CLIENT: DIAND – Yukon Region	BOREHOLE NO: 0014618-BH04
Mount Nansen Mine Site,	DRILL: Schramm Air Rotary	PROJECT NO: 0201-0014618
Carmacks, YT	UTM ZONE: 8 N – E –	ELEVATION: 1127.25 m

SAMPLE TYPE: GRAB SAMPLE; NO RECOVERY; STANDARD PEN.; 75 mm SPOON; CRREL BARREL

BACKFILL TYPE: BENTONITE; PEA GRAVEL; SLOUGH; GROUT; DRILL CUTTINGS; SAND

Depth(m)	SAMPLE TYPE	RUN NO	USC	SOIL SYMBOL	SOIL DESCRIPTION
0.0					SAND – silty, gravelly
1.0					SILT – sandy – poor recovery due to water and fine grained soils
2.0					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					
10.0					END OF BOREHOLE @ 10.4 m – water table encountered – thermistor cable #1384 installed
11.0					
12.0					
13.0					
14.0					

STANDARD PENETRATION 10 20 30 40

PLASTIC M.C. LIQUID 10 20 30 40

PERCENT GRAVEL 20 40 60 80

PERCENT SAND 20 40 60 80

PERCENT SILT OR FINES 20 40 60 80

PERCENT CLAY 20 40 60 80

ELEVATION(m): 1127.0, 1125.0, 1123.0, 1121.0, 1119.0, 1117.0, 1115.0, 1113.0

EBA Engineering Consultants Ltd. Whitehorse, Yukon	LOGGED BY: JSB	COMPLETION DEPTH: 10.4 m
	REVIEWED BY: JRT	COMPLETE: 20/01/01
		Page 1 of 1

02/06/21 03:51PM (NANSEN 1)

Drilling/Instrument Installation	CLIENT: DIAND – Yukon Region	BOREHOLE NO: 0014618-BH05
Mount Nansen Mine Site,	DRILL: Schramm Air Rotary	PROJECT NO: 0201-0014618
Carmacks, YT	UTM ZONE: – N – E –	ELEVATION: 1127.25 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	SAMPLE TYPE	RUN NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	STANDARD PENETRATION 10 20 30 40 / PLASTIC M.C. LIQUID 10 20 30 40	PERCENT GRAVEL 20 40 60 80 / PERCENT SAND 20 40 60 80 / PERCENT SILT OR FINES 20 40 60 80 / PERCENT CLAY 20 40 60 80	ELEVATION(m)
0.0					SAND – silty, gravelly			1127.0
1.0					SILT – sandy – poor recovery due to water and fine grained soils			1125.0
2.0								
3.0					END OF BOREHOLE @ 3.0 m – water encountered			
4.0								

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB	COMPLETION DEPTH: 3 m
REVIEWED BY: JRT	COMPLETE: 20/01/01
	Page 1 of 1

02/06/21 03:53PM (NANSEN T)

Drilling/Instrument Installation	CLIENT: DIAND – Yukon Region	BOREHOLE NO: 0014618-BH06
Mount Nansen Mine Site,	DRILL: Schramm Air Rotary	PROJECT NO: 0201-0014618
Carmacks, YT	UTM ZONE: – N – E –	ELEVATION: 1126.85 m

SAMPLE TYPE: GRAB SAMPLE | NO RECOVERY | STANDARD PEN. | 75 mm SPOON | CRREL BARREL

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	SAMPLE TYPE	RUN NO	USC	SOIL SYMBOL	SOIL DESCRIPTION	STANDARD PENETRATION 10 20 30 40	PLASTIC M.C. LIQUID 10 20 30 40	PERCENT GRAVEL 20 40 60 80	PERCENT SAND 20 40 60 80	PERCENT SILT OR FINES 20 40 60 80	PERCENT CLAY 20 40 60 80	ELEVATION(m)
0.0					SAND – silty, gravelly							1126.0
1.0					SILT – sandy – poor recovery due to water and fine grained soils							
2.0												
3.0					END OF BOREHOLE @ 3.0 m – water encountered							1124.0
4.0												

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

LOGGED BY: JSB
REVIEWED BY: JRT

COMPLETION DEPTH: 3 m
COMPLETE: 20/01/01

02/06/21 03:52PM (NANSEN T)