BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

NANISIVIK MINE, A DIVISION OF CANZINCO LTD.

NANISIVIK MINE CLOSURE STUDIES

ASSESSMENT OF SURFACE CELL AND TEST CELL TALIKS

(WATER LICENSE PART G ITEM 5)

FINAL

PROJECT NO.: 0255-008-03
DATE: FEBRUARY 6, 2004

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Project No. 0255-008-03
February 6, 2004

Mr. Bob Carreau
Manager, Environmental Affairs
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Suite 950, 95 Wellington Street W.
Toronto, Ontario
M5J 2N7

Re: Final Report: Assessment of Surface Cell and Test Cell Taliks

Dear Bob:

Please find attached four copies of our above referenced report dated February 6, 2004.

Should you have any questions or comments regarding this report, please contact BGC at your convenience.

Yours truly,
BGC Engineering Inc.
per:

James W. Cassie, M.Sc., P.Eng.
Specialist Geotechnical Engineer

encl. Final Report

JWC/sf

EXECUTIVE SUMMARY

Under the terms of Water Licence NWB1NAN0208 issued by the Nunavut Water Board (NWB), CanZinco Ltd., the current owner of the Nanisivik Mine, is responsible for continuation of on-site environmental protection activities and developing for submission and approval of a Final Reclamation and Closure Plan ("RCP").

The Nanisivik Mine 2004 FCP has been developed, as per the terms of the Water Licence as a series of stand-alone documents, each addressing in detail the information and proposed closure measures for one specific component or topic area. This document and the information presented herein are provided in response to the requirements for component report Part G Item 5, the West Twin Disposal Area Talik Assessment.

In accordance with Part G, Item 5 of the Water Licence, this report provides the following requirements for the Talik Assessment:

The Licensee shall submit to the Board for approval a report assessing the postulated Talik in the surface tailings cell and the test cell, which shall include but not be limited to:

1. *The results of drilling and other investigations to characterize the extent of the Talik;*
2. *Thermal conditions and soil properties within the Talik;*
3. *Identification of the potential for and extent of frost heave, pore water expulsion (volume, rate and water quality) and Pingo formation, and measures to mitigate the effects of any of these processes should they be expected to occur; and*
4. *Water sampling requirements in conjunction with a water quality predictive model.*

In summary, the talik assessment report should provide for the following:

- Characterize the talik in the Surface Cell and Test Cell in terms of physical extent and geothermal conditions;
- Provide a basis for performance monitoring during closure; and
- Develop contingency plans should observed performance deviate from anticipated performance.

Nanisivik is located in the region of continuous permafrost. Permafrost has been observed to extend to a depth of at least 430 m, as observed in a borehole drilled from the underground workings. Ground conditions in the area have been characterized as having the potential for medium amounts of ground ice (as high as 20%) and mean annual ground temperatures colder than -10°C.

The West Twin Disposal Area is comprised of an upper, solids retention pond, the Surface Cell, and a lower, water retention pond, the Reservoir. An earthen dike, the West Twin Dike, separates the Surface Cell and the Reservoir. The Reservoir is further divided by the Test Cell Dike, which separates the Reservoir and the Test Cell. Both dikes are constructed of frozen shale fill and are founded on frozen, settled tailings.

The first shale lift of the West Twin Dike was built in 1991. The dike has been raised in an upstream manner where each new lift begins on top of beached tailings material deposited previously and a sealing lift of frozen shale rockfill. The dike was raised every year between 1991 and 1999, except 1994.

The Test Cell Dike is also constructed of frozen shale fill overlying frozen tailings. The dike was constructed in two stages. The first stage increased the height of the Test Cell Dike to an approximate elevation of 383.5 m. The second stage increased the height of the Test Cell Dike to an approximate elevation of 385.5 m. The second stage of the dike is partially founded on the first stage dike and partially founded on the tailings in the Test Cell.

The development of the taliks within the tailings is closely associated with their depositional history. Tailings were initially deposited sub-aqueously into the bottom of West Twin Lake beginning in 1977. By 1988, the capacity of West Twin Lake to store tailings was exhausted and approval was received from the NWT Water Board to begin surface deposition of tailings. To accommodate this, West Twin Lake was divided into two sections by the West Twin Dike. The eastern portion of the lake, the Reservoir, remained at the original lake level. The western portion of the lake, the Surface Cell became the main deposition area for the tailings. The tailings in the Surface Cell, were deposited sub-aerially, commencing in 1990. The excess water from the tailings were collected in a depression upstream of the south end of the dike, then siphoned into the Reservoir. The ultimate raise of the dike to elevation 388 m was completed in 1999. Tailings continued to be placed into the Surface Cell until the mine closed in September 2002. In total, it is estimated that 6.5 million m^3 of tailings were deposited into the Surface cell between 1978 and 2002.

In the Reservoir and Test Cell area, tailings deposition into West Twin Lake began in 1976. The discharge of tailings took place along the centreline of the West Twin Dike from the north end of the dike resulting in tailings spreading in a south-easterly direction into the Reservoir. Tailings were also placed along an east-west trending line from the centre of the West Twin Dike. By 1988 a tailings causeway was exposed in the Reservoir, which became the foundation for the east-west arm of the Test Cell Dike. Additional tailings deposition along a northwest-southeast trending line resulted in exposure of a second tailings causeway, which became the foundation for the north/south arm of the Test Cell Dike. The Test Cell Dike was constructed in 2000-2001, increasing the tailings storage capacity of the Test Cell. Tailings were also deposited along the toe of West Twin dike, resulting in aerial exposure of tailings in the Reservoir. In total, it is estimated that 3.5 million m^3 of tailings have been deposited into the Reservoir and Test Cell since 1978.

Once the tailings became exposed above the level of West Twin Lake, the material was no longer protected from freezing. A complex freezeback process evolved in the Surface Cell as a result of the continuous placement of tailings and the presence of the water-filled depression. The tailings under the water continued in a thawed state, resulting in a vertical continuation of the original talik under West Twin Lake. Tailings that were placed sub-aerially were subjected to permafrost aggradation, primarily from the surface downwards and towards the margins of the surface pond.

A staged geotechnical investigation was conducted in 2002 and 2003 to gain a better understanding of the physical characteristics of the West Twin Disposal Area tailings deposits. A total of 44 boreholes were drilled in the Surface Cell, Test Cell Area and Dike and at the toe of the West Twin Dike. The investigations included installation of instrumentation to measure ground temperatures. If thawed ground conditions were encountered, monitoring wells and piezometers were installed to assess water quality and water pressures. Various samples collected from the boreholes were selected for laboratory testing. Tests included grain size, moisture content, bulk density, frozen bulk density, specific gravity and thermal conductivity. Tests were conducted on tailings and lake bed sediments. Bedrock core samples were tested for point load strength index.

The results of the geotechnical investigation programs, indicates that taliks exist within the tailings in the Surface Cell and Test Cell. This information, along with the historical tailings deposition practices in the West Twin Disposal Area, were reviewed and interpreted in order to characterize the geotechnical and geothermal properties as well as the extent and magnitude of the taliks. No permafrost aggradation is anticipated into the Reservoir tailings due to the water cover.

One of the significant findings of the investigations was the presence of thawed tailings at temperatures below 0°C. Analysis of the water samples collected within the thawed zones indicated the presence of soluble salts, with an estimated concentration of 4 parts per thousand (ppt). This resulted in a freezing point depression of about 0.2° C. Instrumentation installed in the Surface Cell indicates freezing pint depression values potentially as low as -1.2°C.

Within the Surface Cell, the estimated limits of the talik were based on drilling data and temperature measurements. It is estimated that the Surface Cell contains about 2,000,000 m^3 of thawed tailings. Additionally, some 1,000,000 m^3 of thawed tailings are located in the Test Cell Area. Using a volumetric water content of 40%, the total volume of pore fluid that may be expelled upon freezing within the Surface Cell and Test Cell tailings was estimated to be 104,000 m^3. This volume has been assumed within the water balance done for the contaminant loading of the West Twin Disposal Area.

Geothermal modelling of the Surface Cell talik was carried out to predict the rate of permafrost aggradation into the talik. Analyses were also conducted to assess the variability and sensitivity of the results to initial thermal conditions, global warming, snow cover and the placement of shale as a cover material. The freeze-back temperature was assumed to be –0.2° C. Analyses were done to estimate the time required for the talik to freeze back to several key elevations within the Surface Cell:

- Elevation 371 m - the approximate base elevation of the West Twin Dike. The model predicted a time period ranging between 7 to 8 years after the initial winter, depending on the modelled scenario.
- Elevation 365 m - the approximate base elevation of the tailings base beneath the West Twin Dike. Depending on the modelled scenario, the estimated time for permafrost aggradation ranged from 13 to 15 years after the initial winter.
- Elevation 353 m – the approximate elevation of the deepest part of the tailings. The estimated time for permafrost aggradation was between 27 and 32 years after the initial winter, depending on the modelled scenario.

The geotechnical implications of permafrost aggradation into the taliks are the potential for frost heave, pore water expulsion and pingo formation. A review was undertaken of the various mechanisms associated with these issues in order to identify the potential effects and measures required to mitigate these processes, should they occur. Following a review of the information, the following determinations were made:

- Frost heave of the surface is likely.
- Cryoconcentration within the talik is likely.
- Hydrofracturing that reports to the surface is unlikely.
- Pingo formation is unlikely.
- Formation of a cryopeg, an isolated zone of saline permafrost, is likely within the Surface Cell talik.
- Pre fluid from the Surface Cell cryopeg may possibly migrate towards the Reservoir area, under the frozen extent of the West Twin Dike.

A performance monitoring program was developed to provide a means of assessing the freezeback of the taliks and potential impacts that may occur. The monitoring requirements are fully detailed in the Monitoring Report (Water Licence requirement Part G, Item 9). The monitoring program provides for freezeback monitoring during the 2-year Reclamation Period and for a subsequent 5-year Closure Period. Monitoring will involve visual inspections, surveys, installation of new instrumentation and measurement of ground temperatures, water pressures and water quality.

Several contingency plans have been developed in order to address performance issues that may be identified during the reclamation and post-closure monitoring periods. These issues may include slower than anticipated freezeback of the taliks, elevated pore pressures in the taliks, poor Reservoir water quality, formation of pingos or frost mounds and dike instability. The consequences of each issue and suggested mitigation approach are identified. Common to all suggested mitigation measures is identification of the root cause and appropriate reaction to limit the environmental consequences of each issue.

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This report was prepared by BGC Engineering Inc. (BGC) for the account of CanZinco Ltd. The material in it reflects the judgement of BGC staff in light of the information available to BGC at the time of report preparation. Any use which a Third Party makes of this report or any reliance on decisions to be based on it are the responsibility of such Third Parties. BGC Engineering Inc. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

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1.0 INTRODUCTION

1.1 Overview of Development of the Nanisivik Mine Final Closure and Reclamation Plan

The Nanisivik Mine began production of zinc and lead concentrates in 1976. The current owner of the mine, CanZinco Ltd., has been in possession of the mine since 1996.

Prior to mid-2002, the Nanisivik Mine was scheduled to operate until the depletion of economic ore reserves in 2004 or 2005. However, depressed international base-metal prices necessitated a re-evaluation of the mine production plan in mid-2002, which resulted in a reduction of economic ore reserves such that these reserves were depleted in September 2002. The mine was permanently closed at that time.

An interim mine reclamation plan had been developed and updated on a regular basis by CanZinco Ltd. in response to terms of the Water License. However, the announcement of permanent closure in October 2001 triggered a requirement in the (then) current water licence for submission of a Final Closure and Reclamation Plan. In response to this trigger, CanZinco submitted a Closure and Reclamation Plan (C & R Plan) in February 2002 that described CanZinco's approach to closure and reclamation of the Nanisivik site.

Subsequent to a Public Hearing on renewal of the water licence held in the community of Arctic Bay in July 2002 and a technical meeting held in August 2002, the Nunavut Water Board ("NWB") issued Water Licence No. NWB1NAN0208, with an expiry date of May 1, 2008 (the "Water Licence"). The Water License provides for the continuation of on-site environmental protection activities during the development and submission, for approval, of a Reclamation and Closure Plan ("RCP").

The Nanisivik Mine 2004 RCP has been developed, per the terms of the Water License, as a series of stand alone documents, which each document providing, in detail, information and proposed closure measures for one specific component or topic area. The individual reports that have been developed in this manner are listed under Section G of the Water License as summarized in Table 1.

This document and the information presented herein are provided in response to the requirements for component Part G Item 5, the West Twin Disposal Area Talik Assessment.

1.2 Specific Requirements for the Reclamation and Closure Plan

The specific requirements for the West Twin Disposal Area Talik Assessment (the "Talik Assessment") come from two sources: Part G Item 5 of the Water Licence and the requirements of CanZinco to plan closure operations and long-term monitoring requirements with respect to the site.

Part G Item 5 of the Water Licence, as excerpted below, provides the following requirements for the Talik Assessment:

The Licensee shall submit to the Board for approval a report assessing the postulated Talik in the surface tailings cell and the test cell which shall include but not be limited to:

1. *The results of drilling and other investigations to characterize the extent of the Talik;*
2. *Thermal conditions and soil properties within the Talik;*
3. *Identification of the potential for and extent of frost heave, pore water expulsion (volume, rate and water quality) and Pingo formation, and measures to mitigate the effects of any of these processes should they be expected to occur; and*
4. *Water sampling requirements in conjunction with a water quality predictive model.*

CanZinco's specific requirements for the Talik Assessment are largely satisfied by those provided in the Water Licence. The requirements provided by the Water Licence are focussed largely on confirming the existence of, and defining the extent of the taliks and identifying potential concerns associated with permafrost aggradation into the taliks. CanZinco's requirements, while including those satisfied by the Water Licence, also include a priority need for the gathering of monitoring information focussed on the immediate needs of managing the site and implementing potential contingency plans, if required.

Therefore, in summary, the talik assessment report should provide for the following:

1. Characterize the talik in the Surface Cell and Test Cell in terms of physical extent and geothermal conditions;
2. Provide a basis for performance monitoring during closure; and
3. Develop contingency plans should observed performance deviate from anticipated performance.

2.0 SITE CONDITIONS

2.1 Location and Topography

Nanisivik Mine is located at the northern end of Baffin Island at approximately 73°N latitude as shown in Figure 1. The mine is approximately 5 km from Strathcona sound, which is connected to the Arctic Ocean through Admiralty Inlet.

The mine area consists of a few intermittent planar areas predominantly surrounded by relatively steep high-relief hills rising out of Strathcona Sound. The surface topography is moderately steep rising from sea level to a high of approximately 650 m immediately west of the mine area (Mt. Fuji).

2.2 Climate

Nanisivik Mine is located on Baffin Island in the Canadian Arctic and is therefore subjected to a harsh climatic environment year round. Atmospheric Environment Services (AES) of Environment Canada maintains a network of climate monitoring stations in Nunavut, including one at the Nanisivik Airport, Resolute, Pond Inlet and Arctic Bay. These stations have systematically collected detailed climatic data for the Canadian Arctic. A detailed review of the available climatic conditions at Nanisivik and proximal stations was conducted to aid in reclamation and closure planning activities. The results of this review are discussed in detail in Appendix I and the main parameters are summarized in Table 2.

In addition to a review of all available historical climatic conditions at Nanisivik, an estimate of future climate trends was conducted in order to include potential long-term climate changes in the design of the reclamation works. This estimate was conducted utilizing current guidelines for climate warming estimates. This is also discussed in detail in Appendix I.

2.3 Geology

2.3.1 Bedrock

The bedrock geology of the area has been mapped in detail by Patterson and Powis (2002) and Patterson et al. (2003). The regional bedrock stratigraphy is illustrated on Figure 2. The Nanisivik region is underlain by carbonate and terrigenous clastic strata of the Mesoproterozoic Bylot Supergroup. The Bylot Supergroup is comprised of two terrigenous formations (Adam's Sound and Arctic Bay formations) and two carbonate formations (Society Cliffs and Victor Bay formations) and a mixed carbonate and terrigenous clastic formation (Strathcona Sound Formation). Quartz arenite of the Gallery Formation unconformably overlies the Proterozoic strata.

The Adams Sound Formation is a beige- to light orange-brown, well cemented, medium- to coarse-grained quartz arenite. It is over 100 m thick and is exposed in the Nanisivik Area.

The Arctic Bay Formation is a medium grey to brown, micaceous, fine sandy siltstone interbedded with dark grey micaceous, silty shale. This formation outcrops southeast and southwest of Nanisivik and is approximately 200 m thick.

The Society Cliffs Formation is over 500 m thick and is exposed in the Nanisivik Area. This formation has been subdivided into three units:

- Microbial dolostone (lower);
- Intraclastic dolostone (middle); and,
- Laminated dolomudstone (upper).

All components of the formation exhibit dolomite mineralization. Known sulphide deposits in the Nanisivik area are hosted within the middle and upper subdivisions of this formation.

The Victor Bay Formation is characterized by a gradual upward change from organic rich pyritic shale, to dolomudstone, to more intraclastic and dolomitic facies. It is exposed throughout the Nanisivik area. The formation has been subdivided into three units:

- Shale and dolomitic mudstone unit (lower);
- Dolomitic mudstone and intraclast floatstone (middle); and,
- Silty dolomitic mudstone and intraclast rudstone (upper).

The lower unit is approximately 180 m thick and consists of interbedded, organic rich, fissile shale and light-grey, planar-bedded dolomitic mudstone.

The middle unit is approximately 80 m thick and is marked by the appearance of intraclast rudstone and floatstone. Occasional occurrences of light-grey dolomudstone and black shale similar to those found in the lower unit are observed within the middle unit.

The upper unit is approximately 70 m thick and is characterized by the absence of shale and the prevalence of dolomitic intraclastic carbonate and the presence of terrigenous material within clastic carbonate rocks. This unit forms a transitional unit into the terrigenous Strathcona Sound Formation.

The Strathcona Sound Formation contains two mappable units; a carbonate pebble to boulder conglomerate and an interbedded quartz wacke and shale unit.

The conglomerate unit is a matrix-supported, carbonate pebble to boulder conglomerate that consists of light brown to orange, subrounded to angular 1 to 50 cm diameter dolomudstone clasts in a grey-green, poorly sorted quartz wacke matrix. It thickness ranges from several metres to approximately 50 m.

The interbedded quartz wacke and shale unit is green to dark grey, planar bedded and forms a thick (>130 m), monotonous succession. The quartz wacke and shale are interbedded at scales ranging from 1 to 200 cm. Beds of carbonate pebble to boulder conglomerate are common within 10 m of the contact between the two units.

The Phanerozoic rocks of the Gallery Formation overlie the Mesoproterozoic strata and are exposed predominantly west of Nanisivik. The Gallery Formation forms a thick (>300 m) succession of interbedded red and white, poorly cemented, medium- to fine-grained quartz arenite. The Gallery Formation is easily identified by its deep red hematite-stained colour, and friable texture.

2.3.2 Overburden

Overlying the bedrock, specifically in the area of West Twin Lake, is a combined unit of lakebed sediments (silt and sand, trace to some clay) and glacial till (silty sand with gravel fragments). The lakebed sediments are identified by their red colour, a product of hematite oxidation staining. The till is generally very granular in nature, frozen below the depth of active layer thaw and may contain excess ice content. The thickness of the lakebed sediments/ till unit varies from 1 to 4 m. The lake bed sediments/ till upper surface generally follows the underlying bedrock topography.

2.4 Permafrost

Nanisivik is located in the region of continuous permafrost, as shown in Figure 3. Permafrost has been observed to extend to a depth of at least 430 m, as observed in a borehole drilled from the underground workings. Ground conditions in the area have been characterized by NRC (1995) as having the potential for medium amounts of ground ice (as high as 20%) and mean annual ground temperatures colder than -10°C. This has been verified by ground temperature measurements at various locations around the mine site as cold as -13°C at depth. The depth of the active layer in natural ground has been observed to average between 1 to 2 m below ground surface.

3.0 WEST TWIN DISPOSAL AREA

3.1 Current Configuration and Operational Practices

The West Twin Disposal Area (WTDA), illustrated in Figure 4, is comprised of an upper, solids retention pond, the Surface Cell, and a lower, water retention pond, the Reservoir. An earthen dike, the West Twin (WT) Dike, separates the Surface Cell and the Reservoir. The Reservoir is further divided by the Test Cell Dike, which separates the Reservoir and the Test Cell. The Test Cell was used to evaluate the performance of several test cover designs. Both dikes are constructed of frozen shale fill and are founded on frozen, settled tailings.

The first shale lift of the West Twin Dike was built in 1991. The initial lift had a top width of approximately 4 m, which brought the elevation of the top of the dike to approximately 374 m. The dike has been raised in an upstream manner where each new lift begins on top of beached tailings material deposited previously and sealing lift of frozen shale rockfill. The dike was raised every year between 1991 and 1999, except 1994. The current crest elevation of the dike is nominally 388 m.

The Test Cell Dike is also constructed of frozen shale fill overlying frozen tailings. The dike was constructed in two stages. The first stage increased the height of the Test Cell Dike to an approximate elevation of 383.5 m. The second stage increased the height of the Test Cell Dike to an approximate elevation of 385.5 m. The second stage of the dike is partially founded on the first stage dike and partially founded on the tailings in the Test Cell. The staged construction resulted in the formation of a bench on the Reservoir side of the dike.

Excess water from the Surface Cell is transferred to the Reservoir by pumping or a siphon system that controls water levels. The Reservoir and a final Polishing Pond are separated by a causeway and stop log structure, which controls the water level in the polishing pond. Water from the polishing pond is then discharged to Twin Lakes Creek through the West Twin Outlet Structure, a 3 to 5 m high earth fill dam with a valve controlled, concrete lined spillway. Excess water from the WTDA is discharged to the environment via the West Twin Outlet Structure between July and September of each year.

3.2 Historical Tailings Deposition Practices

Tailings were initially deposited sub-aqueously into West Twin Lake (WTL) beginning in 1977. Based on the known mine reserves at the time, WTL had sufficient tailings storage capacity for the life of the mine. Mine reserves, however, continued to expand each year and by the mid 1980's it was apparent that continued production would exceed the storage capacity of WTL. In 1988, an approval was received from the NWT Water Board to begin surface deposition of tailings at Nanisivik. To accommodate this, WTL was divided into two sections using an earthen dike. The dike was constructed using a north/south trending causeway that was developed by beaching of tailings in the lake as a foundation. The eastern portion of the lake, the Reservoir, retained its original lake level and was used as a stand-by when surface disposal was not practical (i.e. during annual dike construction periods). The western part of the lake, the Surface Cell, became the main deposition area for the tailings and accommodated sub-aerial tailings.

On-land deposition of tailings in the Surface Cell commenced on August 27, 1990. The tailings were mainly discharged from the north-west corner of the Surface Cell. The full capacity level of the Surface Cell was raised to an elevation of 374 m with the construction of the initial lift of the West Twin Dike in 1991. Tailings discharge in the Surface Cell continued throughout the 1990's with annual (except for 1994) raises of the West Twin Dike in 2 m increments. Tailings continued to be discharged mainly from the north-west corner of the Surface Cell with a deeper section of the pond in the southeast corner for water reclamation and mineral processing purposes.

Tailings discharge practices were amended during the mid-1990's to promote stratification of sediments by discharging from the perimeter of the Surface Cell. Excess supernatant pond water continued to be collected in a depression situated upstream from the south end of the dike. This water was siphoned to the Reservoir. The ultimate raise of the dike, to a nominal elevation of 388 m, was completed in 1999 and tailings continued to be placed in the Surface Cell until the mine closed in September 2002.

Figure 5 illustrates how the tailings level in the Surface Cell evolved over time, with the original lake bottom elevations shown, based on bathymetry maps produced by the mine. As can be seen, an east/west causeway had become fully exposed in the Surface Cell by 1982. Although not shown on the section in Figure 5, a north/south tailings causeway had also developed within the lake at the same time. This north/south causeway was eventually used as the foundation for the West Twin Dike. Tailings continued to be deposited sub-aqueously into the Surface Cell until 1991, at which the first lift of the West Twin Dike was constructed. Construction of the initial lift and subsequent annual raises of the West Twin Dike allowed for sub-aerial and sub-aqueous deposition of tailings to continue throughout the 1990's. Tailings were generally discharged from an on-land deposition point near the north-west corner of the Surface Cell. Tailings discharge was also conducted along the upstream face of the West Twin Dike providing the foundation for the next raise of the dike. Surface water was generally directed to the south-east portion of the Surface Cell where a depression was located, referred to in the remainder of the report as the "deep water storage pond". In total, it is estimated that 6.5 million m^3 of tailings were deposited into the Surface Cell between 1978 and 2002.

Figure 6 illustrates the evolution of the tailings level in the Reservoir and Test Cell over time. Tailings were deposited sub-aqueously into the Reservoir beginning in 1976. The discharge of tailings generally took place near the current location of the West Twin Dike resulting in the aggradation of the tailings deposit in a south-easterly direction into the Reservoir. Tailings deposition along an east-west trending line from the centre of the West Twin Dike resulted in exposure of a tailings causeway in the Reservoir by 1988. This causeway eventually became the foundation for the east/west arm of the Test Cell Dike. Tailings deposition along a northwest-southeast trending line resulted in a second tailings causeway near the reclaim water pumphouse, which was exposed by 1992. This causeway eventually became the foundation for the north/south arm of the Test Cell Dike. The majority of the tailings discharge activities in the 1990's occurred in the Surface Cell. The Test Cell Dike was constructed in 2000 and 2001, increasing the storage capacity of the Test Cell thereby allowing for the additional placement of tailings into the Test Cell. Deposition of tailings at the toe of the West Twin Dike in 2000 resulted in aerial exposure of tailings in the Reservoir and Test Cell. In total, it is estimated that 3.5 million m^3 of tailings have been deposited into the Reservoir and Test Cell since 1978.

4.0 GEOTECHNICAL INVESTIGATIONS

4.1 Geotechnical Investigations of West Twin Disposal Area

Several geotechnical investigations of the WTDA have been conducted over the mine history. Approximately 50 geothermal monitoring instruments were installed during these investigations. The following is a chronological history of the significant geotechnical investigations conducted at the WTDA:

- 1989/1990 – Geotechnical investigations of the causeways that had developed in West Twin Lake to assess permafrost aggradation. Thermocouples were installed in five boreholes.