Nyrstar Myra Falls

Operation, Maintenance and Surveillance (OMS) Manual for the Tailings Disposal Facilities & Water Treatment System

nyrstar

Updated November 2014

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1.0 Introduction

1.1 Objective

This is the Operation, Maintenance and Surveillance (OMS) manual for the Tailings Disposal Facilities (TDFs) and water treatment system at Nyrstar Myra Falls (NMF). The objective of this manual is to define and describe the following:

- The roles and responsibilities of personnel assigned to operate and maintain the TDFs and the water treatment system.
- The key components of the TDFs and the water treatment system.
- The procedures and processes for managing change.
- The procedures required to ensure that the TDFs and the water treatment system function in accordance with their design, that they meet regulatory and corporate policy obligations, and that they are linked to emergency planning and response.
- The requirements for the assessment and the documentation of the performance of the TDFs and the water treatment system.

1.2 Nyrstar Environment Policy Statement

The following is Nyrstar's Environmental Policy Statement:

"We are a global leader in mining, metals processing and recycling with operations across multiple cultures and continents. Our metal products meet society's needs worldwide and are inherently recyclable. We are located within communities who have expectations of us, which we must meet.

We operate our businesses in an environmentally responsible way. Our aim is to prevent harm to the environment and the community. We will build trust with our key stakeholders by meeting our commitments and maintaining open and honest communications.

To achieve this, we will:

- *Minimize the environmental impact of our operations by applying leading practice, innovation and sound science.*
- *Continually improve our performance through the identification and management of environmental risks and establishment of measurable objectives and targets.*
- *Comply with legal obligations as a minimum and meet the requirements of our voluntary agreements.*
- *Provide material stewardship through efficient and responsible use of resources, minimizing waste and expanding recycling options.*
- *Recognize the environmental impact from past operations and address legacy issues.*
- *Develop a culture of environmental ownership through integration of business goals and by increased awareness, skills and competency of our people.*
- *Engage with our stakeholders, understand and respond to their expectations and effectively communicate our environmental performance.*

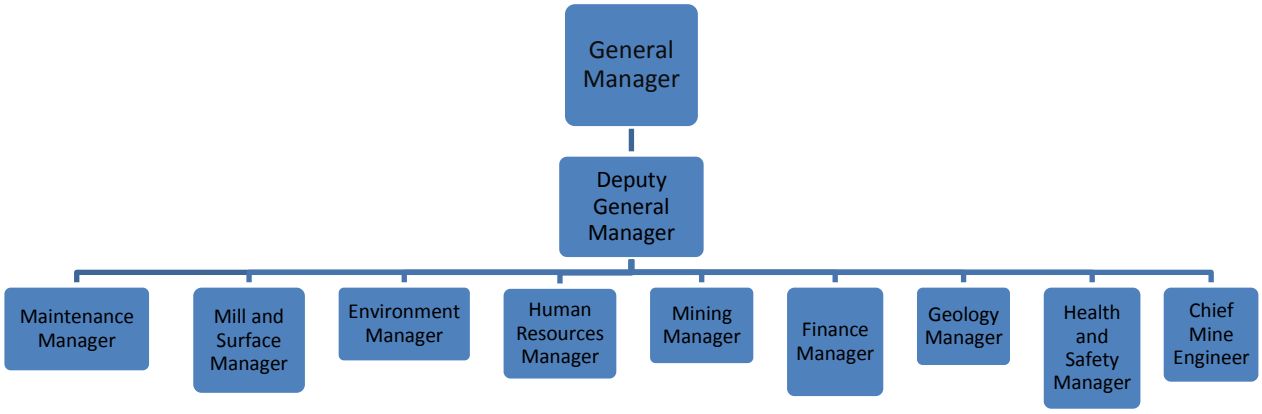
We believe that these commitments provide the foundation for a sustainable business."

1.3 Organizational Structures

1.3.1 Management Structure

NMF's management structure organizational chart is provided in Figure 1-1.

Figure 1-1 Management Structure Organizational Chart



1.3.2 Organizational Charts Identifying Roles and Responsibilities

Table 1-1 identifies NMF management personnel who responsible for operating, maintaining, and monitoring the TDFs and/or the water treatment system.

Table 1-1 Responsibilities for Tailings and Water Treatment Facilities

Name	Phone no. or Extension	Position	Responsibilities
General Manager			
John Knapp	3279	General Manager	Overall responsibility for the mine site
Tailings Facilities Management			
Hugh Sawyer	3269	Mill and Surface Manager	Overall responsibility for the tailings and water treatment facilities
Surveillance			
Nicole Pesonen	3316	Environmental Manager	Facility inspections, regulatory affairs, environmental coordination, public consultation
Engineer-of-Record			
Dan Hughes-Games	250-758-1887	Senior Geotechnical Engineer, AMEC Foster Wheeler	Engineer-of-Record, External Advisor/Consultant
External Liaison/Public Affairs			
Eileen Olivier	3260	Human Resources Manager	External and public communication, media relations
Administration			
Victor Hugo	3202	Finance Manager	Financial control

1.4 Competency and Training

Competency and training at NMF is based on a common core and competency model. OMS training will be administered by the Safety Department and will be broken up into units with knowledge requirements aimed at demonstrating competencies in operations, maintenance and surveillance.

Records demonstrating that each employee tasked with a job pertaining to the TDFs or water treatment system are maintained by the Safety Department. All training is scheduled by the Surface Trainer.

For a complete training package for the TDFs and water treatment facility please contact the Safety Department.

1.5 Managing Change in the OMS Manual

1.5.1 Changes to Design

A request to change the design of either the water treatment system or the TDFs is generally initiated by the Mill and Surface Manager who has overall responsibility for these facilities. Design change requests require the Environment Department to review the design concept and the General Manager to approve the change prior to initiating design work.

After approval is given to initiate the change, proposals are given to AMEC Foster Wheeler, the Engineer-of-Record. It is their role to conduct any necessary stability analysis to ensure the new configuration is stable and is consistent with safety standards. The Engineer-of-Record will draft design drawings of the changes for which approval will be given from the Mill and Surface Manager, the Environmental Manager and the General Manager. After approval, the Engineer-of-Record will issue final design drawings approved for construction.

In addition to the above procedure for design change, any major change will require an amendment to Permit M-26 which governs the entire site. Permit M-26 is administered through the B.C. Ministry of Energy and Mines (MEM) and any permit amendment request would have to be reviewed by their geotechnical engineers. Implementation of the design change may only proceed after the permit amendment is granted in writing by the MEM.

1.5.2 Changes to Operating Plans

A change to the operating plan for either the water treatment facility or the TDFs is most often initiated by the Mill and Surface Manager. Any procedural or operating plan changes must involve consultation with all of the Mill Operations, Maintenance and Environmental Departments. This is to ensure that all operating parameters of the facilities will continue to be met.

After the operating plans have been approved by all the necessary departments, the changes should also be reviewed by the Engineer-of-Record to ensure that these changes will not compromise the stability of the facilities or their ability to safely retain tailings (or treated water).

In order to implement an operational change, a formal procedure must be prepared. This procedure is prepared by the department most affected by the change. After the written procedure is approved by the Mill and Surface Manager and the Environmental Manager, it is given to the Safety Department so the necessary employees can be trained on the new procedures. This training is to be documented and signed off by each employee.

After the procedure has been documented it must be incorporated into this manual. The procedure for making changes to the OMS manual is given in the next section.

1.5.3 Responsibility for Reviewing & Updating the OMS Manual

The OMS manual is constantly evolving and requires regular updates. These updates may include personnel and contact information, changes to the organizational structure, photographic updates to reflect the current state of the facilities, and map changes amongst others. The responsibility for ensuring this document is updated rests with the Mill and Surface Manager, although any department may initiate and provide the update. Input from all groups is necessary to ensure that all changes are appropriately made.

Due to corporate commitments and in the interest of corporate social responsibility, all updates to the OMS manual are consistent with the guidelines provided by the Mining Association of Canada (MAC) in their document *"Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Treatment Facilities" (MAC, 2011)*.

1.6 Document Control of OMS

Below is a table listing the holders of copies of the OMS Manual. As a controlled document, it is critical that each person has a current copy. This is the responsibility of the Mill and Surface Manager. All out-of-date copies should be collected and destroyed, with the exception of one hard copy and one electronic copy for the archive (held by the Environmental Department).

Table 1-2 OMS Manual Holders

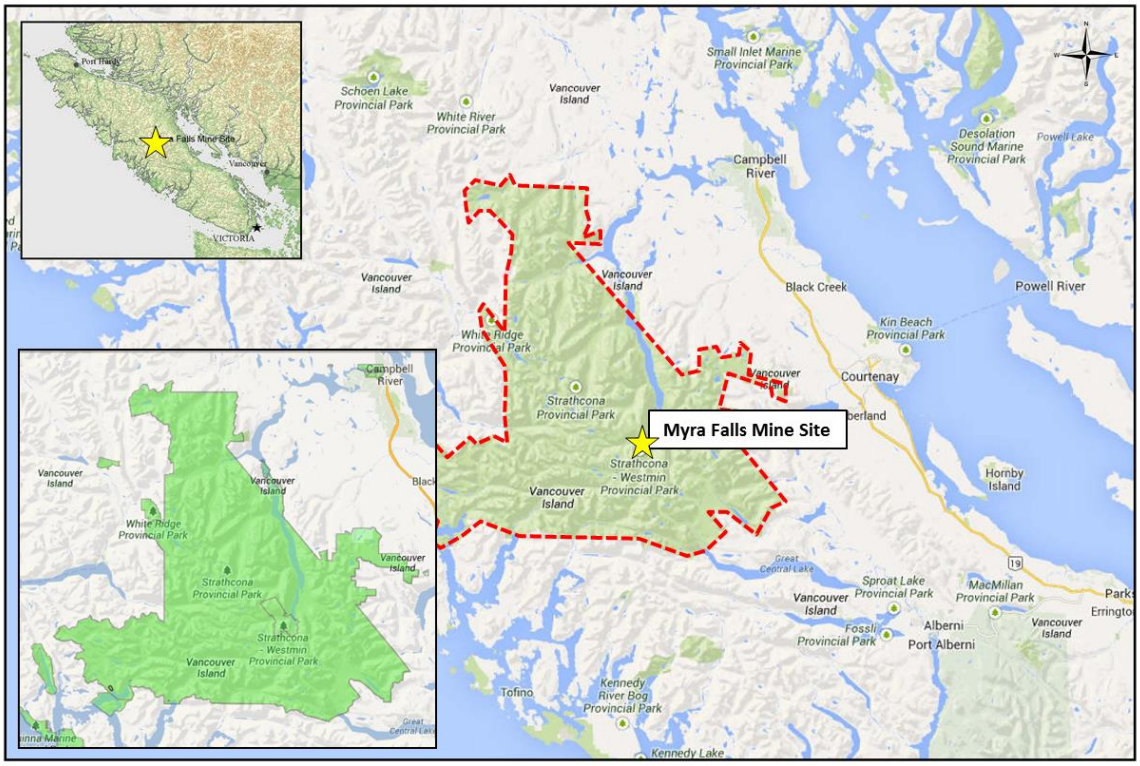
Manual Holder	Name	Manual Number
Nyrstar Corporate (digital copy)	Uploaded to Sharepoint	n/a
General Manager	John Knapp	1
Deputy General Manager	Sylvain Tremblay	2
Mill and Surface Manager	Hugh Sawyer	3
Mill Shifter's Office	G. May/C. Rouse	4
Maintenance Manager	Rod Burchby	5
Health and Safety Manager	Rory McFadden	6
Mill Metallurgist	Martin Bussieres	7
Environmental Manager	Nicole Pesonen	8
Chief Mine Engineer	Patrick Ferland	9
Finance Manager	Victor Hugo	10
Manager Environmental Geoscience & Permitting, B.C. Ministry of Energy & Mines	Kim Bellefontaine	11
Engineer-of-Record, AMEC Foster Wheeler	Dan Hughes-Games	12
Environmental Protection Officer, B.C. Ministry of Environment	Andrea Miskelly	13

2.0 Site Description

2.1 Location of Nyrstar Myra Falls

NMF is located 90 km from Campbell River on Vancouver Island in western B.C. (see Figure 2-1). NMF operates in the Strathcona-Westmin Provincial Park under several permits that authorize mining-related activities on provincial park lands. The Strathcona-Westmin Provincial Park (33 km^2) is surrounded by the much larger Strathcona Provincial Park, which covers 2,458 km^2 of mountainous terrain near the center of Vancouver Island.

Figure 2-1 Map of Strathcona-Westmin Provincial Park



2.2 Mining Infrastructure & Waste Facilities

1.5.3 Buildings and Roads

NMF is accessed via a 90 km paved public road that runs along Buttle Lake from the City of Campbell River. The 40 km stretch of road from the Gold River junction is jointly maintained by NMF and the B.C. Ministry of Transportation. NMF also maintains Jim Mitchell Road, a gravel road that provides access to public trails in Thelwood Valley, Jim Mitchell Lake, Thelwood Lake, and the Thelwood power station.

The paved public road from Campbell River runs through the site and ends at a B.C. Parks parking lot near the Lynx offices. A number of unpaved, restricted access roads branch off from

the main road within the boundaries of NMF. The main road through NMF runs past a set of buildings near the entrance to the site that is commonly referred to as the 'HW offices'. The headframe at NMF is located near these buildings. A 1.4 km long enclosed conveyor system runs across the site from the headframe to the Mill. Other key infrastructure at the site includes the Paste Plant (near Phillip's Reach) and the Backfill Plant near the HW offices.

Recreational use of the Strathcona-Westmin Provincial Park is limited but there are numerous trailheads in the larger Strathcona Provincial Park to the west of the site. Access to these trails is provided by the main road that runs through the site.

1.5.3 Open Pits

In 1966, the Lynx mine became the first producing area of NMF. Production began from an open pit at a rate of 850 tonnes per day and was later augmented by underground production in 1968. Production from the open pit and underground sources continued until 1973 when ore reserves in the open pit were considered mined-out. The Myra open pit, on the other side of the valley, was also mined during this period. Remnant pockets of ore in the Lynx open pit were occasionally mined from 2000 to 2008 and the crown pillar was removed in 2007/2008. Underground mining continued until 1993 when mining was suspended for economic reasons.

The Lynx open pit has been converted into the Lynx TDF and has been partially backfilled with paste tailings. The original design for the Lynx TDF assumed that the crown pillar (at 12L elevation) separated the base of the mined-out pit from the underground workings below. As a result of crown pillar removal, sand-filled stopes were exposed in the floor of the Lynx pit. A liner and cemented paste tailings were used to prevent tailings from entering the underground workings and an under-drain system was installed to collect seepage from the Lynx TDF (see AMEC, 2008).

1.5.3 Underground Mine Workings

NMF consists of four underground mines. These mines are located within five Crown-granted mining leases that extend over parts of Phillip's Ridge, Myra Valley, Mount Myra, Price Valley, and Thelwood Valley. Portals to the HW, Lynx, and Myra mines are located in Myra Valley and portals to the Price mine are located in the Thelwood Valley. The HW, Lynx, and Myra mines are connected via common mine levels within Myra Valley. The Price mine is connected to the Myra mine by the common 1300-level workings that run between Myra Valley and Thelwood Valley.

The Myra and Lynx mines have remained dormant since 1985 and 1993, respectively. These mines are maintained in order to provide ventilation and emergency access to the HW mine. Mining in the HW underground mine is ongoing and the expansion into the undeveloped Price mine is now underway.

1.5.3 Tailings Disposal Facilities

From 1966 to 1984, tailings were stored sub-aqueously in Buttle Lake. Since 1984, tailings have been stored sub-aerially at the site in the Old TDF or Lynx TDF. From 1984 to 2011, tailings were deposited in the Old TDF. The Old TDF is a horseshoe-shaped facility that features an embankment dam constructed using the upstream method. Each year, the southeast perimeter embankment of the Old TDF was raised by 1.5 to 3.0 m to provide sufficient storage capacity for

the subsequent twelve months of operations. Annual raises were built partially on the existing upstream tailings beach (AMEC, 2013).

The Old TDF was constructed as a two-celled facility with a partition embankment oriented from north-to-south across the valley. Construction of "Area I", the western-most cell, was done from 1982 to 1984. Construction of the "Area II" cell was done from 1984 to 1985 and involved re-locating Myra Creek to a new, riprap-lined channel. This dual-stage construction schedule permitted the construction of the Inner Drain while transitioning to sub-aerial tailings disposal.

From 1984 to 2003, only cycloned fine tailings (CFT) were deposited in the Old TDF. In 2003, the Paste Plant was commissioned and a new cell was constructed to receive thickened fine tailings (i.e. 'paste' tailings). This cell is commonly referred to as the Amalgamated Paste Area (APA). It overlies the majority of CFT in the Old TDF. Paste tailings were deposited in the APA until 2011 when the final capacity of this APA was reached. The Seismic Upgrade Berm and spillway have since been completed and closure of the Old TDF is planned as part of progressive reclamation during operations.

Since 2008, paste tailings have been deposited in the Lynx TDF (i.e. within the former Lynx Open Pit). The Lynx TDF starter dam was constructed of tailings from the former Emergency Tailings Area (ETA) near the Cookhouse and potentially acid generating (PAG) waste rock from WRD#5 (AMEC, 2008). The final height of the Lynx TDF berm will be 57 m and reach an elevation of 3,430 m[1]. This is about 30 m higher than the current embankment elevation. Each dam raise will consist primarily of PAG rock from the underground mines and adjacent WRDs. The final volume of the berm will be approximately 1.9 million cubic meters (AMEC, 2013).

In addition to the TDFs, the Reclaim Sand Area (RSA) is an important component of the active management of tailings during operations. The RSA is located at the western end of the Old TDF and is used to store the coarse tailings fraction that is not sent underground for backfill. These tailings are used for construction material and the RSA is to remain operational until final closure.

1.5.3 Waste Rock Dumps

Between 1966 and 1973, over 4.6 million m^3 of waste rock was generated from mining the Lynx Open Pit. This rock was placed in WRDs #1, #2, #3, and #4. Additional material from the underground mining operations has since been added to these WRDs. WRDs #1 and #2 contain 5.6 million tonnes and 1.8 million tonnes, respectively. WRDs #3 and #4 combined contain 0.5 million tonnes.

WRD#1 is the largest of the dumps at NMF. It has been partially covered by tailings during deposition of CFT and paste tailings into the Old TDF. WRD#1 extends west beyond the main access road to the Paste Plant to near the southern toe of WRD#2. Waste rock placed above the grade of this road is referred to as 'WRD#6'. WRD#6 is steeply-sloped and contains waste rock that was removed during mining of the Lynx crown pillar in 2007 and 2008.

Also above the grade of the main access road to the Paste Plant is the historic 'Refuse Dump'. This dump lies on top of WRD#1 and contains domestic waste from past years of operation.

[1] To maintain positive elevations for the underground workings, 3,048 m (or 10,000 feet) is added to all elevations on site and in mine plans (i.e. the final raise of the Lynx TDF berm will reach 382 m above sea level).

Currently, putrescible waste is shipped offsite and residual domestic waste is disposed of into the Lynx TDF. For the purpose of this report, the Refuse Dump is considered part of WRD#1.

WRDs #2, #3, and #4 are each located north of the Lynx TDF. WRD#2 is located north of the Lynx TDF and is the second largest WRD. WRD#4 is located in a forested area to the north of the Lynx offices that is known as the 'Lynx switchback area'. The road in this area was built to access the Lynx 6L adit and it switches back and forth across WRD#4.

WRD#4 is the smallest of the historic WRDs at Myra Falls in terms of area and volume. This WRD primarily contains material end-dumped from the Lynx 6L West adit. WRD#3 is located to the east of WRD#4 (and the Lynx 8L adit) near the northern edge of the Lynx open pit.

Formerly there was a WRD#5 that was often referred to as the 'Super Pile'. It was depleted in 2011 and 2012 to construct the Lynx TDF berm. This location is now used to stockpile waste rock for construction. These materials consist mainly of waste rock from underground and reclaim sand for future dam raises (known as the "J-zone construction pile"). Reclaim sand is also stored in the Reclaim Sand Area (RSA) adjacent to the Old TDF.

1.5.3 Surface Water Management System

The surface water management system at NMF consists of several diversions and a spillway to divert clean runoff water and control flood events. The Lynx Diversion Channel is a shotcrete-lined, engineered channel that runs along the northern perimeter of the site and prevents clean surface water (and some shallow groundwater) from entering the TDFs. Clean water from the Lynx Diversion Channel enters Myra Creek immediately downstream of the Old TDF. Contact water from the mine site is captured and sent to the water treatment system.

1.5.3 Seepage Interception System (Old TDF Drains)

The seepage interception system (SIS) at Myra Falls consists of a system of five under-drains beneath the Old TDF. The Inner Drain and Area II Outer Drain were installed to reduce contaminant loads to Myra Creek by intercepting groundwater impacted by seepage from WRD#1. Both drains were constructed during the transition period between sub-aqueous tailings disposal in Buttle Lake and sub-aerial tailings disposal in the Old TDF in the mid-1980s. Water from the under-drains report to Pumphouse #4, a central pumping station located at the eastern end of the Old TDF.

The Inner Drain was constructed along the toe of WRD#1 and intercepts shallow, highly-impacted groundwater that flows east towards Myra Creek[2]. This drain consists of two buried pairs of 114 mm diameter perforated HDPE pipe surrounded by granular filter. These pipes are situated about 1 m below the former creek bed of Myra Creek. The drain is connected to a sloping filter blanket placed against the face of the WRD#1 in Area I and the natural valley sidewall in Area II. The purpose of the filter blanket is to intercept and convey contaminated seepage from the WRDs into the Inner Drain. The Inner Drain is still operational but most access ports are lost except an access pipe near the top of the APA and the riser near Pumphouse #4.

[2] The distance ('chainage') along the toe of the Old TDF (from 0+000m to 1+350m) provides a convenient reference system to describe different sections of the drain system (and Myra Creek) (see Figure 2-3).

The Area I and II Outer Drains are located beneath the starter embankment of the Old TDF along Myra Creek. These drains consists of a series of fourteen 90 to 120 m long sections of perforated seepage collector pipes (i.e. three 150 mm HDPE pipes in Area I and two 150 mm diameter HDPE pipes in Area II) that are attached to a conveyance pipe. The collector pipes are located about 1 to 2 m below the adjacent creek bed. During construction of the Seismic Upgrade Berm in 2004/2005, access chambers to the Area II Outer Drain (and associated risers) were decommissioned. Manual control of heads and flow is, therefore, no longer possible. The Area II Outer Drain from 0+100 m to 0+400 m is disconnected and does not intercept groundwater. The Area II Outer Drain (from 0+450m to 1+350m) is still functional and collects flow by gravity to the Pumphouse #4.

Three additional drains were installed between 2004 and 2005 during construction of the Seismic Upgrade Berm. These 'new' Outer Drains were installed about 20 m south (downgradient) of the Area II Outer Drain and are referred to as Short, Medium, and Long Outer Drains based on their lengths. These drains were intended to replace the Area II Outer Drain should it be damaged during construction of the Seismic Upgrade Berm and enhance the performance of the Old TDF under-drain system by capturing flows of impacted groundwater that bypass the Area II Outer Drain (see RGC, 2014).

To this end, the drain pipes were placed approximately 1 m below the drain elevation of the Area II Outer Drain (or about 2 m below the creek bed of Myra Creek) to increase potential drawdown. Note that a fourth section of drain pipe was installed from 0+400m to 0+800m but this drain section was not connected to the Long Drain because of bedrock that outcrops near 0+850. If required, this disconnected section could be pumped (from Riser B4) across the spillway and into the Long Drain (at Riser A).

Flow from the new Outer Drains is directed into a solid conveyor pipe that runs to Pumphouse #4. Electronically-controlled sluice gates were installed on the discharge pipe of each of these new drain sections to control the flow out of the drain. These gates are run remotely from the mill control room. The New Outer Drains are typically run well below full capacity. Based on Myra Creek seepage monitoring, the New Outer Drain system was run at settings of "10-0-10" in 2014. This represents a 10% opening for the Medium Drain, 0% opening for the Short Drain and 10% opening for the Long Drain.

1.5.3 Mine Water Management System

The mine water management system at NMF collects different sources of water impacted due to contact with different mine waste ("contact water"). The primary sources of contact water at NMF (besides impacted groundwater collected in the Old TDF under-drain system) are:

- Surface runoff from the HW office area, the Mill area, Old TDF, and Lynx TDF.
- Gravity flows of mine water from the upper levels of the Lynx and Myra underground workings.
- De-watering flows from the Lynx, HW, and Myra mines.

Once collected, all contact water is then directed to the Super Pond for treatment. Runoff from the APA and exposed tailings in the Old TDF (i.e. the Strip Area) is collected in several decants

while runoff from the Lynx TDF is pumped directly to the Super Pond for treatment. De-watering flows from the Lynx underground workings are pumped to surface via the surface ramp at Phillip's Reach and are then directed to the Super Pond via an unlined channel. This channel runs along the top of WRD#1. Mine drainage from the Lynx 10L East adit and some surface runoff from the Lynx office area are directed in an unlined channel (referred to as "Lynx ditch") through the mill area towards the Super Pond.

Mine drainage from the Myra 10 level and mine water pumped from the Myra 12 and 13 levels (via the Myra ramp) runs in an unlined channel from the Myra 11 portal into the HW Myra Sump, located just east of Polishing Pond #1. Mine water pumped from the deeper HW mine is also pumped to the HW Myra Sump. All mine water collected in the HW Myra Sump is then pumped in a pipe across Myra Creek into the Super Pond for treatment.

1.5.3 Water Treatment System

The water treatment system at Myra Falls consists of three components:

- Two sets of mixing/reactor tanks.
- A primary settling pond called the Super Pond.
- Six polishing ponds to the south of Myra Creek.

Water reporting for treatment enters a shotcrete-lined ditch that directs flows to the reactor tanks where hydrated lime slurry is added. Water subsequently flows to the Super Pond wherein metals are precipitated from solution. Water then flows sequentially through six polishing ponds. Effluent is additionally treated with carbon dioxide to ensure effluent pH is within the 6.5 to 9.5 range and then discharged to Myra Creek.

A byproduct of water treatment at Myra Falls is a low-density (2 to 4% solids by weight) sludge comprised of metal hydroxide precipitates. During the treatment process, sludge settles and accumulates at the bottom of the Super Pond and, to a lesser extent, the polishing ponds. Sludge from the Super Pond is periodically dredged and pumped to the Paste Plant where it is incorporated into paste tailings destined for the Lynx TDF. Sludge from the polishing ponds is removed every few years as required and is also disposed of into the Lynx TDF.

1.5.3 Groundwater and Surface Water Monitoring Networks

Myra Falls features a network of fifty seven monitoring wells. Forty one of these wells were installed in 2013 as part of RGC's environmental drilling program (i.e. the 'MW13' or 'TD13' well series). Other wells were installed during previous site investigations in 2011 or earlier (see RGC, 2014 for additional details).

Borehole logs and hydraulic testing data for the 'MW13' and 'TD13' wells are provided in RGC (2014). Groundwater levels in each of the wells at Myra Falls are monitored at least monthly by NMF staff. Pressure transducers have also been placed in several wells to monitor short-term changes in groundwater levels. Groundwater quality data is collected at least quarterly in most of the historic wells and wells installed in 2013 (see RGC, 2014).

Flows in Myra Creek are routinely monitored at the carbridge over Myra Creek. The gauge at the carbridge consists of a pressure transducer that records variations in the creek's water level. Water levels are converted to flow via a historic rating curve that yielded reasonably representative flows for 2012. Flows in Myra Creek fluctuate in response to seasonal changes in rainfall and snowmelt as do other rivers and creeks on Vancouver Island.

Water quality along Myra Creek is monitored monthly at MC-M1 (upstream of NMF) and downstream of the site at MC-TP4 and MC-M2. NMF also conducts monthly water quality surveys along Myra Creek adjacent to the Old TDF (from MC-100 m to MC+1400 m). Treated effluent water quality (at 'Runoff 11A'), water quality in Myra Creek at MC-S11, and water quality in Buttle Lake are also routinely monitored.

1.5.3 Hydroelectric Facilities and Power Lines

In the 1960s, a small dam was constructed on Tennent Lake to provide water storage for the 3.0 MW Tennent power station that was being built near the confluence of Myra Creek and Tennent Creek. A penstock consisting of a 24" pipe conveys water from Tennent Lake to the Tennent power station. This penstock follows a hiking trail from Tennent Lake. The power line from the Tennent power station is buried under the shoulder of the gravel access road and daylights near the Mill.

In the early 1980s, the 8.2 MW Thelwood power station was built to provide the additional electricity needed to expand production at NMF to include the HW underground mine. This power station is located in the adjacent Thelwood Valley to the southeast of NMF. The Thelwood power station is fed by a penstock from Jim Mitchell Lake. An overhead power line from the Thelwood power station runs along a gravel access road and then into the Price 13L portal before it daylights in Myra Valley.

Additional overland and buried communications and power lines that support mining activity are located within the boundaries of NMF. Backup diesel generators are located in the Powerhouse building next to the Mill.

2.2 Facility Components

2.2.1 TDF and Lynx TDF Impoundment Components

Individual components of the tailings system, including aspects of water management, are itemized in Table 2-1 for the Old TDF and the Lynx TDF.

Table 2-1 Components of the Tailings System

COMPONENT	SUB-COMPONENTS	DESCRIPTION
Old TDF		
Dams & Containment Structures	Foundation	Consists of pervious fluvial sand and gravel deposits
	Starter Embankment	8 m high, built of compacted alluvial sand and gravel gained from within each area, with riprap erosion protection on outside face

	Perimeter Embankment	Berm surrounding tailings material. Raised progressively with rise of deposited tailings, typically in 1.5-3.0 m increments via upstream construction methods. Built of local fill materials.
	Seismic Upgrade Berm	Reinforcement to Perimeter Embankment built to stabilize the containment facility in the event of a maximum design earthquake
	Paste Berm	Berm to contain cyclone overflow paste tailings - built on conventional tailings
Impoundment Areas	Amalgamated Paste Area	Storage area within the confines of the Paste Berm to store paste tailings
	Reclaim Sands Area	Storage area for tailings sands, located at western end of facility
	TDF Strip Area	Area between the paste berm and the perimeter embankment. This area contains only conventional tailings.
Diversion Ditch	Lynx Diversion Ditch	Ditch that runs along the northern hillside of Myra valley upslope of the Lynx Pit and TDF to capture surface runoff and divert it into Myra Creek and/or Arnica Creek.
Ditch	TDF Strip Area Ditch	A ditch is maintained along the downstream toe of the paste berm to channel water along the western half of the strip area to a decant structure.
Drains	Inner Drain	This drain runs along the toe of the northern hillside at the base of waste dump #1 and the TDF. It is designed to intercept runoff and groundwater, conveying the flow to Pumphouse #4.
	Old Outer Drain	This drain runs along the base of the TDF, downstream of the original starter berm. It collects runoff and groundwater from the tailings within the TDF and conveys the flow to Pumphouse #4.
	New Outer Drain	This series of 3 drains was installed downstream of the old outer drain to capture seepage from the base of the TDF that is not captured by the old Outer Drain. This water is conveyed to Pumphouse #4.
Liners	Geotextile	The only liner in the TDF facility is the geotextile fabric that the paste berm and APA are built on. It lies overtop of the conventional tailings.
Tailings and Water Pipelines	Paste Pipelines (2)	One single 8” schedule 80 line runs along the diversion ditch access road from the paste plant to the TDF, the other 8” steel line runs to the Lynx TDF.
	Pumphouse #4 Return Line	A 28” (reduced to 24”) HDPE pipe that runs along the length of the Strip upstream

		of the perimeter embankment crest and carries water from the Pumphouse #4 to the Super Pond.
	Sand Reclaim Pipeline	This is a 6” line that runs from the cyclone building and discharges into the sand reclaim area.
	Backfill Pipeline	This is a 6” line that runs from the cyclone building along the perimeter embankment to the Red Pipe Bridge. It carries the fine fraction of the tailings stream to the backfill plant and hence to underground.
	Backfill Overflow Pipeline	This is a 5” line that runs from the backfill plant across a Red Pipe Bridge over Myra Creek, up the seismic upgrade berm to discharge into the sand reclaim area.
	Flump line	From the Super Pond flump pump, discharging into the paste plant and/or the TDF.
Pumps and Pumphouse	Pumphouse #4	This pumphouse acts as the collection sump for the three drain systems (inner, outer and new outer). It contains 3 ITT 12 X 16 3-stage vertical turbine pumps using 250 HP 1800RPM 3/60/575V motors which feed into the pumphouse #4 return line. The starter for the pumphouse is a Toshiba CV212-GATU 600 V 160 A vacuum breakers with Starco ground protection.
Decants	Sand Reclaim	10” line that runs from the sand reclaim area into the paste plant overflow line. This line discharges upstream of the Mix Tanks.
	Strip Area	This pipe begins as a 600mm vertical decant, reducing to 250mm after 15 m horizontal distance. This pipe discharges upstream of the Mix Tanks.
	Amalgamated Paste Area	This pipe begins as an 800mm vertical decant and reduces to 600mm after 30 m horizontal distance. This pipe discharges upstream of the Mix Tanks.
Spillway	Seismic Upgrade Berm Spillway	Spillway located in the centre of the seismic upgrade berm designed to carry floodwaters to Myra Creek in the case of a flood that exceeds the 1000-year storm threshold.
Tailings Beaches	Sand Reclaim	10 m beach along the berm crest of the sand reclaim area.
	TDF Strip	20 m beach along the berm crest of the perimeter embankment along the Strip Area.
Dam Crests	Perimeter	Crest of the outer seismic berm. The crest

	Embankment	is at approximately 3385m
	Paste Berm	The Paste Berm crest is at approximately 3391.5m
Lynx TDF		
Dams & Containment Structures	Foundation	Consists of pervious fluvial sand and gravel deposits
	Starter Embankment	16 m high, built of compacted waste rock.
	Perimeter Embankment	Berm surrounding tailings material. This will be progressively raised as the tailings level rises, typically in 3-6 m increments via centerline construction methods. Built of local fill materials.
	Cemented Paste	Reinforcement to Perimeter Embankment built to stabilize the containment facility during and after a maximum design earthquake
Impoundment Areas	Main Area	Storage area within the confines of the Perimeter Embankment to store paste tails
Drains	Underdrain System	This drain system, at elevation 3372m, ties into a drainage outlet at the base of the Starter Embankment and discharges upstream of the Mix Tanks..
Dam Crests	Starter and Perimeter Embankment	Crest of Starter Embankmant is 3389m. Crest of the Perimeter Embankment will progressively rise until it reaches its maximum design elevation.
Pipe Line Bridges	Red Pipe Bridge	There is one pipe bridge at 0+1000 m that carries the backfill pipes across Myra Creek. It also carries a fresh water line to the Backfill plant.
	Grey Pipe Bridge	There is one pipe bridge at 0-50 m that carries 1) the Super Pond discharge pipe, 2) the sludge line from the Myra Ponds and 3) the H-W/Myra sump line.
Vegetation		Red alder and Douglas fir seedlings planted on the TDF East Abutment area in 2008 and 2009.
Dust Control Systems	Water Truck	A water truck is used to suppress dust on travel ways across the TDF. This truck uses water from the reclaim pumphouse.
	Lignin sulfonate	A road binder compound used on an as-needed basis to suppress dust.

2.2.2 Support Infrastructure Components

Table 2-2 Support Infrastructure Components

COMPONENT	SUB-COMPONENTS	DESCRIPTION
Product Lines (Tailings Lines)	Paste Plant to TDF	An 8"steel line from Paste Plant east along diversion ditch road to discharge location in back of Amalgamated Paste Area of the TDF.
	Paste Plant to Lynx TDF	An 8" steel line from the Paste Plant west past Phillips Reach Ramp to discharge location along north wall of Lynx TDF.
	Cyclone Sands to Backfill Plant	6" buried line from cyclone building that runs east across TDF outer embankment to the Red Bridge and then to the Backfill Plant.
	Cyclone Sands to TDF	6" buried line runs along interior side of embankment crest road to Reclaim Sands Area. The discharge point is elevated and is moved to create an even beach slope along embankment.
	Cyclone Fines to Paste Plant	Pipeline route for tailings feed from cyclone building to paste plant that follows existing road.
Roads	Road from Super Pond to Paste Plant	
	Upper Diversion Ditch Road	
	Lower Diversion Ditch Road	
	Perimeter Embankment Crest Road	
	Paste Berm Road	
	Seismic Upgrade Road	
	Upper Lynx Access Road	
	Lower Lynx Access Road	
Bridges	Red Pipe Bridge to Backfill Plant	Piping and power cables across bridge • 2 – 120 V lighting power CCTS • 1 – 4160 V O/H powerline = #2 ASCR (620 m to backfill plant) • 6" backfill overflow pipeline to tailings area (Macdonald flow switch at end of overflow pipe at tailings pond) • 6" coarse tails pipeline to backfill plant from cyclone building • 3Ø 30 hp freshwater pump

		(600 V) supplies freshwater to backfill plant; Lighting at bridge to aid in pipe inspections.
	Silver Pipe Bridge	Waste water lines and sludge line connecting Super Pond to Myra Polishing Ponds.
	Myra Car Bridge	Provides road access across Myra Creek – carries 24" diameter HDP secondary overflow line from Super Pond to Myra Polishing Pond 1.
Buildings	Pumphouse #4	
	Piezometer Hut A	
	Paste Plant	
	Piezometer Hut B	
	Piezometer Hut C	
	Cyclone Building	
	Backfill Plant	
	Electrical Hut for outer drain between 0+400 and 0+800	
Power supply/ Transmission Lines	Pumphouse #4	Powered from HW Hoistroom area Fused contactor CGE 4160V/1000KVA/140A; Transformer at No. 4 Pumphouse GE 1000kva 4160V/600V 3Ø
	Piezometer Hut A	2 X 60 watt solar panels powering the seismic trigger and 1 X 30 watt solar panel powering the piezometers and data logger. Both sets of panels are attached to 12v batteries.
	Piezometer Hut B	1 X 30 watt solar panel powering the piezometers and data logger attached to a 12v battery.
	Piezometer Hut C	2 X 60 watt solar panels powering the seismic trigger, piezometers and data loggers. The panels are attached to a 12v battery.
	Paste Plant	Connected to site grid via 4160 v transmission line from Super Pond.
	Cyclone building	Connected to site grid via 4160 v transmission line from mill building.
	Outer drain 0+400 to 0+800 power	Connected to site grid via transmission line.
Telecommunications	Radio channel	Mill Channel – 164.940 First Aid Channel – 165.030 Road Channel – 164.475 Transmit – 168.505 Receive

		– 167.900 PL Tone
	PLC in Pumphouse #4	

2.2.3 Water Treatment System Components

The primary components of the water treatment system include:

- Upslope water diversion system for surface runoff;
- Surface water collection system with decants and emergency spillways;
- Underdrain systems for both the TDF and Lynx TDF;
- Treatment settling ponds;
- Associated piping and ditches to convey water between the various components.

The objective of the water management system is twofold - the capture and treatment of water that comes in contact with the site and the diversion of upslope surface runoff around the perimeter of the site.

Connecting diversion ditches were constructed on the north side of the site to capture runoff from the forested areas upslope and to divert the water away from the general Lynx Pit area, conveying it directly to Myra Creek at a point near the east end of the site.

Upgrades to this diversion ditch system started in 2008. This included increasing the capacity and efficiency of the Upper Reach (the portion running upslope of the Lynx TDF), improving the access to the Upper Reach and constructing a secondary ditch near the west end of the Upper Reach. This secondary ditch now diverts water from the upslope catchment westwards towards Arnica Creek. In 2010 a secondary ditch was also added to the Lower Reach, and is known as the "Alder Reach".

Lynx TDF

The Lynx TDF is designed so that sufficient freeboard is available to retain the 1000 year return period peak flood flow without the use of decants or pumping, given that the diversion ditch is fully functional during the event. Surface water which accumulates against the berm would be pumped to the water treatment system (via the collection ditch downstream of the Lynx TDF) once levels in the treatment ponds permit. A series of rock filled drains are currently being constructed as part of an under-drain system.

Water inputs to the Lynx TDF that feed the water treatment system include:

- Runoff from the immediate upslope areas;
- Rainfall and snowmelt on the facility;
- Water decanted from the backfill plant to the Lynx TDF, and

- Supernatant water from the tailings paste.

Old TDF

Although some surface water is removed by evaporation, the vast majority of water collecting on the TDF is removed via surface and sub-surface drainage systems to the water treatment system. Surface water is continuously removed through decants in the Amalgamated Paste Area, in the Strip Area and in the Reclaim Sands Area. Some of the surface runoff, from precipitation and snow melt, on the outer embankment of the TDF will flow towards Myra Creek.

Groundwater is collected in the sub-surface Inner and Outer Drains system and piped to Pumphouse #4. From here it is pumped to the head of the Water Treatment System.

As part of the initial construction of the TDF, a sloping filter was built along the bounding north valley wall (and waste rock dump) to an elevation of ~3368 m. This was to assist in decanting tailings supernatant and to intercept contaminated seepage from the waste rock dump. Water intercepted by the filter was directed to the Inner Drain. The filter was rapidly blinded by tailings and operational experience indicated that decants were far more effective at surface water removal. The filter has not been raised for a number of years. It remains as a buried interceptor for the sub-surface seepage from the waste rock dump.

The original Outer Drain consists of a system of perforated drain pipes with a solid conveyance pipe embedded in gravel located ~3 m below creek level. In the event of an emergency at Pumphouse #4, the conveyance line was built with three take-offs along its length allowing direct discharge to Myra Creek. These access chambers were decommissioned in 2005/2006 leaving the drain fully open. Now the control is at Pumphouse #4 where the drain can be partially or completely closed.

A new Outer Drain, constructed in 2005/2006, consists of two discontinuous sections, one from 0+350 m to 0+850 m and the other from 0+850 m (built at an elevation of ~3348.4 m, or 4 m below Myra Creek) to the Pumphouse #4, Refer to KC 2005c for a detailed performance assessment of the outer drain and Appendix I for as-built drawings of the outer drain structures. In detail, the section from 0+850 m to Pumphouse #4 is drained through a series of three perforated lines that intercept the sub-surface flow from ~0+875 m to ~1+340 m and convey the water to Pumphouse #4.

Water Treatment System

Water collected from both tailings facilities, plus process water and water collected in other onsite catchment works, is directed to the head of the Super Pond for pH adjustment through lime addition. This treated water flows into the Super Pond and subsequently into the Myra Polishing Ponds. The Super Pond provides adequate residency time to effect primary settling of the suspended solids with the polishing ponds providing secondary settling of the finer particulate solids before release of the treated effluent into Myra Creek. Table 2-19 details the components of the water treatment system. A flow sheet for the system is provided in Appendix I.

Table 2-3 Water Treatment Infrastructure Components & Instrumentation

COMPONENT	SUB-COMPONENTS	DESCRIPTION
Lynx Diversion	Upper Reach	Built into hillside with access road

Ditches		along right bank adjacent Lynx TDF. Upgraded in 2008, including shotcrete.
	Cascade Reach	Cascading waterfall in a steeply incised channel in bedrock, access is very difficult.
	Lower Reach	About 900 m long mostly in shotcrete lined ditch, adjacent TDF.
	Sharp drop, rip-rap & culverts leading to Myra Creek	Short shotcrete lined portion leading to a riprap lined length, to three 1.8m diameter CSP culverts under quarry access road directing discharge into Myra Creek.
Super Pond	Inflow Ditch	Shotcrete lined ditch collects water from all site inputs.
	Mix tanks	6
	pH probes	2
	Lime addition pipes	2
	Liner	HDPE liner on top of filter fabric
	Pond	45,000 m^3 containment
	Discharge Pipes	
	Flump Raft	
	Primary Overflow Weir	
	Secondary Overflow Weir	
	Discharge Pipe	
	Secondary overflow pipe	
	Grey Pipe Bridge	
Myra Polishing Ponds	Pond 1	10,000 m^3 containment
	Pond 2	15,000 m^3 containment
	Pond 2A	10,000 m^3 containment
	Pond 3	5,000 m^3 containment
	Pond 3A	5,000 m^3 containment
	Pond 4	40,000 m^3 containment
Surface Sumps	H-W/Myra Sump	Includes sump, 2 pumps, control mechanism, pH probe and line to discharge upstream of mix tanks.
	#25 Sump	Includes sump, 2 pumps, control mechanism and lines to Super Pond and pond 1.

2.2.4 Electrical Components of TDF and Water Treatment Facility

The Super Pond infrastructure is powered through a line from the Mill complex. Pumphouse #4 is wired from a dedicated line that is routed from the Backfill Plant and the HW mine complex.

Instrumentation Huts A, B & C are powered by solar cells or batteries. Huts A and C each have two 60 watt panels charging a 12 volt battery and powering the seismic triggers, plus a 30 watt

panel powering the piezometers and data loggers. Hut B has one 30 watt panel powering the piezometers and data logger.

Table 2-4 Electrical components of TDF and Water Treatment Facility

Component	Sub-Component	Description
Super Pond and west end of TDF	Flump Shack	Line from Powerhouse with overhead 4160 v 600 A line with Vanossi 52F2 breaker; CRISIFULLI Starter/ VFD cabinet 3Ø 600 v; Micro-1 PLC Controller; AC TECH 3Ø 575 v 2 HP VFD; FPE Type GFRM Ground Protection 75 hp Robot Pump Lighting panel; Telemetered pump status and level alarms
	TDF Instrumentation Hut A	2 – 60 w solar panels charging 12 v automobile battery to power the seismic trigger; 1 – 30 w solar panel and 12 v battery powering the data logger and vibrating wire piezometers
	TDF Instrumentation Hut B	1 – 30 w solar panel charging 12 v battery that powers the data logger and the vibrating wire piezometers.
Backfill Plant and east end of TDF	Pumphouse #4 and MCC;	Powered from HW Hoistroom area • Fused contactor CGE 4160V/1000KVA/140A; Transformer at Pumphouse #4 • GE 1000kva 4160V/600V 3Ø Starter at Pumphouse #4 • Toshiba CV212-GATU 600 V 160 A vacuum breakers • Starco ground protection Telemetered pump status, level alarms and control • 984 MODICON PLC • MULTIRANGER PLUS w/ level probes • Taylor Proworx ver 1.57 control software; Flow measurement of water in discharge pipeline, outside building • Hydra 5X40 Flow Meter at pumphouse • Milltronics “The Probe” Ultrasonic Level 8611200 at Superpond inflow.
	Backfill Plant MCC	Provides power to plant and Red Pipe Bridge area, fed from HW

	Backfill Plant, Red Pipe Bridge	Piping and power cables across bridge • 2 – 120 V lighting power CCTS • 1 – 4160 V O/H powerline = #2 ASCR (620 m to backfill plant) • 6" backfill overflow pipeline to tailings area (Macdonald flow switch at end of overflow pipe at tailings pond) • 6" coarse tails pipeline to backfill plant from 80'foot thickener building • 3Ø 30 hp freshwater pump (600 V) supplies freshwater to backfill plant;
	TDF Instrumentation Hut C	2 – 60 w solar panels charging 12 v automobile battery to power the seismic trigger, the data logger and the vibrating wire piezometers.
Paste Plant	Contains its own MCC	Connected to main site grid
	Communication link to Mill Control Room	
Cyclone Building	MCC for Pumphouse building	Powered from Mill

2.3 Facility Monitoring – Instrumentation Types & Locations

2.3.1 Instrumentation for Monitoring of Electrical Components

The electrical and instrumentation systems of Pumphouse #4 are wired back to the Mill Control Room for monitoring and remote operation. The monitored information includes percent oxygen, flow volumes and status of drains regarding percent open or closed.

Instrumentation installed for monitoring the performance of the TDFs includes vibrating wire and pneumatic piezometers, for pore pressure monitoring, and surface movement survey monuments. Table 2-10 provides a summary of all instrumentation in place.

Table 2-5 Basic Components – Instrumentation for Monitoring

COMPONENT	SUB-COMPONENT	DESCRIPTION
Piezometers	Electric (vibrating wire) units in: • Foundation soils and tailings embankment; • Sand Storage Area; • Under Amalgamated Paste Area Berm. They are either wired to data loggers or have loose leads for manual downloading	Complete with data loggers and seismic triggers in Instrumentation Huts A & C

	Pneumatic units from original installation consist of: Three of original 6 in Plane A; three of original 6 in Plane B	Leads are loose, permitting manual readings in Huts A & C
Seismic Triggers	Mounted on concrete slabs in both Hut A and Hut C	Trigger continuous reading of electric piezometers into data loggers. Currently set at 0.05 g. set point.
Groundwater Wells		Allow for measurement of groundwater level and water sampling at strategic locations, including either side of the Outer Drain
Survey Control	Surface movement monuments	Located on outer slope of embankment, read using GPS based survey equipment
	Berm crest surveying	Done during berm raises, using GPS based survey equipment
Flow Monitoring	Pumphouse discharge flows	Real-time flow indication to mill control room from flow meter in #4 Pump house return line
	Diversion ditch channel	Flowlink pressure based flow meter
	Inner and outer drains	Checked periodically by Environmental Department using manual methods
Meteorological Station	Environment Canada station at powerhouse	Manually checked daily for maximum and minimum temperatures and precipitation
	Automated station at soil cover test plots	Electronic compilation of a range of parameters including temperature, precipitation, net radiation, wind speed and direction

1.5.3 Piezometers

Piezometers are aligned in three planes (A, B & C) along the TDF and beneath the paste berm. Plane A is located at station 0+360 (approx) and trends perpendicular to Myra Creek, from the left bank of the creek to the paste berm. Plane B consists of two vibrating wire piezometers at the west end of the APA in the vicinity of the sand reclaim area. Plane C runs perpendicular to Myra Creek at station 0+1240 (approx) from the left bank of the creek to the paste berm. Piezometers are also installed beneath the paste berm at seven stations, two piezometers per station.

The elevations for the piezometers are listed in Table 2-11 and Table 2-12 below. All existing piezometers are shown on drawing 2009-6 (plan view) and on drawing 2009-7 (sectional view for planes A and C).

Two piezometers have been installed into the Lynx TDF berm foundation.

Table 2-6 Plane A and C Vibrating Wire Piezometer Threshold Levels

PIEZOMETER	LOCATION [1,2,3,4]	TIP ELEVATION (m)	WARNING THRESHOLD LEVEL I [5,6]	WARNING THRESHOLD LEVEL II [5,7]	WARNING THRESHOLD LEVEL III [5,8]
Instrumentation Plane A					
A-2E	Foundation	3352.9	3360	3360.2	3361.2
A-4E	Foundation	3352.73	3360	3359.8	3360.8
A-5E	OES	3357.91	3362.5	3361.3	3362.3
A-6E	OES	3358.44	3362.5	3361.4	3362.4
A-8E	OES	3358.52	3362.5	3361.3	3362.3
A-9E	OES	3359.24	3362.5	3361.8	3362.8
A-10E	OES	3359.82	3362.5	3362.7	3363.7
A-12E	OES	3359.9	3362.5	3361	3362
A-13E	OES	3360.9	3362.5	3364.1	3365.1
A-14E	OES	3360.92	3362.5	3363.3	3364.3
A-16E	OES	3361.11	3362.5	3365	3366
A-17E	OES	3364.5	3366.8	3366.5	3367.5
A-18E	OES	3364.26	3366.8	3367.2	3368.2
A-20E	OES	3364.15	3366.8	3366.7	3367.7
A-26E	OES	3371.2	3377.9	3377.5	3378.5
A-27E	OES	3371.4	3377.9	3379	3380
A-28E	OES	3372.65	3377.9	3375.9	3376.9
A-30E	LTB	3372.33	3377.9	3377.3	3378.3
A-31E	OES	3375.33	3377.9	3378	3379
A-32E	LTB	3375.18	3377.9	3378.5	3379.5
A-33E	UTB	3374.97	3377.9	3379.4	3380.4
Instrumentation Plane C					
C-2E	OES	3348	3352.6	3352.6	3353.6
C-5E	OES	3357.59	3358.8	3359.5	3360.5
C-6E	OES	3351.23	3358.8	3357.6	3358.6
C-10E	OES	3354.78	3358.8	3357.5	3358.5
C-12E	OES	3353.02	3358.8	3358.9	3359.9
C-13E	OES	3356.41	3358.8	3357.2	3358.2
C-14E	OES	3356.26	3358.8	3358.8	3359.8
C-16E	OES	3356.2	3358.8	3361.8	3362.8
C-17E	OES	3350.66	3354.8	3354.8	3355.8
C-18E	OES	3362	3364.4	3364.6	3365.6
C-20E	OES	3362	3364.4	3365.8	3366.8
C-21E	OES	3363.12	3364.4	3363.7	3364.7
C-22E	OES	3362.93	3364.4	3363.8	3364.8
C-24E	OES	3362.71	3364.4	3363.9	3364.9
C-29E	OES	3369.8	3377.3	3375.5	3376.5
C-30E	OES	3369.53	3377.3	3378.8	3379.8
C-31E	LTB	3369.5	3377.3	3380.1	3381.1
C-32E	OES	3372.3	3377.3	3374.9	3375.9
C-34E	LTB	3374.17	3381.1	3380.8	3381.1
C-35E	OES	3374.2	3381.1	3379.9	3380.9
C-36E	LTB	3374.1	3381.1	3380.2	3381.2
C-37E	UTB	3374.1	3381.1	3383.6	3384.6

Table 2-7 Plane B and Paste Berm - 2008/2009 VW Piezometer Threshold Levels

PIEZOMETER	LOCATION [1,2,3,4]	TIP ELEVATION (m)	WARNING THRESHOLD LEVEL I [5,6]	WARNING THRESHOLD LEVEL II [5,7]	WARNING THRESHOLD LEVEL III [5,8]
Instrumentation Plane B					
B-1E	PBF	3375.49	3385.6	3385.6	3388.1
B-5E	OES	3365.13	3373.8	3373.8	3378.1
Paste Berm					
P-1	PBF Area 2	3371.9	3371.7	none	3372.7
P-2	PBF Area 2	3376.9	3378.4	none	3379.4
P-3	PBF Area 2	3371.8	3372.2	none	3373.2
P-4	PBF Area 2	3376.8	3378.9	none	3379.9
P-5	PBF Area 2	3372.6	3378.7	none	3379.7
P-6	PBF Area 2	3376.9	3382.4	none	3383.4
P-7	PBF Area 2	3367.3	3372.4	none	3373.4
P-8	PBF Area 2	3372.5	3376.4	none	3377.4
P-9	PBF Area 2	3378.94	3382	none	3383
P-10	PBF Area 2	3374.37	3377.9	none	3378.9
P-12	PBF Area 2	3374.05	3381.6	none	3382.6
P-11	PBF Area 2	3380.14	3384.8	none	3385.8
P-14	PBF Area 2	3374.2	3376.1	none	3377.1
P-13	PBF Area 2	3379.68	3382.3	none	3383.3

1) OES - below outer embankment slope

2) LTB - lower 1/3 of upstream tailing beach deposits

3) UTB - upper 2/3 of upstream tailings beach deposits

4) PBF - below paste berm foundation

5) meters of pressure head

6) Generally, set as average of historical maximum readings within the representative section of the sta

7) Set as individual historical maximum reading.

8) Set as 1.0 m above historical maximum reading.

1.5.3 Surface Movement Survey Monuments

Surface movement survey monuments have been established along the length of the Old TDF outer berm and on the paste berm. These are illustrated on Drawing 2009-6 and the coordinates are given below in Table 2-13. When the Old TDF is not snow covered, these monuments are surveyed monthly to assess any settling that has occurred on the tailings facility.

As yet no monuments have been established for the Lynx TDF.

Table 2-8 Old TDF Survey Monuments

Station	Northing	Easting	Elevation
STA363			
MPT355	4031.529	3297.172	3373.791
MPT356	4090.275	3263.713	3378.202
MPT403	4106.991	3282.999	3371.754
MPT404	4085.976	3257.116	3379.235
MPT405	4082.965	3252.234	3380.421
MPT406	4028.564	3267.937	3379.700
STA364			
MPT354	3844.803	3206.163	3374.059
MPT358	3856.513	3195.272	3378.314
MPT360	3652.873	3106.473	3377.847
MPT407	3864.546	3187.815	3380.425
MPT408	3768.549	3125.419	3380.332
MPT409	3655.569	3093.036	3380.155
STA365			
MPT500	3301.748	2702.256	3365.100
MPT501	3312.906	2695.064	3372.428
MPT502	3350.162	2667.547	3378.933
MPT503	3434.861	2933.592	3363.231
MPT504	3450.420	2923.148	3372.592
Paste Berm			
PB07	3874.261	3133.515	3384.873
PB09	4102.629	3170.162	3385.053

2.3.2 Groundwater and Surface Water Sampling Points

Refer to Section **5.0** for a comprehensive listing of sampling locations.

2.3.8 Weather Data Collection

Weather data is collected at two locations in Myra valley. An Environment Canada station is located outside the diesel Power House, and a second station is located outside the Paste Plant between the soil cover test plots and the old refuse dump. The Environment Canada station is checked manually by power house staff on a daily basis. This station records rainfall, snowfall, maximum temperature and minimum temperature. The data is located on the computer network at H:\\myffs01\Environment\Enviro Data\Env Lab\Weather Data\MFO Data. The data can also be found on the Environment Canada weather website www.weatheroffice.com under the station Myra Valley.

The second station, by the Paste Plant, is an automated system which takes readings every hour. This station records the following parameters:

- Wind Speed (m/s)

- Wind Direction (Azmuth° & Vector)
- Air Temperature (°C)
- Relative Humidity (%)
- Radiation (MJ/m2)
- Snow depth (m)
- Rainfall (mm)

The data logger also compiles the hourly data into a daily record to provide:

- Minimum, Maximum and Average Wind Speed
- Minimum, Maximum and Average Air Temperature
- Cumulative Precipitation from Midnight to Midnight

This data is manually downloaded monthly using "Loggernet" software, supported by RST Instruments. The downloaded data can be found at H:\\myffs01\Environment\Weather Data\Weather Station. The raw data is stored in five comma delineated ASCII files called Weather Station_daily, Weather Station-hourly, Weather Station_Ppt event, Weather Station_Snow depth, Weather Station_status. These data are then pasted into an Excel spreadsheet called Weather Station (year).xls which can be found in the same directory.

3.0 Operations

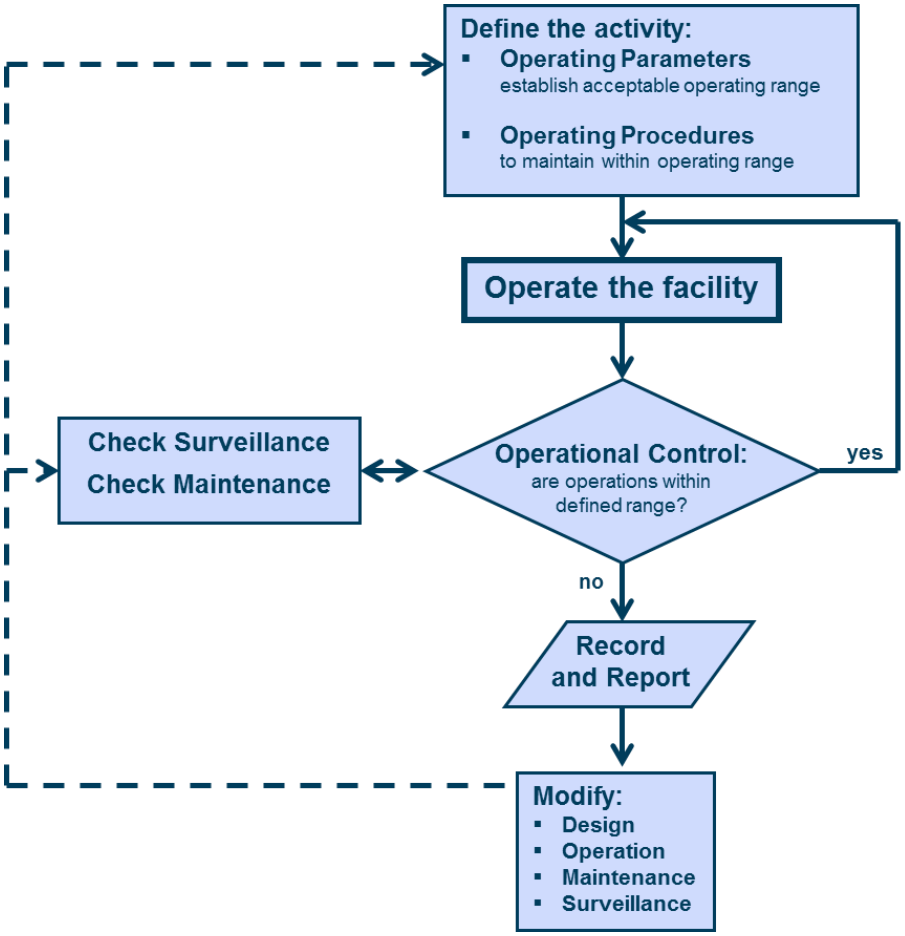
3.1 Objective

The operations plan for tailings and water treatment facilities addresses the transport and containment of tailings, process water, effluents and residues. This includes the recycling of process water.

This section will define operating standards and procedures in accordance with design criteria, regulatory requirements, company policies and sound operating practices, encompassing all significant aspects of, and activities for, the economical, safe and environmentally responsible disposal and storage of tailings and management of water.

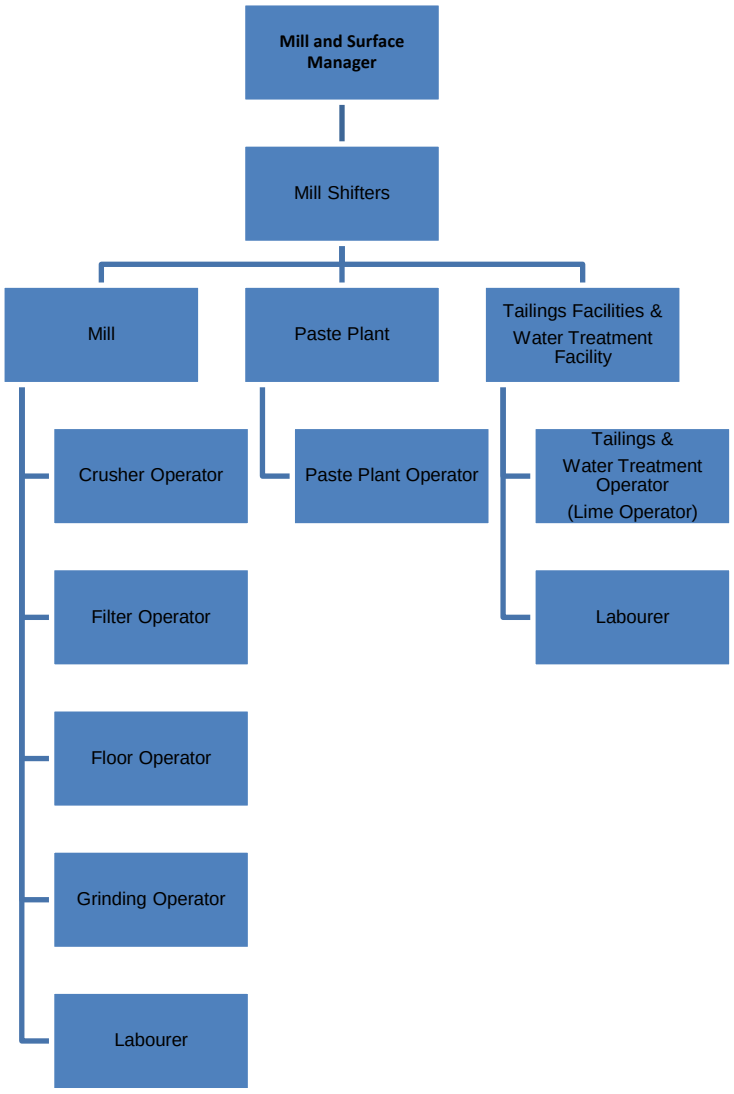
3.2 Operations Organizational Charts

Figure 3-1 Operations Flowchart



(Ref: Mining Association of Canada, Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Management Facilities)

Figure 3-2 Operations Personnel Organizational Chart



Mill and Surface Operations

3.3 Tailings Transport and Deposition

From 1967 until July 1984 tailings were deposited into Buttle Lake. Since then the site has exclusively utilized surface tailings disposal facilities for the impoundment of tailings.

Presently, tailings are disposed of in two ways:

- The coarser, sand-sized portion is separated by cyclones and sent underground as backfill sand material.

- The finer sized portion is thickened through removal of water to a 65% solids content (by weight) at the Paste Plant and then deposited into the tailings disposal facilities. Paste tailings sent to the Lynx TDF between February 2008 and April 2009 had approximately 3.3% (by dry weight of tailings solids) cement added prior to deposition.

In detail, the mill tailings are fed to a backfill cyclone plant. Single stage classification, utilizing eight 15" cyclones, is used to produce backfill sand. Cyclone underflow material sizing is nominally 85% +37 micron. Backfill sand is pumped directly to the Backfill Plant tanks for placement underground or, if it cannot be received underground, is bypassed to the Reclaim Sand Area. Cyclone overflow is pumped to the Paste Plant, where it is dewatered and pumped as paste tails into the TDF or Lynx TDF.

3.3.1 Tailings Slurry Quantity and Flow Rate Projections

The mill is designed to process 4,000 tonnes per day, generating approximately 1,820 tonnes of paste and 1,360 tonnes of sand per day. Currently the mill processes ~1,500 tonnes per day.

The projected long term production rate is 1,500 tonnes per day. This will generate on average 1,225 tonnes of tails per day, with approximately 700 tonnes of paste and 525 tonnes of sand.

A review of previous mill production records and of survey data for paste deposited in the APA indicates that the paste is deposited at an average density of 1.32 tonnes/m³. At this bulk density, future storage requirements for paste will be approximately 530 m³ per day.

3.3.2 Pumping and Pipeline Operations

Operating Pressures

The three significant pumping and pipeline operating pressures are:

- Cyclone Building to Paste Plant - Alice Chalmers 8x6x18 SRL Pump with 5” schedule 80 sclar pipe with an operating pressure of 40 psi/275 kpa.

- Cyclone Building to Backfill Plant - Alice Chalmers 8x6x18 SRL Pump with 5” schedule 80 sclar pipe with an operating pressure of 40 psi/275 kpa

- Paste Plant discharge to TDF and Lynx TDF - Schwing Paste Pump with 8” schedule 80 steel paste line with an operating pressure of 435 psi/3000kpa

All other lines referred to in this manual are open-ended and do not have targeted operating pressures.

Measures to Prevent Line or Pump Sanding or Freezing

All lines are flushed with air and or water before they are shut down to prevent sanding. Additionally, the paste line is flushed with a foam pig. During the winter, water is piped through all critical lines to prevent freezing.

3.3.3 Slurry Density and Other Properties

Target slurry densities in the tailings disposal system are as follows:

- Cyclone overflow to paste plant – 8% to 10% solids as measured by a Marcy Scale;
- Cyclone underflow to backfill plant or sand reclaim area – 55% to 65% solids as measured by a Marcy Scale;
- Cyclone underflow must also have a minimum percolation rate of 2.5 ml/minute to ensure it is appropriate for backfill;
- Paste to the TDF/Lynx TDF – 80% solids as measured by slump (7% slump equates to 80% solids)

Other properties, including gradation, mineralogy, specific gravity, density, angularity, clay content and plasticity, as well as acid-generating and metal leaching potential, is addressed in Section **2.3.5**.

3.3.4 Tailings Deposition Technique and Compaction

There are two tailings streams deposited on site: sand and paste. The sand is combined with cement and sent underground via a pipeline as cemented backfill required in the filling of underground voids. Occasionally, the Mine is unable to receive backfill from the Mill. This sand is sent to the Sand Reclaim Area, located at the west of the TDF. The sand is discharged through an HDPE pipe which is moved to ensure the even deposition of sand and to ensure a slope is retained to force runoff toward the decant on the north side of the area.

The other tailings stream is paste tailings. Deposition of paste tailings is via an 8” schedule 80 steel pipe that runs from the Paste Plant along the Diversion Ditch access road to the Amalgamated Paste Area of the TDF. The paste forms several coalescing alluvial fan-like structures sloping to the south. This ensures maximum capacity is achieved in the Amalgamated Paste Area. The paste line is extended and retracted through the addition or removal of 20’ lengths of pipe. A second line runs to the west, past the Phillips Reach Ramp, and goes to the Lynx TDF where paste is deposited in a similar fashion.

3.3.5 Tailings Beach and Underwater Slopes

There are two tailings beaches on the TDF. The first is in the Sand Reclaim Area. The operating guideline is to maintain a 10 m beach along the length of the outer or southern berm. A beach reduces the likelihood of contaminated water seeping through the outer berm and also helps ensure the stability of the containment structure. There is no concern regarding underwater slopes in the Sand Reclaim Area.

The second tailings beach is located on the TDF Strip outer embankment. Operating guidelines require a 20 m beach to be maintained, keeping contaminated water from seeping through the outer berm and maintaining the stability of the containment structure. As the tailings are no longer added to the Strip, the most significant concern here is the need to maintain good drainage in all weather conditions. A graded channel along the Strip allows water to flow west towards the decant structure.

3.3.6 Maximum Beach Crest Elevations

The maximum tailings elevation of tailings at the paste berm is 3389.5 m in the Amalgamated Paste Area and 3382 m in the Sand Reclaim Area.

The freeboard between these elevations and the containment berm crests is designed to contain flood waters during large storm events.

3.3.7 Chemical Properties of Tailings and Decant Water

Water chemistry for tailings pore water is presented in various Klohn-Crippen reports written between 1999 and 2006 (located in the Environmental Department), specifically, the *Seismic Upgrade Design Report (1999a)* and the *Performance Assessment of the Interim Outer Drain (2005)*.

TDF paste tailings decant water chemistry data is presented in Figure 5.5 Section **5.5.2.3** under "TMA-DECANT".

3.3.8 Response to Deviations from Design Properties

Deviations from Design Properties for Paste Tailings

If the paste deviates from its design properties, corrective action needs to be taken at the paste plant. The most common problem is the slump deviating from its target of 7%. Such a deviation could result in a paste being either too thick for the pumps to handle, or too thin for proper deposition in the TDF or Lynx TDF.

Another common deviation may be dirty overflow from the paste thickener tank. This is often caused when an insufficient amount of flocculent is added, or the flocculent addition system malfunctions. The amount of flocculent is adjusted inside the paste plant.

A comprehensive Paste Plant manual is kept in the following locations: the Mill and Surface Manager's office, the Mill Shifters' office and the Paste Plant.

Deviations from Design Properties for Sand Tailings

The most important property for sand tailings is grain size. Grain size is determined through a percolation test. If the percolation rate drops below 2.5 ml/minute the sand will not drain quickly enough for effective use as backfill. If the percolation rate drops below this target the feed to the cyclone vortexes at the Cyclone Building can be reduced to allow the whole tails to separate more efficiently.

3.3.9 Response to Unusual Operating Conditions

The response to unusual operating conditions, such as severe winter conditions, periods of high rainfall, lack of water and/or high winds depends on the severity of the conditions at hand. Procedures to shut down the Mill and its related functions – the responsibility of the Mill and Surface Manager or his designate - are provided in Section **4.4.6**. The greatest risk is posed by issues listed below.

Heavy Rainfall

Heavy rainfall is the most significant of these conditions. The period of highest risk is between October and March. During a heavy rainfall event, a number of responses must be considered to mitigate the potential of overwhelming the water treatment infrastructure. Also, as safety must always be the first priority, a protocol has been developed for the underground mine (Appendix VIII) relating to potential water inundation. Possible responses may include (in order, as needed):

- Ensure all inflow structures are free of debris.
- Ensure diversion systems for non-contact water are fully functional.
- Notify Environmental Department.
- Close the 3 lines of the new Outer Drain at Pumphouse #4.
- Pull a board from the Super Pond overflow structure to bypass the weir.
- Shut off any non-essential water being pumped to the Water Treatment System.
- Pull boards in Myra ponds to prevent overtopping.
- Close the new outer drains (Long, Medium and Short drains).
- Prepare for overtopping of the Lynx Diversion Ditch and TDF Spillway. The Ministry of Environment must be notified before the TDF overtops. Notify the Environmental Department or contact the Ministry of Environment (contact information - Section **6.3.2**).

Each step should reduce flow to the Super Pond. This will help prevent overtopping and allow adequate treatment of the contained water. After each step it is necessary to observe the system for as long as possible before committing to the next step.

Lack of water

During the periods of February-March and July-September the ability to produce hydropower may be compromised due to the lack of water in the Jim Mitchell and Tennent reservoirs. At this time NMF relies on diesel power generation. Responses that can reduce power demands include:

- Schedule major energy consumers such as skipping, crushing, milling, paste plant
- Turn off lights not in use
- Turn off computers and monitors not in use
- Throttle back fans and pumps whenever safety permits.

Ultimately it is critical to have sufficient power to maintain the facilities of the water treatment system including Pumphouse #4, the lime addition system, the carbon dioxide injection system and all instrumentation (pH probes and auto-samplers).

Severe Winter Conditions

Severe winter conditions bring increased risks to roads and pipelines. Critical access roads must be maintained and free of snow. The surface crew must mobilize sand trucks and plows from the onset of a snow storm to ensure clear roads.

Pipelines are also at risk due to severe freezing conditions. Intense cold periods or periods of freeze/thaw may cause pipeline failures. During 2008, all hugger clamps were removed from surface pipelines to decrease the likelihood of coupling failure. It is critical that during cold spells operators check all lines for evidence of potential pipeline failure.

High Winds

High winds are an infrequent event at NMF. However, the surface crew is fully equipped to remove any downed and/or danger trees. Contract services are also available.

3.3.10 Response to Line Rotation or Line Relocation

The specific mechanical requirements are dependent on the task at hand, however both line rotation and relocation follow the same basic procedure:

- Turn off flow to the line
- Flush line with fresh water and compressed air
- For the paste line, use a foam pig
- Reconnect the line and turn on the flow
- Inspect the line to ensure there are no leaks and that the flow at the discharge end is as expected

3.4 Dam and Basin Raising

No further raises will be built on the TDF. Raises to the Lynx TDF berm should be completed as needed, providing paste storage adequate until the end of the winter season plus a minimum freeboard of 1.5m for temporary storage of surface waters. Details for raise construction are given in AMEC's report Lynx Pit Paste Tailings Disposal Facility Design Report (2008).

Prior to each raise the site conditions must be assessed by a geotechnical engineer to determine the extent of preparations needed prior to fill placement (i.e. stripping abutment preparation, etc.). Fill placement will also need to be monitored regularly to determine that design requirements (i.e. fill type, compaction and berm geometry) are being met.

3.5 Water Management

Contaminated water is collected from several locations and piped to the water treatment facility – refer to "Tailings Disposal System Flow Sheet" in Appendix I. Descriptions of the various contaminated water sources associated with the tailings disposal facilities are provided below.

TDF Tailings Area Decants

Dewatering of the tailings is primarily through three decants. These decants, in the Amalgamated Paste Area, in the Strip Area and in the Sand Reclaim Area, discharge towards the Super Pond. There are no valves on these lines. To temporarily reduce flow, rings can be added to the decant towers. Decant water is likely to contain high levels of suspended solids and/or metals.

Pumphouse #4

Pumphouse #4 collects water from five interceptor drains at the base of the TDF: the old inner drain, the old outer drain and the new outer drain system comprising the long, medium and short drains.

The inner drain is located along the north side of the TDF under the Lynx Diversion Ditch access road. The old and new outer drains are located under the TDF along Myra Creek. These drains prevent contaminated water from reaching Myra Creek. This water can be acidic (pH <4.0) and can contain elevated levels of heavy metals. The water collected in all outer drains is diluted by ground water and creek water and is therefore considered less contaminated. All drains are equipped with valves located in the pumphouse. To effect maximum protection to Myra Creek the current valve "open" settings are 100% for the old inner and outer drains, 10% for the long drain, 9% for the medium drain and 1% for the short drain. Valve settings cannot be altered without approval of the Mill and Surface Manager.

A 28" discharge line from Pumphouse #4 runs inside the outer embankment of the tailings area to the Super Pond. Near the middle of the Amalgamated Paste Area the line is reduced to 24" diameter. The line is equipped with flow monitoring devices which will alarm in the event of a pipeline failure. The line is also equipped with check valves to prevent the release of water from the entire length of the line in the event of a line rupture. These check valves can be manually opened to allow flow back to the pumphouse (for pipeline repairs etc.). Small leaks are indicated by pooled water or wet spots on or along the pipe. Flow monitoring devices should not solely be relied on and line inspections must be part of the regular inspection rounds.

Lynx TDF Underdrains

An underdrain system for the Lynx TDF was started in 2010 and connected to the existing water trap so that contaminated water seeping through the paste tailings is collected and fed by gravity to the head of the Super Pond input ditch.

Super Pond

The ditch at the head of the Super Pond collects and mixes contaminated water from across the site, including process water from the Mill and the underground mines. All of these inputs have the potential to contain high levels of metals and/or suspended solids. The Super Pond discharges to Myra Polishing Pond 1 via a 30" diameter pipeline that is carried on the Grey Pipe Bridge across Myra Creek. A 24" diameter pipeline was plumbed into the Super Pond overflow structure in January 2010 to provide a secondary discharge line during high inflow periods, typically brought on by heavy rainfall events. This pipeline is carried on the Car Bridge. The Super Pond is also equipped with three emergency overflow culverts which can drain towards Myra Creek – these are now redundant since the installation of the second 24" diameter pipeline.

3.6 Water Treatment System

3.6.1 Objectives and Methods

The objective of the Water Treatment System is to produce a final effluent that passes all permit and regulatory criteria. The criteria are listed in Table 3-1 below.

Table 3-1 Effluent Parameter Limits

Parameter	**Limit**	**Permit or Regulation**
Maximum flow volume	<110,000 m^3/d	PE-06858
TSS	25/30 mg/L	PE-06858/MMER
pH	<11/<9.5	PE-06858/MMER
Total copper	0.6 mg/L	PE-06858/MMER
Dissolved copper	0.2 mg/L	PE-06858
Total Zinc	1.0 mg/L	PE-06858/MMER
Dissolved Zinc	0.5 mg/L	PE-06858
Dissolved Cadmium	0.005 mg/L	PE-06858
Dissolved Lead	0.05 mg/L	PE-06858
Acute Toxicity (Rainbow Trout 96h LC_{50})	100% vol/vol	PE-06858
Acute Toxicity (Rainbow Trout screen)	>50% survival	MMER
Arsenic	1.00 mg/L	MMER
Cyanide	2.00 mg/L	MMER
Lead	0.40 mg/L	MMER
Nickel	1.00 mg/L	MMER
Radium 226	1.11 Bq/L	MMER

Metals are removed by pH modification with the addition of a lime slurry ($Ca(OH)_2$). After lime addition and the mixing of the lime through the 6 mix tanks at the head of the Super Pond, the pH of the water is ~10.5. This pH allows for the maximum removal of metals, in the form of a metal hydroxide precipitate, as the water flows through the Super Pond. A series of 6 "polishing" ponds increases the settling time for the treated effluent, maximizing the removal of any remaining suspended solids. Effluent pH can be further adjusted through the addition of carbon dioxide (CO_2) ~20m upstream of the final discharge point, to ensure a final effluent pH <9.5.

3.6.2 Water Treatment System Components

Refer to Appendix I to review a flow sheet for the water treatment system.

3.6.2.1 Super Pond

Liner

The Super Pond is approximately 140 m long, 60 m wide and 5 m deep. It is lined with an HDPE liner to prevent seepage into Myra Creek. The liner is exposed at the pond banks and can be very slippery when wet. Tears or damage to the liner should be repaired promptly.

Inflow Ditch

The inflow ditch is a shotcrete-lined ditch that collects contaminated water inputs from around the site. These include flows from the Mill, the waste rock dumps, Pumphouse #4, the Lynx ditch, the Myra/HW Sump, the sewage treatment facilities, the TDF decants, the Lynx TDF, various sources of surface runoff, #25 Sump, the Phillips Reach Portal and the Paste Plant.

Mix Tanks

Flow from the Inflow Ditch is split to feed two sets of three mix tanks. Each set of tanks can be isolated by stop logs. The function of these tanks is to provide proper mixing of effluent streams after lime addition. The mix tanks are equipped with agitators to enhance mixing.

Lime Addition

Lime slurry is automatically added to the first set of mix tanks. Lime is fed from the mill and is controlled by a pH probe located in the third mix tank. Lime may also be added manually, from the lime slakers direct to the Lynx Ditch, if necessary.

Lime control valves situated near the top of the lime tank in the mill are air actuated. Air is supplied from the instrument air compressor. In the event of an air failure, these valves will fail 100% open to prevent low pH solubilization of metals. The pH probes are equipped with both high and low pH alarms that sound in the control room.

3.6.2.2 Super Pond Operational Parameters

pH Monitoring

pH probes are located in the last two mix tanks. Under normal operating conditions the pH will be between 9.5 and 10.5. The pH probes automatically adjust lime addition based on a target pH of 10.5. Additional lime can be added manually during abnormal conditions of low pH inputs or high flow volumes. Another pH probe is located at the Super Pond outflow. Ideally, the pH at "Super Out" should be ~9.5. All pH probes are wired to the mill control room and displayed on the operator's screen. There is also a data-capture system for the water treatment system pHs, with an automatic update recorded every 15 minutes to a SQLSVR database.

A manual check of Super Pond pH's is made on a regular basis (4 times/24 hours) by the Lime Operators to ensure pH probe accuracy. These manual readings are recorded on a shift Water Treatment Report. Lime Operators regularly clean the pH probes with rags and a 10% HCl solution. Instrumentation personnel calibrate (or standardize) the probes once every 8 days.

High Level

During periods of heavy precipitation/runoff, visual inspections of the Super Pond must be done frequently to ensure pond levels remain below the high water mark on the emergency spillway.

Pond Discharge

Water in the Super Pond decants over a weir, adjacent to the discharge pipe. This water passes through a screen into a discharge chamber, which feeds two discharge lines. These lines feed a 32" diameter pipeline that conveys water over the Grey Pipe Bridge to polishing pond 1. In January 2010 a secondary 24" diameter overflow line was plumbed from the Super Pond overflow weir to polishing pond 1, to increase discharge flows during high flow events.

Sludge Disposal

The Super Pond is equipped with an automatic, self-propelled pump carried on a raft, known as the "flump". The flump is equipped with a suction auger whose depth can be adjusted to remove sludge from surface down to a depth of about 14 feet (~4.3 m). When in operation, the flump will automatically traverse the pond in a rectangular grid pattern.

Sludge can be discharged to the Paste Plant to be mixed with paste tailings, or can be directly discharged into the paste area of the TDF. Sludge should be co-disposed with tailings as much as possible; a thick layer of sludge in the tailings area should be avoided for stability reasons.

3.6.2.3 Myra Polishing Ponds

The Myra Ponds are fed by water conveyed from the Super Pond. The main function of the 6 polishing ponds is to remove any remaining suspended solids from the effluent prior to discharge. This is achieved by maximizing the retention time in the ponds. The water levels in the ponds can be adjusted, if necessary, by the addition and removal of boards at the outflow structures. Approximately 15% of the final effluent is recycled for mill use via the Reclaim Pump house.

3.6.2.4 Myra Ponds Operating Parameters

pH Monitoring

Automatic pH readings are taken at Myra #1 Pond and recorded every 15 minutes. The accuracy of the pH probes are monitored by the Lime Operator twice per shift. Instrumentation personnel calibrate the probe once every four days. There is no ability to control pH in the Myra Pond system other than through the addition of CO_2 just prior to final discharge. As such pH control is heavily reliant on good practices being maintained at the Super Pond.

Two pH probes are located at the Parshall flume near the final effluent discharge location ("Myra Out"). These probes are wired to the mill control room and displayed on the operator's screen.

Flow Monitoring

An ultrasonic flow measurement device is installed in the Parshall flume at Myra Out. Discharges approaching 100,000 m^3/day must be reported to the Environmental Department. The concrete weir directly upstream of the Parshall flume can be used to take manual measurements of the discharge flow.

Pond Levels

The Myra Ponds should be operated at high levels to maximize settling of solids. During periods of high flows, boards can be removed at the pond decant boxes to maintain high pond levels but reducing the risk of overtopping the ponds.

Final Effluent Quality

Final effluent quality must be maintained at all times. Performance of the treatment system is largely a function of pH control, so sufficient lime must be added to remove the metals. Since the sludge is primarily composed of metal hydroxides, sludge carry-over can result in high suspended solids and high metal concentrations. Carry-over of sludge may be a problem during high flow events, or when the ponds have reduced retention time, the result of excessive sludge build-up.

Pond Cleaning

Regular pond cleaning is essential to prevent excessive carry-over of solids. The Myra Ponds, with the exception of Pond #1, can be isolated for cleaning by blocking off flows to the pond to be cleaned. Pond #1 must be cleaned during normal operations.

Sludge Disposal

Sludge can be discharged via a dedicated line to the Paste Plant, to be mixed with paste tailings, or can be directly discharged into the paste area of the TDF. Sludge should be co-disposed with tailings as much as possible.

3.6.3 Regular Monitoring Requirements

The Environmental Department is responsible for effluent quality monitoring on a daily, weekly, monthly and quarterly basis. Monitoring results are reported to the BC Ministry of Environment and to Environment Canada. Any permit excursion must be reported immediately. The Mill and Surface Manager is responsible for tailings disposal and water treatment, and is required to ensure that regular inspection rounds are completed and accurately recorded. The Water Treatment

Report sheet (Appendix III) is to be completed by the Lime Operator for each shift. These sheets are stored in the Mill Shift Supervisor's office.

In addition to items listed on the inspection sheet, a regular tour of the Water Treatment System should include (but not necessarily be limited to) the following:

- Super Pond - possible leaks from sludge line, liner tears, flump pump operation, sludge build-up, pond level, debris build-up on screens, mix tank function, volume and pH of inputs to ditch.

- Myra Ponds - leaks from sludge lines, pond levels, gland water supply to reclaim pumps, clarity of water, any unusual conditions, Myra/HW sump function.

- Lime slakers - system operation, condition of piping, feed to mill and/or ditch.

The objective of a regular tour is for the operator to know the status of the various systems at any time during his shift and to be aware of any abnormalities or changing conditions. A number of pipelines and facilities are located in areas where failures or malfunctions could have immediate environmental consequences (e.g. spills into Myra Creek), as such, the importance of regular inspections cannot be overstated. Early detection of any problem, or potential problem, is vital.

3.6.4 Upset Conditions and Responses

3.6.4.1 High Flows

Significant rainfall is the most likely event to cause upset to the water treatment system. This may lead to:

- significantly increased flows

- flows with reduced pH levels and higher metal concentrations

- an increased use of lime to maintain pH levels

- an increase in suspended solids due to reduced settling time/capacity

Section **3.3.9** "Heavy Rainfall" details the actions to be taken.

It is important that good notes be kept on what emergency steps were taken. These notes may help in formulating responses to similar future problems. Notes are also essential in the event that an emergency needs to be reported to any of the Regulatory Agencies.

3.6.4.2 Insufficient Lime

If the automatic lime addition system is not adequate to treat the water (high volumes of low pH inputs), the manual addition of lime from the slakers to the Super Pond ditch should be employed. The pH probes at the mix tanks should be carefully monitored to prevent any over-correction. In the event of a limited supply of lime on site, the water treatment system will be given priority.

3.6.4.3 Pump Failures

The Pumphouse #4 is equipped with 3 pumps (1 lead and 2 back-up). In the event all three pumps should fail, all 5 drain valves should be closed to eliminate flow to the pumphouse. The Environmental Department should be notified before drain closure.

3.6.4.4 Power Failures

A power failure could shut down Pumphouse #4 and/or the lime silos. To prevent flooding of Pumphouse #4, manually close all drains. Maintain lime feed by direct discharge from the slaker tanks into the Lynx ditch.

After safety considerations (power supply to the mine hoist and air supply), power supply to the water treatment system must be given priority. After a total failure, power will be restored on a priority basis.

3.6.4.5 Spills

Any spill of contaminated water into the receiving environment should be reported to a supervisor and to the Environmental Department. If Environmental personnel are not available, water samples must be taken by attending personnel. A one liter sample every two hours is usually appropriate. Samples should be taken directly from the spill source. If the spill is discharging into Myra Creek, samples should also be taken ~25 m upstream and downstream of the spill entry point. Care must be taken not to contaminate the samples. Sample bottles must be labeled with date, time, location and sampler. Spill Response Stations have been strategically established across the site and are stocked with the necessary sampling kit – additional supplies can be located at the Spill Response Centre outside the Environmental Office at the Lynx buildings. Alternatively, the Mill Shifter may provide clean sampling bottles.

3.6.4.6 Pipeline Failures

In the event of a pipeline failure, flow from the pipe must be contained and the flow shut off if possible. Such an event is considered a spill, and should be treated accordingly. Repair should be completed as soon as possible.

3.6.5 Legal Aspects

3.6.5.1 Legislation

The following Acts govern water treatment, spills and permit regulations:

a. Fisheries Act (Federal)

b. Canadian Environmental Protection Act (Federal)

c. Waste Management Act (Provincial)

All three Acts carry provisions for penalties ranging up to $1,000,000 per day for unauthorized discharges or spills of hazardous products and one year jail terms for responsible individuals. Any employee can be considered a "responsible individual".

3.6.5.2 Permits and Regulations

Effluent quality is governed by two main regulatory agencies: the provincial Ministry of Environment and the federal Environment Canada department. The provincial permit regulations are outlined in the effluent permit PE-06858, issued under BC's Waste Management Act. It is enforced through Environmental Protection Officers. The federal regulations are outlined in the Metal Mining Effluent Regulations (MMER), issued under the Fisheries Act and enforced by Environmental Inspectors.

Further information and documentation can be found in the Environmental Department offices.

3.6.5.3 Violations

The regulations noted above contain conditions that must be adhered to at all times. Since the issuance of a permit is governed by legislation, a violation of a permit is also a violation of the applicable law.

In addition to effluent, the Waste Management Act also covers disposal and storage of other hazardous wastes. Under this Act, deposition of pond sludge, ore, tailings, pyritic waste rock, concentrates and reagents are considered potentially detrimental to the environment and require special handling and disposal procedures. Violation of a permit or regulation could result in a penalty ranging from a ticket to a court order.

3.6.5.4 Spills

A spill is any unauthorized discharge of a product considered hazardous (Transportation of Dangerous Goods Act) or otherwise governed by a permit. This includes: contaminated water, pond sludge, tailings, backfill, diesel fuel, reagents, laboratory acids in bulk, gasoline, propane, waste oils, lime, concentrates, etc… Any accidental spill of such materials must be reported immediately. A failure to report in due time may result in a double charge, one for the spill and one for failing to report. The Environmental Department is responsible for informing the proper authorities in a timely manner. This department must, therefore, be notified as soon as possible in the event of all spills.

3.6.5.5 Liabilities

Nearly all environmental legislation contains provisions for charging companies as well as individuals. Individuals are most at risk if they fail to follow procedures, and are deemed negligent. An individual can also be held liable for not reporting a spill even if they are not directly responsible for the spill.

3.7 Safety and Security

3.7.1 Site Access Limitations

NMF's ability to control site access is limited by its location within a provincial park. A public highway runs through the mine site and provides access to park trails. Park visitors are not authorized to travel off the main road. Such access points are designated with "Authorized Personnel Only" signs. Mine visitors are required to sign in and sign out at the First Aid building. They are also required to participate in a safety and environmental orientation every 6 months.

3.7.2 Personal Protective Equipment (PPE)

NMF maintains strict PPE requirements for working at the mine site. All employees, contractors and visitors are required to use the following equipment:

- Hard hat
- Safety glasses with side-shields
- High visibility reflective vest or coveralls with reflective tape
- Steel toe boots with metatarsal guards
- Seat belts when traveling in a vehicle or other mobile equipment
- Gloves, hearing protection and dust/gas masks must also be worn when appropriate.

3.7.3 Work Place Hazards Related to Tailings and Water Treatment

While there are few toxicity hazards related to working with the tailings and untreated effluent, it is advisable to wear gloves and/or wash your hands after working in direct contact with either substance. Physical hazards to be aware of while working around the tailings and water treatment facilities include:

- Slippery liner around the Super Pond – the orange netting placed on the liner at various locations is to aid in self-rescue should someone slip into the pond.
- Equipment such as trucks, loaders, excavators and other vehicles moving along the network of roads in and around the water treatment facility and TDF.
- Rough and uneven roads with sharp rocks make it necessary to travel slowly as road conditions dictate. Conditions deteriorate during winter with snow and ice build-up.
- Uneven walking surfaces require extra precaution, especially during winter and at night.
- Wildlife - due care and attention must be exercised when working within their vicinity.

As site conditions are constantly changing, exercise caution and keep a focus on safety.

3.7.4 Security Patrols

There is no formal security in place at NMF. First Aid personnel conduct routine "fire-watch" patrols, particularly at nights and weekends. It is the responsibility of all NMF employees to question any unauthorized vehicles or persons in restricted areas of the site in a courteous and respectful manner. Most likely this will be a park visitor requiring some directions.

3.7.5 Signage, Fencing and Gates

Signage is in place around the mine to help mine personnel and park visitors. A "Strathcona-Westmin Park" info board is located at the entrance of the mine site. Information can also be obtained from personnel in the First Aid building.

There is no fencing located on site to restrict access. A gate restricts access on the Tennent road.

3.7.6 Workplace Safe Operating Procedures

All mines in British Columbia are subject to the Mines Act. Where activities are not covered by this legislation, it is the responsibility of the Mine Manager through the Safety Department to compile existing procedures and to create new procedures where required. Procedures are generally available through supervisors or the Safety Department.

3.8 Documentation and Reporting

3.8.1 Documentation

Operational performance indicators are recorded in the following ways: Water Treatment Report, Paste Plant Operator's Report, Control Room Operator's log book and the Mill Shifter's log book.

Copies of the Water Treatment Report and the Paste Plant Operator's Report are located in the Mill Shifter's office.

The log books, maintained in the Control Room and the Mill Shifter's Office, record daily activities including alarms, equipment failures and other operational aspects. It is important to detail all unusual observations.

3.8.2 Reporting

All operating performance information is to be reported to the Mill Shifter. If all performance indicators are within normal operating ranges, the information is captured on the daily reports. If operational maintenance is required, the operator on duty must fill out a work order detailing the issue. This is submitted to the Mill Shifter who in turn submits it to the Mill Maintenance Planner. If significant changes in operating conditions are noted, the operator must contact the Mill Shifter, as well as recording appropriate comments on the report sheet. If a spill has occurred

a Spill Report form (Appendix III) must be filled out and forwarded to the Environmental Department.

4.0 Maintenance

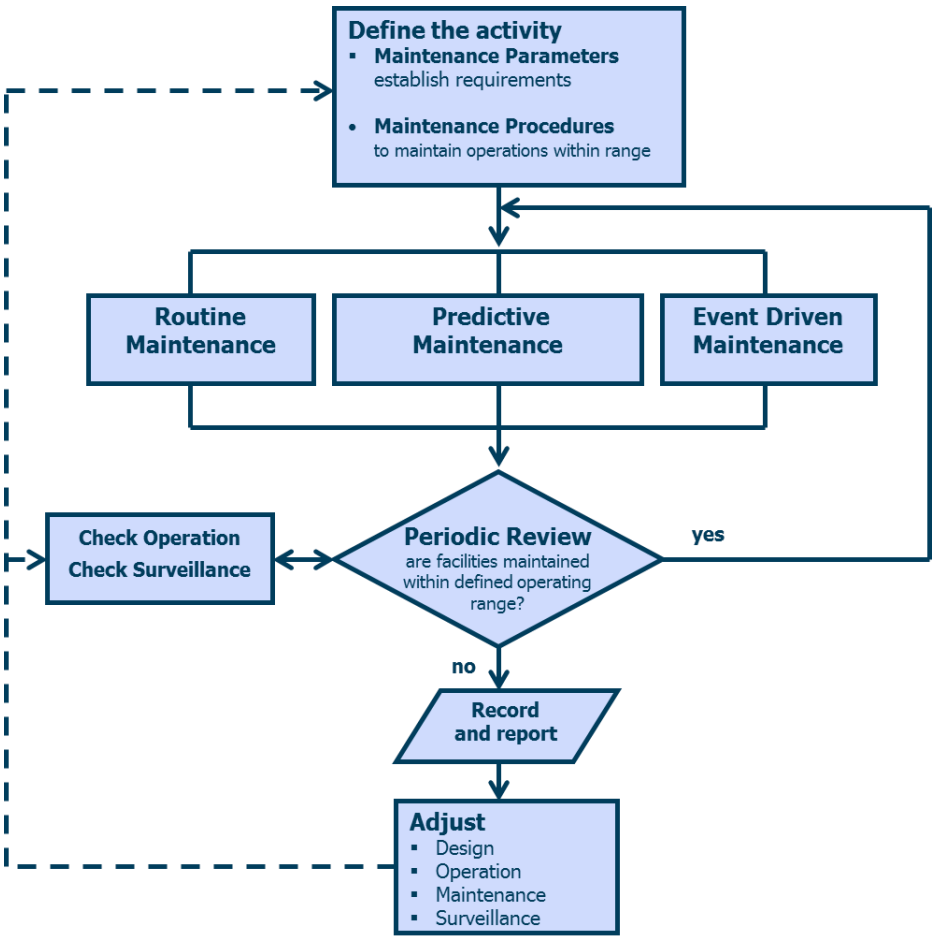
4.1 Objective

The maintenance program for the TDF, the Lynx TDF and the Water Treatment System is designed to address routine, predictive and event-driven maintenance for all civil, mechanical, electrical and instrumentation components of these facilities.

The maintenance program identifies key maintenance parameters and procedures to ensure that the individual components of a facility are maintained in accordance with performance criteria, sound operating practices, company standards and legislative requirements.

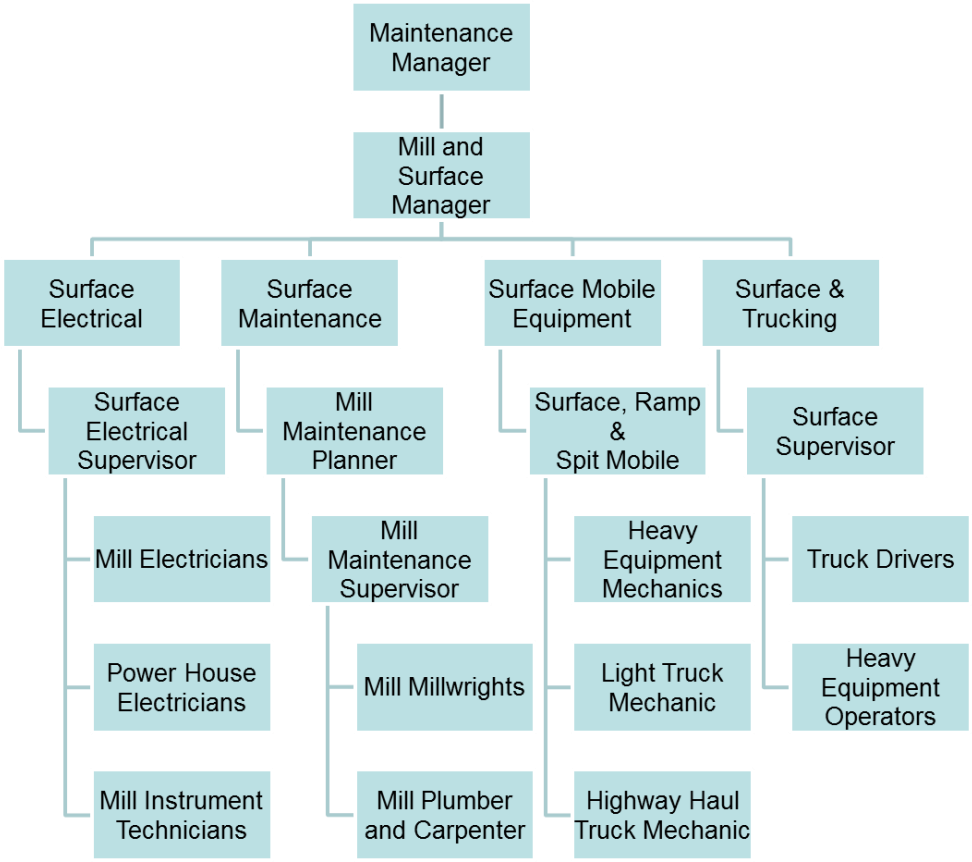
4.2 Maintenance Organizational Charts

Figure 4-1 Maintenance Flowchart



(Ref: Mining Association of Canada, Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Management Facilities)

Figure 4-2 Maintenance Personnel Organizational Chart



4.3 Routine and Predictive Maintenance

Routine maintenance is managed through the SAP software system. This system schedules and tracks all preventative maintenance tasks (PMs). From the PMs the system will generate work orders. This system also manages parts inventories, direct charges to suppliers for non-stock items and services, payroll and warehouse management.

For each equipment number associated with the TDF and Water Treatment System, existing PMs can be called up in the SAP system. Any additions or alterations to PMs are to be made through the Mill Maintenance Planner.

4.3.1 Prioritization

Prioritization of PMs is managed through scheduling by the Mill Maintenance Planner. Routine tasks are prioritized during a weekly maintenance planning meeting. The Mill Maintenance Planner organizes the priorities into a maintenance plan for the following week. The schedule is organized by day and lists the estimated number of man hours to complete each task.

4.3.2 Material and Equipment Availability

Materials and equipment are divided into two categories: stock items and non-stock items. Stock items are part of the warehouse inventory. Non-stock items must be ordered on an as-needed basis directly from suppliers.

Stock items required to perform PM's are requisitioned from the warehouse by the millwright tasked with the PM. Procedures for obtaining stock items can be found in the SAP Training Manual. Materials are linked to the equipment numbers associated with each piece of equipment.

4.3.3 Maintenance Action Plans

Maintenance action plans for all surface facilities are put together by the Mill Maintenance Planner. These plans are reviewed at regularly scheduled planning meetings. These meetings facilitate the coordination, scheduling and allocations of all necessary resources for scheduled PM's and other non-regular maintenance work.

4.3.4 Documentation of Maintenance Undertaken

Documentation of maintenance is required to track the history of equipment and to plan for future maintenance. All maintenance documentation is handled through the SAP system. After the maintenance plan is issued, the Mill Maintenance Planner issues the necessary Preventive Work Orders from the SAP system. An example of a Preventive Work Order is illustrated in Figure 4.3.

The Preventive Work Orders are given to the millwright tasked the specified work as per the maintenance schedule. The millwright performs the specified work and records the actions taken as well as any observations of further maintenance that may be required. The completed Preventive Work Order is returned to the Maintenance Planning Department so that the Mill Maintenance Planner can enter notes and observations into SAP. A hard copy is also filed by Maintenance Planning.

Figure 4-3 Example of Preventative Work Order

PREVENTIVE WORK ORDER

nvi MINING LTD MYRA FALLS OPERATIONS

P-697

Equipment description and component	
Identification no.	Environment
Group	Environment
Sub-Group	
Description	
Location	

Work order codes and specifications			
Trade code		Foreman	

Importants dates			
Planned	5/31/2007 12:00:00 AM	Last maintenance	
Estimated time	0.00 Hrs	Employee Nbr	1
Down date		Restart date	

Action code	MMER Toxicity sampling-pm

Tasks

1 To be done in conjunction with MMER Water Quality Monitoring and Effluent Characterization PM ☐

2 As per Environmental Procedure manual. ☐

Notes: To be done in conjunction with MMER Water Quality Monitoring and Effluent Characterization PM

Problem description / Worked done		
Done by	Time	Date

Page 1 of 1

4.4 Event-Driven Maintenance

The identification for event-driven or unplanned maintenance comes from three sources:

- Observations made during preventive maintenance or routine inspections
- Observations made from operations personnel during routine operations
- Sudden failures of equipment during operations

To ensure that event-driven or unplanned maintenance is addressed in a timely manner a number of steps must be followed. These are detailed below.

4.4.1 Prioritization

Prioritization for event-driven maintenance begins with the Mill Shifter who will assess the situation and the state of the equipment based on a risk and consequence evaluation. The Mill Shifter will call in a millwright or electrician, depending on the nature of the issue, to assist in the risk and consequence assessment if necessary. If further assessment is required, the Electrical Supervisor, Millwright Supervisor and Mill and Surface Manager will be consulted.

4.4.2 Maintenance Team "Call-Out" Procedure

The majority of the mill maintenance team works on a 4x3 shift schedule with half the work force working 10 hour days Monday to Thursday while the other half work Tuesday to Friday. One millwright and one electrician work a 4x4 12 hour day shift and are on call during the night shift, providing for 24 hour coverage. It is the responsibility of the Mill Shifter to call out the 4x4 electrician or millwright during night shift. If additional assistance is required from the maintenance department, millwrights and electricians can be called in from town. This call-out is at the discretion of the Mill Shifter.

4.4.3 Material and equipment availability

Refer to Section **4.3.2**. Should materials be required outside regular warehouse hours, the first aid attendant has access to the warehouse facility. All the usual Guide TI procedures apply.

4.4.4 Maintenance Action Plans

Refer to Section **4.3.3.**

4.4.5 Lock-Out and Safety Procedures/Concerns

4.4.5.1 Lock-Out Procedure

All mechanical and electrical equipment in place for the water treatment facility and for the tailings disposal infrastructure can be locked out. The procedure is as follows:

PURPOSE:

> This program establishes the minimum safety requirements for all locations to ensure the proper deactivation and isolation of/or de-energizing of mechanical, hydraulic, pneumatic, electrical, chemical, and/or radiation energy sources of circuits, equipment, machinery, prime movers, and piping systems. This program provides instructions for the isolation and restoration of equipment and systems to protect personnel from injury and protect equipment from damage in accordance with BC Mining Code sections 4.11.1 to 4.11.7

SCOPE:

> This procedure applies to all employees and/or contractors of NMF.

DEFINITIONS:

Affected Employee: An employee who normally operates or works on or around the equipment being shutdown for servicing and/or maintenance.

Authorized Employee: A knowledgeable/trained employee who has been given the authority and responsibility to lock out a machine or piece of equipment in order to perform servicing or maintenance.

Blocking: The act of putting in place a block, pillar, post, brace or other object for the purpose of preventing the motion of some part, or bracing an elevated part against gravity. It is performed to immobilize components of a piece of equipment, machine or device.

Energized: Connected to an energy source or containing residual or stored energy (electrical, pneumatic, hydraulic, chemical, kinetic or other).

Energy Isolating Device (Control Device): A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control devices are not energy isolating devices.

Energy Source: Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Isolation: Isolation of main energy sources is achieved by securing points of control. Each control must physically cut off the main energy supply to the equipment.

Lockout: The placement of a zero energy lockout device on an energy source, in accordance with an established procedure.

Lockout device: A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in a safe position and prevent the energizing of a machine or equipment or flow of material.

Servicing and/or maintenance: Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines, equipment or systems. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy or hazardous material.

Setting up: Any work performed to prepare a machine, equipment, or system to perform its normal production operation.

Tagout: Placement of a tagout device (Danger Tag) on an energy isolating device, in accordance with the applicable sections of this procedure, to indicate that the energy isolating device and the

equipment being controlled may not be operated until the tagout device is removed. Tagout devices are placed in the same location as lockout devices.

Zero Energy Source: All forms of energy in a machine or system have been controlled or removed and there are no external live energy sources connected.

RESPONSIBILITY:

- It is the responsibility of NMF employees, contractors and sub-contractors to follow this procedure.
- It is the responsibility of NMF supervisors to ensure that this procedure is followed properly by NMF employees, contractors and sub-contractors.

REQUIREMENTS:

- UNAUTHORIZED REMOVAL OF A LOCK OR TAG IS A SERIOUS BREACH OF SAFETY REGULATIONS. DISCIPLINARY ACTION UP TO AND INCLUDING DISCHARGE MAY RESULT FOR VIOLATION OF THE LOCKOUT, TAGOUT AND TRY PROGRAM.
- Before an authorized or affected employee turns off a machine or equipment, the authorized employee shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy. NOTE: Only electricians are permitted to operate disconnect and lock out switchgear loads on 4160 volts or greater.
- The authorized employee must stop the moving parts. A Zero Energy State must be obtained. This alerts supervision to the fact work is being performed and the Lockout, Tagout and Try Program is followed.
- Any hydraulic, pneumatic or gravity stored energy shall be dissipated or contained.
- Energy isolating devices shall be installed if the machine is not already equipped with them.
- All energy isolating devices shall be properly engaged, locked and tagged.
- Isolate the equipment to be worked on by de-energizing circuit:
    - In stopping, use the start-stop station and not the disconnect. Potential electrical hazard can exist when pulling a disconnect under full electrical load (arcing electrical flash).
    - Stand to the right side, face away and use left hand when operating disconnect(s) when energizing or de-energizing in the event of possible explosion due to arching.
- Lockout, Tagout and Try.
    - Start/stop stations are not acceptable, as the main source of power still exists and in any event, the equipment can still be accidentally started.
    - Lock the isolation switch (disconnect) with a multi-locking scissor device and your own personal lock. All persons working on the equipment shall apply their own lock. Under no circumstances lend your lock and key.
- Attempt to restart equipment to verify that the moving parts are stopped, dissipated or contained and therefore safe to work on.
- A tag required to be on the lock shall:

  - Be secure to prevent its accidental removal;
  - State the reason the energy isolating devices are locked and tagged;
  - Show the name of the person responsible for locking and tagging the energy isolating devices; and
  - Show the date on which the energy isolating devices were locked and tagged.
- In the event that work is not completed on your shift, supervision shall apply a Departmental lock to enable you to remove your lock. The next person(s) who continues the work shall apply their locks and tags before beginning work.
- Before lockout or tagout devices are removed and energy is restored to the machine or equipment, procedures shall be followed and actions taken by authorized employee(s) to ensure the following:
  - The work area shall be inspected to ensure that non-essential items have been removed and to ensure that machine or equipment components are operationally intact before electric circuits and equipment are re-energized.
  - Upon completion of the work, the equipment cannot be started until all locks are removed. Thus the need for all to remove their own lock that performed work, so as to ensure everyone is then cleared for a safe start.
  - The work area shall be visually checked to ensure that all employees are positioned such that start-up can be attempted without danger to people.
  - After lockout and tagout devices have been removed and before the machine or equipment is started, affected employees shall be notified that the lockout and tagout devices have been removed.
  - All guards must be replaced
- A lockout should be valid for one shift only; remove locks and tags before you leave the claim. If the job carries over into another shift, make sure the supervisor fills out a tag, in your presence, and places a departmental lock on the switches required to maintain the lockout.

PRESSURIZED EQUIPMENT AND SYSTEMS GENERAL REQUIREMENTS

- Systems or equipment may be pressurized with various media, such as air, gas, steam, and/or hydraulic in the form of water or oil.
- When working on pressurized equipment, the pressurizing source, such as compressors, pumps, boilers, etc., shall be shutdown and locked and tagout out.
- Pipes or lines that convey pressurized substances shall be bled to atmospheric pressure prior to opening the system.
- Once the system has been bled to atmospheric pressure, the pipes or lines shall be disconnected, blinded or closed by valve and locked and tagged out accordingly.

LOCKOUT OF MOBILE EQUIPMENT NO NIGHT SWITCHES

- If the mobile equipment is equipped with a night switch that can be locked then the lock will be put on the switch. If machinery is equipped with a standard night switch, then put switch to the OFF POSITION, remove the NEGATIVE cable from the NEGATIVE battery post and place lock through the clamp. To enable a tradesman to perform inspections and/or repairs to the 12/24V DC systems the lock and tag are to be placed on the starter isolation lock box switch installed on all underground diesel powered mobile equipment.

- In the case of electric hydraulic drills i.e. Gardner Denver jumbos, Atlas Copco jumbo's, Maclean Bolters, Electric long-hole drills, and Diamond drills, the main electric cable connecting the machine to the power source shall be unplugged and tagged.
- On pickup trucks, vans, etc. the key is to be removed from the ignition and a tag placed on the steering wheel.
- Whenever the equipment has a starter button, ensure that the equipment will not start by pushing the button after your personal lock and tag are in position.

DEACTIVATION OF EQUIPMENT HAVING COMBINED / MULTIPLE SOURCES OF ENERGY

- Some equipment may have several sources of energy, such as electrical motors, hydraulic pressure, and may contain hazardous materials.
- Each source of energy shall be deactivated and locked and tagged out accordingly.

LOCK REMOVAL PROCEDURES

- UNAUTHORIZED REMOVAL OF A LOCK OR DANGER TAG IS A SERIOUS BREACH OF SAFETY REGULATIONS. DISCIPLINARY ACTION UP TO AND INCLUDING TERMINATION MAY RESULT FOR VIOLATION OF THE LOCKOUT/TAGOUT PROGRAM.
- Only a supervisor can remove a lock and must follow this procedure.
- This procedure can only be followed in the presence of a worker representative of the Joint Health and Safety Committee. If no worker representative is available, then in the presence of a senior worker.
- Identify equipment requiring power.
- Check all locks for machine and any interlocks that may be present to ensure correct lock(s) are being removed
- Locate employee(s) who have left lock(s) on equipment. If employee(s) is located, then employee(s) is to remove lock if applicable.
- If employee(s) has left for the day, call employee(s) who have left lock(s) on equipment.
- Employee must detail work that has been done and assure their supervisor that work is complete.
- If employee(s) cannot be contacted, the supervisor must conduct a thorough inspection to ensure all work is complete.
- Supervisor inspects the equipment for completion of work and any other possible hazards.
- Supervisor must ensure that the area is clear and all personnel in the area are notified that the lock(s) will be removed and the equipment will start up.
- Complete attached Lock Removal Form (Attachment "A") and file.

TRAINING REQUIREMENTS:

- All NMF employees, who will be performing work where this procedure is required, will be trained on an annual basis on the Lockout, Tagout and Try Procedure.

RECORDS:

- A record of each employee's training shall be retained for a period of their employment.
- Lock Removal Forms retained for a period of one year.

RELATED DOCUMENTATION:

Lock Removal Form

LOCK REMOVAL FORM

When Supervisor Removes a Lock & Tag in the presence of JHSC worker rep:

- Identify equipment requiring power.
- Check all locks for machine and any interlocks that may be present to ensure correct lock(s) are being removed.
- Locate employee(s) who have left lock(s) on equipment. If employee(s) is located, then employee(s) is to remove lock if applicable.
- If employee(s) has left for the day, call employee(s) who have left lock(s).
- Employee must detail work that has been done and assure supervisor(s) that work is complete.
- If employee(s) cannot be contacted, the supervisor must conduct a thorough inspection to ensure all work is complete.
- Supervisor inspects the equipment for completion of work and any other possible hazards.
- Supervisor must ensure that the area is clear and all personnel in the area are notified that the lock(s) will be removed and equipment will start up.

Figure 4-4 Lock Removal Form

Date: _____ Time: _____ Supervisor: _____

Employee's Name: _____ Witnesses: _____

Reason for Removing Lock:

_____

Person(s) Contacted:

_____

Indicate Areas / Machinery Inspected Prior to Cutting Lock:

_____

_____

Follow-up / Contact with Employee:

_____

Additional Safety Precautions Taken:

4.4.5.2 Safety Procedures

A comprehensive list of all safety procedures can be found in the Safety Department. Procedure requests can be made to Safety Department personnel or a supervisor.

4.4.5.3 Safety Concerns

All safety concerns are to be directed to an immediate supervisor. As per the *Health, Safety and Reclamation Code for Mines in British Columbia* all employees have the right to refuse work under the following sections:

- 1.10.1 A person shall not carry out any work or operate any equipment, tool, or appliance if he has reasonable cause to believe that to do so would create an undue hazard to the health and safety of any person.

- 1.10.2 A supervisor shall not knowingly perform or permit a worker to perform work which is, or could create, an undue hazard to the health or safety of any person.

- 1.10.3 A person who refuses to carry out any work or operate any equipment, tool, or appliance, in compliance with section 1.10.1, shall forthwith report the circumstances to his supervisor.

NMF maintains a Joint Occupational Health and Safety Committee (JOHSC). This committee promotes safety at all levels of the organization. Safety concerns brought forward by employees can be discussed by this committee and recommendations made to upper management levels.

4.4.6 Return to Normal Operation

After a shutdown due to maintenance related issues the decision to return to normal mill operations rests with the Mill and Surface Manager or his designate. The Mill and Surface Manager will review the work completed and ensure that it is safe to restart the mill.

After a prolonged shutdown due to non-maintenance related issues, such as a natural disaster, it is the decision of the General Manager to resume operations. However, the Mill and Surface Manager still has the authority to delay the resumption of mill operations until all safety or environmental concerns have been fully addressed.

The Mill start-up and Mill shutdown procedures are detailed in Figure 4.5 and Figure 4.6.

Figure 4-5 Mill Start-up Procedure Sheet

Mill Startup Sheet **Date** _____

Acct		Bcct			
Yes	No	Yes	No		
	x				South tails line from final tails box opened
x				*	Rod mill cooling fan on
x				*	Gland water booster pump on
	x				Conc thickeners cone open, flush water off, U/F pumps on
x				*	Floculant on to conc thickeners
	x				OSA head on
x					Main launder water valve open
x				*	Flotation blowers on
x					Zn Conc pumpbox filled, pump & gland water on
x					Zn regrind feed pumpbox filled, pump & gland water on
x					Zinc conditioner tank filled, pump & gland water on
x					Cu Conc pumpbox filled, pump & gland water on
x					Cu regrind cyclone feed pumpbox filled, pump & gland water on
x					Flotation sumps to final tails
	x				Zn Clnr cells filled, dart valves open in manual
x				*	Zn Clnr cells air and spindles on
	x				Zn Rghr cells filled, dart valves open in manual
x				*	Zn Rghr cells air and spindles on
x				*	Cu Clnr cells air and spindles on
	x				Cu Rghr cells filled, dart valves open in manual
x				*	Cu Rghrcells air and spindles on
x					Head sample return pump and gland water on, pumpbox filled
x					Sample lines flushed - both ways - pumps and gland water on - valves open
x					MIBC main header valve open
					- leave pumps recirculating open back pressure valves
x					CuSO4, Collector and ZnSO4 reagent lines open manually at controllers,
x				*	MIBC pumps on
x		x		*	Reagent controllers output zeroed
x		x		*	Ph controllers output zeroed
x		x			Lime loop on, lime feed pump and gland water on
					- cyclone wash water on
					Regrind pumpboxes filled, pumps and gland water on,
x				*	Regrind mills filled and turned on
					Regrind sumps to circuit
x		x			Regrinds online
x					Rod mill water addition manual valve open
x		x			Primary cyclone feed pump on, gland water on, pumpbox filled
x					Grinding sumps to final tails
x					Crusher water to final tails
x		x		*	Ball mill water addition controllers output zeroed
x		x		*	Ball Mill ground out 20-25 minutes, shut down, motors on
x		x		*	Rod mill water addition controller output zeroed
x		x		*	Rod Mill turned on
x		x			Knelson on, manual water valves open
x		x		*	# 12 conveyor activated

Figure 4-6 Mill Shutdown Procedure Sheet

Mill Shutdown Sheet

Date _____

Acct		Bcct		
Yes	No	Yes	No	
x		x		* # 12 conveyor ran empty
x		x		Knelson down, manual water valves closed
x		x		* Rod Mill ground out for 10-15 minutes, shut down, motors off
x		x		* Rod mill water addition controller output zeroed
x		x		* Ball Mill ground out 20-25 minutes, shut down, motors off
x		x		* Ball mill water addition controllers output zeroed
x				Crusher water to final tails
x				Grinding sumps to final tails
x		x		Primary cyclone feed pump down, gland water off, pumpbox drained
x				Rod mill water addition manual valve closed
x		x		Regrinds bypassed
				Regrind sumps to circuit
x				* Regrind mills ground out, shut down
				Regrind pumpboxes drained, pumps and gland water off,
				- cyclone wash water off
x		x		Lime loop flushed, lime feed pump and gland water off
x		x		* Ph controllers output zeroed
x		x		* Reagent controllers output zeroed
x				* MIBC pumps off
x				CuSO4, Collector and ZnSO4 reagent lines closed manually at controllers,
				- leave pumps recirculating open back pressure valves
x				MIBC main header valve closed
x				Sample lines flushed - both ways - pumps and gland water off - valves closed
x				Head sample return pump and gland water off, pumpbox drained
x				* Cu Rghrcells air and spindles off
	x			Cu Rghr cells drained, dart valves open in manual
x				* Cu Clnr cells air and spindles off
x				* Zn Rghr cells air and spindles off
	x			Zn Rghr cells drained, dart valves open in manual
x				* Zn Clnr cells air and spindles off
	x			Zn Clnr cells drained, dart valves open in manual
x				Flotation sumps to final tails
x				Cu regrind cyclone feed pumpbox drained, pump & gland water off
x				Cu Conc pumpbox drained, pump & gland water off
x				Zinc conditioner tank drained, pump & gland water off
x				Zn regrind feed pumpbox drained, pump & gland water off
x				Zn Conc pumpbox drained, pump & gland water off
x				* Flotation blowers off
x				Main launder water valve closed
	x			OSA head off
x				* Floculant off to conc thickeners
	x			Conc thickeners cone closed, flush water on, U/F pumps off
x				* Gland water booster pump off
x				* Rod mill cooling fan off
	x			South tails line from final tails box closed

4.4.7 Documentation of Maintenance Undertaken

Documentation of event-driven maintenance is recorded in two forms: log books and corrective work orders.

Three primary log books record events and maintenance required or performed. These are: the Shifter's Log, the Shift Millwright's Log and the Control Room Operator's Log. These log books are found in the Mill Shifter's office, the Millwright's office and the Control Room.

Corrective work orders are similar to preventive work orders (Figure 4.3). An example of a corrective work order is given in Figure 4.7. Corrective work orders are generated by the Mill Maintenance Planner based on a work request form filed by an operator or a maintenance worker. While the maintenance work is being completed, observations and actions taken are noted on the corrective work order form. Once the work is complete and the job has been inspected, the worker signs off that the work is complete. The work order is then returned to the maintenance planning department for filing.

Figure 4-7 Example of Corrective Work Order

CORRECTIVE WORK ORDER

nvi MINING LTD MYRA FALLS OPERATIONS

GUIDE TI

C - 1357

Equipment description and component	
Identification no.	75003
Group	Stationary
Sub-Group	Underground
Description	H-W 26L CONVEYOR/DRIVE SYS/DIVERTER GATE G9
Location	14

Work order codes and specifications			
Requester	HINGSBURGER, LARRY J.	Priority	High
Trade code	MILLWRIGHT	Accounting code	1-63-075-000-03
Employee		Estimated time	0

Importants dates		Others opened work orders	
Issued	6/12/2007 1:29:33 PM	P - 981	
Requested		P - 865	
Planned	6/18/2007 12:00:00 AM	-	
Down date		Restart date	

Notes - Equipment

Tasks

replace "A" loading pocket liners as required

Problem description / Worked done

Done by	Time	Date

Page 1 of 1

5.0 Surveillance

5.1 Objective

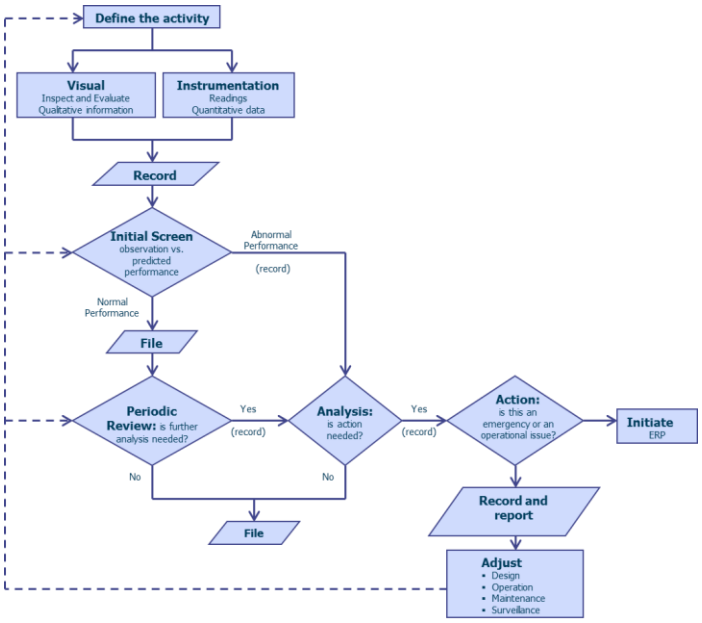
The objective of the surveillance program is to:

- Monitor the operation, including all safety and environmental aspects of the tailings and water management facilities;
- Promptly identify and evaluate deviations from the norm that affect or may affect the operational safety, structural integrity and/or environmental performance of the facilities;
- Report significant observations for response; and
- Ensure that personnel are aware of the need to report and act on observed departures from the norm.

All personnel are responsible for surveillance, in as much as it forms a routine part of daily activity to be aware of the one's work environment. In addition to this are surveillance-specific monitoring routines, as outlined in Figure 5-1.

5.2 Surveillance Flowchart

Figure 5-1 Surveillance Flowchart



(Ref: Mining Association of Canada, Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Management Facilities)

5.3 Surveillance Parameters

5.3.1 Typical Surveillance Parameters

A number of key performance indicators help predict the performance and expected behavior of the facilities.

5.3.1.1 Visual Observations – Tailings Disposal Facilities

Visual inspections are fundamental in ensuring that the facility is operating as expected. Visual inspections can quickly identify unusual conditions. Specific parameters include the following:

- Water elevation in tailings areas - the surface water elevation should be kept below 1 meter of the spillway invert. This 1 meter is designed to hold the flood waters from a 1:200 year storm.
- Settlement or holes in embankments or benches – may indicate sub-surface subsidence and potential contaminated groundwater flow.
- Sinkholes in tailings area – could indicate sub-surface flow of tailings.
- Diversion ditch checks – observe for cracks in the shotcrete, debris, bank failure, overtopping or culvert blockages.
- Pipeline integrity – check for leaks
- Embankment integrity
- Water flowing from Pumphouse #4 – indicates pump failure
- Water color in Myra Creek – turbid water may indicate a TDF upset

5.3.1.2 Visual Observations – Water Treatment System

Visual observations of the Water Treatment System include the following components:

- Super Pond Input Ditch – check for cracks in the shotcrete lining, debris build-up, ensure inflow from input pipes are directed into the ditch
- Super Pond Mix Tanks – pH readings, agitators functioning, lime addition checks
- Super Pond - Flump checks (operation, leaks), water clarity, sludge level.
- Super Pond Liner – check for rips, holes or materials that may potentially damage the liner (boulders, steel…)

- Super Pond Discharge – check that flow through screen is not obstructed, weir level, and emergency overflow structure is free and clear.

- Super Pond Discharge Pipes – no leaks in pipes, and bridges in good shape.

- Myra Ponds – water clarity/color, freeboard, pHs, sludge levels.

- Myra/HW Sump and #25 Sump – pumps are functional, water level, free of debris.

- Myra Ponds final discharge (Myra Out) – pH below 9.5 (9.0 is ideal), water clarity, water flow volume, CO_2 tank level, CO_2 sparger functional.

5.3.1.3 Instrumentation – Tailings Disposal Facilities

Key components of TDF surveillance instrumentation include:

- Piezometers – measure pore pressures in the tailings facilities. Rising pore pressures could indicate a drainage problem or saturated tailings.

- Survey monuments along the embankment to measure any settlement/movement.

- Piezometer Seismic Triggers – record ground acceleration due to seismic activity. Seismic trigger are triggered during earthquakes; help monitor for potential liquefaction of tailings and failure of the TDF.

- Weather station – continuous automatic hourly monitoring for temperature, precipitation, wind speed and direction, humidity and net radiation. Data is downloaded via wireless radio network.

- Pipeline flow and pressure - manual and automatic pressure gauge on the paste discharge line. The automatic gauge is read in the Paste Plant and the Control Room.

- Water level sensor in Pumphouse #4 - controls pumping rates and transmits to Mill Control.

- Flow meter in Pumphouse #4 - monitors flow volumes pumped.

- Diversion ditch flow meter – indicates diversion ditch flow volumes.

- Automatic water sampler – collects water for analysis every 3 hours. Indicates water quality in Myra Creek at the downstream end of the TDF. Water quality can be correlated with the operation of the Inner and Outer drains and/or Pumphouse #4 functioning.

- Instrumentation has yet to be installed for surveillance of the Lynx TDF.

5.3.1.4 Instrumentation – Water Treatment System

Key components of Water Treatment System instrumentation include:

- pH probes - monitor the pH at several stages of the water treatment process. Two probes are located below the mix tanks at the head of the Super Pond. These control automatic lime addition. Other probes are located at the Super Pond discharge, the Myra #1 Pond discharge, Myra/HW sump, and two at the final discharge location. One of the pH probes at the final discharge location controls the carbon dioxide addition. The pHs can be viewed in real-time in the control room and are recorded into a mill database.

- Water level monitor - ultrasonic water level sensors are found at the final discharge point and at Myra/HW sump. A high water float connected to an audio alarm is in place at the Super Pond and at #25 sump. High level alarms are sounded in the control room.

5.4 Surveillance Procedures

5.4.1 Monitoring Schedule and Summary Checklist

Table 5-1 Monitoring Schedule

Monitoring Task		Daily	Weekly	Monthly	Quarterly	Annually	Event Driven	Responsibility
Visual Inspections								
	Tailings & Water Treatment Inspection	●						Lime Operator
	TDF Inspection		●					Environment
	Ponds Inspection			●				Environment
	Diversion Ditch			●				Surface Supervisor
	Post-Earthquake Inspection						●	Environment
	Post-Flood Inspection						●	Environment
Instrument Monitoring								
	Hut A Vibrating Wire Piezometers			●				Environment
	Hut B Vibrating Wire Piezometers			●				Environment
	Hut C Vibrating Wire Piezometers			●				Environment
	Flow meters: MC and Diversion ditch			●				Environment
	Monument Survey				●			Survey
Third Party Inspections								
	Annual Stability Review of TDFs					●		Engineer-of-record

5.4.2 Visual Monitoring and Routine Inspections

Inspection forms have been created for each of the six inspections in the monitoring schedule above. Copies of these inspection forms are included in Appendix III. These forms are updated on an as-needed basis.

5.4.3 Instrumentation Network

This section outlines the network of monitoring instrumentation for the TDF and the Water Treatment System. Historical data for each instrument is presented in Appendix VII.

5.4.3.1 Piezometers

The site has implemented extensive instrumentation to monitor the performance of the TDF. Piezometer networks are laid out in two parallel planes (Planes A & C) through the perimeter embankment and in one plane (Plane B) that runs along the paste berm, perpendicular to Plane A and Plane B. The piezometer monitoring equipment is stored in the Environmental office, which also retains manuals on the detailed piezometer monitoring procedures.

The piezometer huts are wirelessly connected via 900 Mhz Campbell Scientific Instruments radios to the NMF computer network. The connection point is the H-W server room where a Campbell Scientific NL-100 network interface ties the radios to the network. Data is downloaded using Loggernet software. Daily automatic downloads are scheduled between 12:30-13:00, after each hut has recorded the noon readings. The data files reside in H:\ENV LAB\TDF, Piezos, Ponds\Piezo Monitoring & TDF inspections\Piezo A - data. The files are comma-separated .dat files.

If wireless downloads are not possible due to radio communication failure, see detailed manual download procedure in Appendix III.

The pneumatic piezometers (located in Huts A and C), are no longer monitored as per the engineer-of-record.

<u>New piezometer installations:</u>

- Order piezometer(s) and associated components from RST Instruments knowing specifics of application, distance of lead and whether lead will be wired into a permanent datalogger station, a temporary hut or remain loose;
- Piezometers are installed as directed by the geotechnical consultants;
- Calibrate piezometer as specified;
- Install into prescribed location, with tip at appropriate elevation;
- Care must be taken to avoid exposing newly installed piezometers to freezing temperatures;
- Have exact location and piezometer tip elevation checked by Survey group.

<u>Seismic Trigger Adjustments:</u>

The seismic triggers (inside Huts A & C) have occasionally been set to higher values to prevent excessive data generation caused by heavy equipment setting off the units. During normal operations, they are set at 0.3 g. Adjustments are usually made by the Environmental Department. It is essential to re-set the triggers upon completion of such a program. Detailed instructions to alter the trigger settings can be found in the seismic trigger ‘mitigator’ manual or in the Environmental Procedures Manual, both of which are located in the Environmental Office.

5.4.3.2 Survey Control

Survey control is conducted quarterly, weather permitting, by NMF Engineering Department on the perimeter embankment and the paste berm of the TDF. Results are sent to the Engineer-of-Record (AMEC). No routine survey control is conducted on the water treatment facility.

Routine surveying of the surface movement monuments on the exterior slope of the tailings embankments is used to monitor embankment movements. Settlement of the embankment raises can be expected, with the largest values occurring near the embankment crest. Settlement amounts have historically decreased with elevation towards the embankment toe.

For a list of the locations of survey stations and monument locations refer to Figure 2.14 in Section **2.3.3**. An example of the spreadsheet used to record the data from surveying the monuments is given in Figure 5.3.

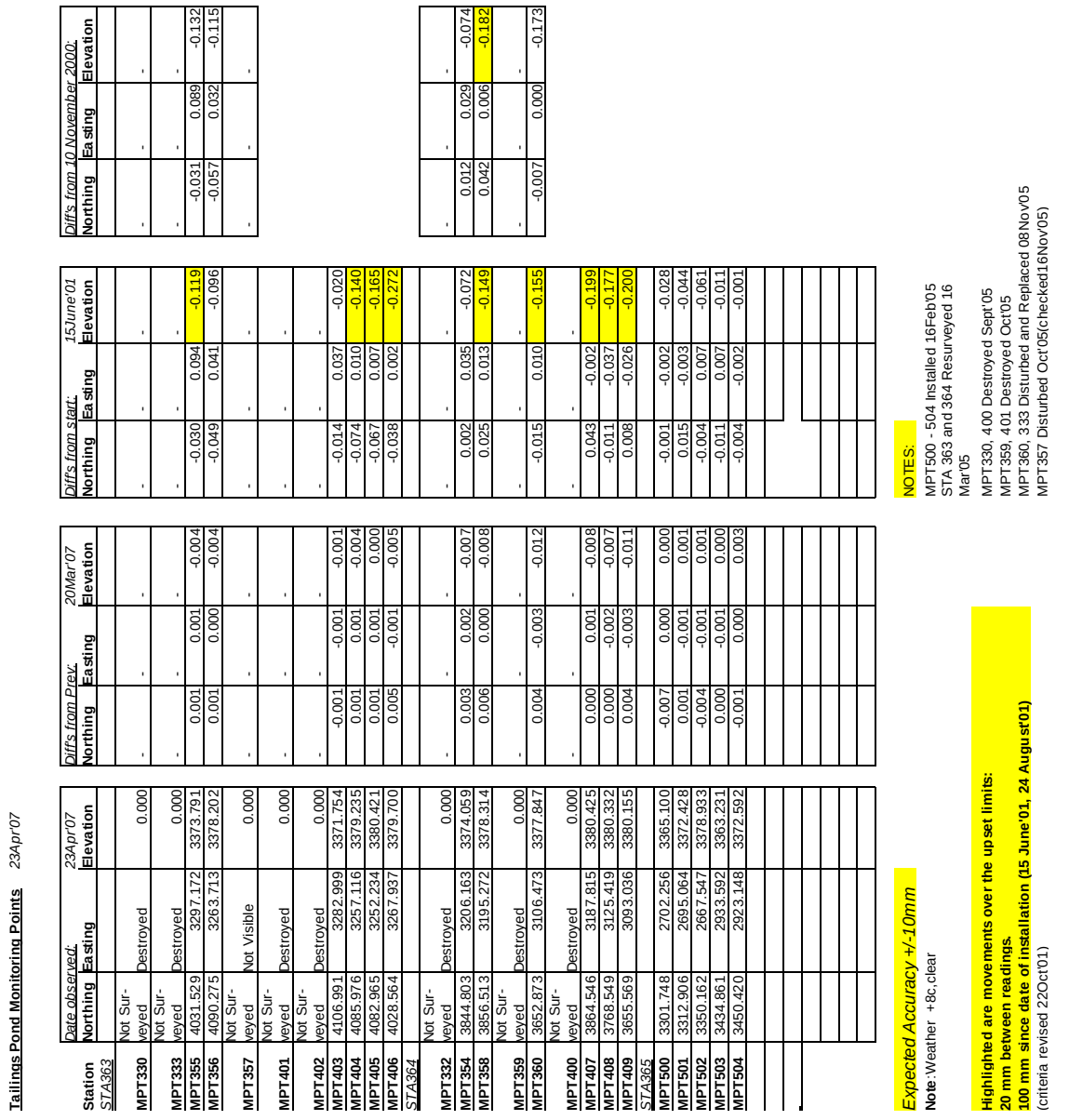
5.4.3.3 Water Treatment System Instrumentation

Water treatment system instrumentation consists of pH probes and ultrasonic water level indicators. These instruments are monitored continuously in the control room at the mill through the FOXBORO I/A computer system. Manual pH readings and cleanings are performed daily by the lime operator to ensure accurate readings.

The Myra Out flume water level indicator produces instantaneous effluent flow volumes in m^3. These flow volumes are totalized on the control room display to produce a daily flow volume in m^3/day. The daily flow volume is recorded on the nightshift Tailings and Water Treatment Report by the Lime Operator.

A flow meter is located in the Lynx Diversion Ditch.

Figure 5-2 Survey Monument Data Recording Spreadsheet



Tailings Pond Monitoring Points *23Apr'07*

Station	*Date observed:* Northing	Easting	*23Apr'07* Elevation	*Diff's from Prev.:* Northing	Easting	*20Mar'07* Elevation	*Diff's from start:* Northing	Easting	*15June'01* Elevation	*Diff's from 10 November 2000:* Northing	Easting	Elevation
STA363												
MPT330	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-	-	-	-
MPT333	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-	-	-	-
MPT355	4031.529	3297.172	3373.791	0.001	0.001	-0.004	-0.030	0.094	-0.119	-0.031	0.089	-0.132
MPT356	4090.275	3263.713	3378.202	0.001	0.000	-0.004	-0.049	0.041	-0.096	-0.057	0.032	-0.115
MPT357	Not Surveyed	Not Visible	0.000	-	-	-	-	-	-	-	-	-
MPT401	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-			
MPT402	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-			
MPT403	4106.991	3282.999	3371.754	-0.001	-0.001	-0.001	-0.014	0.037	-0.020	-	-	-
MPT404	4085.976	3257.116	3379.235	0.001	0.001	-0.004	-0.074	0.010	-0.140	0.012	0.029	-0.074
MPT405	4082.965	3252.234	3380.421	0.001	0.001	0.000	-0.067	0.007	-0.165	0.042	0.006	-0.182
MPT406	4028.564	3267.937	3379.700	0.005	-0.001	-0.005	-0.038	0.002	-0.272			
STA364												
MPT332	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-	-	-	-
MPT354	3844.803	3206.163	3374.059	0.003	0.002	-0.007	0.002	0.035	-0.072	0.012	0.029	-0.074
MPT358	3856.513	3195.272	3378.314	0.006	0.000	-0.008	0.025	0.013	-0.149	0.042	0.006	-0.182
MPT359	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-	-	-	-
MPT360	3652.873	3106.473	3377.847	0.004	-0.003	-0.012	-0.015	0.010	-0.155	-0.007	0.000	-0.173
MPT400	Not Surveyed	Destroyed	0.000	-	-	-	-	-	-			
MPT407	3864.546	3187.815	3380.425	0.000	0.001	-0.008	0.043	-0.002	-0.199			
MPT408	3768.549	3125.419	3380.332	0.000	-0.002	-0.007	-0.011	-0.037	-0.177			
MPT409	3655.569	3093.036	3380.155	0.004	-0.003	-0.011	0.008	-0.026	-0.200			
STA365												
MPT500	3301.748	2702.256	3365.100	-0.007	0.000	0.000	-0.001	-0.002	-0.028			
MPT501	3312.906	2695.064	3372.428	0.001	-0.001	0.001	0.015	-0.003	-0.044			
MPT502	3350.162	2667.547	3378.933	-0.004	-0.001	0.001	-0.004	0.007	-0.061			
MPT503	3434.861	2933.592	3363.231	0.000	-0.001	0.000	-0.011	0.007	-0.011			
MPT504	3450.420	2923.148	3372.592	-0.001	0.000	0.003	-0.004	-0.002	-0.001			

Expected Accuracy +/-10mm

Note: Weather +8c, clear

Highlighted are movements over the upset limits:
20 mm between readings.
100 mm since date of installation (15 June'01, 24 August'01)
(criteria revised 22Oct'01)

NOTES:
MPT500 - 504 Installed 16Feb'05
STA 363 and 364 Resurveyed 16 Mar'05
MPT330, 400 Destroyed Sept'05
MPT359, 401 Destroyed Oct'05
MPT360, 333 Disturbed and Replaced 08Nov'05
MPT357 Disturbed Oct'05(checked16Nov'05)

5.4.4 Procedures for Required Action in the Event of Sudden Change

Changes in the operating conditions of the tailings facilities and the water treatment system can be sudden, can occur at any time and can be the result of any number of causes. Timely reporting of abnormal conditions will help in identifying their root causes. Some changes may include:

- Abnormal Water Levels
- Increased Seepage
- Crest Drops
- Slumping
- Cracking
- pH Change

Abnormal Water Levels - TDF

In the event that high water levels are observed in the TDF the observer is to report immediately to the Mill Shifter and the Environment Department. High water level thresholds are as follows:

- TDF APA Area – water is less than 1 m below the emergency spillway invert.
- TDF Strip Area – water is within 20 m of the perimeter embankment
- Sand Reclaim Area – water is within 10 m of the perimeter embankment

After notification, the first course of action is to check that decants are functioning properly and are not blocked by debris. If the decants are confirmed clear, the following steps are to be followed, in order:

1. Shut off the flow from the backfill overflow discharge
2. Shut down the mill
3. Shut down the paste plant
4. Set up emergency 6” diesel pump and pump excess water to a functional decant
5. The Environmental Department must prepare for the controlled release of water through the Emergency Spillway. This involves ensuring that the invert for the spillway is clear and that the BC Ministry of Environment is notified in advance of the release. If a discharge is imminent, sampling must be done prior to the release.

Abnormal Water Levels – Lynx TDF

An abnormally high water level occurs when the water level is less than 1.5 m below the berm crest. This must be reported immediately to the Mill Shifter and to the Environmental Department. After notification, the first step is to check that the reclaim pond pump is functioning properly and is not blocked with debris. If the pump is confirmed functional, the following steps are to be taken:

1. Set up an emergency 6" diesel pump and pump excess water over the berm to the Super Pond Input Ditch.

2. Ensure that the Diversion Ditches are functional.

It will be the decision of the Mill Shifter under the guidance of the Environment Department to determine the necessary level of response based on conditions at the time.

Abnormal Water Levels – Super Pond

High water levels in the Super Pond must be reported immediately to the Mill Shifter and the Environmental Department. After notification is complete, the following steps are to be taken in order:

1. Clean the Super Pond discharge screen to ensure flows maximized.

2. Ensure that #25 sump is operational.

3. If necessary, pull boards from the Super Pond.

It will be the decision of the Mill Shifter under the guidance of the Environmental Department to determine the necessary level of response based on conditions at the time. The Ministry of Environment will need to be notified in advance of any imminent spill or overtopping. If a discharge is imminent, sampling is required.

Abnormal Water Levels – Myra Ponds

All Myra Ponds are to maintain 0.6 m of freeboard. Weir boards may need to be removed to maintain this freeboard and/or prevent overtopping.

High water levels may result in a daily flow volume in excess of 110,000 m^3, the permitted maximum discharge. Again, notification to the Ministry of Environment is required. Under these conditions, the Ministry may allow the temporary discharge at elevated TSS levels.

Increasing Seepage in the TDF, Lynx TDF or Myra Ponds

Increasing seepage through the TDF, Lynx TDF or Myra Ponds berms is an indicator of a shift in preferential flow paths. In the event that a new seep is discovered or known seepages increase in volume, the Engineer-of-Record (AMEC) should be notified. The underground flood emergency protocol should also be activated if required.

In addition, piezometer data should be checked as per Section **5.4.3.1**, if the seepage is on the TDF. Piezometer readings can indicate if the seepage is caused by an increase in pore pressure

within the TDF. AMEC should be notified is there is an increase in infiltration in the Lynx TDF or an increase in inflow turbidity in the associated underground (Philips Reach) sump.

Crest Drops along the Embankments or Slumping within the Tails

A noticeable drop in elevation along any of the crests on the TDF, Lynx TDF or water treatment system is definitely a cause for concern. Any such observation should be reported immediately to the Environmental Department and then to the Engineer-of-Record. As with the guidelines for seepage such an observation should trigger immediate gathering of piezometer data in order to understand what may be causing such settling.

Cracking

Cracking of the berms can be caused by a number of factors including the freeze/thaw cycle or differential settling. Cracks can also form if a portion of the berm is excavated and then filled in. Any new cracks must be reported to the Environment Departmental and the Engineer-of-Record for assessment. From that assessment the following actions may be recommended:

- Monitor the crack to see if it expands
- Repair the crack and monitor it to see if it reforms
- Install instrumentation to measure movement associated with the crack.

5.4.5 Triggers for Event-Driven Inspections

There are two triggers for event-driven inspections of the tailings facilities and the water treatment system: flooding and earthquakes. These triggers are as follows:

Flooding

A post-flood inspection is carried out after any water containment facilities are overwhelmed. These facilities include the containment berms of the TDF and the Lynx TDF, the Super Pond, Myra Ponds and the Lynx Diversion ditches. The inspection form is included in Section **5.5.2.3**.

Earthquake

A post-earthquake inspection is completed after one of two possible events. Seismic triggers, located in Huts A and C on the lower access road of the TDF, are triggered by ground acceleration greater than 0.3 g. If an earthquake triggers the piezometers, data will be uploaded to the network and stored at *H:\ENV LAB\TDF, Piezos, Ponds\Piezo Monitoring & TDF inspections*. Additionally, an e-mail is generated to Environmental Department personnel, Mill Control and First Aid notifying them a trigger or triggers have been set off. It must first be confirmed that it is not a false alarm. This is done by ensuring that both triggers were activated, not just one. Additionally, Natural Resources Canada website can be checked, as they report all seismic events.

The second event is if seismic activity is felt. This should, but may not, coincide with the activation of the seismic triggers.

In the event of an earthquake, notification must be made to the BC Ministry of Energy and Mines in the form of an "Advice of Geotechnical Incident or Unusual Occurrence" – Appendix III. Event-driven inspections will initially involve internal personnel who may make the decision to involve the Engineer-of-Record in the post-event inspection and review. The inspection form for a post-earthquake inspection is also provided in Appendix III.

5.4.6 Collation and Analysis of Data

Most of the data gathered during inspections of the facilities is interpreted by NMF staff, although some data must be sent to the geotechnical consultants. Data interpretation results are provided in the Annual Review Report.

Collation of Data

Data are compiled in the following locations:

- Inspection forms are stored in files in the Environmental offices.
- The daily Tailings and Water Treatment Report for the current year are kept on a clip board in the Environmental offices.
- Instrument data is maintained in electronic form on *H:\ENV LAB\TDF, Piezos, Ponds\Piezo Monitoring & TDF inspections*. Within this directory are the following:
    - Piezometer spreadsheets
    - Backups of the programs which run the data loggers in the piezometer huts
    - Historic readings for the cracks on the TDF

Analysis of Data

Data compiled from the instrumentation and inspections are submitted to the Environmental Department for screening. Initial screening includes the following:

- Reviewing the results of the routine and event-driven inspections to determine the priority for any required action and to create work orders to address such required actions.
- Convert the daily raw piezometer data into a usable format using the Excel spreadsheet provided by the Engineer-of-Record. Usable data is in the form of pore pressure linked to actual elevation.
- Reduce the daily piezometer data to a maximum weekly value for each piezometer and update graphs associated with the spreadsheets to track movement of the pore pressure.

- Review the daily tailings and water treatment reports to ensure that pH in the water treatment system is below the permitted level of 9.5 and that the total daily flows are below the permitted volume of 110,000 m^3/day. In order to reduce the volume of data these records are used to calculate a daily average pH value for the effluent discharge.

- Review monthly water chemistry data for water treatment system. The data is compiled into monthly reports, and submitted to the Ministry of Environment as per permit requirements. These reports are found at *H:\ENV OFFICE\WMB Reports\2013 Reports*.

Downloaded data from vibrating wire piezometers is entered into an MS Excel spreadsheet. Regular review of the data assesses the performance of the TDF against established threshold warning pore water pressures. Level I, II and III thresholds have been established for each piezometer based on a review of historical data and stability concerns. Exceeding any of the thresholds requires action. These thresholds are:

- Level I: Set as an average of the historical maximum readings for that horizontal section of tailings. Given the limited amount of data for instrument plane B and the paste berm, the Level I thresholds were set as historical maximums for plane B and 2006 maximum for the paste berm. Should the Level I thresholds be exceeded, site conditions are to be reviewed for possible triggers (i.e. weather, drainage system changes, etc.) which would be rectified if possible. Data is to be forwarded to the Engineer-of-Record for a review of overall stability issues.

- Level II: Set at historical maximum readings for individual piezometers. Should Level II thresholds be exceeded the summarized data should be forwarded to the Engineer-of-Record for review of overall stability issues.

- Level III: Set at 1m above historical maximum readings for individual piezometers. Should Level III thresholds be exceeded construction on or in the vicinity of the TDF is to cease immediately, the site conditions are to be reviewed for possible triggers and the summarized data is to be forwarded to the Engineer-of-Record for review of overall stability issues.

The frequency of downloads and data analysis is set out in the monitoring program outlined in the Annual TDF Review Report compiled by the Engineer-of-Record, as recommended by the geotechnical consultants. Results of the assessments are forwarded to the Engineer-of-Record weekly and both the Ministry of Environment and the Ministry of Energy and Mines in the form of an Annual TDF Review Report and an Annual Environmental Report.

5.4.7 Expert Inspections and Reviews

NMF has its Engineer-of-Record undertake an independent annual inspection of the tailing facilities and provide a detailed report. This reporting coincides with the annual reporting filed with the Ministry of Energy and Mines by March 31st of each year.

The report includes the following information:

- A compilation of operating and surveillance information from the previous year along with interpretation of all data;
- Information on each of the components making up the facility;
- Summary information on construction work;
- An updated monitoring program for the facility for the following year;
- Conclusions and recommendations.

The report addresses the operation and performance of the tailings facilities in accordance with the document *BC Guidelines for Annual Reports-Dam Safety Inspections* by MEMPR, dated February 14, 2002. Several aspects of the tailings facilities including water balance, groundwater seepage losses and water quality are reported on in the annual M-26 Reclamation Report.

Any major project is reviewed by a third party prior to implementation. All major civil construction work associated with the tailings facilities, such as the Seismic Upgrade Project or Lynx Berm raises, will be routinely inspected/supervised by NMF's Engineer-of-Record.

External inspection and review may also be necessary after significant events such as earthquakes, floods or other operational upsets. This will be based on the decision of the General Manager.

A major independent review is conducted every 5-7 years to assess the stability and environmental compliance of the tailings facilities. This review is independent from the Engineer-of-Record and serves as an audit. The last major independent review was conducted by Robertson GeoConsultants (Vancouver) in 2013 – refer to Section **2.5.1**. Copies of these Dam Safety Review reports are available in the Environmental Department office.

5.5 Documentation and Reporting

5.5.1 Documentation

Figure 5.4 details the surveillance assignments and responsibilities, and details the record keeping system for inspection reports, data, analyses and photos for all monitoring activities of the tailings facilities and water treatment system.

Table 5-2 Tailings & Water Treatment Surveillance Assignments

TASKS	RESPONSIBLE PARTY	LOCATION OF RECORDS	DISTRIBUTION
Tailings & Water Treatment Report – PER SHIFT	Lime Operator & Mill Shifter	Clipboards in Mill Shifter and Environmental offices. Records are entered into a spreadsheet at *H:\\Environment\ENV*	• Mill Shifter – Original; • Environmental Dept - copy;

		LAB\Physical Parameters\Daily\[year]\Daily Measure – [month][year].xls	• Previous year records in Environmental Office • Records form part of monthly report to Ministry of Environment
Daily water samples - DAILY	Environmental Department	*H:\\Environment\ENV LAB\AA Results\[year]\AA – [date].xls* This data is compiled in EQWin	• Environment Dept staff • Records form part of monthly report to Ministry of Environment
Water Quality Monitoring – WEEKLY, MONTHLY, BI-MONTHLY, QUARTERLY & ANNUALLY	Environmental Department	Data is kept in EQWin, the environmental database stored on *H:\\Environment\ENV LAB\EQWIN\WATER*. Raw data is kept in *H:\\Environment\ENV LAB\Outside Labs\Assay Files*. Data files are tracked in *H:\\Environment\ENV LAB\QA_QC\Tracking\Tracking[year].xls*	• Environmental staff • Records form part of monthly report to Ministry of Environment • Data is summarized into the Annual Environmental Reports
Bioassay sampling – Acute lethality – QUARTERLY Sub-lethality - ANNUALLY	Environmental Department	Environmental Office and *H:\\Environment\ENV LAB\Bioassays\Toxicity\year*	• Environmental Dept • Data is summarized into the Annual Environmental Report
Ponds Inspection – MONTHLY	Environmental Department	Environmental Office	• Environmental Dept • Mill and Surface Manager
TDF Inspection – WEEKLY (MONTHLY when snow-covered)	Environmental Department	Environmental Office	• Environmental Dept • Engineer-of-Record • Mill and Surface Manager
Piezometer	Environmental	*H:\\Environment\ENV*	• Original on Env. Dept

Download Report - WEEKLY	Department	*LAB\TDF, Huts, Ponds\Piezometer Monitoring & TDF Inspections* *PiezoA.xls*	computer. • Engineer-of-Record – emailed copies quarterly;
Survey Monuments Report - MONTHLY	Engineering Department	*H:\\Environment\ENV LAB\TDF, Huts, Ponds\TDF Data\Slope Monitoring – Survey Data* *Outer berm – MovPts[DATE].xls* *Paste Berm-* *PastBerm[DATE].xls*	• Environment Department • Engineer-of-Record copy • Electronic copy kept on Environment Department computer network
Diversion Ditch Inspection Sheet - MONTHLY	Surface Supervisor or Environmental Department	Environmental Department	• Environmental Dept • Surface Supervisor • Mill and Surface Manager
Photo Records – AS NEEDED	Mostly Environmental staff	Electronic copies in *H:\\Environment\ENV LAB\Photos\year*.	• The photo record is maintained on the environmental network drive and distributed on request

5.5.2 Reporting

5.5.2.1 Reporting Requirements – Tailings Disposal Facilities

Formal submissions to regulators

An annual review report for the tailings facilities is compiled by the Engineer-of-Record for submission to the MEM in accordance with the Canadian Dam Association (CDA) Safety Guidelines.

Reporting guidelines under normal operating conditions

Weekly inspections are also conducted as per CDSG. The inspection reports are submitted to the Engineer-of-Record with the piezometer data for the purpose of continual review of the overall stability of the structure. On a monthly basis the survey monument data is added to the submission package to the Engineer-of-Record.

Reporting guidelines for initiating emergency response alerts

Refer to the Tailings Disposal Facility Emergency Preparedness Plan and to the Emergency Management Plan.

Reporting conditions requiring adjustment to design, operation, maintenance or surveillance

Any observed condition during an inspection that may require a change to the design, operation, maintenance or surveillance is to be noted on the TDF/Lynx TDF inspection form. The Mill and Surface Manager will be notified to address any operational or maintenance issue. The Environmental Department will address any changes to surveillance procedures. If the issue relates to design change, the Environmental Department will review before forwarding to the Engineer-of-Record. Any recommendations will be forwarded to the General Manager. The General Manager will review the recommendations and decide on the appropriate follow-up.

5.5.2.2 Reporting Requirements – Water Treatment System

Formal submissions to regulators

Refer to the Environmental Procedures Manual for reporting requirements for the Water Treatment System. Reports are submitted to two agencies: Environment Canada and the BC Ministry of Environment.

Reporting guidelines under normal operating conditions

The NMF Environmental Procedures Manual outlines the reporting requirements under normal operating conditions.

Reporting guidelines for initiating emergency response alerts

Refer to the Emergency Management Program for reporting guidelines for initiating emergency response alerts.

Reporting conditions requiring adjustment to design, operation, maintenance or surveillance

Any observed condition during an inspection that may require a change to the design, operation, maintenance or surveillance is to be noted on the Tailings and Water Treatment Report or the Pond Inspection form. The Mill and Surface Manager will be notified to address any operational or maintenance issue. The Environmental Department will address any changes to surveillance procedures. If the issue relates to design change, the Environmental Department will review before forwarding to the Engineer-of-Record. Any recommendations will be forwarded to the General Manager. The General Manager will review the recommendations and decide on the appropriate follow-up.

5.5.2.3 Examples of Standard Inspection Forms

Refer to Appendix IV.

5.0 References

AMEC (2008), Lynx Tailings Disposal Facility, Design Report, Myra Falls Mine, Technical Report, August 2008.

AMEC (2013) Myra Falls Tailings Storage Facilities 2012 Annual Dam Status Report

Mining Association of Canada (2011), Developing an Operations, Maintenance and Surveillance Manual for Tailings and Water Treatment Facilities.

RGC (2014), Site Hydrogeology Report for Nyrstar Myra Falls, Report No. 212001/5, July 2014.

Appendix I

Drawings

GENERAL SITE PLAN
NYRSTAR MYRA FALLS

LEGEND:

STP SEWAGE TREATMENT PLANT
LPG LIQUID PROPANE GAS
FAR FRESH AIR RAISE
RAR RETURN AIR RAISE

nb. Northing & Easting coordinates relative to Mine Grid

1010 E
2010 E
3010 E
4010 E
5010 N
4010 N
3010 N
2010 E
3010 E
4010 E
3010 N

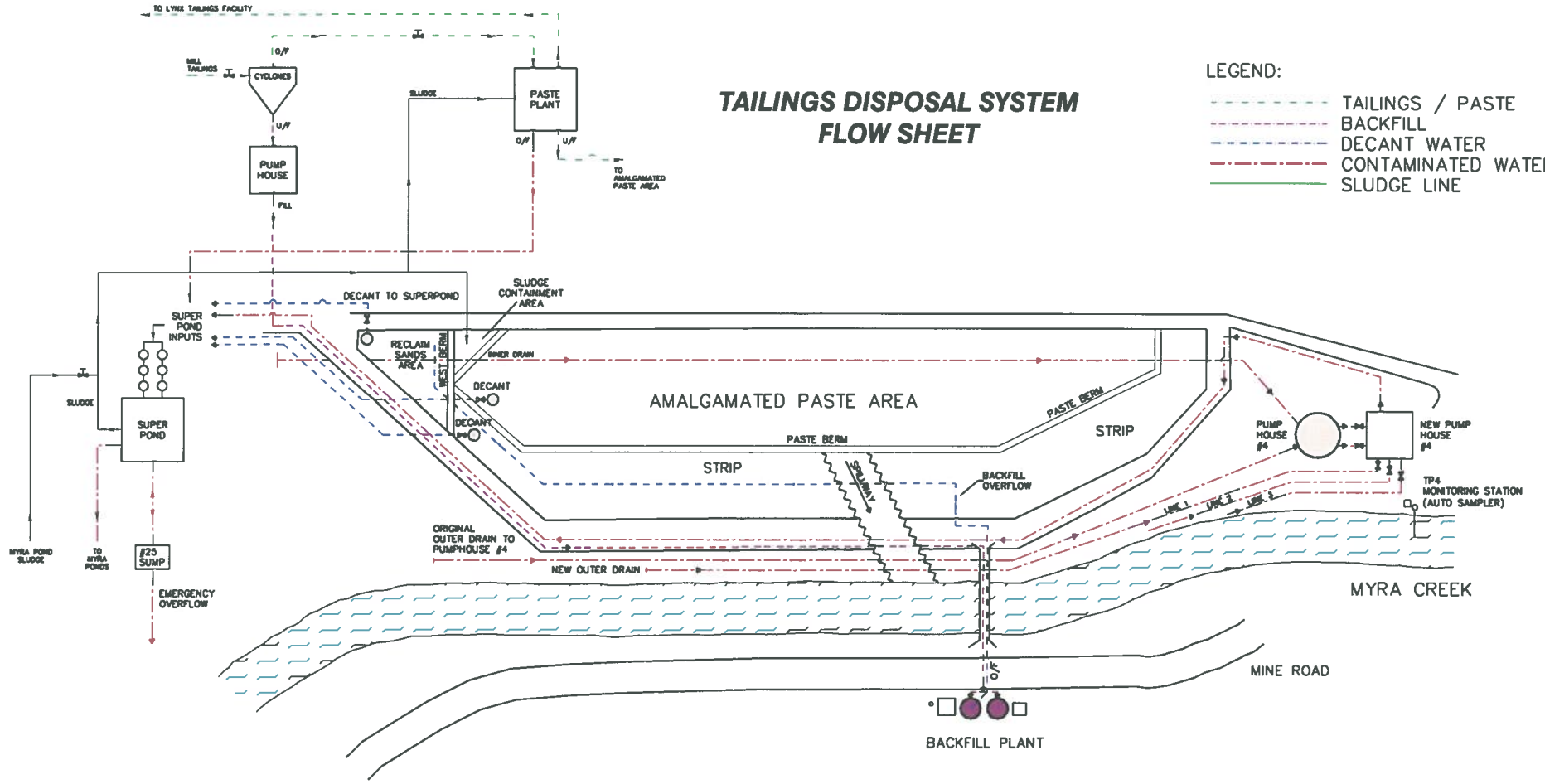
ARNICA REACH (2008) EST. LOCATION
ARNICA CREEK
UPPER REACH
CASCADE REACH
LOWER REACH
ALDER REACH EXTENDED AUG. 2010
M2 SAMPLE SITE
TP4 SAMPLE SITE
PUMPHOUSE #4
QUARRY
HAUL BRIDGE
MYRA CREEK
STRATHCONA-WESTMIN INTERPRETIVE CENTRE
CRAB CORE RACKS AREA BORROW
TO CAMPBELL RIVER
CORE RACKS
WASTE ROCK DUMPS
#2 WRD
PASTE PLANT
WEATHER STATION
WASTE ROCK DUMP #6
TDF
AMALGAMATED PASTE AREA
BACKFILL DISCHARGE
PASTE BERM
HUT B
SPILLWAY
DECANT
STRIP
RECLAIM SAND AREA
WASTE ROCK DUMP #1
REPAIR AREA
LYNX MINE
LYNX TDF
LOWER EAST BORROW
FRESH WATER SCREENS
WOOD STAVE TANK
CHLORINE PLANT
WATER TOWERS
MILL
TAIL-RACE PUMP HOUSE
TENNENT POWERHOUSE
POWDER AND CAP MAGAZINES
COOK HOUSE AREA
LIME SLAKING TANKS
LIME MIX TANKS
OVERLAND CONVEYOR
SUPER POND
SUPER OUT
SUPER IN
RECLAIM PUMPHOUSE
HUT A
MYRA OUT
MYRA IN
MYRA POLISHING PONDS
MYRA MINE
H-W MINE
WATER TOWER
BACKFILL PLANT
TRUE NORTH 0° 00'
MAGNETIC NORTH 2009
18°15'E
MINE NORTH
18°E

DRAWN BY	IMcW / SH / JLG
CHECKED BY	
DATE	2013/Mar/20
SCALE	NOT TO SCALE
DWG. LOC.	H:\ENVIROMENTAL\
NAME/VIEW	SITE-PLAN-11X17-20MAR2013

nyrstar MYRA FALLS

GENERAL SITE PLAN
SURFACE FACILITIES
FIGURE 1-4

TAILINGS DISPOSAL SYSTEM
FLOW SHEET



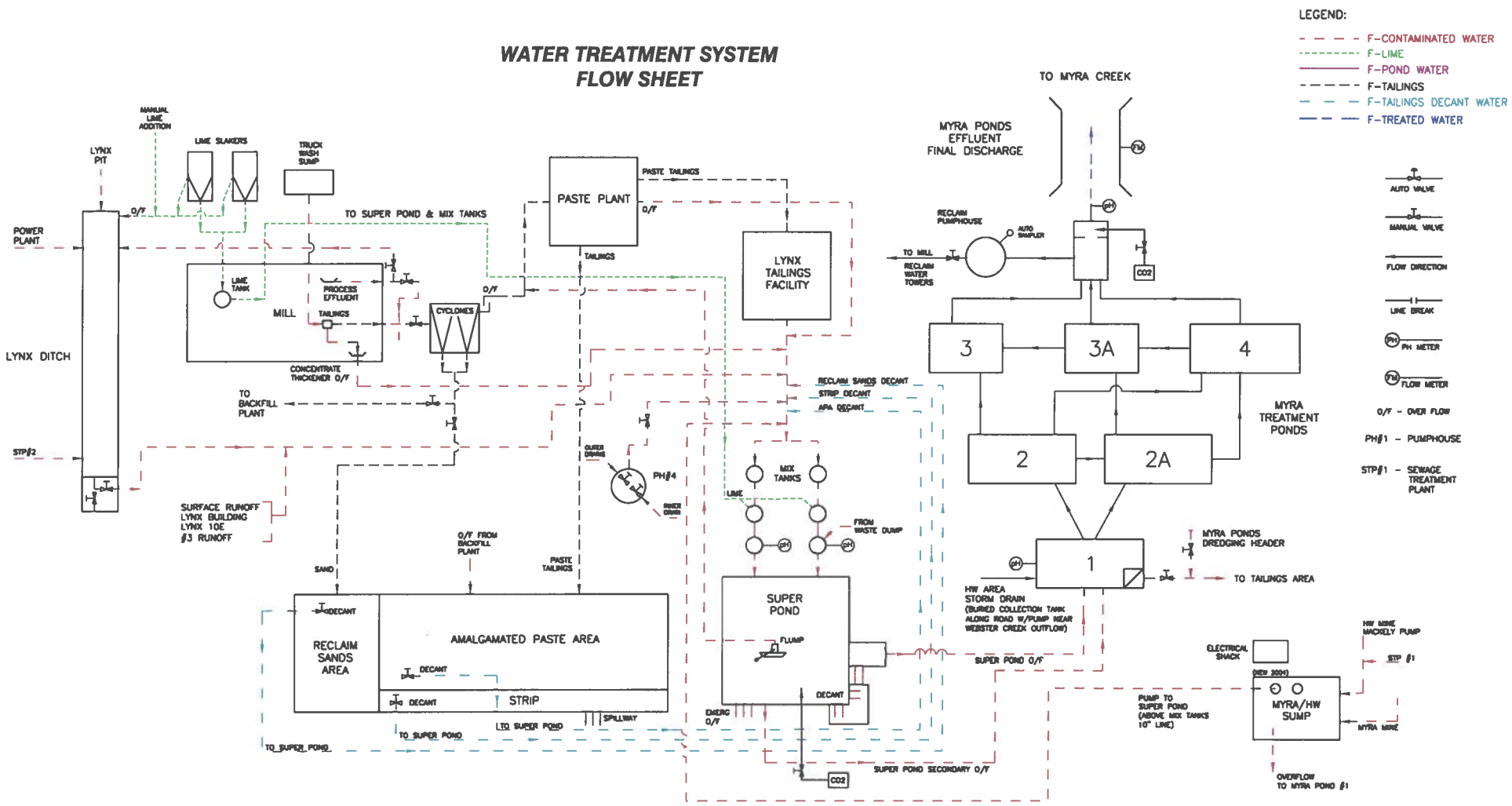
REVISIONS: ORIGINAL – FEB 1994 – R. VAN DYK
1. 6" PASTE LINE – MAR 96 – JG
2. BARRIER DYKE & DECANT CULVERT SYSTEM – FEB 99 – SJ
3. REMOVAL OF PASTE LINE & ADD DECANT WELL – FEB 99 – SJ
4. ADD VALVES & FLOW TO LYNX TANK FROM TAILINGS THICKENER – MAR 01 – GMP
5. BACKFILL OVERFLOW TO AREA 1, DECANT 2 TO PH #4, RECLAIM SANDS AREA, WEST BERM, MYRA POND SLUDGE TANK, PASTE BERM IN AREA 2, DECANT SYSTEM AREA 1, TP 4 MONITORING STATION – FEB 03 – GCD
6. ADD AREA 1 DECANTS, REMOVE PH #3 & 80FT TAILINGS THICKENER, COMBINE TAILINGS AREAS 1D & 2D – NOV 05 – BAC
7. MOVE BACKFILL OVERFLOW LINE, ADD SLUDGE CONTAINMENT AREA, & ADJUST SLUDGE FLOW. 07/03/15 TAH
8. UP-DATE PASTE PLANT AND ASSOCIATED LINES – MAR 08
9. REMOVAL OF CEMENT ADDITION – JULY 08
10. EXTEND BACKFILL OVERFLOW LINE – 2010

DRAWN BY	IMcW / SMH
CHECKED BY	
DATE	2010/12/31
SCALE	N.T.S.
DWG. LOC.	E:\PROJECTS\PROJDWGS\
NAME/VIEW	0842

MYRA FALLS OPERATIONS nvi MINING LTD.

TAILINGS DISPOSAL SYSTEM
FLOW SHEET – REVISION 10
FIGURE 2-3

WATER TREATMENT SYSTEM
FLOW SHEET



REVISIONS
15. 2009 REMOVAL OF CEMENT TO THE PASTE TAILINGS
16. JANUARY 2010 ADDITION OF SUPERPOND SECONDARY OVER-FLOW LINE

DRAWN BY	McW/SH/JLG
CHECKED BY	
DATE	2010/12/31
SCALE	NOT TO SCALE
DWG. LOC.	I:\PROJECTS\PROJDWGS\
NAME/VIEW	4190

MYRA FALLS OPERATIONS nvi MINING LTD.

WATER TREATMENT SYSTEM

FLOW SHEET REVISION 16

FIGURE 2-4

TRUE NORTH

MINE NORTH

FLUME

DIVERSION DITCH

SEE DETAIL 1

NO.4 PUMPSTATION

MYRA CREEK

INSTRUMENT HUT C

FORMER SPILLWAY

TO CAMPBELL RIVER

TDF AMALGAMATED PASTE AREA

AREA II

PASTE BERM

AREA I

INSTRUMENTATION HUT B

ROAD

AREA II STRIP

NEW SPILLWAY

RECLAIM SANDS AREA

AREA I STRIP

SUPER POND

NO.3 PUMPSTATION

PIPE BRIDGE

CONVEYOR

INSTRUMENTATION HUT A

WEATHER STATION

MYRA BRIDGE

POND EFFLUENT

MYRA TREATMENT (POLISHING) PONDS

RED BRIDGE

BACKFILL PLANT

FIRST AID

MAIN OFFICE

H-W MINE SHAFT

LPG

DETAIL 1 - INSET

0m 20 40 60 80

1 : 2000

0m 40 80 120 160

1 : 4000

DRAFT

LEGEND

P10	STANDPIPE PIEZOMETER
502	SURFACE MOVEMENT MONUMENT
B-5E	VIBRATING WIRE PIEZOMETER
A-19E	PNEUMATIC PIEZOMETER
P9	PASTE BERM FOUNDATION PIEZOMETER
L31	CRACK MONITORING SURVEY POINTS
1	CRACK EXTENSOMETER
PB01	PASTE BERM SURVEY MONUMENT
BKS04-10(PZ)	TDF PIEZOMETER
PS-4	FOUNDATION PNEUMATIC PIEZOMETER
	OUTER DRAIN STANDPIPE PIEZOMETER
*	NOT FUNCTIONING OR LOST

CLIENT: nvi MINING LTD.

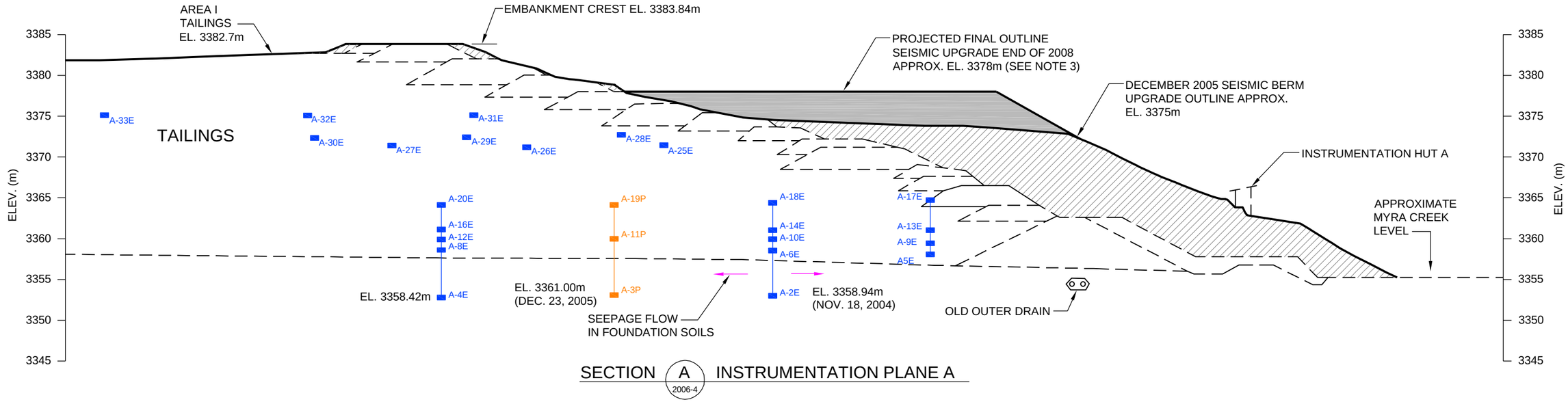
AMEC Earth & Environmental
2227 Douglas Road, Burnaby, B.C., V5C 5A9
Tel. 604-294-3811 Fax 604-294-4664

DWN BY:	SM
CHK'D BY:	JS
DATUM:	-
PROJECTION:	-
SCALE:	AS SHOWN

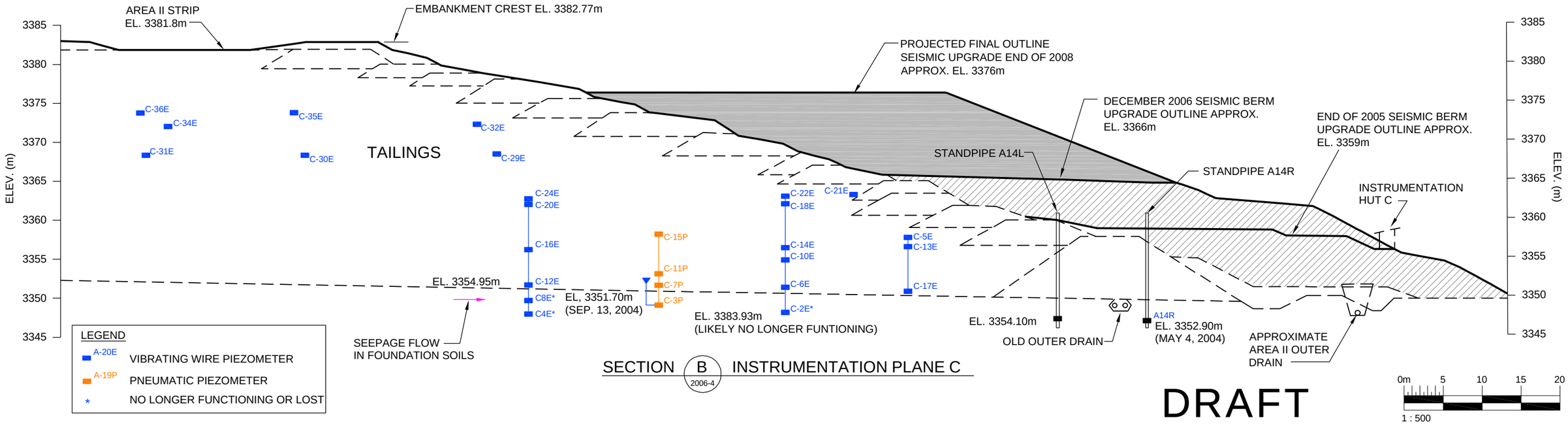
PROJECT: MYRA FALLS OPERATIONS
2006 ANNUAL REVIEW REPORT

TITLE: TAILINGS DISPOSAL FACILITY
GEOTECHNICAL INSTRUMENTATION PLAN

DATE:	MARCH 2007
PROJECT NO:	VM00442-2006-3
REV. NO.:	A
FIGURE No.	2004-4



SECTION A INSTRUMENTATION PLANE A
2006-4



SECTION B INSTRUMENTATION PLANE C
2006-4

DRAFT

NOTE:

1. SECTION FROM KLOHN CRIPPEN BERGER, PROJECT No. M07632 A52, DRAWING No. D-52304, REV. B DATED MARCH 31, 2006.

2. SURFACE TOPOGRAPHY UPDATED WITH SEPTEMBER 2006 SURVEY DATA.

3. NO FILL PLACED IN VICINITY OF SECTION A IN 2006.

CLIENT: nvi MINING LTD.

AMEC Earth & Environmental
2227 Douglas Road, Burnaby, B.C., V5C 5A9
Tel. 604-294-3811 Fax 604-294-4664

DWN BY:	SM
CHK'D BY:	JS
DATUM:	-
PROJECTION:	-
SCALE:	AS SHOWN

PROJECT: MYRA FALLS OPERATIONS
2006 ANNUAL REVIEW REPORT

TITLE: TAILINGS DISPOSAL FACILITY
INSTRUMENTATION PLANES
SECTIONS A AND C

DATE:	MARCH 2007
PROJECT NO:	VM00442-2006-3
REV. NO.:	A
FIGURE No.	2006-5

THIS AREA NOT UP TO DATE

TAILINGS DISPOSAL FACILITY (TDF)

AMALGAMATED PASTE AREA

AREA 1

AREA 2D

DIVERSION DITCH

RECLAIM SANDS AREA

CONTROL STATION

CONTROL STATION

CONTROL STATION

CONTROL STATIONS

BACKFILL PLANT

3600 N
2700 E
3300 N
3000 E
4200 N
3300 E
3900 N
3600 E
6300 N
5700 N

MPT502 MPT501 MPT500 MPT504 MPT503 MPT409 MPT360 MPT408 MPT407 MPT358 MPT354 MPT353 MPT355 MPT357 MPT356 MPT403 MPT402 MPT404

PB09 PB08 PB07 PB06

STA372R STA363R STA364R STA375

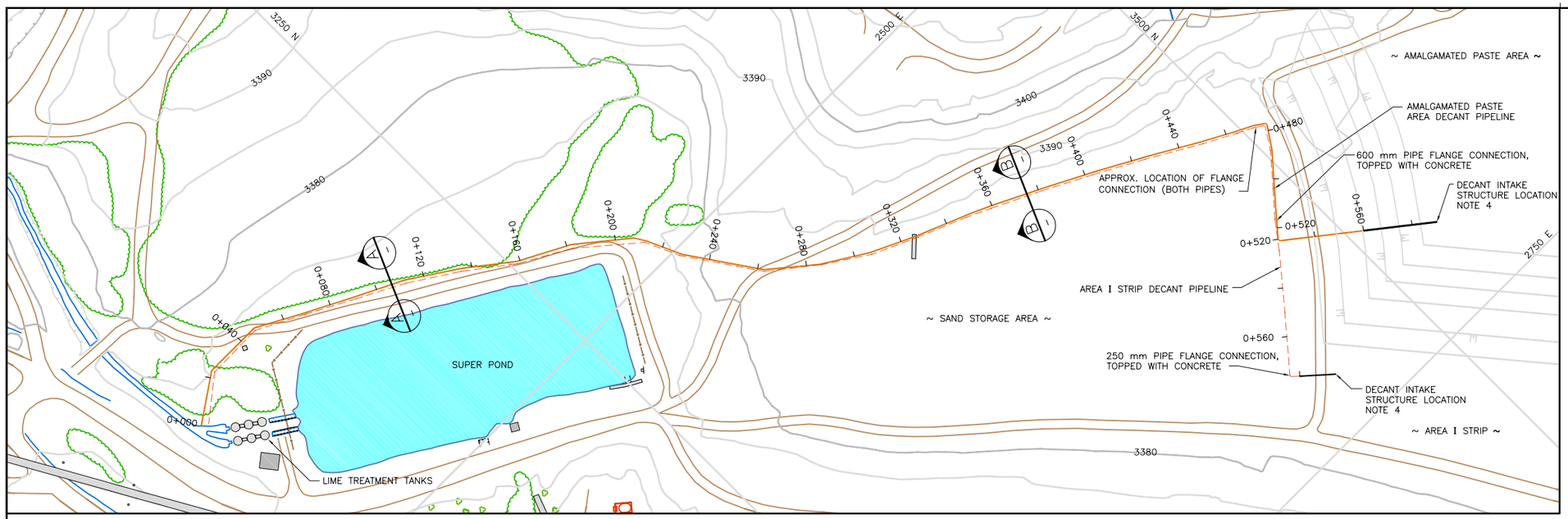
DRAWN BY	RT
CHECKED BY	
DATE	2006/06/20
SCALE	1:3000
DWG. LOC	\SlopeMonitoring\TailingsBerm\
NAME/VIEW	SlopeMonitoringStations2006.dwg

MYRA FALLS OPERATIONS

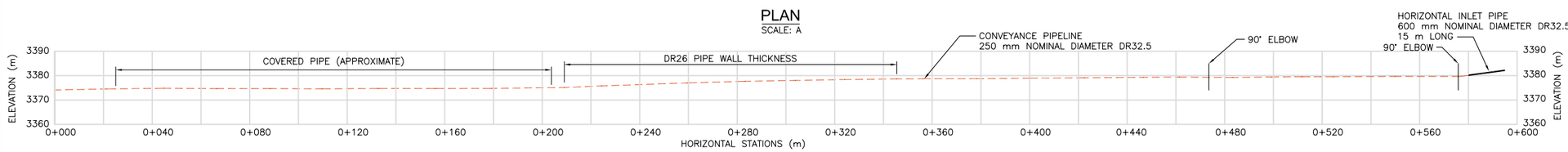
nvi MINING LTD.

TDF SLOPE MONITORING

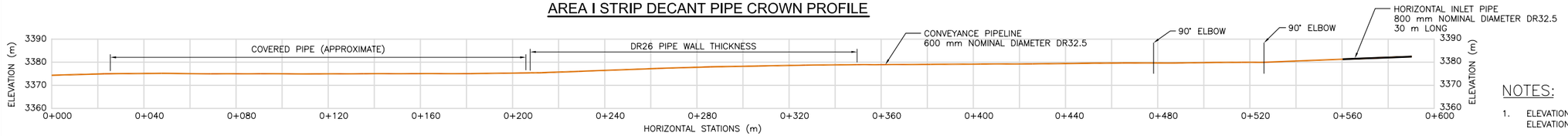
STATION AND TARGET LOCATIONS



PLAN
SCALE: A

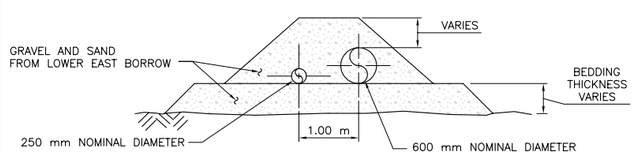


AREA I STRIP DECANT PIPE CROWN PROFILE

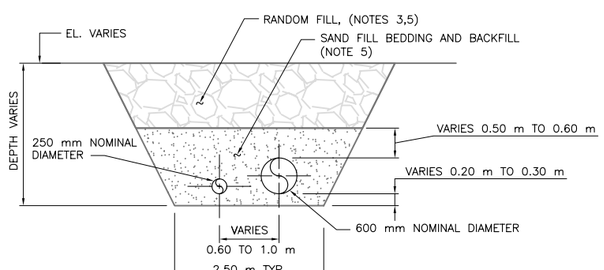


AMALGAMATED PASTE AREA PIPE CROWN PROFILE

-



SECTION A
SCALE: B
COVERED PIPE



SECTION B
SCALE: B
BURIED PIPE

NOTES:

1. ELEVATIONS AND DIMENSIONS ARE IN METRES. COORDINATES AND ELEVATIONS ARE REFERENCED TO MINE DATUM. (MASL + 3048m)
2. TOPOGRAPHY IS BASED ON AERIAL SURVEY FLOWN IN DECEMBER 2004.
3. RANDOM FILL CONSISTS OF SAND, WASTE ROCK OR MIXTURE OF BOTH.
4. DECANT STRUCTURE NOT SHOWN, SEE DWG. D-51805 FOR DETAILS.
5. BACKFILL WAS PLACED AND COMPACTED CAREFULLY IN TRENCH TO PREVENT DAMAGE TO INSTALLED PIPE.

TRUE NORTH
MINE NORTH

SCALE: A 0 50 m
SCALE: B 0 2 m

CONSTRUCTION RECORD | DRAFT

DRAWING NO.	REFERENCE DRAWING	NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
		1	JAN. 27, 2006	CONSTRUCTION RECORD				
		0	MAY 3, 2005	APPROVED FOR CONSTRUCTION				

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS
2005 CONSTRUCTION

TITLE: PASTE STORAGE AREA I AND AREA I STRIP DECANT INSTALLATIONS
PLAN, PROFILE AND SECTIONS

SCALE	PROJECT No.	DWG. No.	REV.
AS NOTED	M07632 A51	D-51803	1

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC-DM

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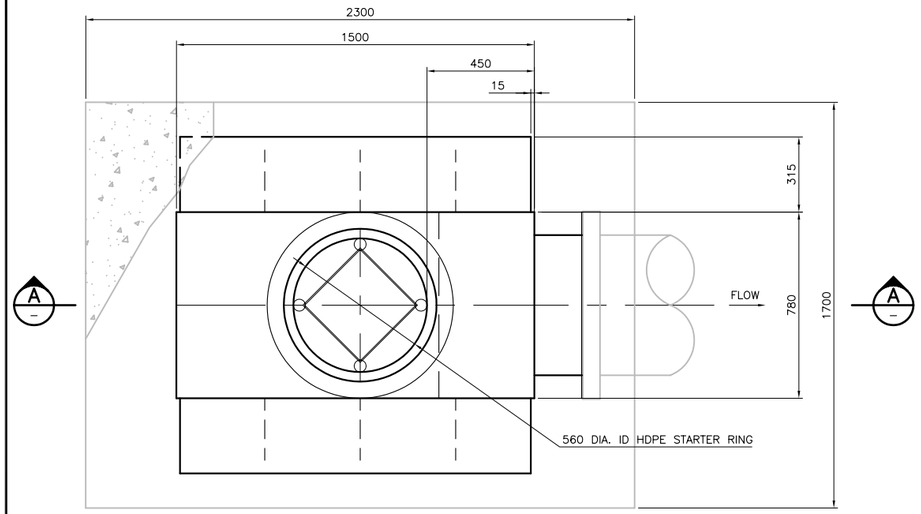
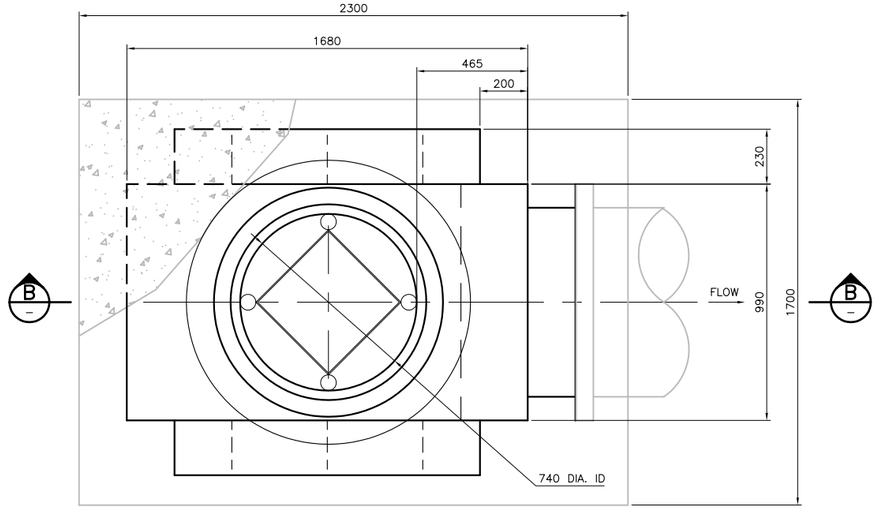
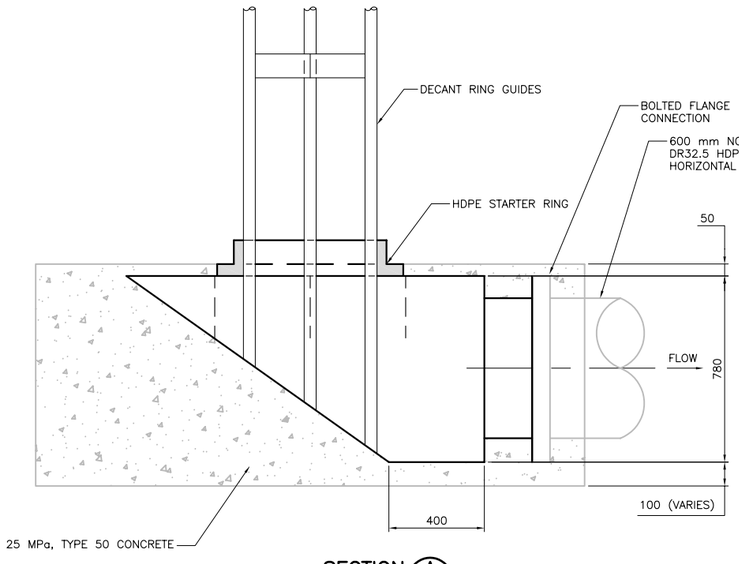
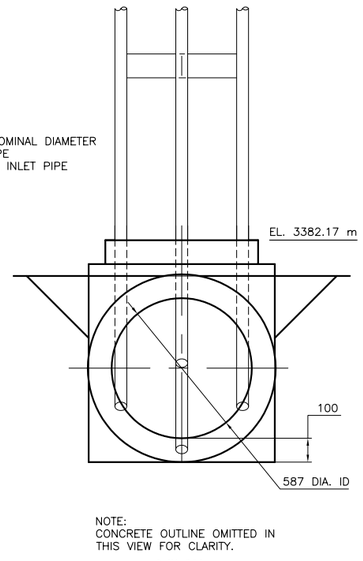
Date: 1/10/2006
Scale: 1=1(PS)
Drawing File: N:\M07632\A51 - 2005 Construction Services\400 Design\410 Drawings\09 - 2005 Construction\CONSTRUCTION RECORD\D-51803_rev1.dwg (Hutton)
Xrefs: BM-MyraFalls-Mar05





PLAN





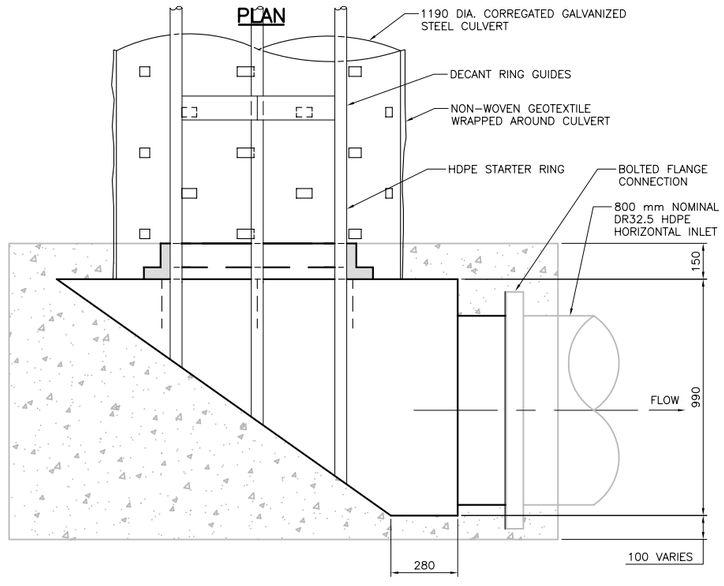
NOTE:
CONCRETE OUTLINE OMITTED IN THIS VIEW FOR CLARITY.

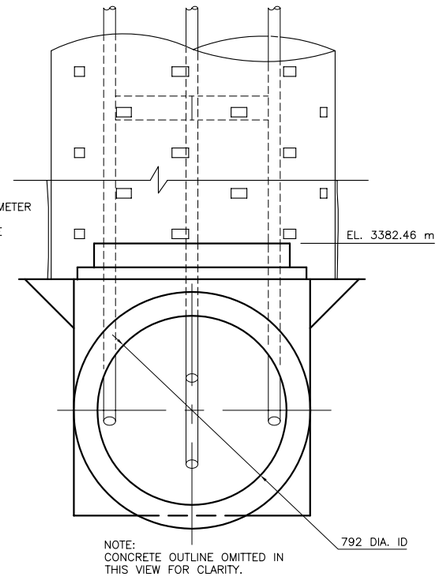
SECTION A – A

VIEW

AREA I STRIP DECANT INTAKE STRUCTURE

PLAN





NOTE:
CONCRETE OUTLINE OMITTED IN THIS VIEW FOR CLARITY.

SECTION B – B

VIEW

AMALGAMATED PASTE AREA DECANT INTAKE STRUCTURE

CONSTRUCTION RECORD | DRAFT

SCALE A: 0 500 mm

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. FOR DECANT INTAKE STRUCTURE LOCATION SEE D-51803.

DRAWING NO.	REFERENCE DRAWING	NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
		A	JAN. 27, 2006	CONSTRUCTION RECORD				

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS 2005 CONSTRUCTION

TITLE: DECANT INTAKE STRUCTURES PLAN AND SECTIONS

SCALE	PROJECT No.	DWG. No.	REV.
AS NOTED	M07632 A51	D-51805	A

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC-DM

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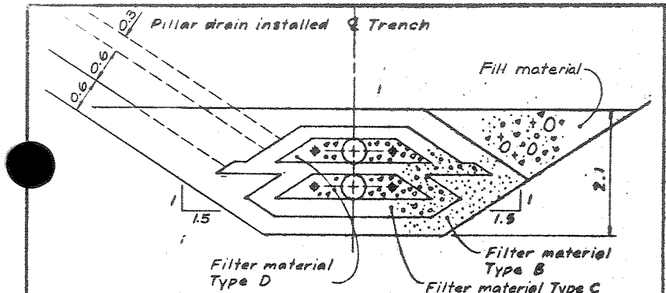
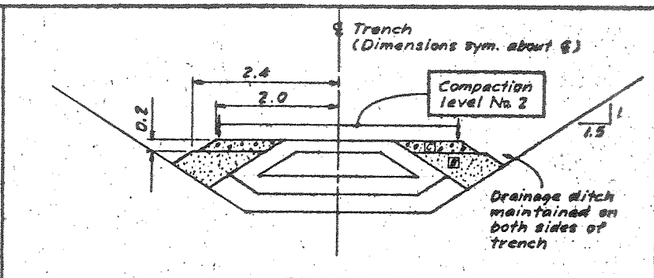
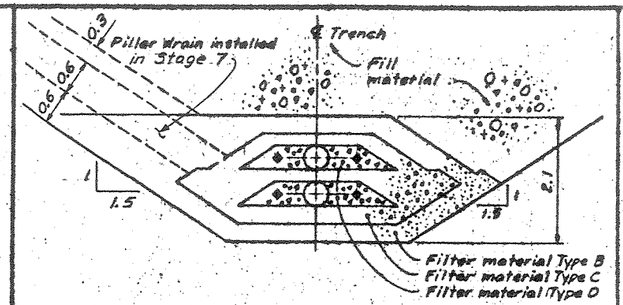


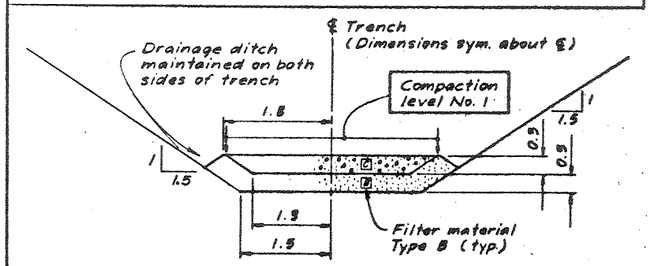
FINAL ARRANGEMENT



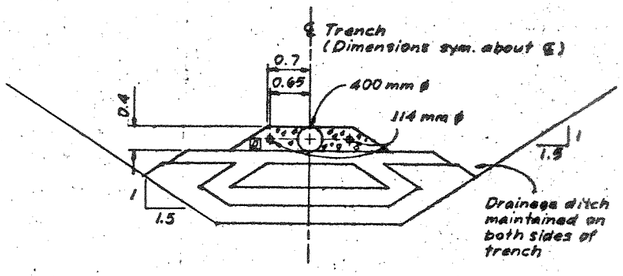
STAGE 4



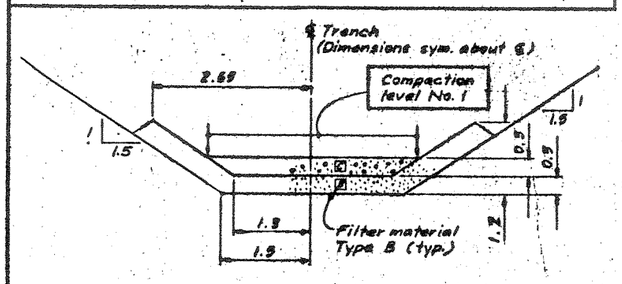
FINAL ARRANGEMENT



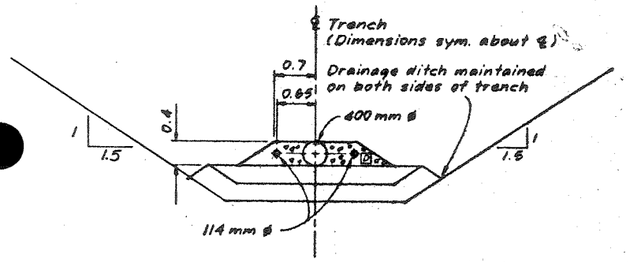
STAGE 1



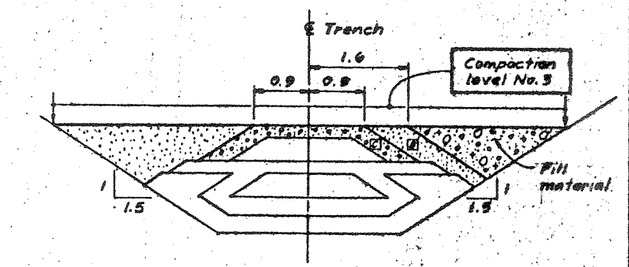
STAGE 5



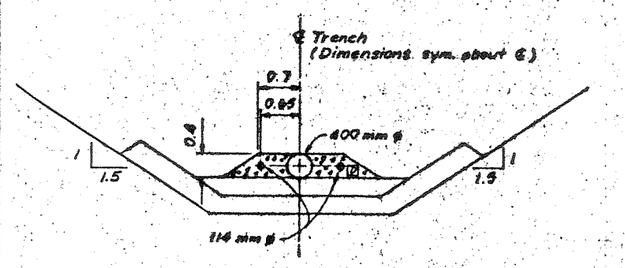
STAGE 1



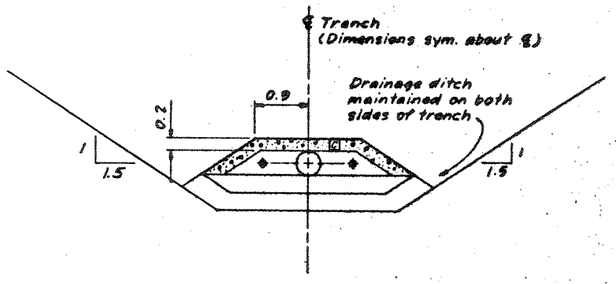
STAGE 2



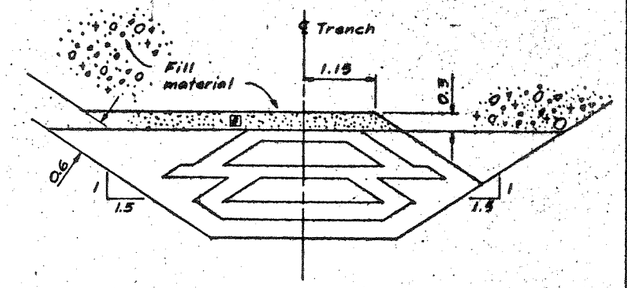
STAGE 6



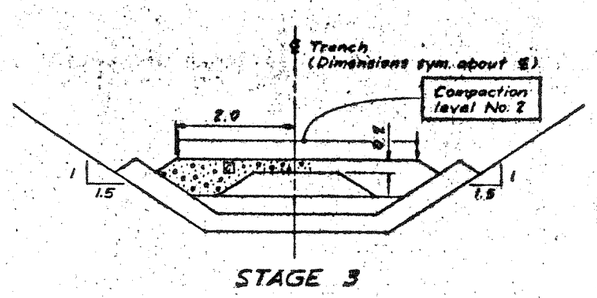
STAGE 2



STAGE 3



STAGE 7



STAGE 3

NOTE: Stages 4, 5, 6 and 7 similar to Stages 1 through 7 for wet conditions

CONSTRUCTION IN WET CONDITIONS
Scale A

CONSTRUCTION IN DRY CONDITIONS
Scale A

Scale A 1 : 50 0 1 2 3 4 5 m

Notes:

1. All dimensions are in metres unless noted otherwise.
2. All side slopes on filter materials to be 1 vertical to 1.5 horizontal.
3. For construction in wet conditions, drainage ditches are to be maintained on both sides of the trench and led to sumps at intervals.
4. All filter materials to be placed above water level.
5. Compaction level No.'s 1, 1A and 2 to be accurately brought to grade for pipe laying operation.
6. At upstream and downstream ends of drain, all fill materials in lower 2.5 m of trench to be bentonite modified backfill material, see Drg. No. 1289.124 for locations.

DRG NO.	DESCRIPTION
1289.112	MATERIALS SPECIFICATION
1289.125	INNER DRAIN - DETAILS AND SECTIONS
1289.124	INNER DRAIN - PLAN AND PROFILE

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25, 1984	APPROVED FOR CONSTRUCTION	
1	JUNE 25, 1984	ISSUED FOR TENDER	

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
3	AUG. 23/85	AS CONSTRUCTED	

REVISIONS

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

DESIGNED J. P. H.
DRAWN D. E. W.
CHECKED
APPROVED

WESTMIN RESOURCES LIMITED

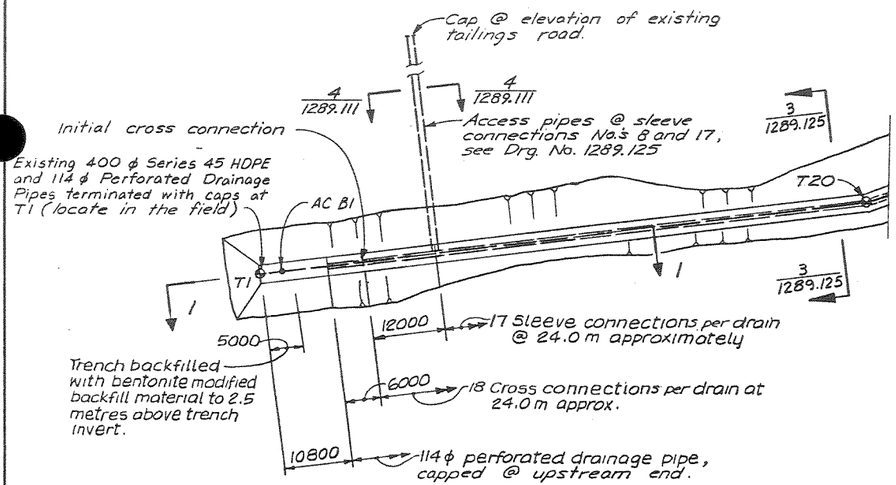
WESTERN MINES DIVISION

MYRA FALLS

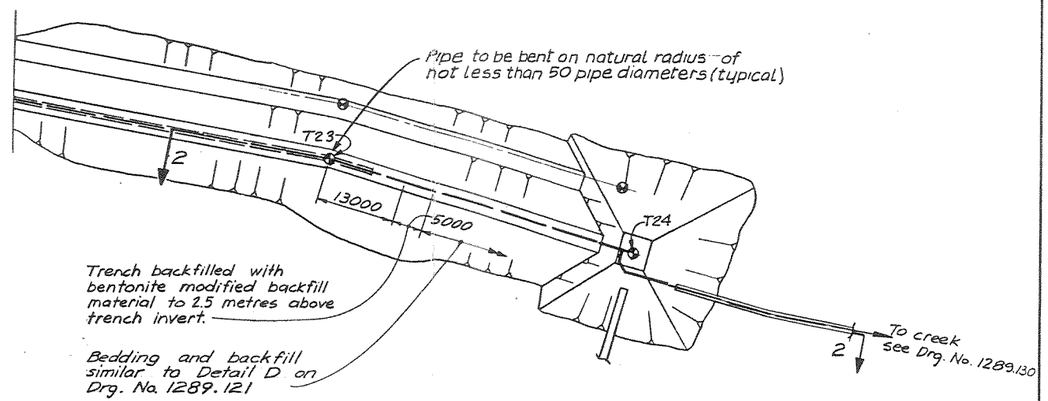
TAILINGS DISPOSAL FACILITY - AREA II

INNER DRAIN CONSTRUCTION DETAILS

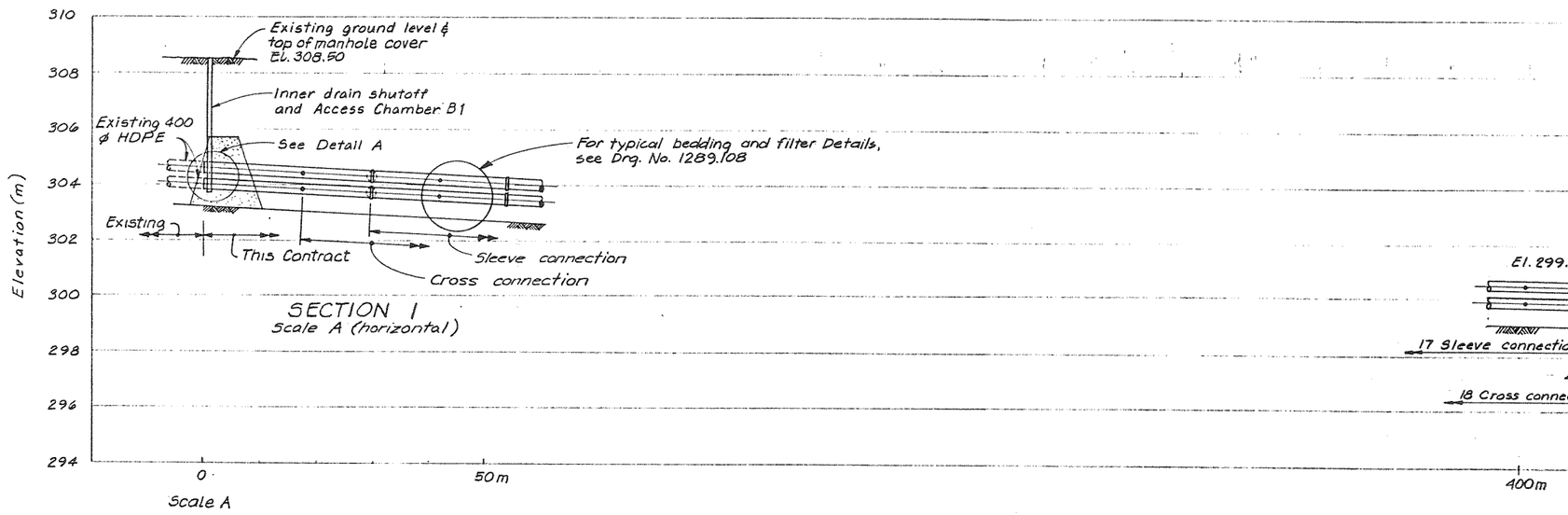
DATE MAY 31, 1984 | SCALE AS SHOWN | DRG. NO. 1289.108 | REV. 3



PLAN - UPSTREAM END
Scale A

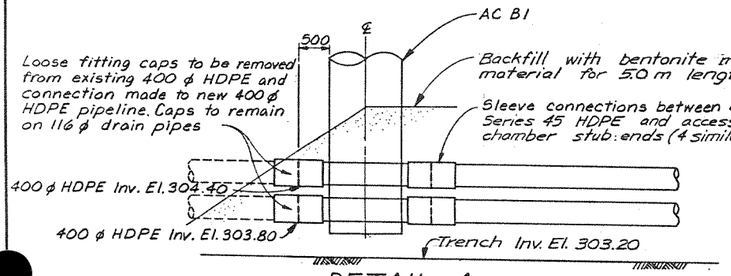


PLAN - DOWNSTREAM END
Scale A

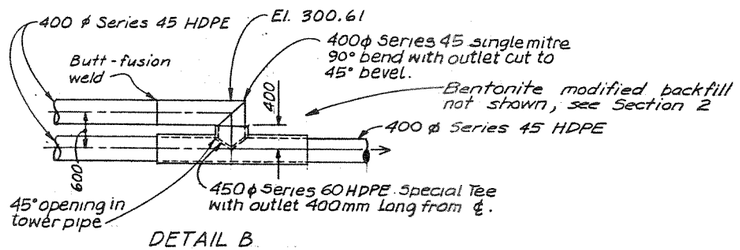


SECTION 1
Scale A (horizontal)

SECTION 2
Scale A (horizontal)



DETAIL A - Scale B



DETAIL B
Scale B

Notes
1. All dimensions in millimetres and all elevations in metres unless noted otherwise.
2. See Drg. No. 1289.125 for additional notes and details.

Scale B: 1 0.5 0 1 2 3 4 5m
Scale A: 10 5 0 10 20 30 40 50m

DRG. NO.	DESCRIPTION
1289.111	GENERAL ARRANGEMENT – SECTIONS
1289.130	PUMP STATION - BURIED PIPEWORK
1289.125	INNER DRAIN - DETAILS AND SECTIONS
1289.121	OUTER DRAIN DETAILS
1289.108	INNER DRAIN CONSTRUCTION DETAILS

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25, 1984	APPROVED FOR CONSTRUCTION	
1	JUNE 25, 1984	ISSUED FOR TENDER	

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
3	AUG. 23, 1985	AS CONSTRUCTED	

REVISIONS

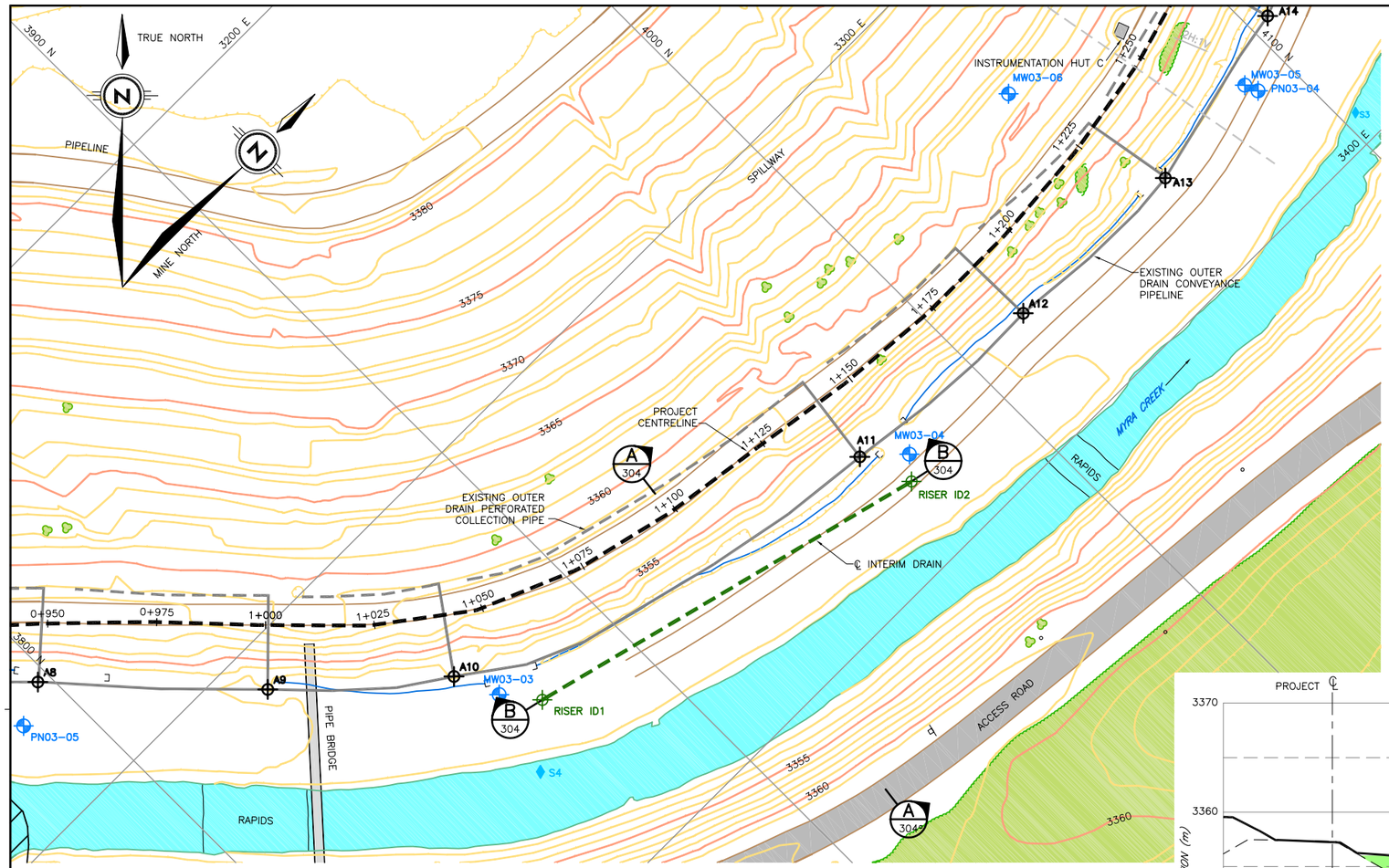
KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA H. E. DEW 25 Stroke 84

DESIGNED HED
DRAWN and
CHECKED
APPROVED

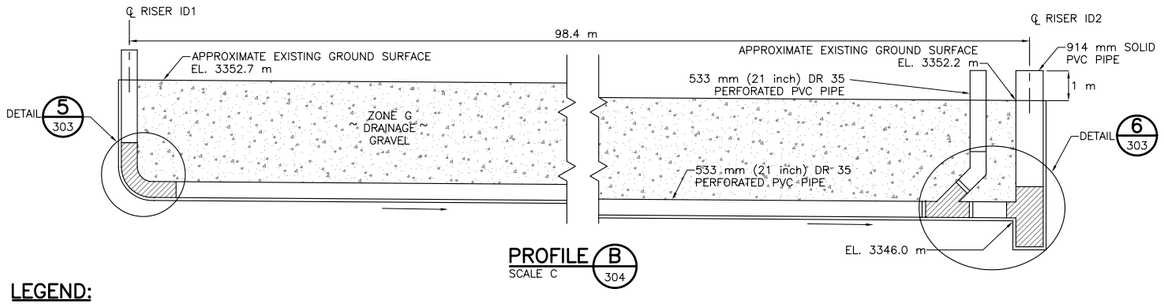
WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION
MYRA FALLS
TAILINGS DISPOSAL FACILITY - AREA II
INNER DRAIN
PLAN AND PROFILE

DATE JUNE 6, 1984 | SCALE AS SHOWN | DRG. NO. 1289.124 | REV. 3

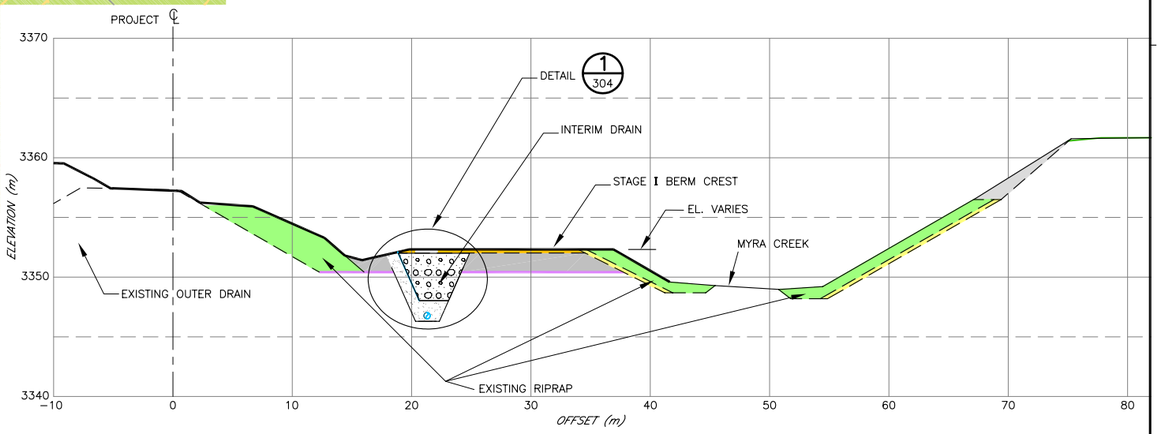
BCL-6060-K.P



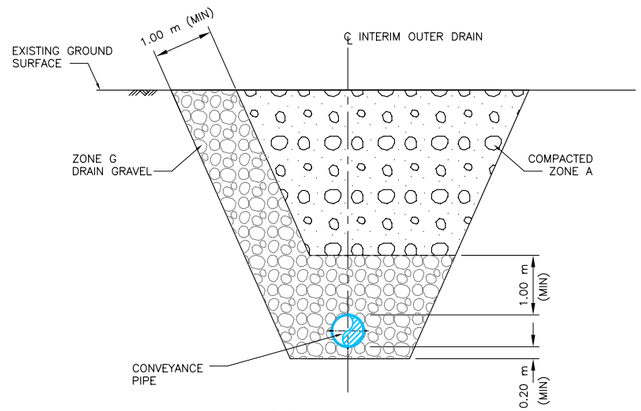
PLAN
SCALE A



PROFILE B
SCALE C



SECTION A 304
SCALE B



DETAIL 1 304 — DETAIL OF TRENCH BACKFILL
SCALE NTS

LEGEND:

- A8 — EXISTING ACCESS CHAMBERS
- ID2 — NEW OUTER DRAIN RISER
- MW03-01 — MONITORING WELLS AND PNEUMATIC PIEZOMETERS INSTALLED IN MARCH/APRIL 2003
- S4 — CREEK WATER SAMPLING LOCATION
- 0+100 — PROJECT CENTRELINE
- CENTRELINE OF INTERIM OUTER DRAIN

NOTES:

1. LAYOUT FOR AREA II OUTER DRAIN TAKEN FROM KNIGHT AND PIESOLD LTD. REPORT TITLED "MYRA FALLS CONSTRUCTION REPORT FOR TAILINGS DISPOSAL FACILITY AREA II", AUGUST 1985.

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
3	MARCH 17, 2005	CONSTRUCTION RECORD				
2	JUNE 23, 2004	PIPE TYPE AND DETAIL 4 REVISED				
1	MAY 28, 2004	ISSUED FOR CONSTRUCTION	AW	RWC	HDP	RWC
0	APR. 28, 2004	ISSUED FOR TENDER – CONTRACT No. C04002	AW	RWC	HDP	RWC

DRAWING NO.	REFERENCE DRAWING

SCALE C: 0 5 m
SCALE B: 0 10 m
SCALE A: 0 25 m

CONSTRUCTION RECORD

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS
2004 CONSTRUCTION

TITLE: TAILINGS DISPOSAL FACILITY
INTERIM OUTER DRAIN
PLAN, PROFILE AND SECTIONS

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A50	D-49304	3

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC-DM

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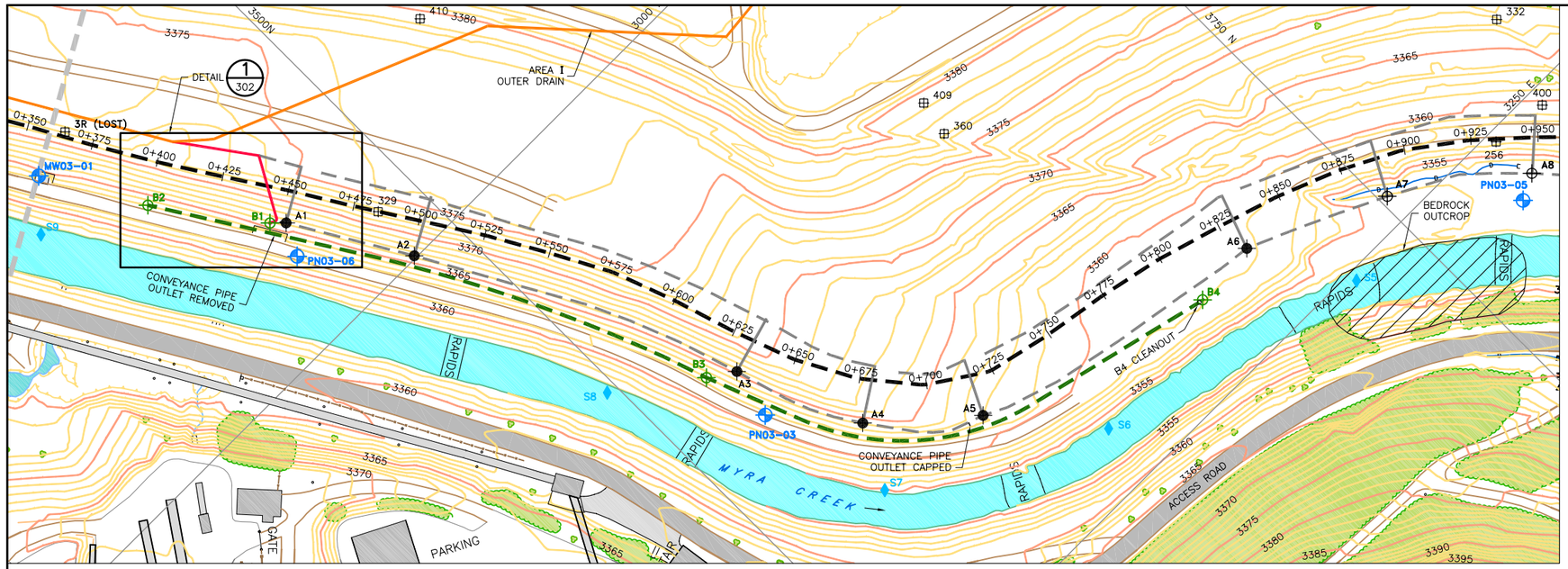
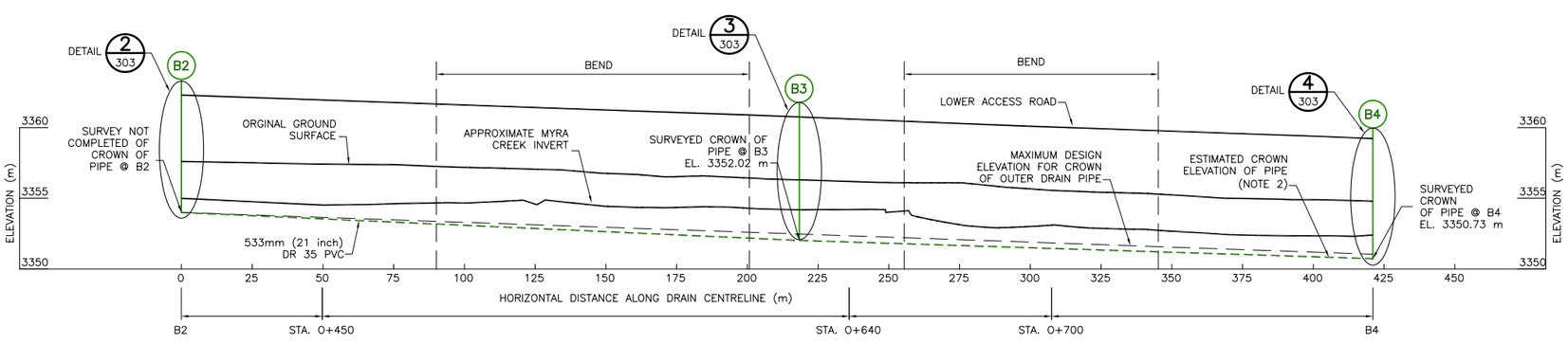
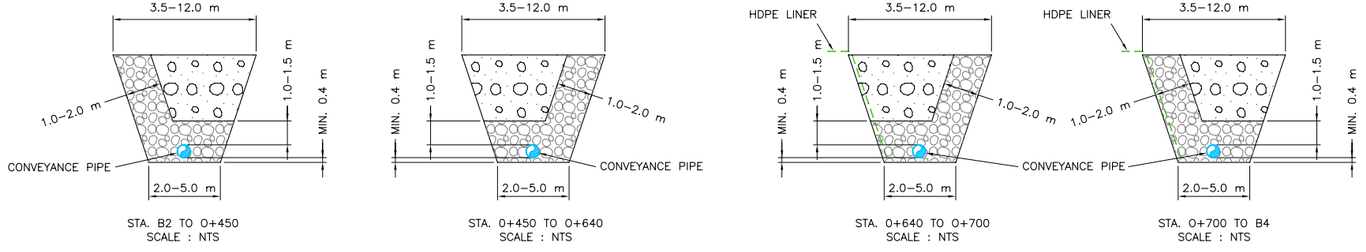
Xrefs: BM-Myrafall-Jan05



PLAN





STA. B2 TO 0+450
SCALE : NTS

STA. 0+450 TO 0+640
SCALE : NTS

STA. 0+640 TO 0+700
SCALE : NTS

STA. 0+700 TO B4
SCALE : NTS

OUTER DRAIN PROFILE AND SECTIONS

VERTICAL SCALE = 5 X HORIZONTAL SCALE

TRUE NORTH

MINE NORTH

LEGEND:

- MW03-01 — PIEZOMETER OR MONITORING WELL
- 986 — SURFACE MOVEMENT MONUMENT
- A7 — ACCESS CHAMBERS
- A1 — DECOMMISSIONED ACCESS CHAMBERS
- B1 — NEW OUTER DRAIN RISER
- S1 — CREEK WATER SAMPLING LOCATIONS
- 0+100 — PROJECT CENTERLINE
- CENTRELINE OF NEW OUTER DRAIN
- ZONE A
- ZONE G (DRAIN GRAVEL)

NOTES

1. FOR GENERAL NOTES SEE DRAWING D–49101.
2. A HAND LEVEL REFERENCED TO LOCAL SURVEY STAKES WAS USED TO SET PIPE GRADE.

CONSTRUCTION RECORD

SCALE: 0 100m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	MARCH 17, 2005	CONSTRUCTION RECORD				
1	MAY 28, 2004	ISSUED FOR CONSTRUCTION				
0	APR. 28, 2004	ISSUED FOR TENDER – CONTRACT No. C04002	AW	RWC	HDP	RWC

DRAWING NO. | REFERENCE DRAWING

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS 2004 CONSTRUCTION

TITLE: TAILINGS DISPOSAL FACILITY OUTER DRAIN PLAN AND PROFILE

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A50	D–49301	2

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC–DM

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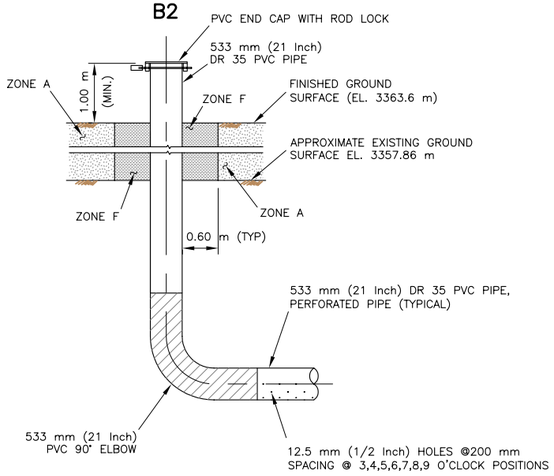
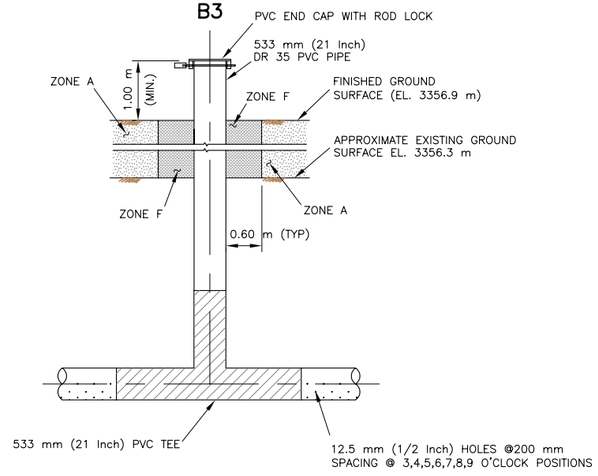
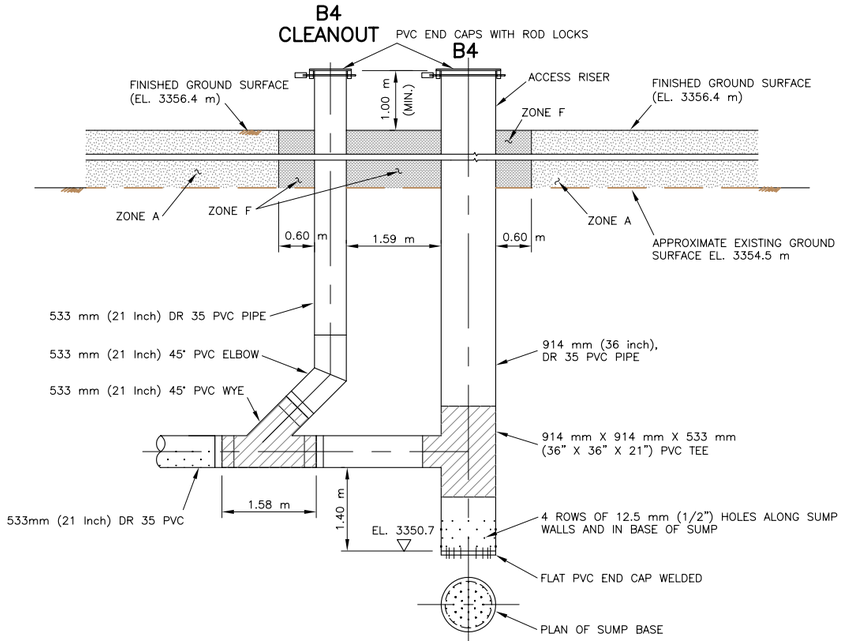
Xrefs: BM–MyraFall–Jan05



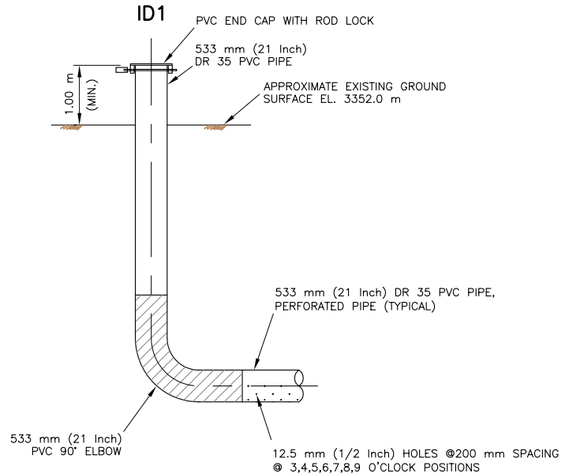
DETAIL 2 / 303 ACCESS RISER B2



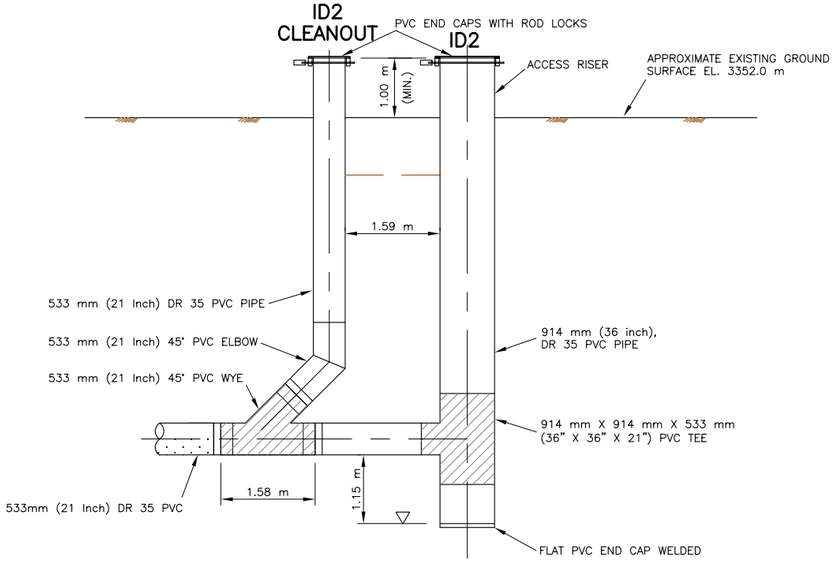
DETAIL 3 / 303 ACCESS RISER B3



DETAIL 4 / 303 ACCESS RISER B4 WITH PUMP SUMP



DETAIL 5 / 303 ACCESS RISER ID1



DETAIL 6 / 303 ACCESS RISER ID2 WITH PUMP SUMP

CONSTRUCTION RECORD

SCALE: 0 2 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
3	MARCH 17, 2005	CONSTRUCTION RECORD				
2	JUNE 23, 2004	PVC PIPE REPLACES HDPE, DETAIL 4 REVISED				
1	MAY 28, 2004	ISSUED FOR CONSTRUCTION	AW	HDP	TY	RWC
0	APR. 28, 2004	ISSUED FOR TENDER – CONTRACT No. C04002	AW	HDP	TY	RWC

DRAWING NO. | REFERENCE DRAWING

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS
2004 CONSTRUCTION

TITLE: TAILINGS DISPOSAL FACILITY
OUTER DRAIN
DETAILS AND SECTIONS (SHEET 2 OF 2)

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A50	D-49303	3

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC-DM

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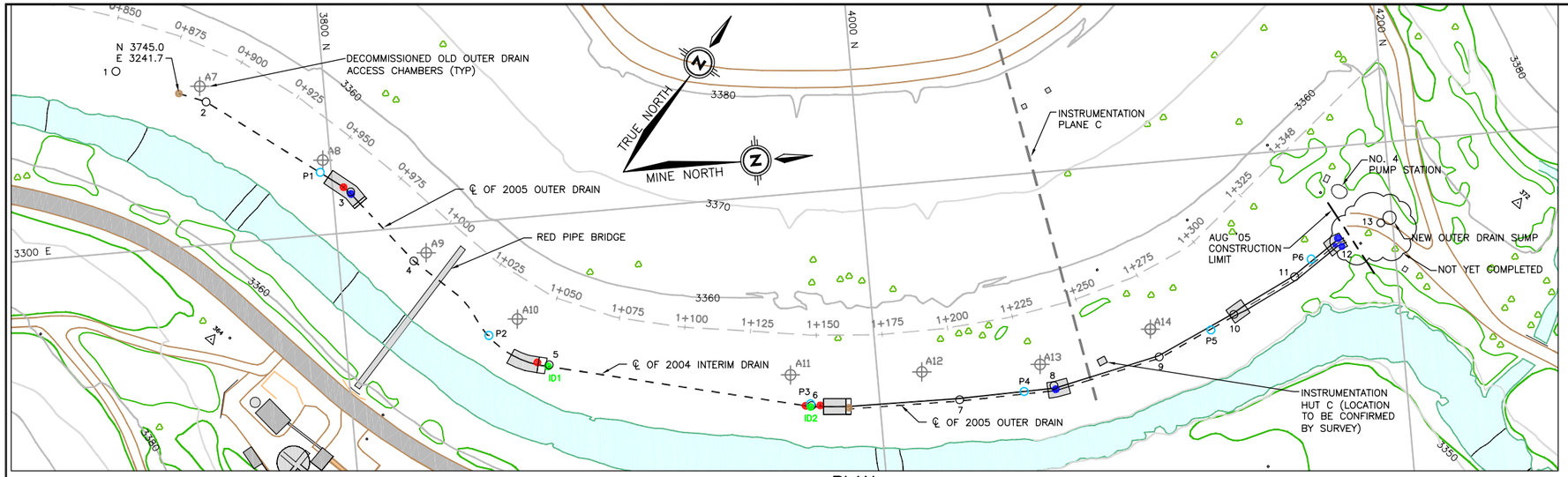
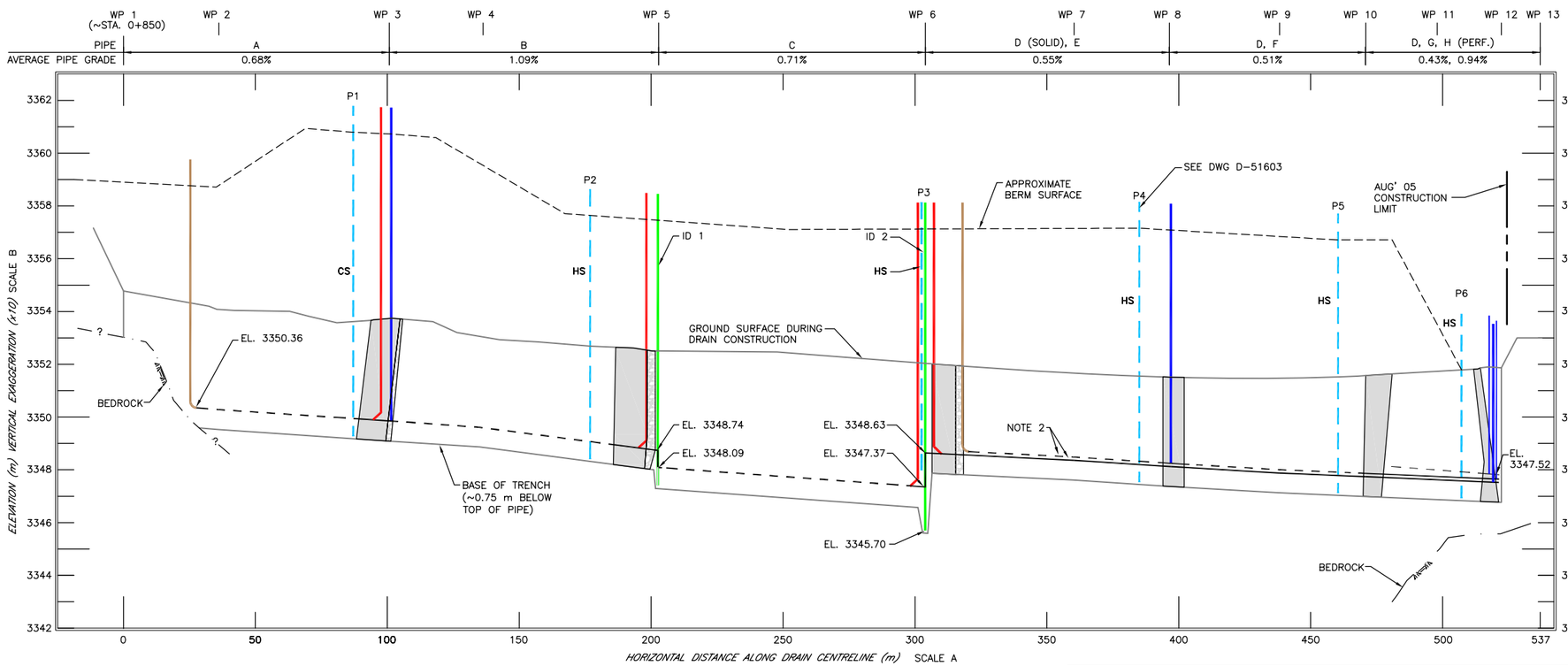


PLAN
SCALE A



2005 OUTER DRAIN PROFILE (CROWN OF PIPE)

CONSTRUCTION RECORD | DRAFT

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
3	DEC. 15, 2005	CONSTRUCTION RECORD				
2	JUNE 27, 2005	REVISED CROWN OF PIPE ELEVATIONS AT WP6 AND WP8				
1	JUNE 17, 2005	STANDPIPES ADDED, WP11, 12, 13 MOVED				
0	JUNE 1, 2005	APPROVED FOR CONSTRUCTION				

DRAWING NO. | REFERENCE DRAWING

NOTES :

1. FOR GENERAL NOTES REFER TO DRAWING D-51101. FOR ADDITIONAL DETAILS SEE LPB'S APPENDIX II OF THE 2005 OUTER DRAIN CONSTRUCTION SUMMARY REPORT.
2. PIPES ARE AT THE SAME ELEVATION BUT ARE SHOWN SEPARATED FOR CLARITY.
3. PIPE CROWN ELEVATION DATA ARE FOR PIPES A, B, C AND D.
4. **DRAIN PIPE PERFORATIONS:** 12.5 mm DIA. HOLES. 150 m SPACING BETWEEN ADJACENT HOLES, MEASURED CENTER TO CENTER ALONG EACH ROW. ROWS LOCATED OVER BOTTOM HALF OF PIPE FROM 3 O'CLOCK TO 9 O'CLOCK POSITION EXCEPT AS NOTED. HOLES STAGGERED ON ALTERNATE ROWS. PIPES A AND B: 10 ROWS AT 95 mm CENTERLINE SPACING BETWEEN ROWS. PIPE B (BETWEEN 20 m AND 64 m UPSTREAM OF ID1); 10 ROWS AT 150 mm TO 75 mm CENTERLINE SPACING BETWEEN ROWS. THREE ADDITIONAL ROWS NEAR 11 O'CLOCK, 1 O'CLOCK AND 2 O'CLOCK COVERED BY ONE LAYER OF NON-WOVEN GEOTEXTILE. PIPES E AND F: 10 ROWS AT 81 mm CENTERLINE SPACING BETWEEN ROWS. PIPE H: 7 ROWS AT 110 mm TO 55 mm CENTERLINE SPACING BETWEEN ROWS. TWO ADDITIONAL ROWS NEAR 11 O'CLOCK AND 1 O'CLOCK COVERED BY ONE LAYER OF NON-WOVEN GEOTEXTILE.
5. PIPE CROWN ELEVATIONS AT WORK POINTS PROVIDED BY CONTRACTOR. PLAN LOCATION OF STANDPIPES AND RISERS AND PLAN/ELEVATION LOCATIONS OF 500 mm PIPE NEAR WP10 AND WP12 – PROVIDED BY OWNER. DRAIN PLAN ALIGNMENT WAS ESTIMATED BASED ON SURVEYED LOCATIONS OF DRAIN PIPE RISERS AND FIELD OBSERVATION.

LEGEND :

- P2 — OD-P2, OUTER DRAIN STANDPIPE PIEZOMETER
- CS/HS — STANDPIPE IS LOCATED ON CREEK SIDE (CS) OR HILL SIDE (HS) OF PERFORATED OUTER DRAIN PIPE
- ZONE H FILL (LOW PERMEABILITY BARRIER) (LPB)
- 12 mm MINUS GRANULAR FILL
- ACCESS RISERS FOR 2004 INTERIM DRAIN
- Y-FITTING CLEAN OUT RISER
- 90° ELBOW CLEAN OUT RISER
- T-FITTING RISER
- PERFORATED DRAIN PIPE (NOTE 4)
- SOLID DRAIN PIPE
- # — WORK POINT

SUMMARY OF DRAIN PIPES

PIPE	DESCRIPTION	PVC, NOM. SIZE
A, B, C	PERFORATED	SDR35, 525 mm
D	SOLID	C905 DR18, 500 mm
E, F	PERFORATED	C905 DR18, 450 mm
G	SOLID	C905 DR18, 450 mm
H	PERFORATED	C905 DR18, 300 mm

WORK POINTS

WP	NORTHING (m)	EASTING (m)	PIPE CROWN EL. (m)	LPB LENGTH (m)
1	3721.9	3231.3		
2	3755.0	3245.8	3350.28	
3	3806.7	3284.6	3349.85	11
4	3828.3	3312.9	3349.61	
5	3876.1	3356.7		12
6	3974.1	3380.8		9
7	4030.3	3383.5	3348.36	
8	4066.4	3381.3	3348.12	8
9	4107.2	3373.9	3347.88	
10	4136.9	3360.4	3347.74	7
11	4161.1	3348.1		
12	4182.3	3337.3	3347.52	7
13	4195.5	3330.5		

SCALE A 0 50 m SCALE B 0 5 m

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS 2005 CONSTRUCTION

TITLE: 2005 OUTER DRAIN PLAN AND PROFILE

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A51	D-51601	3

CANCEL PRINTS BEARING PREVIOUS REVISION

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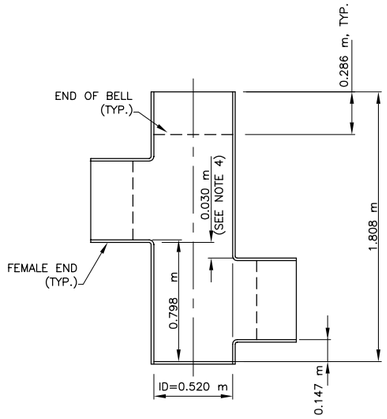
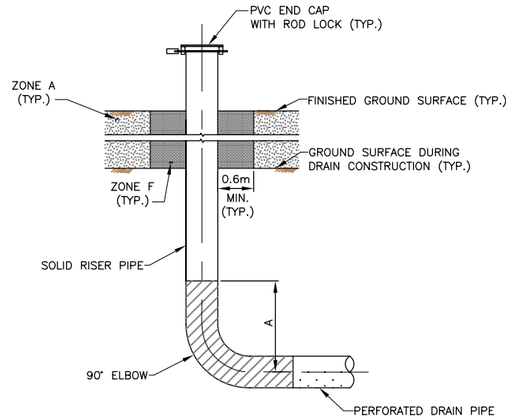
Xrefs: BM-MyraFalls-Mar05



ID1 CUSTOM FITTING DIMENSIONS

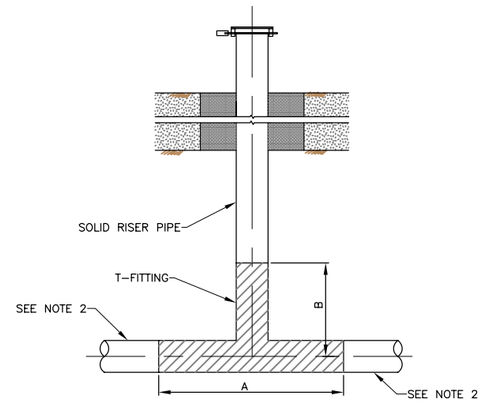
N.T.S.



TYPICAL 90° ELBOW

SCALE A

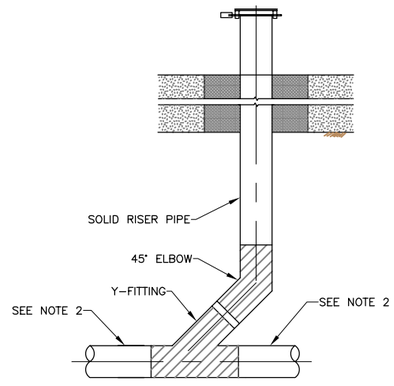
PIPE CONNECTION SIZE		
WORK POINT	DESCRIPTION	A (m)
NEAR 2	PVC SDR35 525 mm NOM. SIZE	1.0
6	PVC C905 DR18 450 mm NOM. SIZE	1.1



TYPICAL T–FITTING

SCALE A

PIPE CONNECTION SIZE			
WORK POINT	DESCRIPTION	A (m)	B (m)
3	PVC SDR35 525 mm NOM. SIZE	1.4	0.7
8, 12	PVC C905 DR18 450 mm NOM. SIZE	1.5	0.9
12	PVC C905 DR18 300 mm NOM. SIZE	1.0	0.5
12	PVC C905 DR18 500 mm NOM. SIZE	1.6	0.9

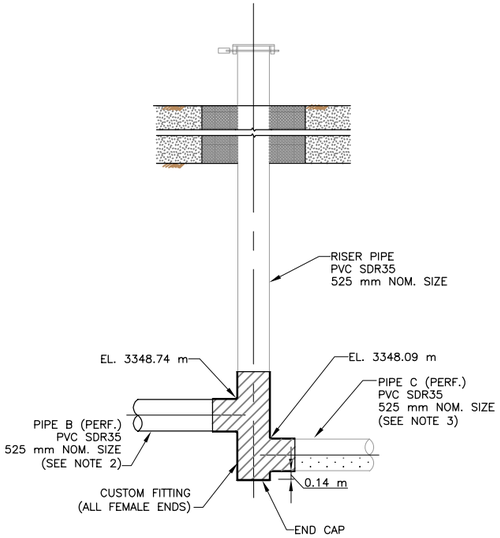


TYPICAL Y–FITTING

SCALE A

PIPE CONNECTION SIZE		
WORK POINT	DESCRIPTION	
3, 5	PVC SDR35 525 mm NOM. SIZE	
6, 13	PVC C905 DR18 500 mm NOM. SIZE	WP13 NOT YET INSTALLED
13	PVC C905 DR18 300 mm NOM. SIZE	
13	PVC C905 DR18 450 mm NOM. SIZE	

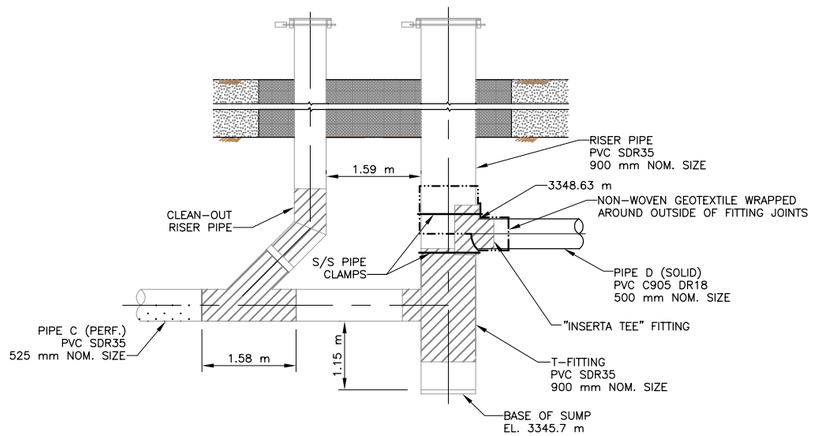
ID1



CUSTOM FITTING AT ACCESS RISER ID1

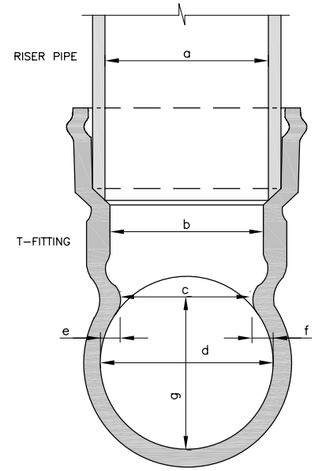
SCALE A

CLEANOUT ID2



TIE IN WITH ACCESS RISER ID2

SCALE A



TYPICAL SECTION OF "T" AND "Y" FITTINGS (LOOKING UPSTREAM)

N.T.S.

T AND Y FITTINGS INTERNAL DIMENSIONS

"T" Fittings (nom. size)	Dimensions (mm) [looking upstream]						
	a	b	c	d	e	f	g
300 mm	290	290	285	305	10	10	230
450 mm	425	420	>420	435	8	8	–
500 mm	475	464	450	480	15	15	390
525 mm	525	525	530	525	–5	10	435
"Y" Fittings (nom. size)	Dimensions (mm) [looking upstream]						
	a	b	c	d	e	f	g
300 mm	290	300	295	305	5	5	225
450 mm	425	445	465	450	20	20	420
500 mm	475	525	515	520	2	2	370
525 mm	525	525	545	530	20	20	415

NOTES:

1. RISERS WERE RAISED DURING FILL PLACEMENT.
2. SOLID DRAIN PIPE EXTENDS 2 m BEYOND THE LIMITS OF THE LOW PERM. BARRIER.
3. ONE 4 m LENGTH OF PERFORATED PIPE REMOVED WITH 90–DEGREE ELBOW AND REPLACED WITH PIPE B (PERF.).
4. LENGTH OF VERTICAL PIPE WITH CONSTANT CIRCULAR SECTION.

CONSTRUCTION RECORD | DRAFT

SCALE A 0 2.5m

DRAWING NO.	REFERENCE DRAWING	NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
		1	DEC. 15, 2005	CONSTRUCTION RECORD				
		0	JUNE 1, 2005	APPROVED FOR CONSTRUCTION				

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS
2005 CONSTRUCTION

TITLE: 2005 OUTER DRAIN JOINT DETAILS

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A51	D–51602	1

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC–DM

Time: 14:19:20
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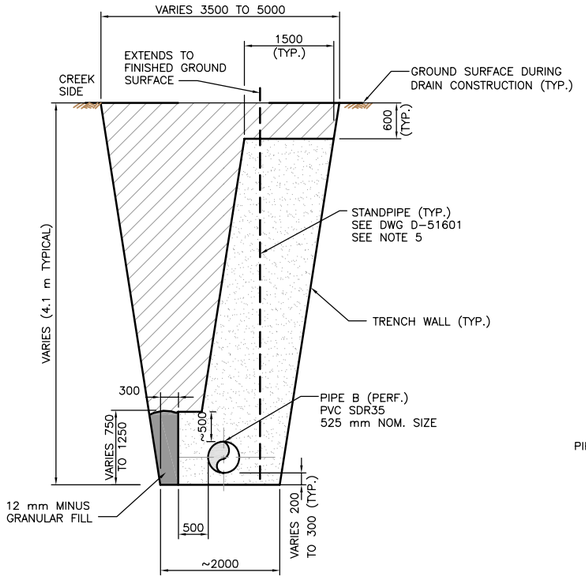
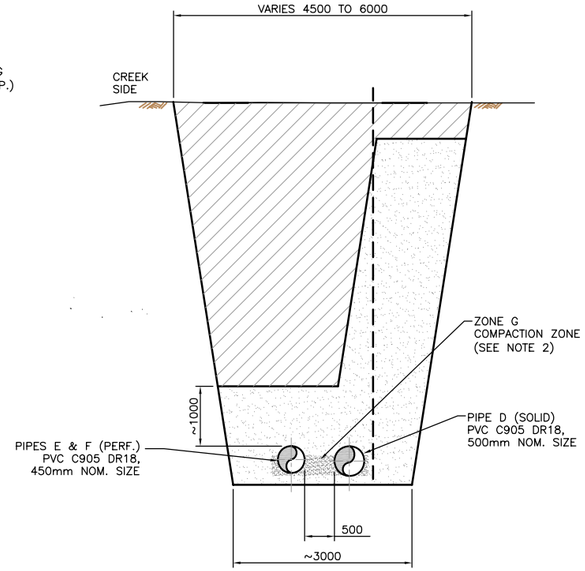
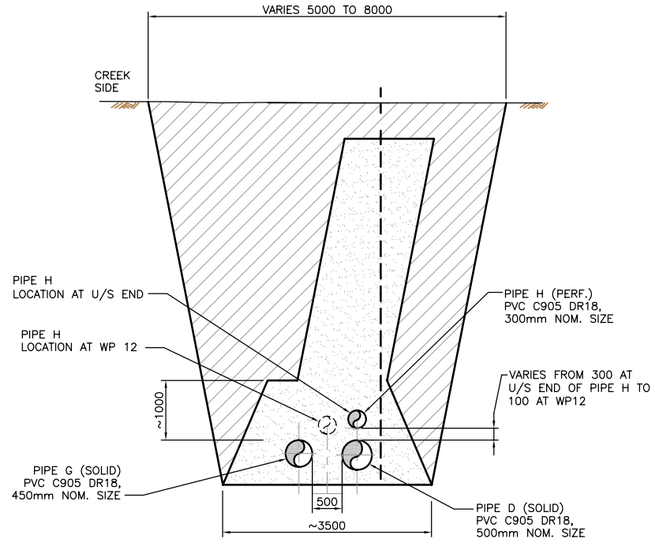


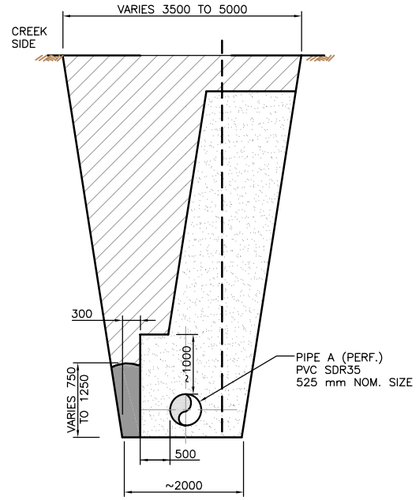
RED PIPE BRIDGE TO WORK POINT 5



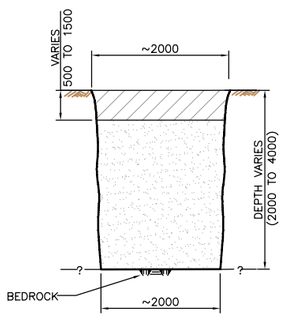
WORK POINT 6 TO WORK POINT 10



WORK POINT 10 TO WORK POINT 12



U/S END OF PIPE TO RED PIPE BRIDGE



WP1 TO U/S END OF PIPE

LEGEND:

- ZONE A
- ZONE G
- 12 mm MINUS GRANULAR FILL

NOTES:

1. DIMENSIONS ARE IN MILLIMETRES.
2. THE SPECIFIED COMPACTION ZONE EXTENDS FROM PIPE INVERT LEVEL TO 75 mm ABOVE THE SPRINGLINE OVER THE FULL WIDTH OF THE TRENCH, MINIMUM 95% STANDARD PROCTOR. ACTUAL COMPACTION VARIED AS INDICATED.
3. DIMENSIONS ARE APPROXIMATE, VARYING WHERE NOTED. BOUNDARIES WERE JAGGED, NOT LINEAR AS INDICATED.
4. UPSTREAM END OF DRAIN TRENCH ENDED IN PREVIOUSLY PLACED ZONE A FILL. THE 2005 DRAIN WAS NOT CONNECTED TO THE 2004 DRAIN.
5. A) STANDPIPES WERE INSTALLED UPSTREAM OF LOW PERMEABILITY BARRIERS AND EXTEND FROM 100 mm ABOVE BASE OF TRENCH TO 1 m ABOVE FINISHED GROUND SURFACE.
   B) PIPE IS PVC C900 DR14 150 mm NOM. SIZE WITH CAST IRON END CAP ON BOTTOM END.
   C) STANDPIPE PERFORATIONS:
   - PERFORATED SECTION LOCATED FROM 350 mm TO 600 mm ABOVE BOTTOM CAP.
   - PERFORATED SECTION OF STANDPIPE INSTALLED BETWEEN SPRING LINE AND CROWN LEVEL OF ADJACENT OUTER DRAIN PIPE.
   - 6.5 mm DIAMETER HOLES.
   - 4 ROWS OF PERFORATIONS AT 90 DEG. INTERVALS AROUND PIPE.
   - 5 HOLES ALONG EACH ROW AT 60 mm SPACING.

SCALE 0 2 m

CONSTRUCTION RECORD | DRAFT

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
2	DEC. 15, 2005	CONSTRUCTION RECORD				
1	JUNE 17, 2005	STANDPIPES ADDED				
0	JUNE 1, 2005	APPROVED FOR CONSTRUCTION				

DRAWING NO. | REFERENCE DRAWING

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS
2005 CONSTRUCTION

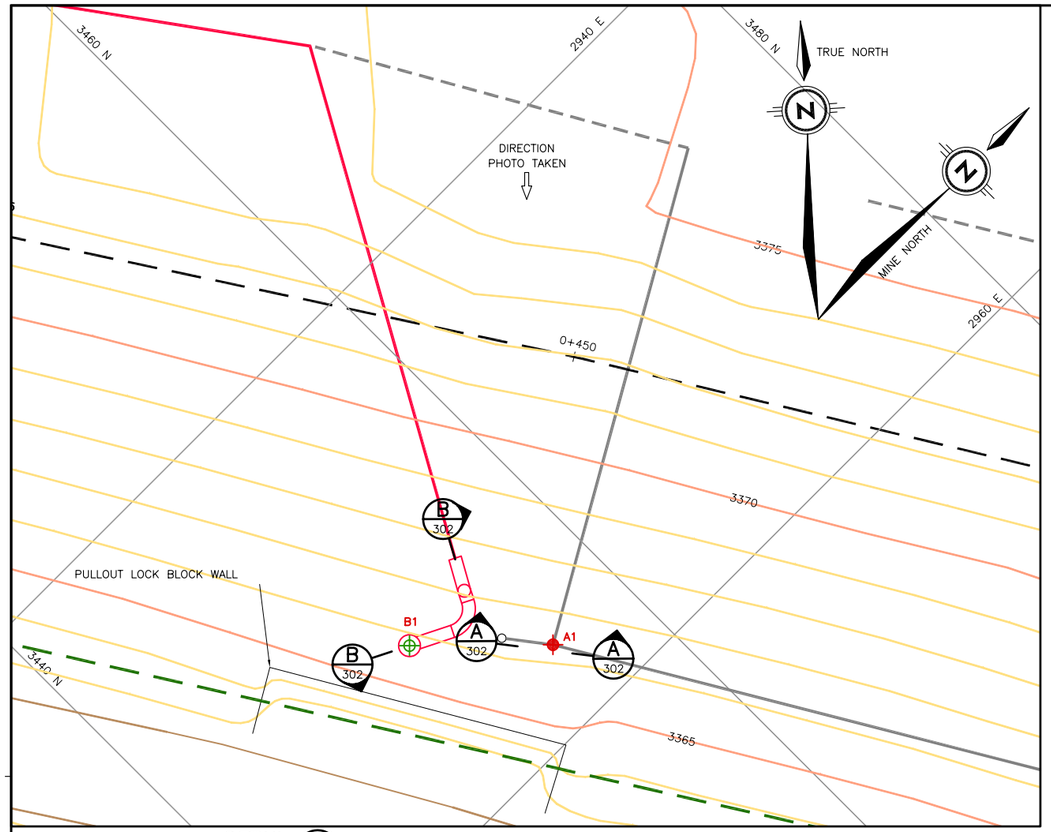
TITLE: 2005 OUTER DRAIN
TYPICAL SECTIONS

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A51	D-51603	2

CANCEL PRINTS BEARING PREVIOUS REVISION

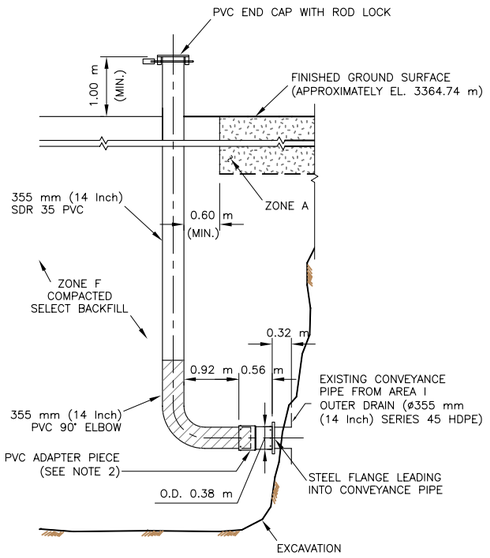
KCC-DM

Time: 14:41:4
Date: 12/8/2005
Scale: 1=1(PS)
Drawing File: M:\M07632\A51 - 2005 Construction Services\400 Design\410 Drawings\09 - 2005 COnstruction\CONSTRUCTION RECORD\D-51603_rev2.dwg (lhutton)



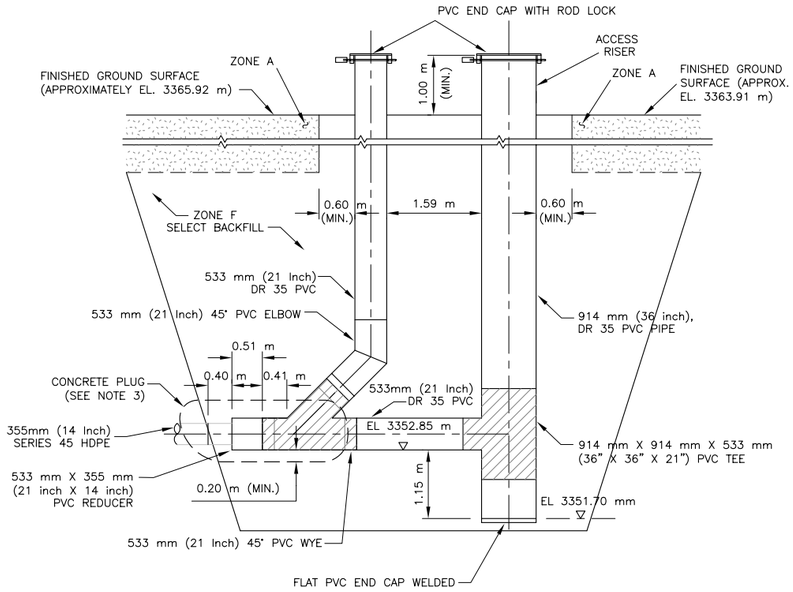
DETAIL 1 (301) PLAN OF CONNECTION TO EXISTING DRAIN
SCALE A

CONVEYANCE PIPE CLEANOUT



SECTION A (302)
SCALE B

B1 CLEANOUT B1



SECTION B (302)
SCALE B

LEGEND:

- MW03-01 — PIEZOMETER OR MONITORING WELL
- A1 — DECOMMISSIONED ACCESS CHAMBERS
- B1 — NEW OUTER DRAIN RISER
- 0+100 — PROJECT CENTRELINE
- CENTRELINE OF NEW OUTER DRAIN
- CONVEYANCE PIPE FROM AREA I OUTER DRAIN CONNECTING TO ACCESS RISER B1

NOTES:

1. FOR GENERAL NOTES SEE DRAWING D-49101.
2. 8 STAINLESS SCREWS USED TO SECURE CONNECTION AT BOTH ENDS.
3. CONCRETE PLUG CONSTRUCTED OF 30MPa TYPE 50 CEMENT.

CONSTRUCTION RECORD

SCALE B: 0 2 m
SCALE A: 0 5 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
3	MARCH 17, 2005	CONSTRUCTION RECORD				
2	JUNE 23, 2004	PVC PIPE REPLACES HDPE, SECT. B REVISED				
1	MAY 28, 2004	ISSUED FOR CONSTRUCTION	AW	RWC	HDP	RWC
0	APR. 28, 2004	ISSUED FOR TENDER – CONTRACT No. C04002	AW	RWC	HDP	RWC

DRAWING NO. | REFERENCE DRAWING

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

PROJECT: MYRA FALLS OPERATIONS 2004 CONSTRUCTION

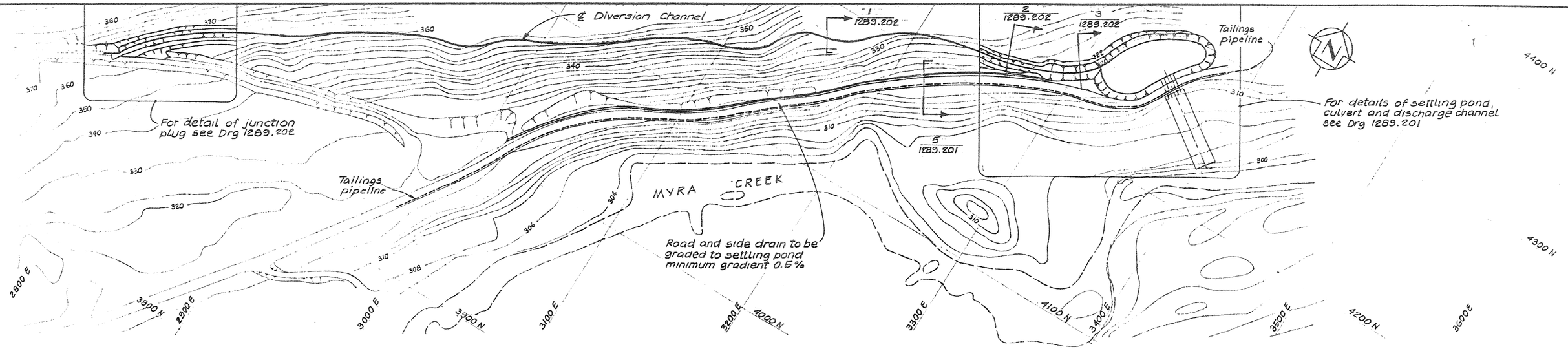
TITLE: TAILINGS DISPOSAL FACILITY CONSTRUCTION RECORD OUTER DRAIN DETAILS AND SECTIONS (SHEET 1 OF 2)

SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A50	D-49302	3

KCC-DM

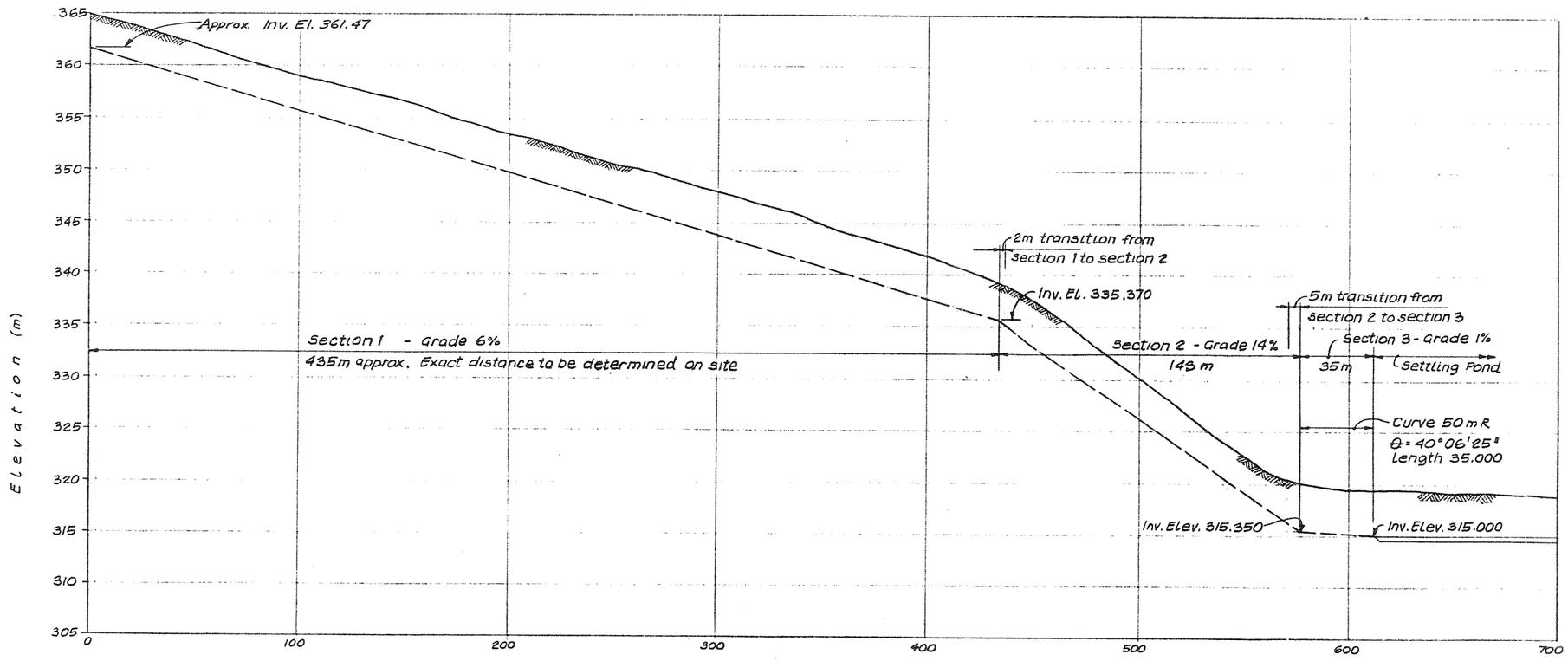
CANCEL PRINTS BEARING PREVIOUS REVISION

Time: 14:22:13
Date: 15 Mar 2005
Scale: 1=1(FS)
Drawing File: M:\M07632\A50 - 2004 Construction Monitoring\400 Design\410 Drawings\06 2004 Construction Record\D-49302r3_2005.dwg (plee)
Xrefs: BM-MyraFall-Jan05



PLAN

Scale A



PROFILE

Horiz. scale A

Scale A 20 10 0 20 40 60 80 100m

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
3		AS CONSTRUCTED	

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25,1984	APPROVED FOR CONSTRUCTION	
1	JUNE 28,1984	ISSUED FOR TENDER	

REVISIONS

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS — VANCOUVER, B.C.

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — E. S. KNIGHT

DESIGNED
DRAWN AT.
CHECKED
APPROVED

DATE

WESTMIN RESOURCES LIMITED

WESTERN MINES DIVISION

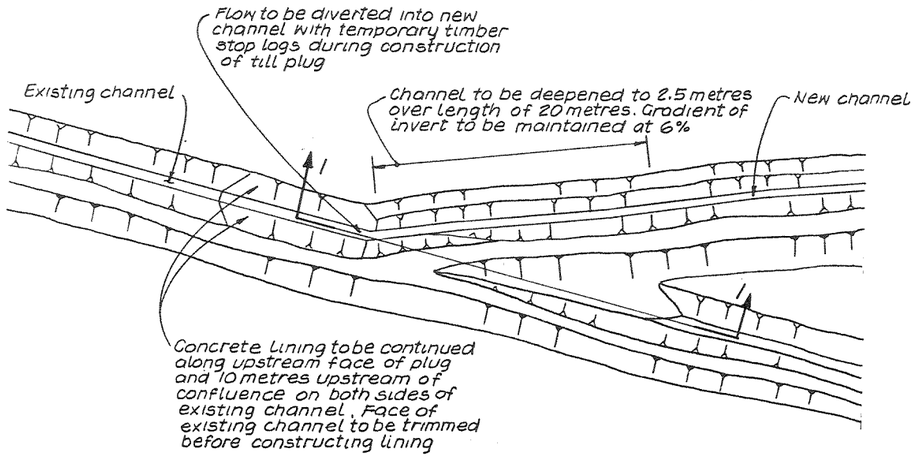
MYRA FALLS

TAILINGS DISPOSAL FACILITY - AREA II

LYNX DIVERSION CHANNEL

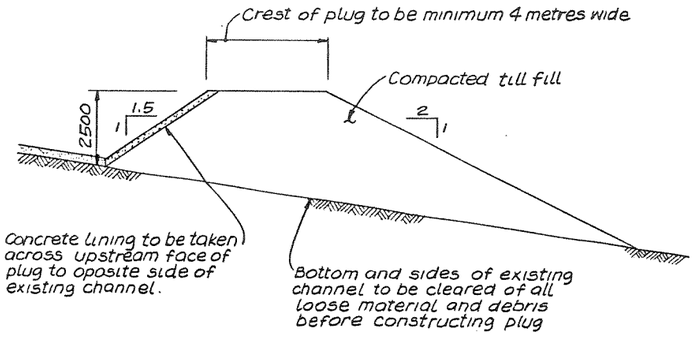
GENERAL ARRANGEMENT AND PROFILE

SCALE AS SHOWN | DRG. NO. 1289.200 | REV. 3



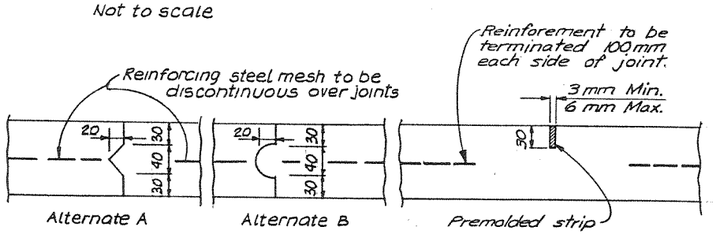
DETAIL OF JUNCTION PLUG

Not to scale



SECTION 1

Not to scale

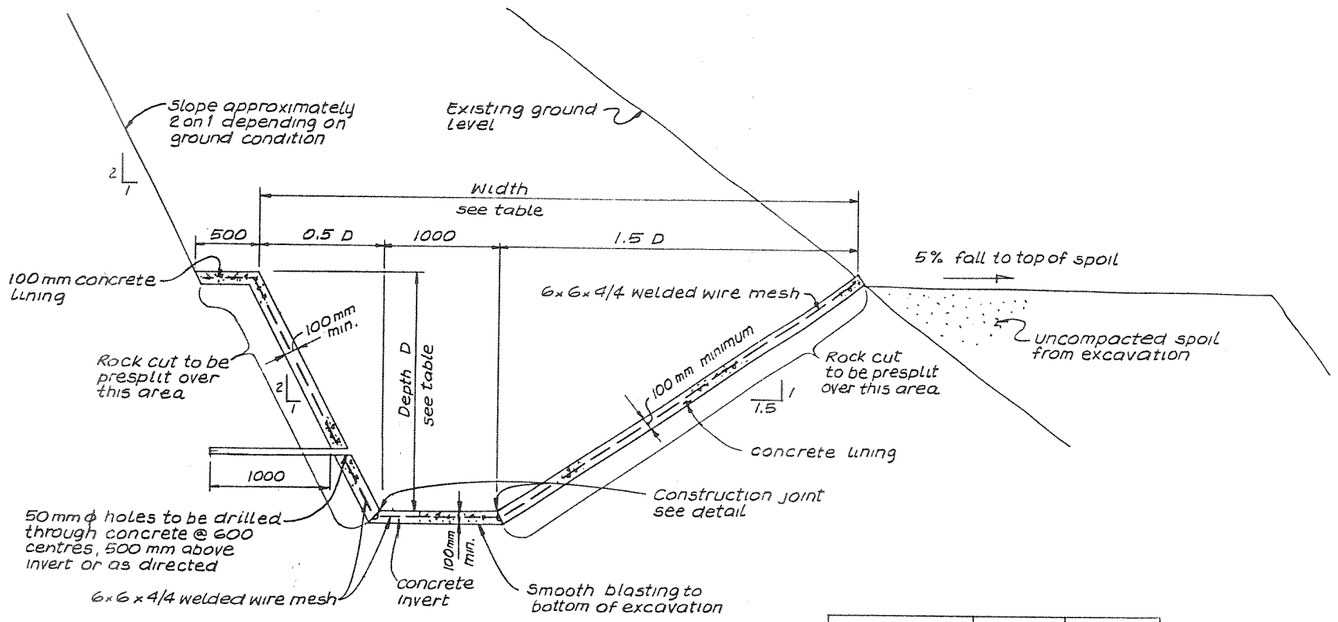


DETAIL OF CONSTRUCTION JOINT

Scale A

DETAIL OF CONTRACTION JOINT

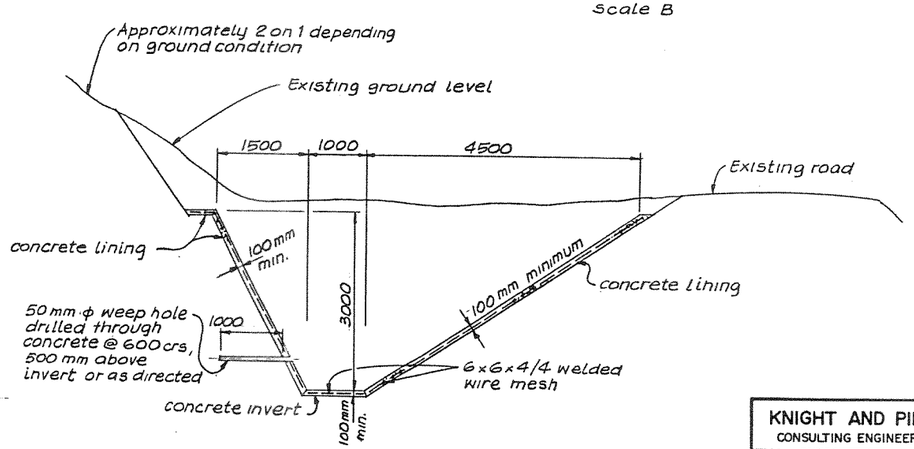
Scale A



SECTION 1 and 2 / 1289.200

Scale B

	Depth	Width
Section 1	2000	5000
Section 2	1750	4500



SECTION 3 / 1289.200

Scale C

Scale C 1 0 1 2 3 4 5 m

Scale B 1000 500 0 1000 2000 mm

Scale A 100 0 100 200 300 400 mm

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
3		AS CONSTRUCTED	

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25, 1984	APPROVED FOR CONSTRUCTION	
1	JUNE 28, 1984	ISSUED FOR TENDER	

REVISIONS

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS — VANCOUVER, B.C.

PROFESSIONAL ENGINEER — L. S. KNIGHT — BRITISH COLUMBIA

DESIGNED L S Knight
DRAWN A.C.
CHECKED
APPROVED

DATE

WESTMIN RESOURCES LIMITED

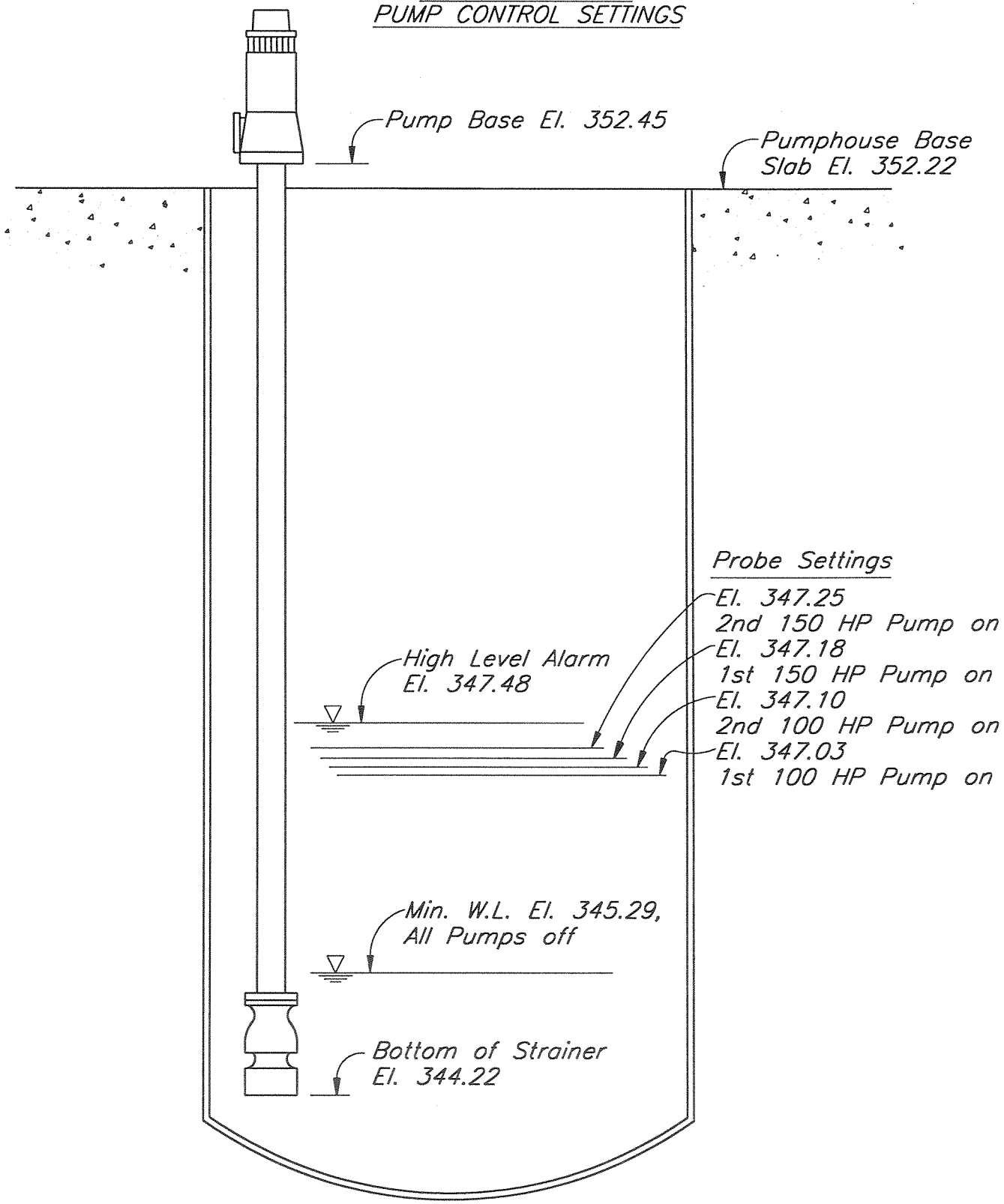
WESTERN MINES DIVISION

MYRA FALLS

TAILINGS DISPOSAL FACILITY - AREA II
LYNX DIVERSION CHANNEL
CHANNEL DETAILS

SCALE AS SHOWN | DRG. NO. 1289.202 | REV. 3

WESTMIN RESOURCES LIMITED
MYRA FALLS
TAILINGS DISPOSAL FACILITY
PUMPHOUSE NO.4
PUMP CONTROL SETTINGS



Pump Sequencing – 100 HP Pumps alternate as lead pumps. 150 Hp Pumps alternate as backup pumps.

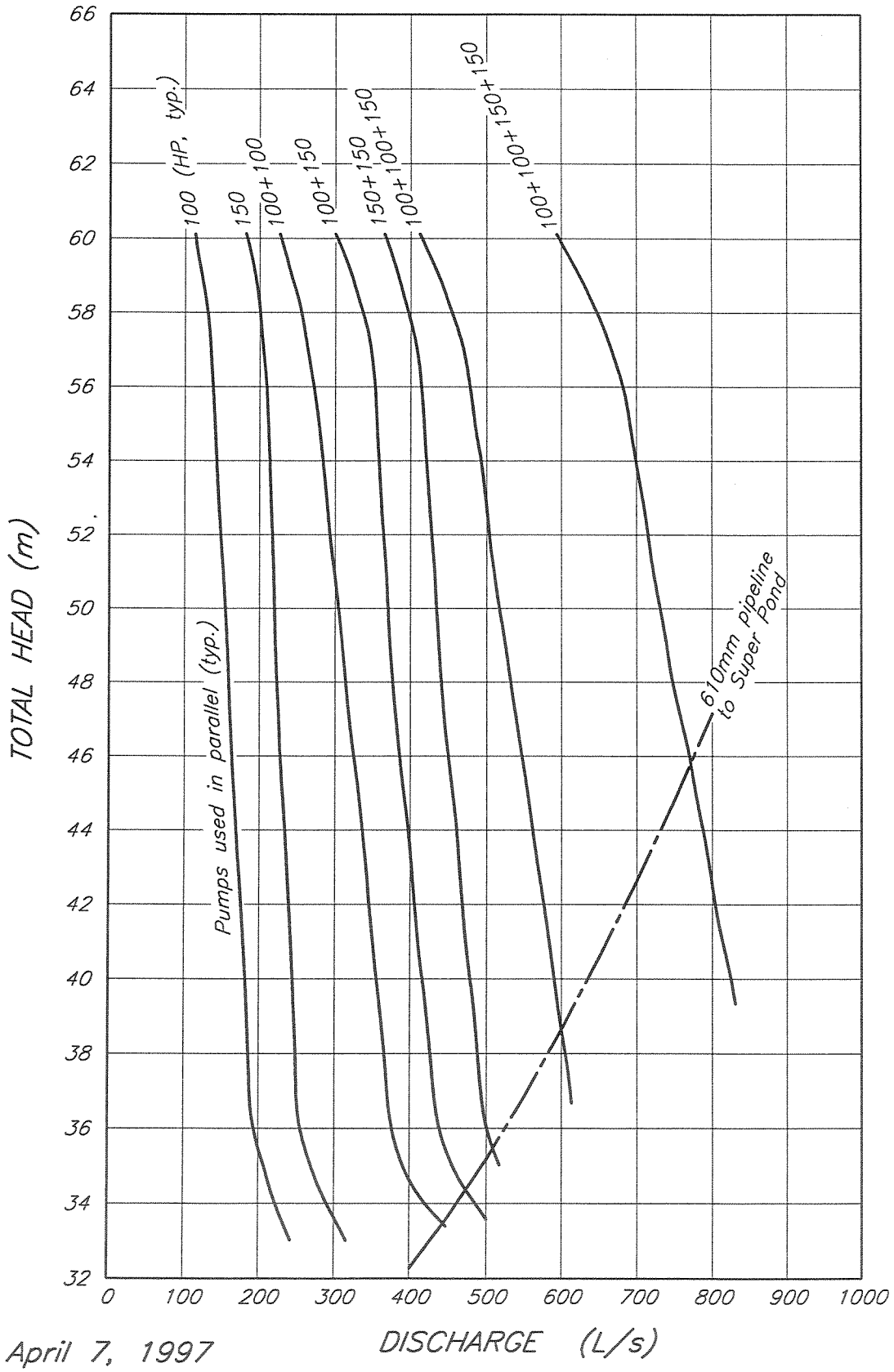
April 7, 1997

KNIGHT PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 6.3

WESTMIN RESOURCES LIMITED
MYRA FALLS OPERATION

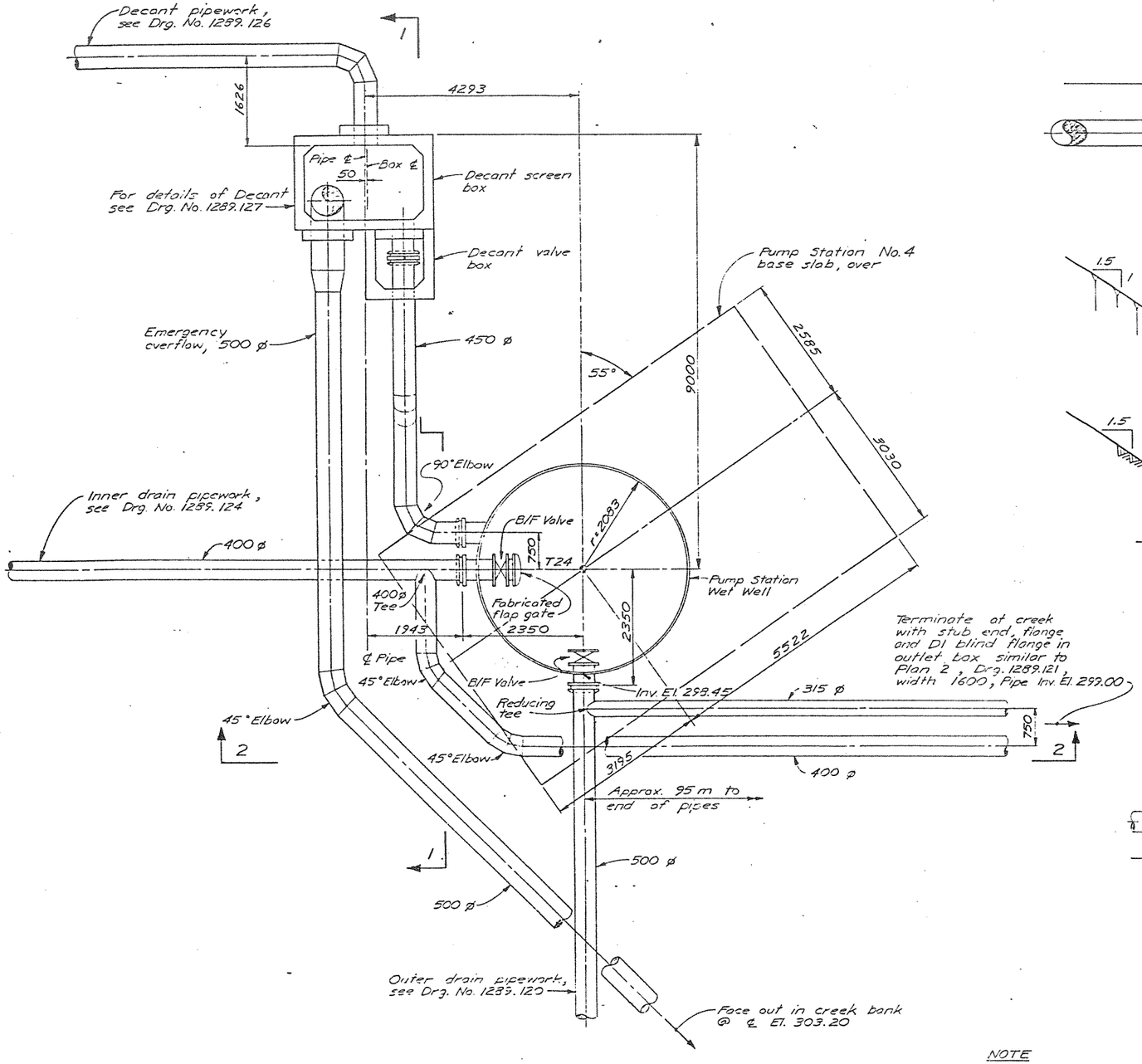
EXISTING NO. 4 PUMPSTATION OPERATING ENVELOPE AND TDH FOR ALTERNATIVE PIPELINE SYSTEMS



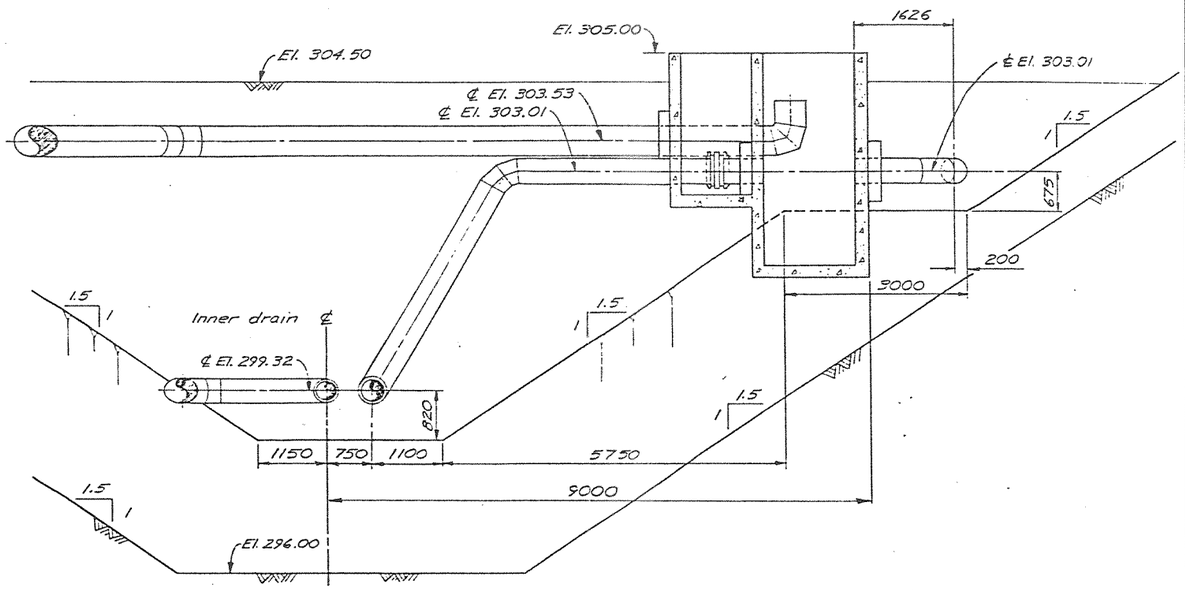
April 7, 1997

KNIGHT PIESOLD LTD.
CONSULTING ENGINEERS

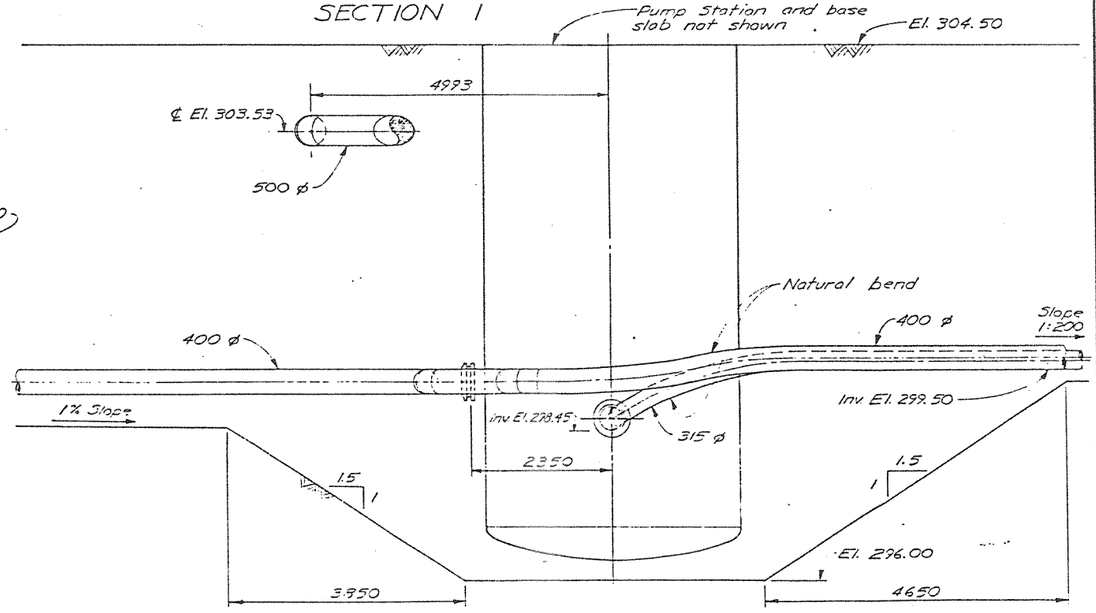
FIGURE 6.2



Terminate at creek with stub end, flange and DI blind flange in outlet box similar to Plan 2, Drg. 1289.121, width 1600, Pipe Inv. El. 299.00



SECTION 1



SECTION 2

FOR INFORMATION ONLY

NOTE

1. This drawing similar to Drawing No. 1289.130 Rev. 4. Included for reference only.

Scale 1 0 5 0 1 2 3 4 5m

DRG. NO.	DESCRIPTION	APPROVED
REFERENCE DRAWINGS		

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

DESIGNED
DRAWN
CHECKED
APPROVED

WESTMIN RESOURCES LIMITED

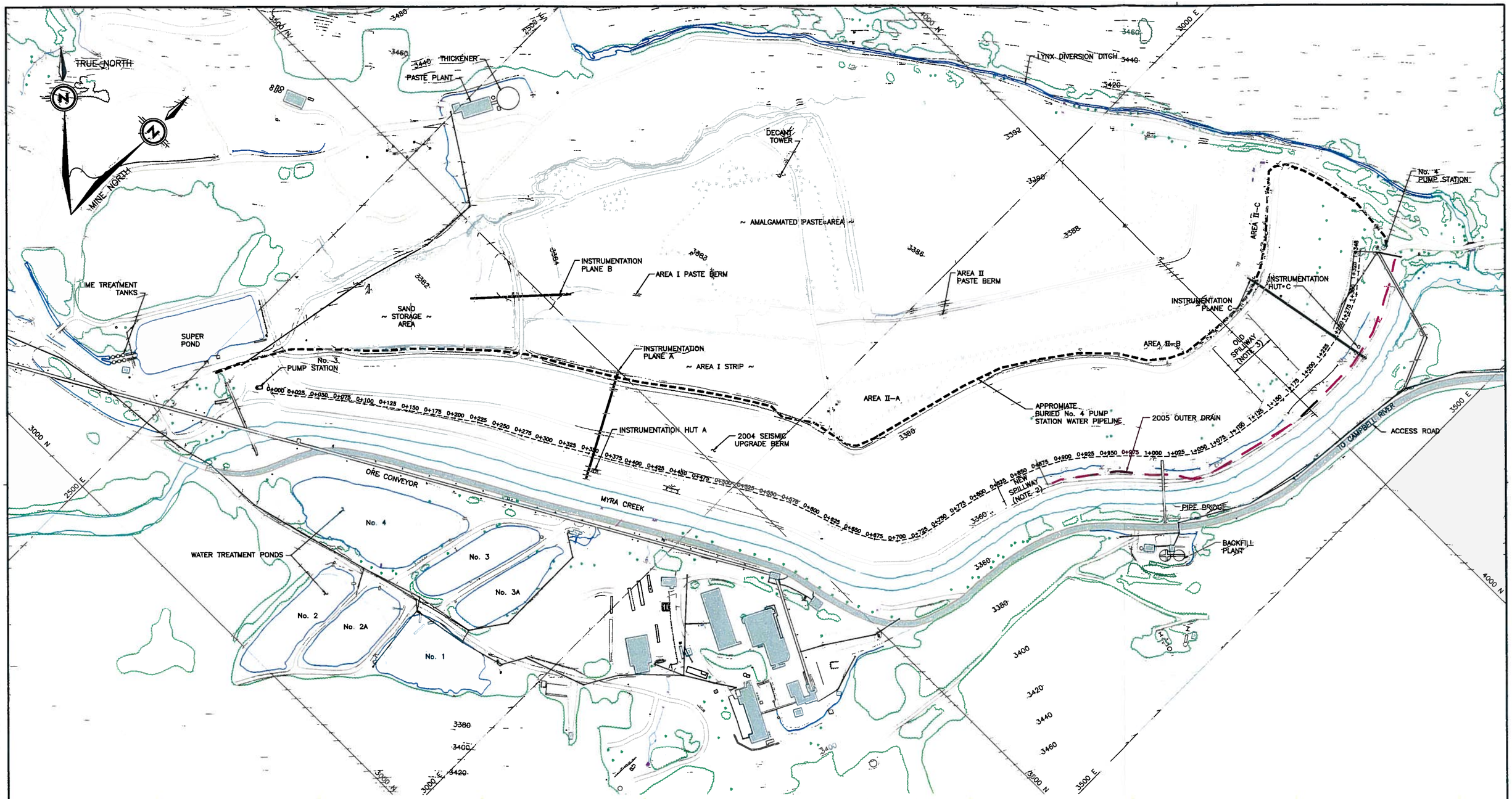
WESTERN MINES DIVISION

MYRA FALLS

TAILINGS DISPOSAL FACILITY - AREAS I AND II

PUMP STATION NO. 4 - BURIED PIPEWORK

DATE JAN. 31, 1985 | SCALE AS SHOWN | DRG. NO. 1289.415 | REV.



LEGEND:

- ACCESS CHAMBERS DECOMMISSIONED IN 2005
- POWER LINES
- 0+100 PROJECT CENTRELINE
- ACCESS RISER FOR 2004 OUTER DRAIN
- ACCESS RISER FOR 2004 INTERIM DRAIN
- 2005 OUTER DRAIN

NOTE:

1. FOR GENERAL NOTES REFER TO DRAWING D-51101.
2. SEISMIC UPGRADE BERM SPILLWAY.
3. PREVIOUS TDF SPILLWAY.

CONSTRUCTION RECORD

SCALE: 0 100 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
1	DEC. 11, 2006	2005 CONSTRUCTION RECORD	tv		TB	
0	JUNE 2, 2005	APPROVED FOR CONSTRUCTION				

DRAWING NO. | REFERENCE DRAWING

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — R. W. CHAMBERS

CLIENT: NVI MINING LTD.

KLOHN CRIPPEN

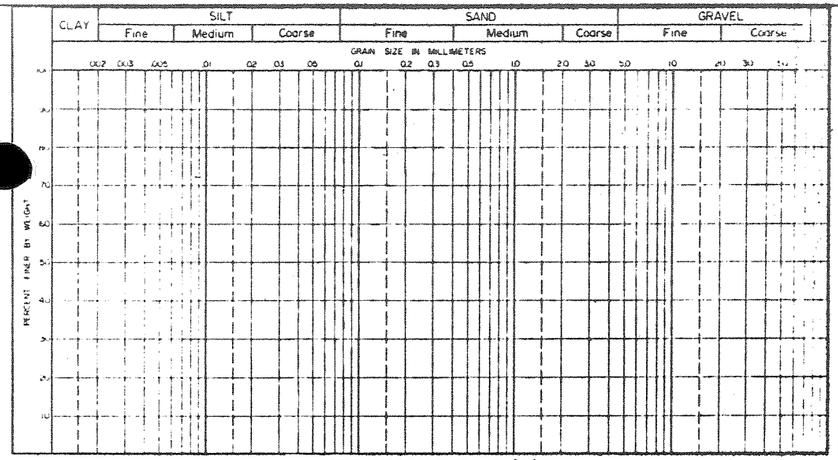
PROJECT: MYRA FALLS OPERATIONS 2005 CONSTRUCTION

TITLE: TAILINGS DISPOSAL FACILITY GENERAL ARRANGEMENT

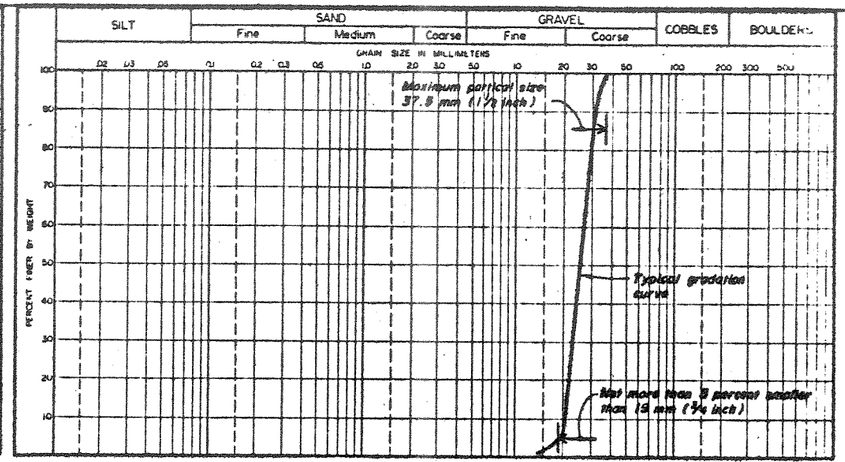
SCALE	PROJECT No.	DWG. No.	REV.
AS SHOWN	M07632 A51	D-51102	1

CANCEL PRINTS BEARING PREVIOUS REVISION

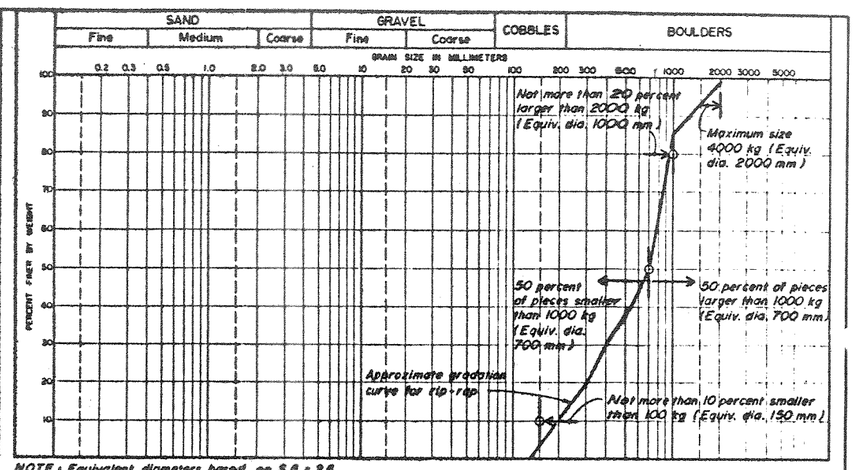
Time: 8:12:56
Date: 11/27/2006
Scale: 1=10(PS)
Drawing File: M:\M07632\A54 - 2005 CW Construction Monitoring\400 Design\410 Drawings\2005Construction_Record_Dec_2006\D-51102_rev1.dwg (awang)
Xrefs: BM-Myra-dtls-Mar06



FILTER MATERIAL TYPE 'A'
(not used)

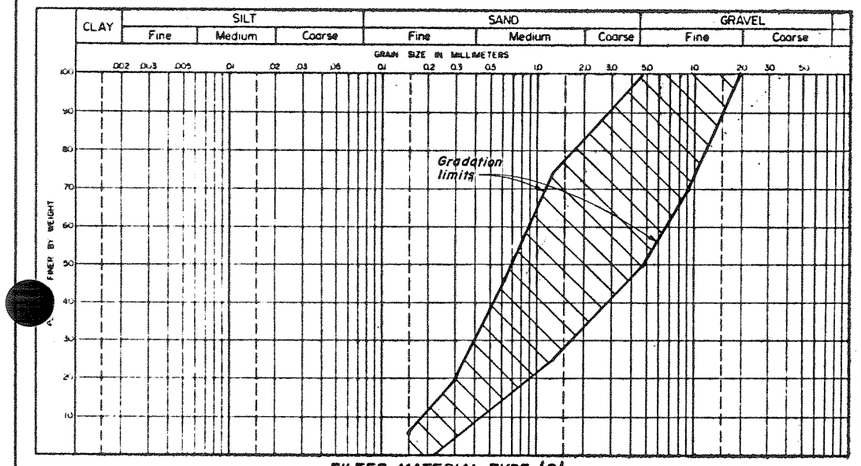


FILTER MATERIAL TYPE 'D'
DRAIN ROCK

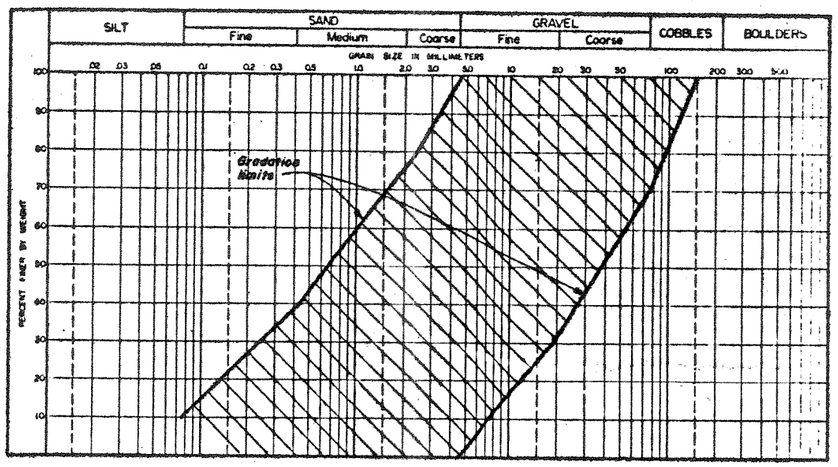


NOTE - Equivalent diameters based on S.G. = 2.6

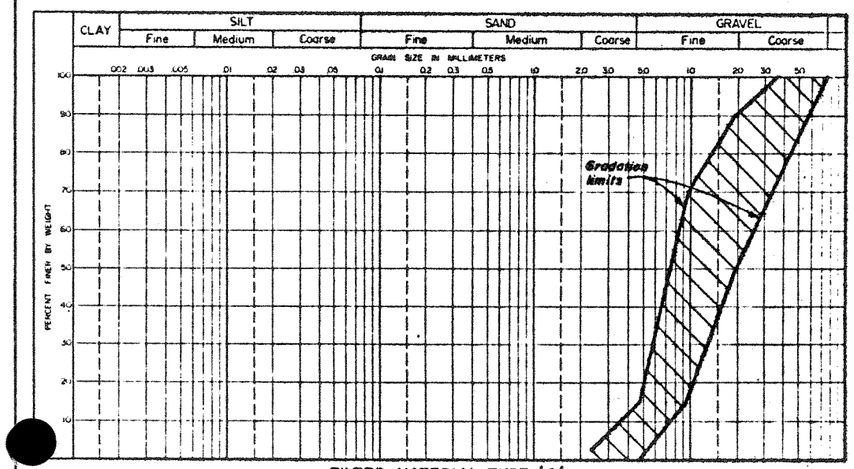
RIP - RAP



FILTER MATERIAL TYPE 'B'
SLOPING FILTER



FILL MATERIAL



FILTER MATERIAL TYPE 'C'
COARSE FILTER

MATERIAL	SOURCE	INTENDED USE
Filter material, Type A	Not Used	Not Used
Filter material, Type B	Washed screened material from processing plant	(i) Inner drain, pitter drains and sloping filter (ii) Pipe bedding and backfill (iii) Backfill to instrumentation
Filter material, Type C	Washed screened material from processing plant	(i) Inner drain and pitter drains
Filter material, Type D	Washed screened material from processing plant	(i) Inner drain
Fill material	Direct from excavation or waste material from processing plant	(i) Embankment (ii) Backfill to trench excavation
Riprap	Riprap quarry or direct from excavation or stockpile	(i) Erosion protection to outside face of embankment and creek diversion channel

DRG NO | DESCRIPTION
REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25, 1984	APPROVED FOR CONSTRUCTION	
1	JUNE 25, 1984	ISSUED FOR TENDER	

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
3	AUG. 23, 1985	AS CONSTRUCTED	

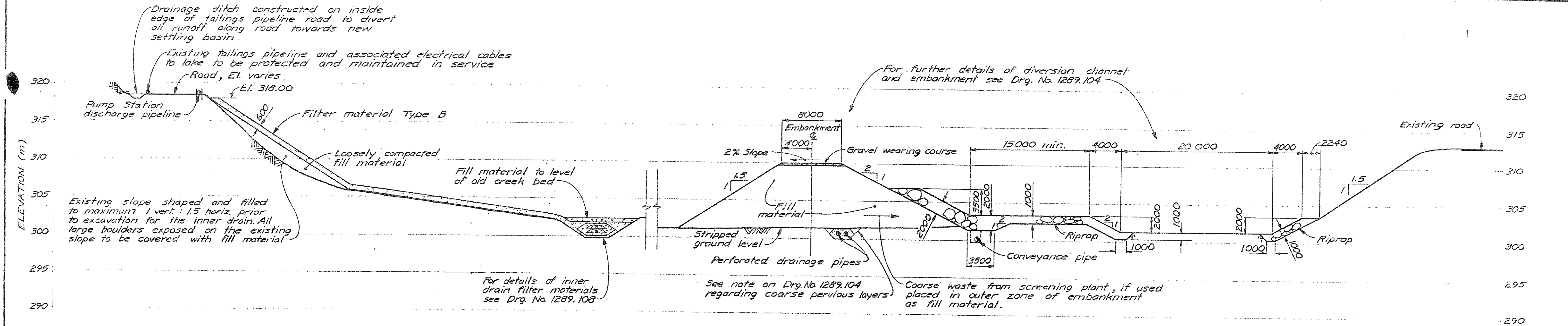
REVISIONS

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS — VANCOUVER, B.C.

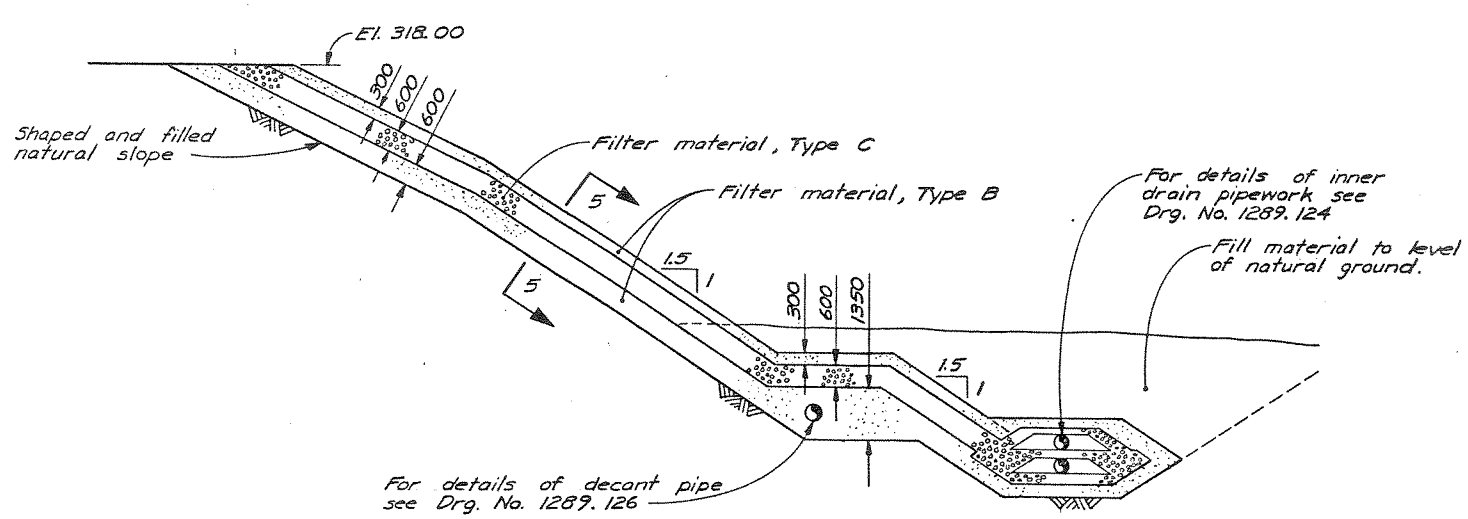
DESIGNED J. P. H.
DRAWN N. R.
CHECKED
APPROVED

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION
MYRA FALLS
TAILINGS DISPOSAL FACILITY - AREA II
MATERIALS SPECIFICATIONS

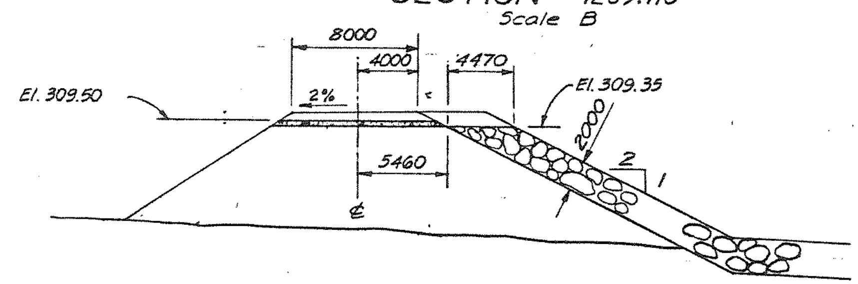
DATE MAY 31, 1984 | SCALE AS SHOWN | DRG. NO. 1289.112 | REV. 3



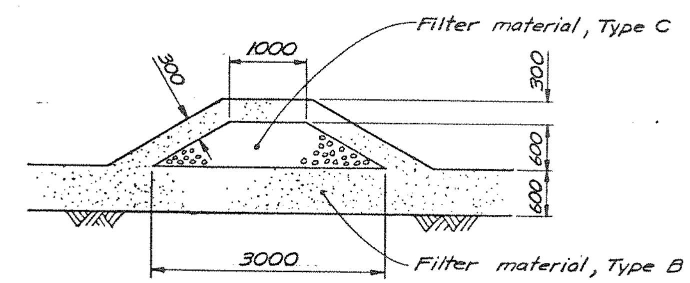
SECTION 1/1289.110
TYPICAL SECTION THROUGH TAILINGS DISPOSAL FACILITY
Scale C



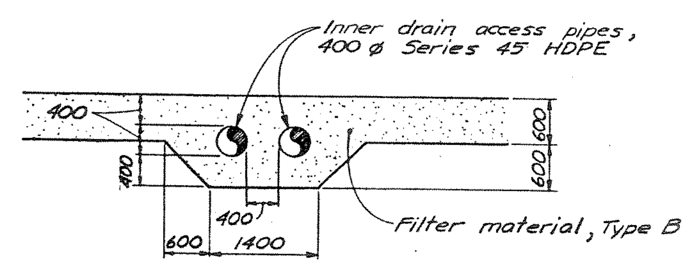
SECTION 2/1289.110
Scale B



SECTION 3/1289.110
EMERGENCY SPILLWAY SECTION
Scale C



SECTION 5
PILLAR DRAIN
Scale A



SECTION 4/1289.124
CUT ON SLOPE
Scale A

NOTE

1. All dimensions are in millimetres and elevations are in metres unless noted otherwise.

Scale C: 10 5 0 5 10 15 20 m
Scale B: 2 1 0 2 4 6 8 10 m
Scale A: 1 0.5 0 1 2 3 4 5 m

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
1289.126	DECANTS - PLAN AND PROFILE
1289.124	INNER DRAIN - PLAN AND PROFILE
1289.110	GENERAL ARRANGEMENT - PLAN
1289.108	INNER DRAIN CONSTRUCTION DETAILS
1289.104	MYRA CREEK DIVERSION - SECTIONS

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25, 1984	APPROVED FOR CONSTRUCTION	
1	JUNE 25, 1984	ISSUED FOR TENDER	

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
4	AUG. 23, 1985	AS CONSTRUCTED	
3	JULY 30, 1984	SECTION 3. REVISED	

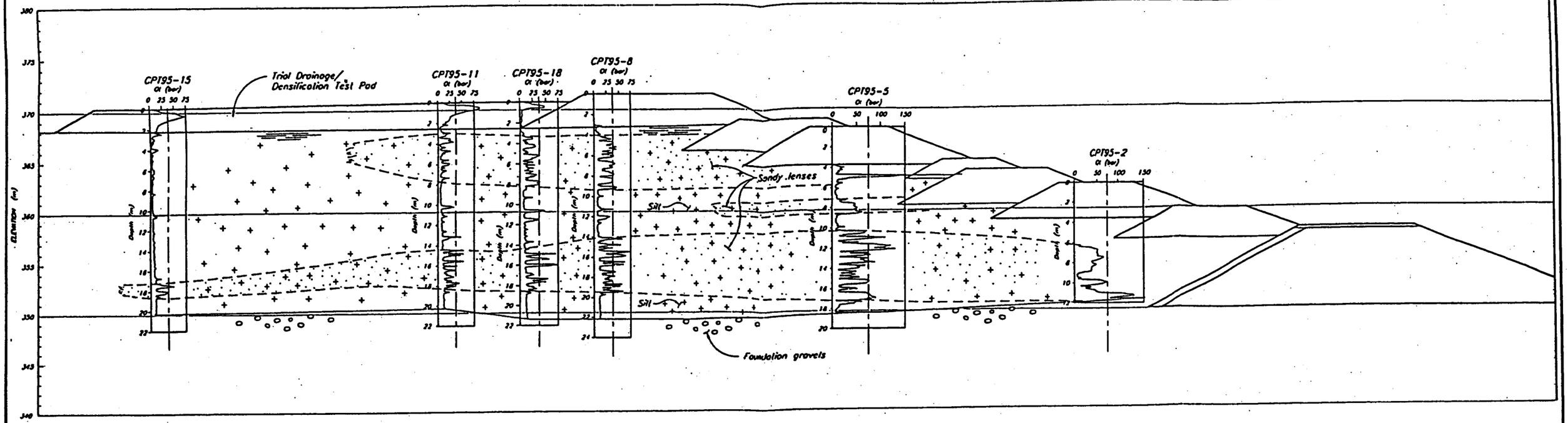
KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS -- VANCOUVER, B.C.

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — D. DOWNS

DESIGNED JPH
DRAWN
CHECKED DD
APPROVED

WESTMIN RESOURCES LIMITED
WESTERN MINES DIVISION
MYRA FALLS
TAILINGS DISPOSAL FACILITY - AREA II
GENERAL ARRANGEMENT - SECTIONS

DATE JUNE 6, 1984 | SCALE AS SHOWN | DRG. NO. 1289.111 | REV. 4



SECTION 1 / 12880.101

LEGEND

qt refers to cone penetrometer tip resistance measured during CPT tests

1288D.101	1995 GEOTECHNICAL SITE INVESTIGATION GENERAL ARRANGEMENT
DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	APPROVED

REVISIONS

REV.	DATE	DESCRIPTION	APPROVED
A	JAN. 16/96	ISSUED FOR REVIEW	

REVISIONS

KNIGHT PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

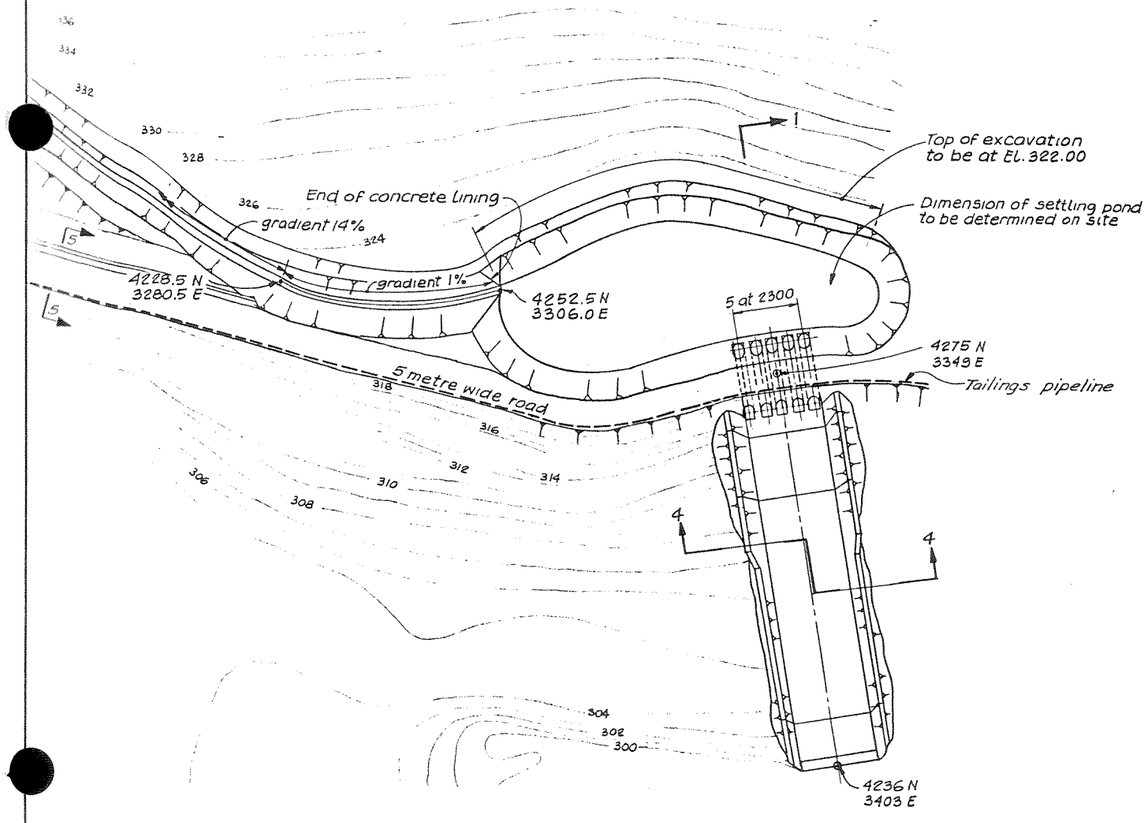
DESIGNED IBM
DRAWN NSD/VY
CHECKED
APPROVED

DATE JAN. 16, 1996 | SCALE AS SHOWN | DRG. NO. 1288D.103 | REV. A

WESTMIN RESOURCES LIMITED

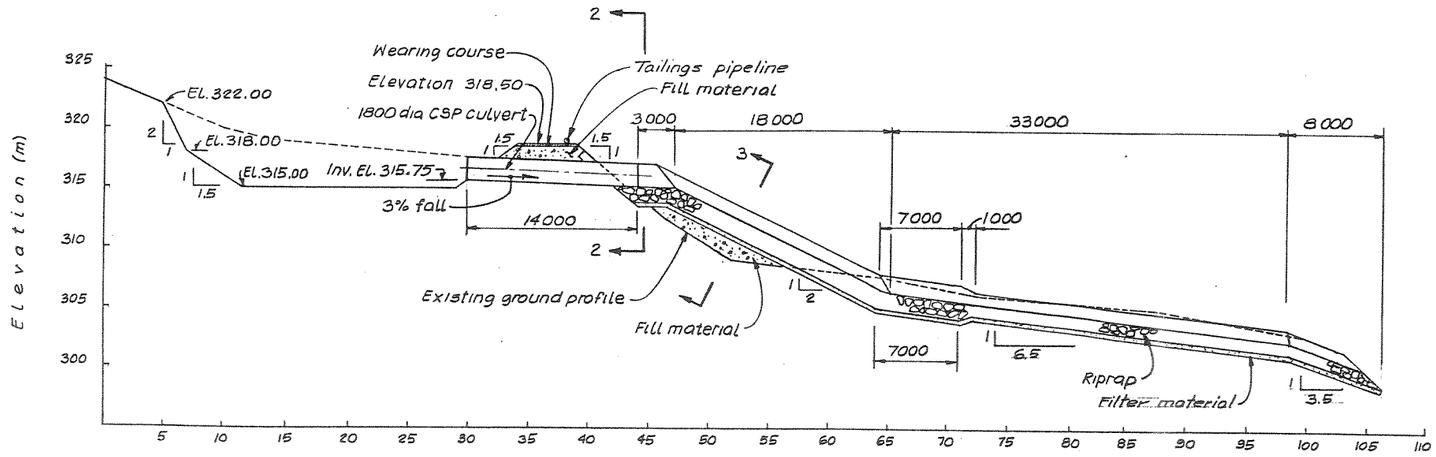
MYRA FALLS OPERATION

TAILINGS DISPOSAL FACILITY
1995 GEOTECHNICAL SITE INVESTIGATION
SECTION AND DETAILS



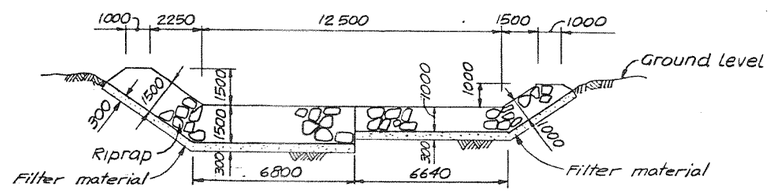
PLAN

Scale A



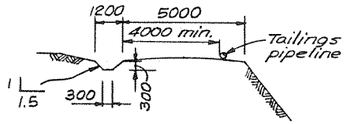
SECTION 1

Scale B



SECTION 4

Scale C



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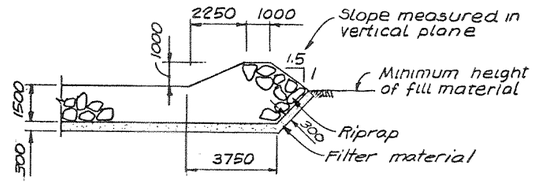
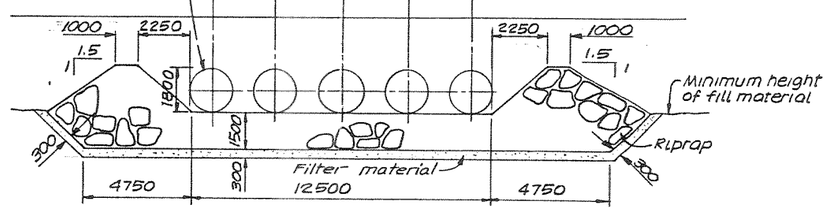


SECTION 3

Scale C



SECTION 2

Scale C

Scale C 2 1 0 2 4 6 8 10 m

Scale B 10 5 0 10 20 m

Scale A 10 5 0 10 20 30 40 50 m

DRG NO.	DESCRIPTION
	REFERENCE DRAWINGS

REV.	DATE	DESCRIPTION	APPROVED
3	AUG 23, 1985	AS CONSTRUCTED	
	REVISIONS		

REV.	DATE	DESCRIPTION	APPROVED
2	JULY 25, 1984	APPROVED FOR CONSTRUCTION	
1	JUNE 28, 1984	ISSUED FOR TENDER	
	REVISIONS		

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS — VANCOUVER, B.C.

PROFESSIONAL ENGINEER — L. S. KNIGHT — BRITISH COLUMBIA

DESIGNED L.S.Knight
DRAWN
CHECKED
APPROVED

DATE

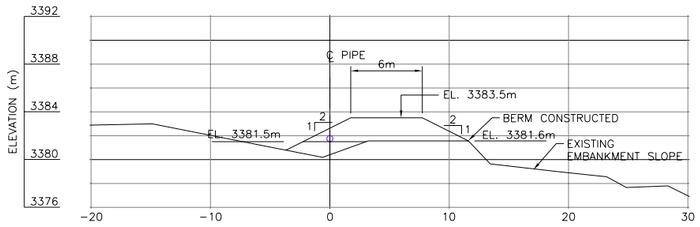
WESTMIN RESOURCES LIMITED

WESTERN MINES DIVISION

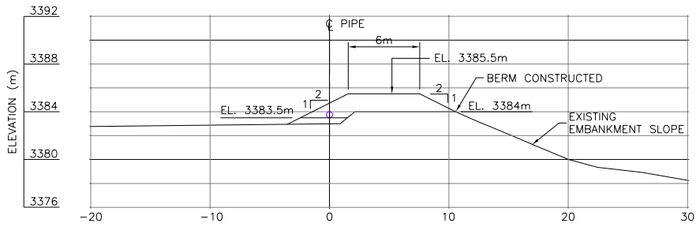
MYRA FALLS

TAILINGS DISPOSAL FACILITY - AREA II
LYNX DIVERSION CHANNEL
SETTLING POND, CULVERTS & DISCHARGE CHANNEL

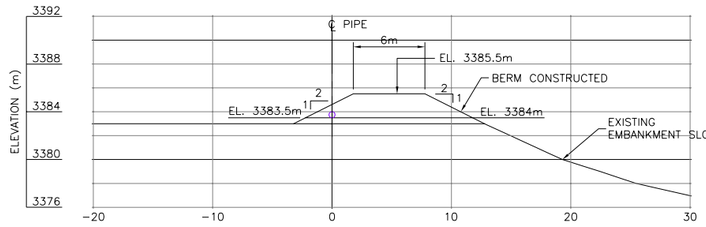
SCALE AS SHOWN | DRG. NO. 1289.201 | REV. 3



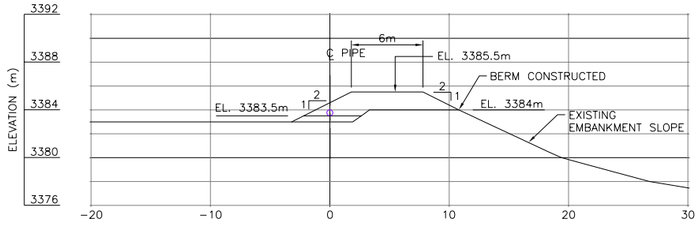
STA. 0+750



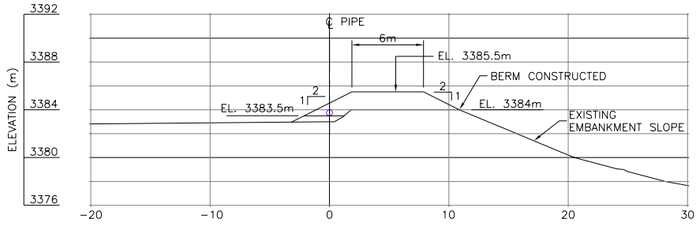
STA. 0+950



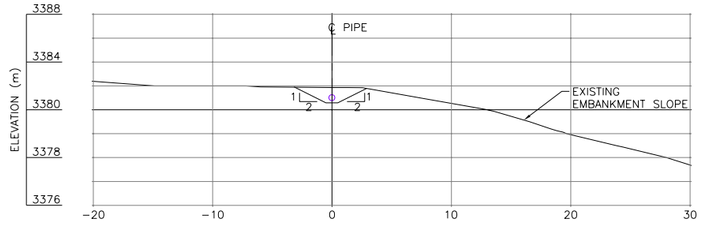
STA. 1+100



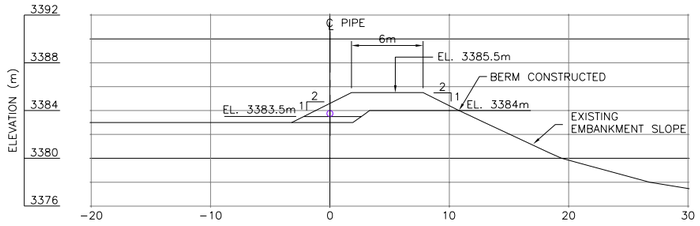
STA. 0+800



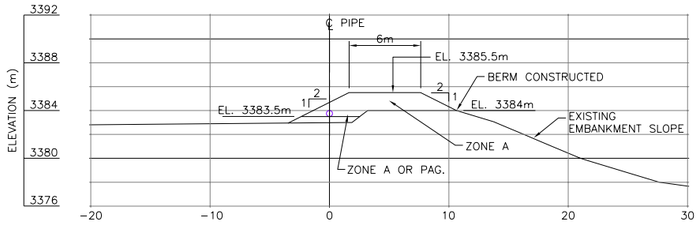
STA. 1+000



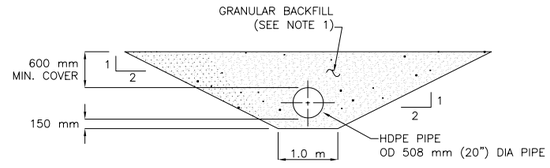
STA. 1+150



STA. 0+850

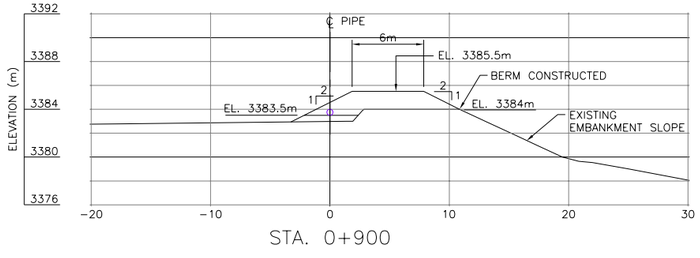


STA. 1+050



TYPICAL PIPELINE CROSS SECTION STA. 1+150 TO 1+659

SCALE :– 1 : 20



STA. 0+900

NOTES:

1. THE GRANULAR BACKFILL WOULD BE 19 mm MINUS WITH MORE THAN 15% PASSING #200 SEIVE. MINIMUM DENSITY OF THE AREA ON THE SIDES OF THE PIPE SHOULD BE GREATER THAN 95% STANDARD PROCTOR MAXIMUM DENSITY. THE BEDDING UNDERNEATH THE PIPE IS NOT COMPACTED.

2. THE GRANULAR BACKFILL WOULD BE 19 mm MINUS WITH LESS THAN 5% PASSING #200 SEIVE. MINIMUM DENSITY SHOULD BE GREATER THAN 95% STANDARD PROCTOR MAXIMUM DENSITY.

DEPARTMENTAL REVIEW					
CIVIL	STRUCTURAL	MECHANICAL	ELECTRICAL	GEOTECH.	HYDROTECH.

DRAFT

NOT FOR CONSTRUCTION

0 10m SCALE 1 : 250 (FOR ALL STATIONS)

CLIENT

BOLIDEN WESTMIN (CANADA) LTD.

KLOHN CRIPPEN

PROJECT

MYRA FALLS OPERATION
SEISMIC UPGRADE BERN PAG INCLUSION

TITLE

SECTIONS FROM STA. 0+750
TO STA. 1+200

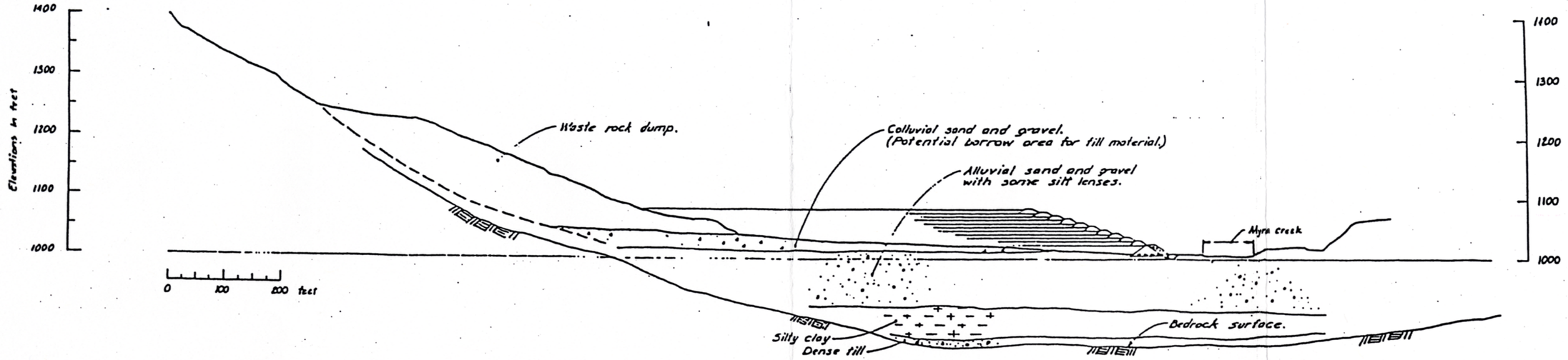
SCALE	PROJECT No.	DWG. No.	REV.
1 : 250	M07632A49	D–002	0

CANCEL PRINTS BEARING PREVIOUS REVISION

KCC–DM

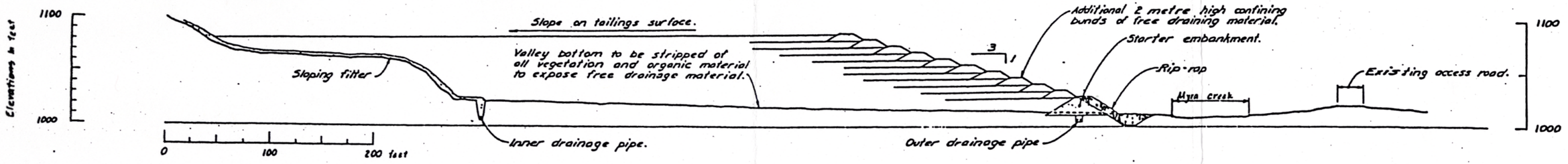
DRAWING NO.	REFERENCE DRAWING	NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D

Time: 17:49:24
Date: 8/10/2004
Scale: 1=1(FS)
Drawing File: M:\M07632\449 - 2004 Construction Services\400 Design\410 Drawings\M07632A49D002.dwg (PLee)
Xref's: 2004AS-PIPE-SECTIONS



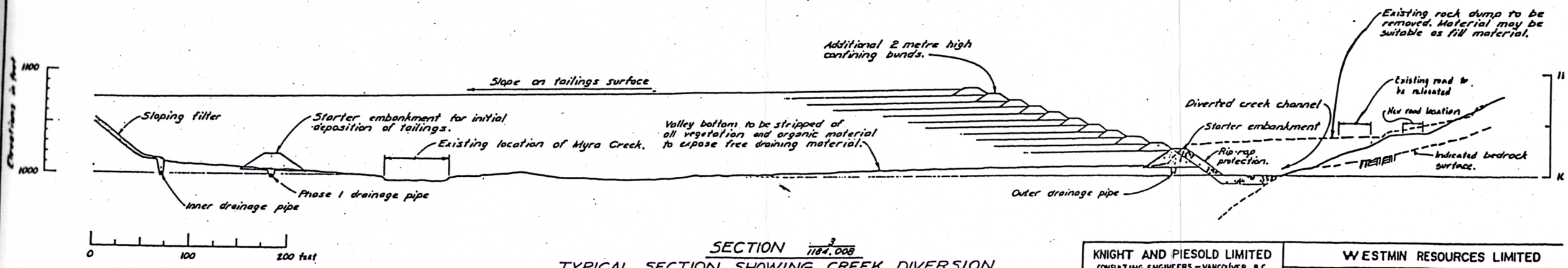
SECTION 1/1184.008

TYPICAL SECTION THROUGH VALLEY SHOWING FOUNDATION MATERIAL STRATIGRAPHY



SECTION 2/1184.008

TYPICAL SECTION THROUGH TAILINGS FACILITY



SECTION 3/1184.008

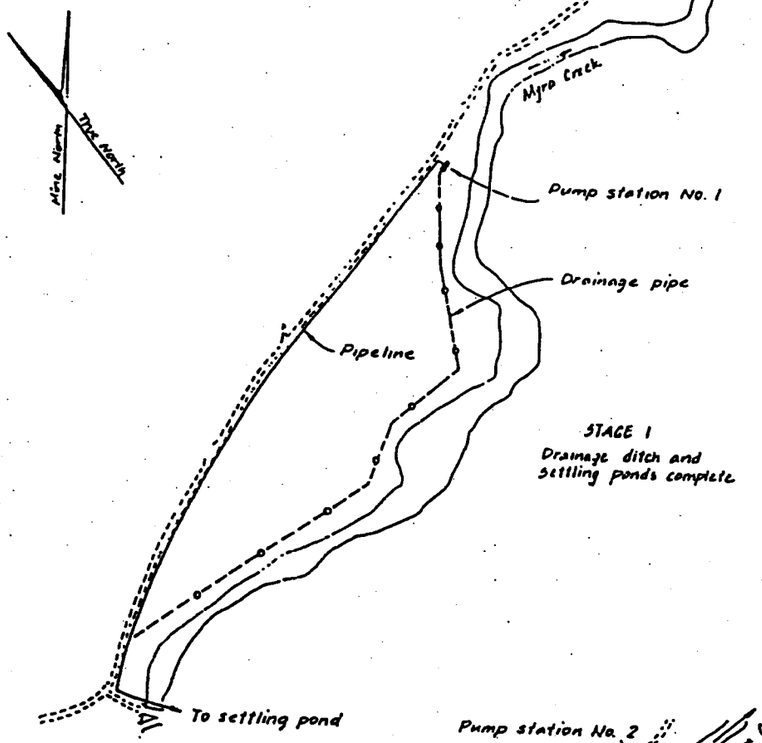
TYPICAL SECTION SHOWING CREEK DIVERSION

NOTE

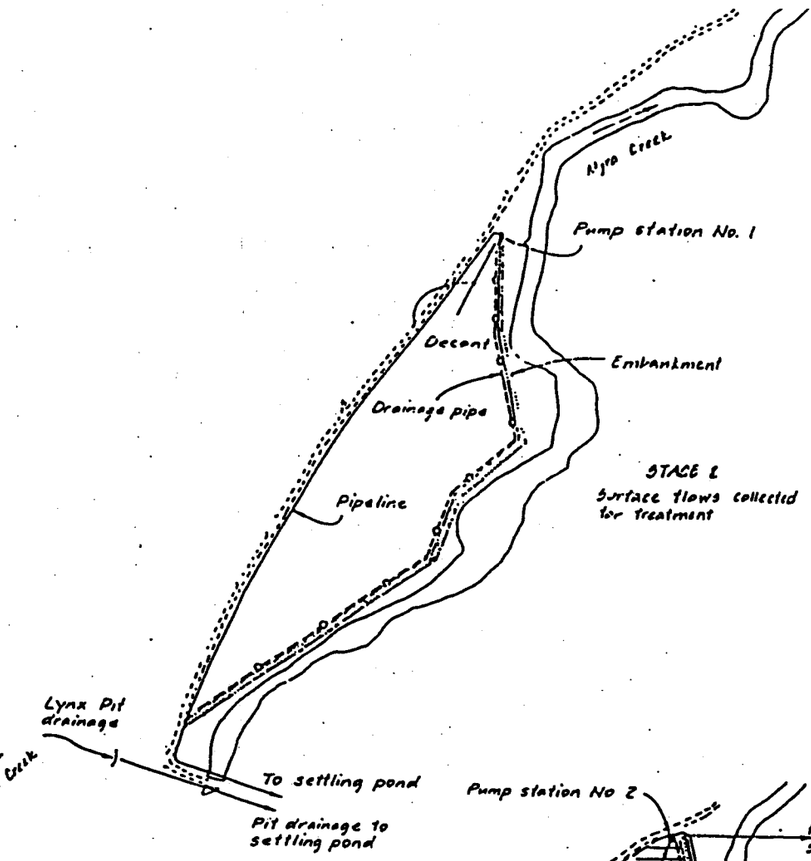
Preliminary design.

KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C.	WESTMIN RESOURCES LIMITED
DESIGNED JPH DRAWN CHECKED CDB APPROVED C.R. Bla..l	WESTERN MINES DIVISION MYRA FALLS TAILINGS DISPOSAL FACILITY SECTIONS
DATE FEB 26 1982	SCALE AS SHOWN

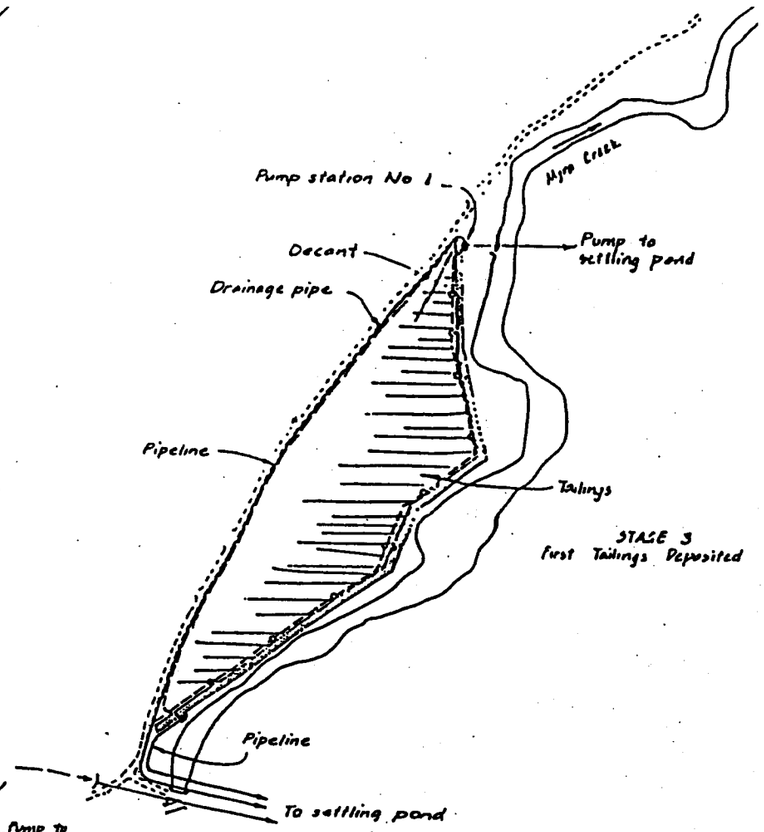
NO.	DESCRIPTION	REV.	DATE	DESCRIPTION	APPROVED	REV.	DATE	DESCRIPTION	APPROVED
	REFERENCE DRAWINGS								



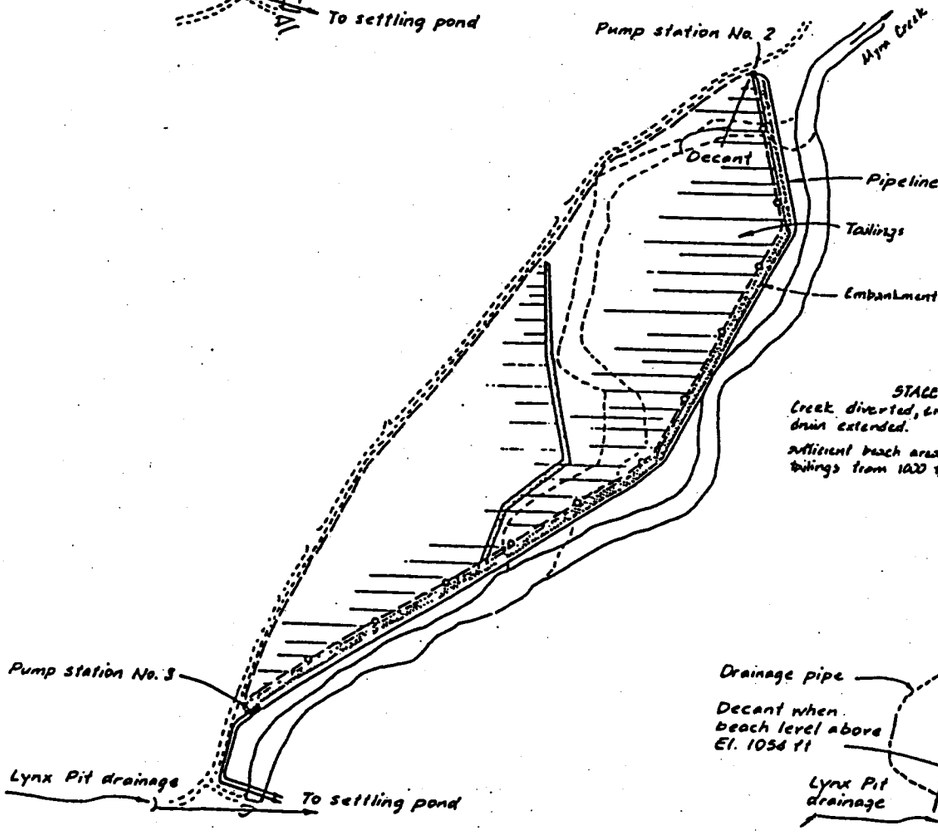
STAGE 1
Drainage ditch and settling ponds complete



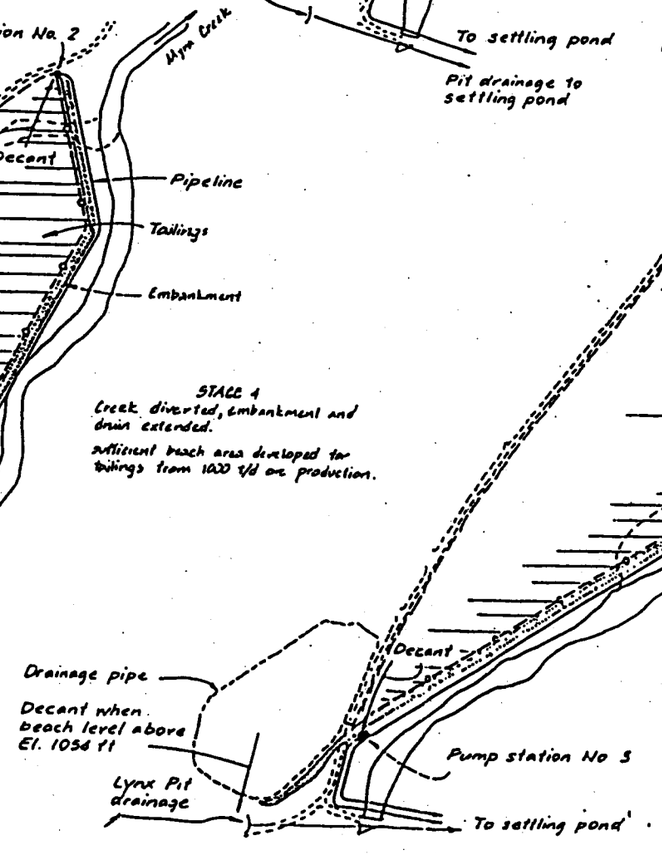
STAGE 2
Surface flows collected for treatment

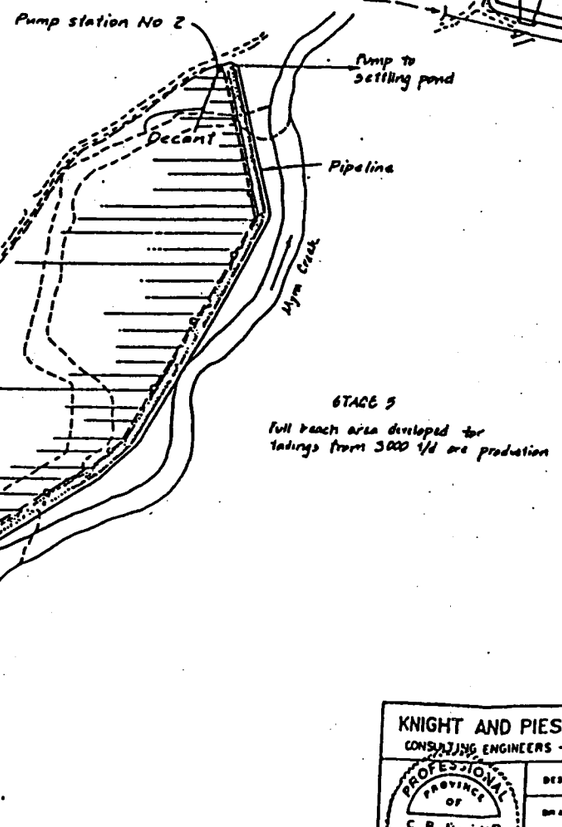


STAGE 3
First Tailings Deposited



STAGE 4
Creek diverted, embankment and drain extended.
Sufficient beach area developed for tailings from 1000 t/d ore production.





STAGE 5
Full beach area developed for tailings from 3000 t/d ore production

400 200 0 400 800 1000 ft

DRG NO	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	APPROVED
REVISIONS			
1	MARCH 1, 1982	REVISED FOR PRELIMINARY DESIGN REPORT	RJC

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

PROFESSIONAL ENGINEERS PROVINCE OF BRITISH COLUMBIA C. R. BLAND

DESIGNED CSI
DRAWN
CHECKED JFH
APPROVED C.R Bland

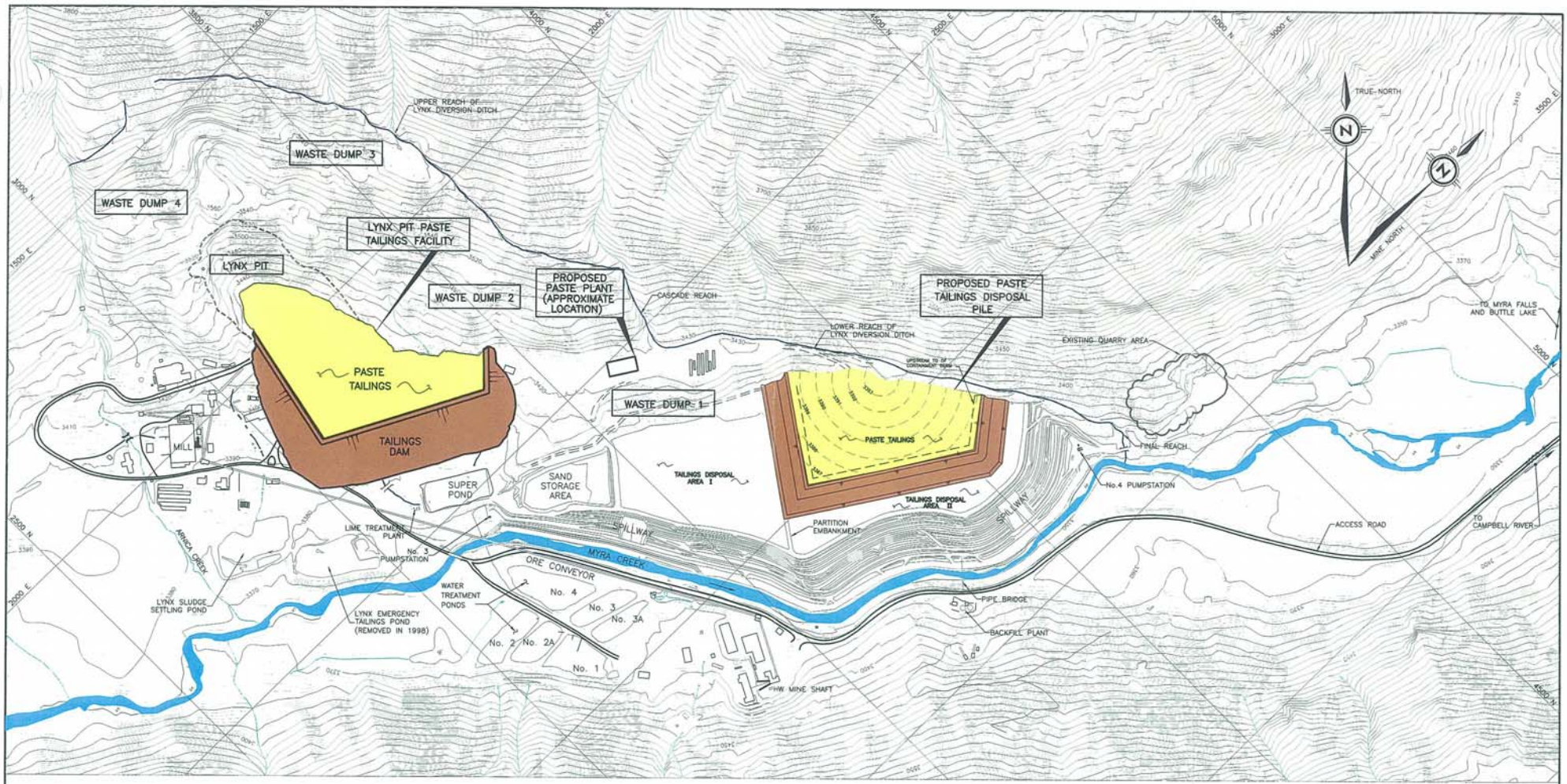
DATE FEBRUARY 19, 1982 | SCALE AS SHOWN | DRG NO. 1283.006 | RE

WESTMIN RESOURCES LIMIT

WESTERN MINES DIVIS

MYRA FALLS

TAILINGS DISPOSAL FACILIT
CONSTRUCTION STAGES



NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES, INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.
4. LAYOUT OF PROPOSED PASTE PLANT IS APPROXIMATE.

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE: 0 200 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT: BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

PROJECT: PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

TITLE: GENERAL SITE PLAN

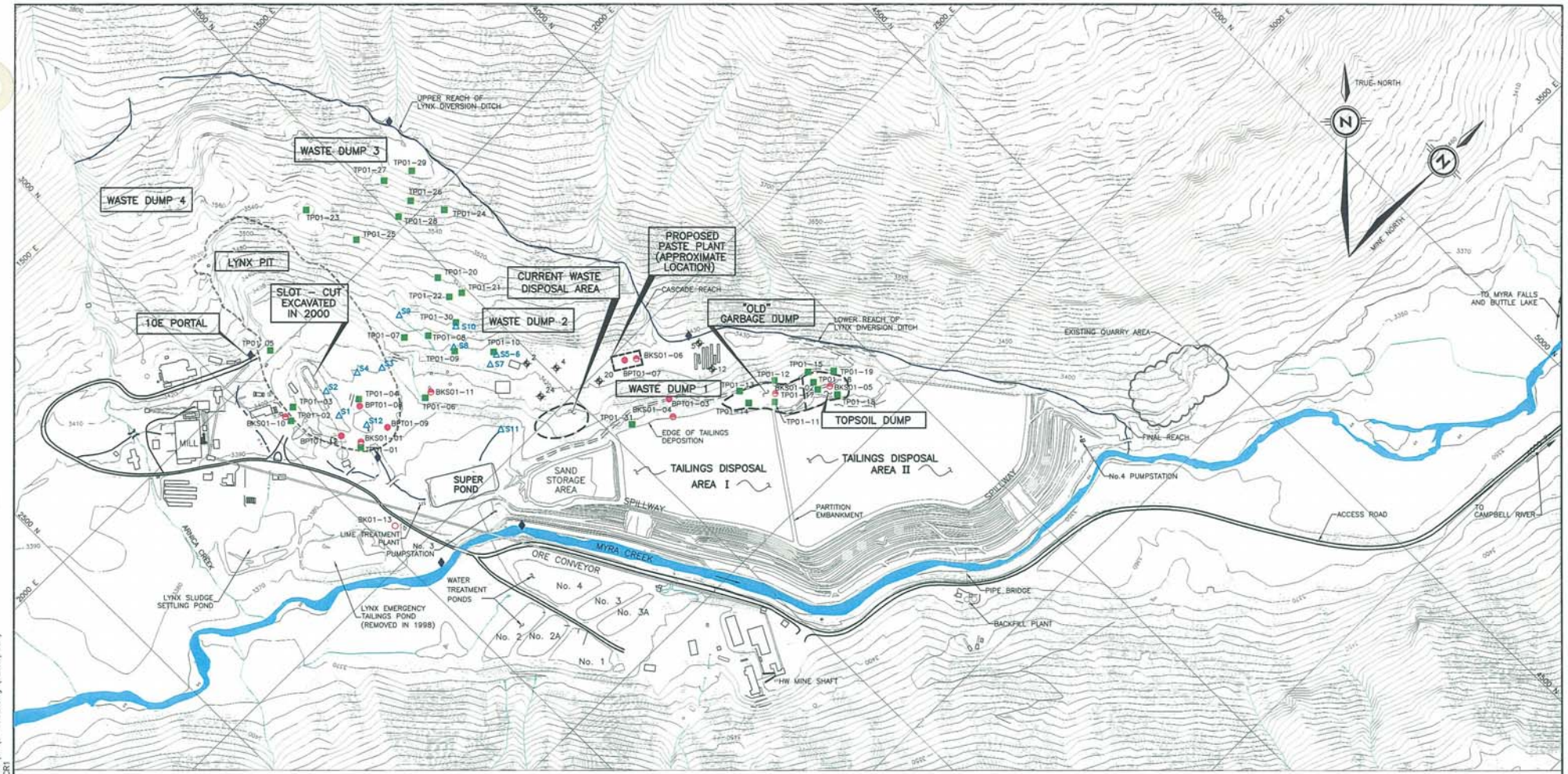
PROJECT No. PM8976 05

DWG. No. D-1501

Rev. A

CANCEL PRINTS BEARING PREVIOUS

Scale:
Drawing: M8976 - MFO Paste Fill\Cadd\01\D-1501R2.dwg (rzakopcan)
Xrefs: XREF1, MYRA_PR1



NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES. INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.
4. EXISTING PIEZOMETERS FROM KNIGHT PIESOLD LTD, JULY 1988.
5. LIMITS OF GARBAGE DUMPS AND TOPSOIL DUMP ARE APPROXIMATE.

LEGEND

- PRE-EXISTING PIEZOMETER (NOTE 4)
- 01-08 CLOSED ENDED
- 01-13 OPEN ENDED
- 01-01 OPEN AND CLOSED ENDED
- TEST PITS
- SEEP SAMPLING LOCATIONS
- WATER SAMPLE LOCATIONS

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE: 0 200 m

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

CLIENT: BOLIDEN WESTMIN (CANADA) LTD. MYRA FALLS OPERATION

KLOHN CRIPPEN

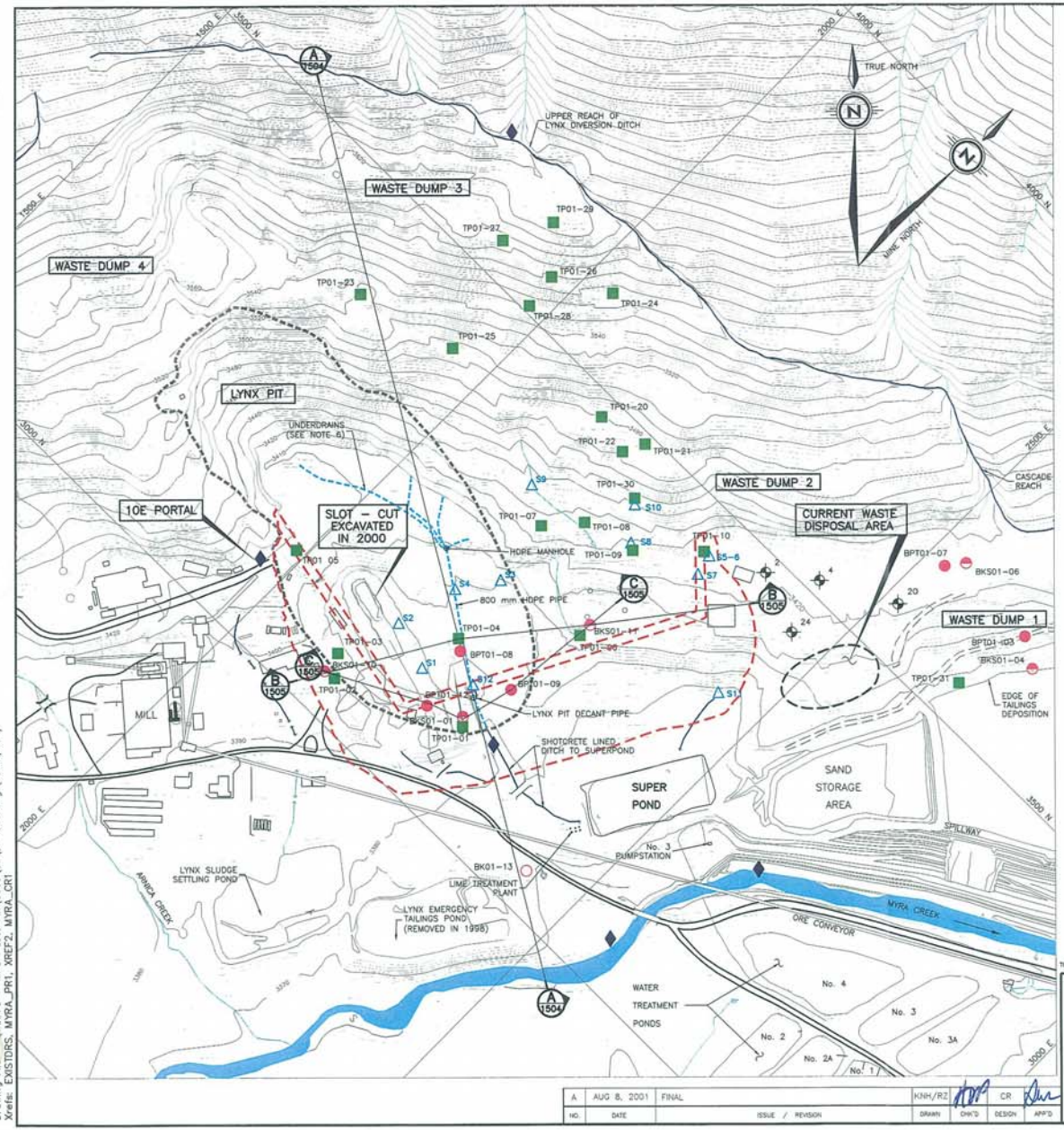
PROJECT: PASTE FILL PROJECT LYNX PIT TAILINGS FACILITY

TITLE: PLAN OF 2001 SITE INVESTIGATIONS

PROJECT No. PM8976 05 | DWG. No. D-1502 | Rev. A

CANCEL PRINTS BEARING PREVIOUS

Scale: 1"=1'
Drawing File: w:\M8976 - MFO Paste Fill\Cadd\01\D-1502.dwg (rzakopcan)
Xrefs: EXISTDRS, MYRA_PR1, XREF2, MYRA_CR1



LEGEND

- 5 — PRE-EXISTING PIEZOMETER (NOTE 4)
- BPT — 01-08 CLOSED ENDED
- BK — 01-13 OPEN ENDED
- BKS — 01-01 OPEN AND CLOSED ENDED
- TP01-06 — TEST PITS
- S7 — SEEP SAMPLING LOCATIONS
- WATER SAMPLE LOCATIONS
- EXISTING UNDERDRAINAGE SYSTEM
- PROPOSED TAILINGS DAM

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES. INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.
4. PRE-EXISTING PIEZOMETERS FROM KNIGHT PIESOLD LTD, JULY 1988.
5. LIMITS OF GARBAGE DUMPS AND TOPSOIL DUMP ARE APPROXIMATE.
6. LOCATIONS OF UNDERDRAINS ARE APPROXIMATE. UNDERDRAINS COMPRISED OF THREE 150 mm CPE PIPES SURROUNDED IN 12 mm TO 25 mm DRAIN GRAVEL (KNIGHT PIESOLD, 1995). PIPES RAISED BY BOLIDEN IN 1998 AND BURIED BY MINE WASTE PLACED FROM 1998 TO 2001.

NOT FOR CONSTRUCTION

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE: 0 100 m

CLIENT: BOLIDEN WESTMIN (CANADA) LTD. MYRA FALLS OPERATION

KLOHN CRIPPEN

PROJECT: PASTE FILL PROJECT LYNX PIT TAILINGS FACILITY

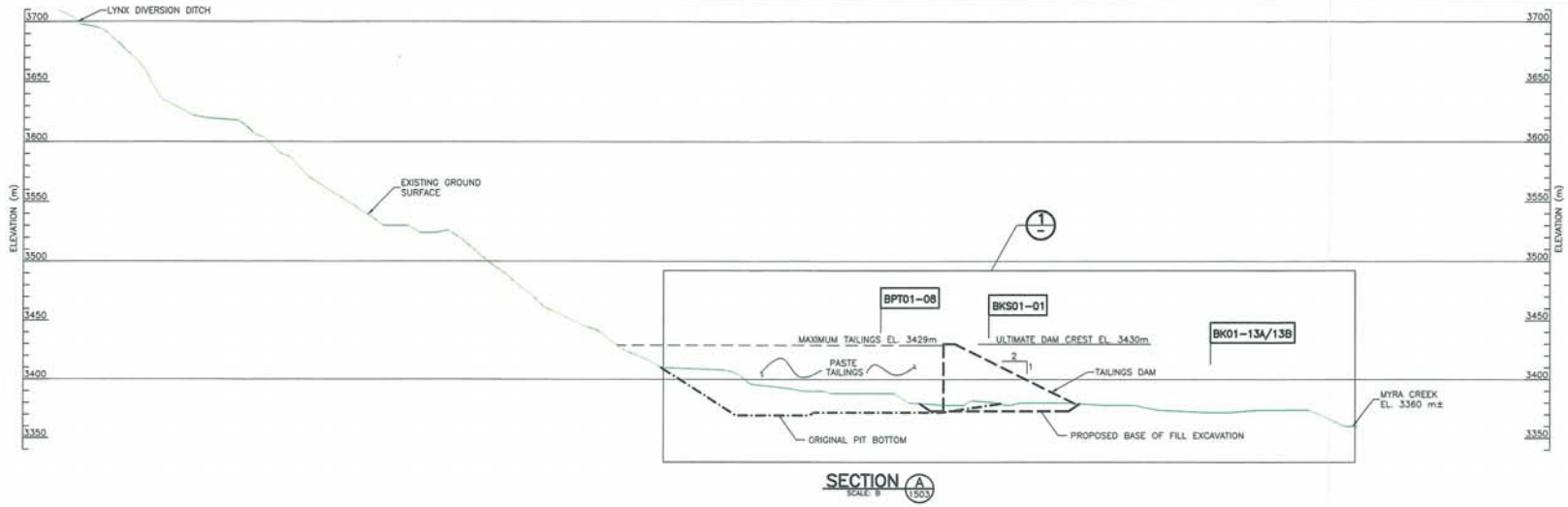
TITLE: PLAN OF LYNX PIT

PROJECT No. PM8976 05 | DWG. No. D-1503 | Rev. A

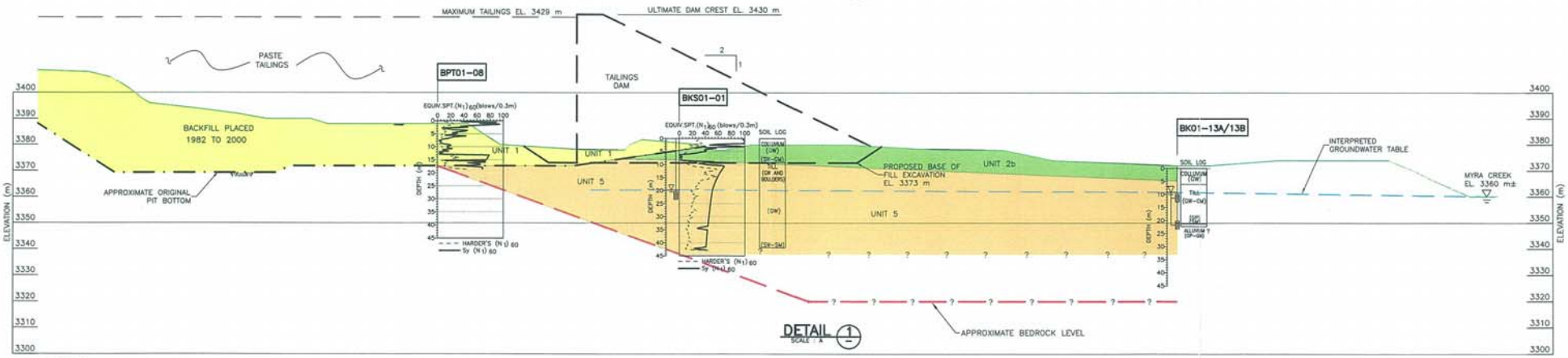
CANCEL PRINTS BEARING PREVIOUS

KLOHN-W

Scale: 1:
Drawing File: ...8976 - MFO Paste Fill\Cadd\01\D-1503.dwg (rzakopcan)
Xrefs: EXISTDRS, MYRA_PR1, XREF2, MYRA_CR1



SECTION A (1503) SCALE: B



DETAIL 1 SCALE: A

LEGEND

SOIL DENSITY

$(N_1)_{60}$	DENSITY
0 – 3	VERY LOOSE
3 – 8	LOOSE
8 – 15	COMPACT
15 – 25	MEDIUM DENSE
25 – 42	DENSE
42 – 58	VERY DENSE

ADAPTED FROM SKEMPTON (1986)

SOIL UNITS

1. FILL
2a. GRAVEL/SAND AND GRAVEL (FLUVIAL)
2b. SILTY GRAVEL (COLLUVIUM)
3. SAND/INTERBEDDED FINE SAND AND SILT
4. LACUSTRINE SILT AND CLAY
5. TILL

MONITORING WELL INSTALLATION

NOTE:
WATER ELEVATION MEASURED IN FEBRUARY, 2001.

NOTE:
1. THE SUBSOIL PROFILES SHOWN ARE INTERPRETED BASED ON DATA AVAILABLE AT ACTUAL TEST HOLE LOCATIONS AND ARE FOR ILLUSTRATIVE PURPOSE ONLY. ACTUAL SOIL CONDITIONS BETWEEN TEST HOLES MAY DIFFER FROM THAT SHOWN.

NOT FOR CONSTRUCTION

SCALE B: 0 100 m
SCALE A: 0 50 m

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

NO.	DATE	ISSUE/REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT: BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

PROJECT: PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

TITLE: GEOLOGIC SECTION A

PROJECT No. PM8976 05
DWG. No. D-1504
Rev. A

CANCEL PRINTS BEARING PREVIOUS

K2018-9

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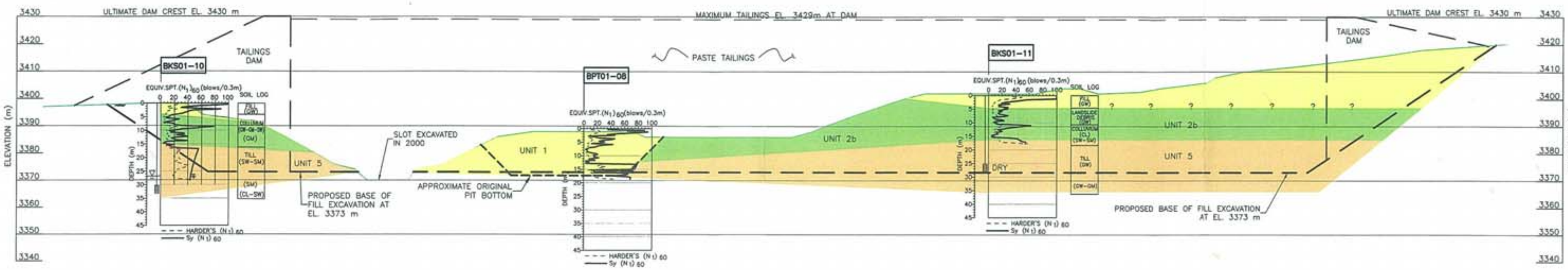
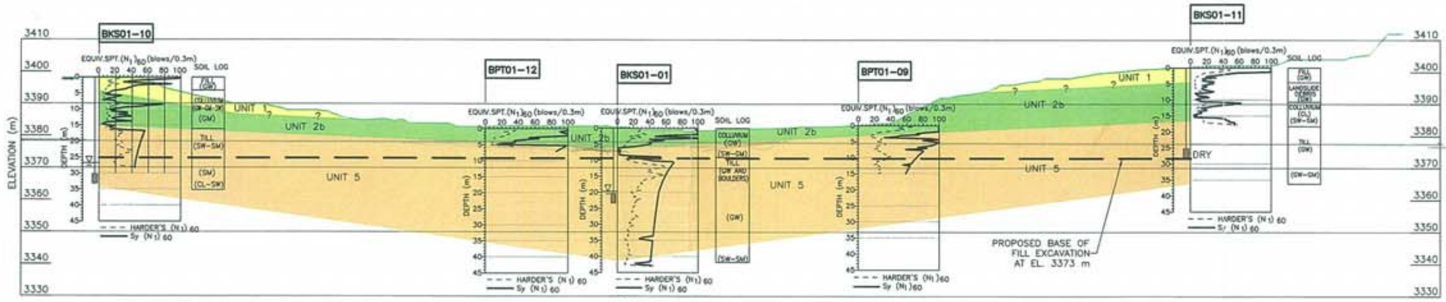
XRefs: BPT01-09, BPT01-12, BPT01-10, BPT01-11, BPT01-08, BPT01-01



SECTION B (1503)
SCALE : A



SECTION C (1503)
SCALE : A

LEGEND

SOIL DENSITY

$(N_1)_{60}$	DENSITY
0 - 3	VERY LOOSE
3 - 8	LOOSE
8 - 15	COMPACT
15 - 25	MEDIUM DENSE
25 - 42	DENSE
42 - 58	VERY DENSE

ADAPTED FROM SKEMPTON (1986)

SOIL UNITS

1. FILL
2a. GRAVEL/SAND AND GRAVEL (FLUVIAL)
2b. SILTY GRAVEL (COLLUVIUM)
3. SAND/INTERBEDDED FINE SAND AND SILT
4. LACUSTRINE SILT AND CLAY
5. TILL

MONITORING WELL INSTALLATION

NOTE:
WATER ELEVATION MEASURED IN FEBRUARY, 2001.

NOTE:
1. THE SUBSOIL PROFILES SHOWN ARE INTERPRETED BASED ON DATA AVAILABLE AT ACTUAL TEST HOLE LOCATIONS AND ARE FOR ILLUSTRATIVE PURPOSE ONLY. ACTUAL SOIL CONDITIONS BETWEEN TEST HOLES MAY DIFFER FROM THAT SHOWN.

NOT FOR CONSTRUCTION

SCALE A: 0 — 50 m

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

NO.	DATE	ISSUE/REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT: BOLIDEN WESTMIN (CANADA) LTD. MYRA FALLS OPERATION

KLOHN CRIPPEN

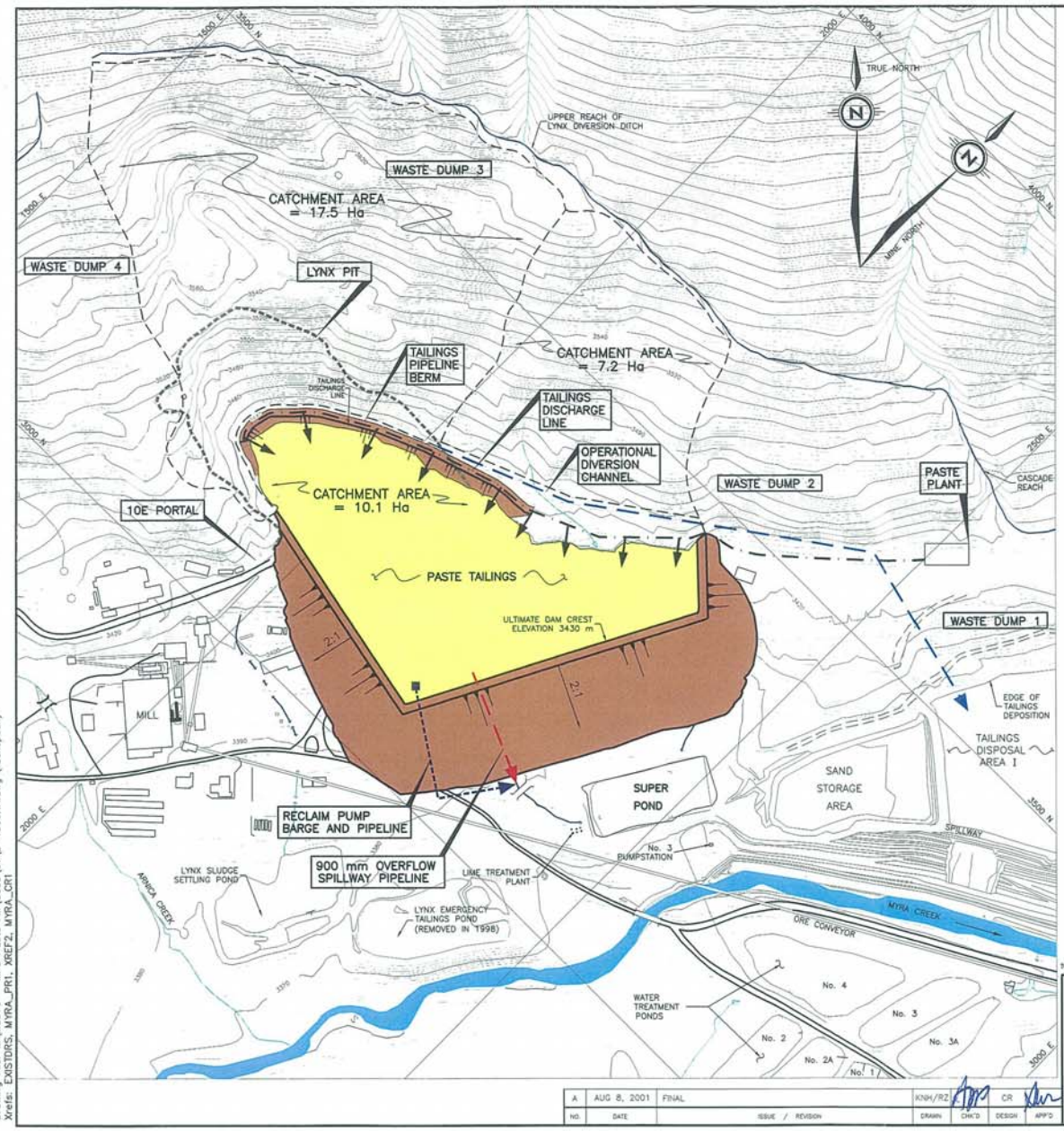
PROJECT: PASTE FILL PROJECT LYNX PIT TAILINGS FACILITY

TITLE: GEOLOGIC SECTIONS B AND C

PROJECT No. PM8976 05 | DWG. No. D-1505 | Rev. A

CANCEL PRINTS BEARING PREVIOUS

Scale: 1:... Drawing F...976 – MFO Paste Fill\Cadd\01\D-1505.dwg (ngk)
Xrefs: TSEC..., XREF2, XREF1, BPT01-09, BPT01-12, BPT01-10, BPT01-11, BPT01-08, BPT01-01



LEGEND

- CATCHMENT BOUNDRAY
- TAILINGS DISCHARGE POINTS (LOCATIONS APPROXIMATE)

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES, INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.

NOT FOR CONSTRUCTION

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE: 0 100 m

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND/OR PUBLICATION OF STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

CLIENT: BOLIDEN WESTMIN (CANADA) LTD. MYRA FALLS OPERATION

KLOHN CRIPPEN

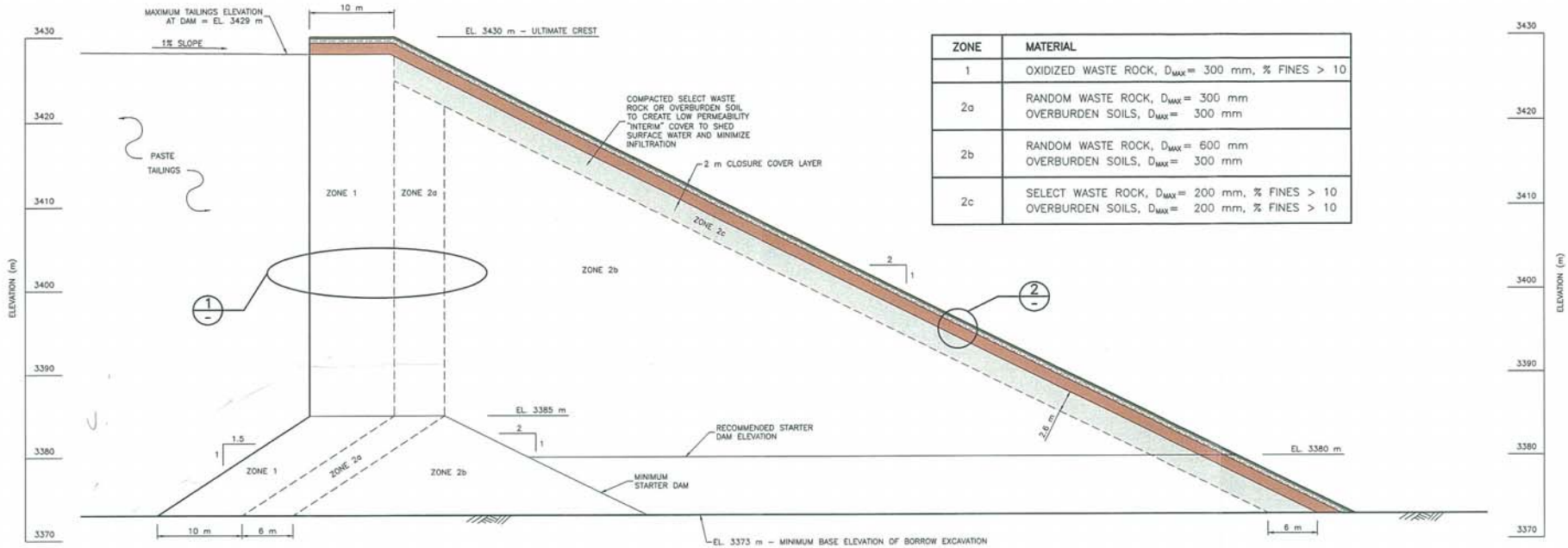
PROJECT: PASTE FILL PROJECT LYNX PIT TAILINGS FACILITY

TITLE: PLAN OF ULTIMATE TAILINGS FACILITY

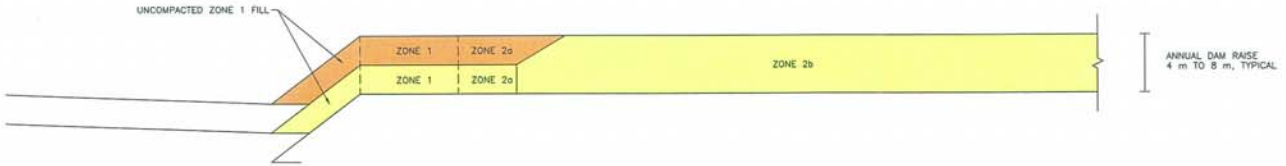
PROJECT No. PM8976 05 | DWG. No. D-1506 | Rev. A

CANCEL PRINTS BEARING PREVIOUS

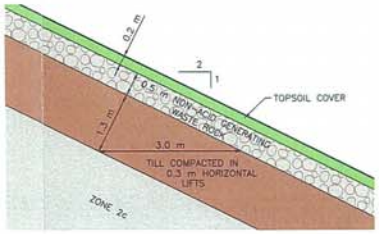
Scale: 1=1
Drawing File: ...d976 - MFO Paste Fill\Cadd\01\D-1506RA.dwg (rzakopcan)
Xrefs: EXISTDRS, MYRA_PR1, XREF2, MYRA_CR1



ZONE	MATERIAL
1	OXIDIZED WASTE ROCK, D_{MAX} = 300 mm, % FINES > 10
2a	RANDOM WASTE ROCK, D_{MAX} = 300 mm OVERBURDEN SOILS, D_{MAX} = 300 mm
2b	RANDOM WASTE ROCK, D_{MAX} = 600 mm OVERBURDEN SOILS, D_{MAX} = 300 mm
2c	SELECT WASTE ROCK, D_{MAX} = 200 mm, % FINES > 10 OVERBURDEN SOILS, D_{MAX} = 200 mm, % FINES > 10



DETAIL 1 STAGING OF DAM RAISING
SCALE: A



DETAIL 2 PRELIMINARY COVER DESIGN
SCALE: B

LEGEND

DAM RAISE COMPLETED IN FALL

SUBSEQUENT DAM RAISE COMPLETED IN FOLLOWING SPRING

NOT FOR CONSTRUCTION

SCALE B: 0 2 m

SCALE A: 0 10 m

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE

CLIENT: BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

PROJECT: PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

TITLE: TYPICAL DAM SECTION

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	RZ		CR	

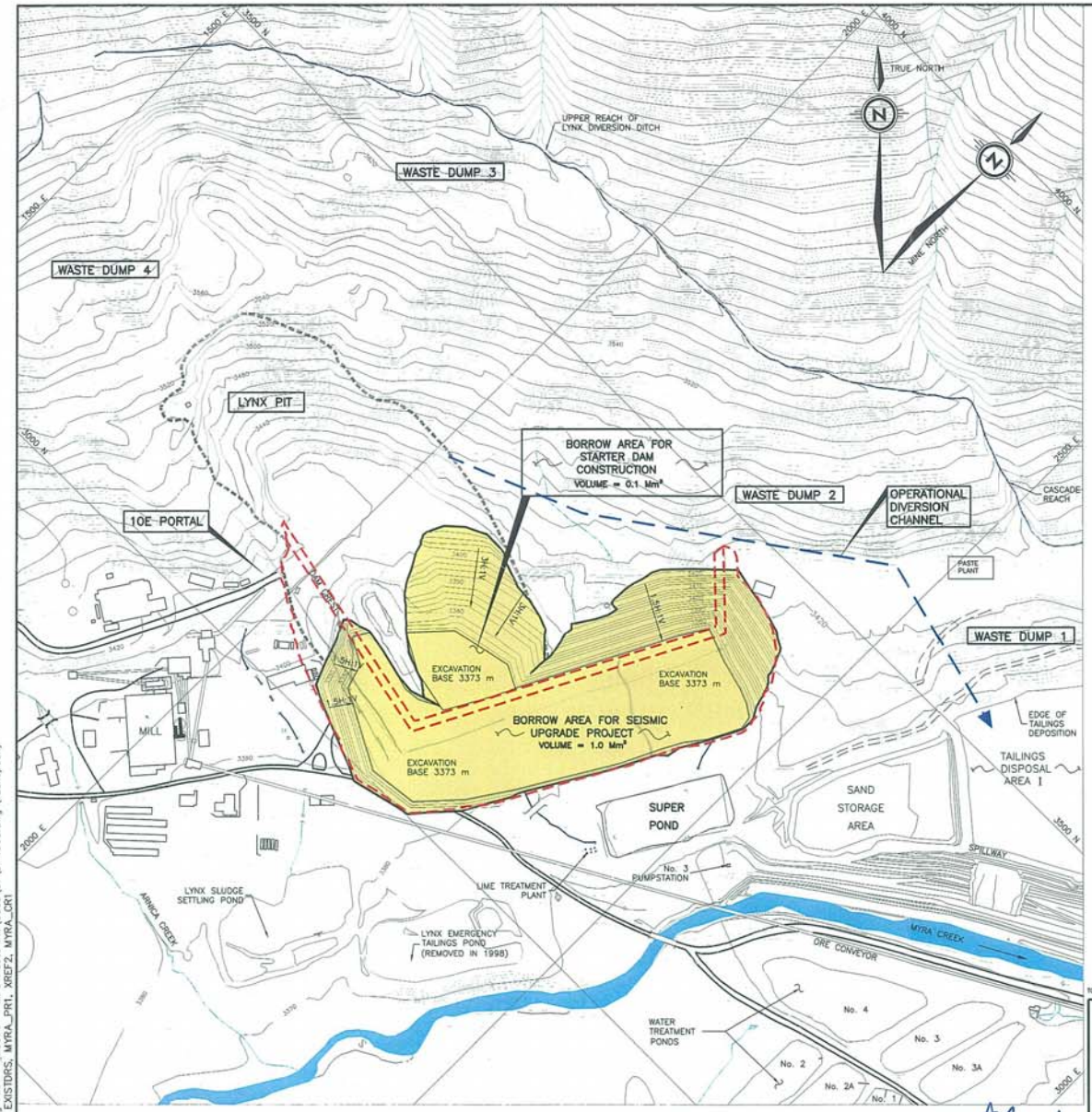
PROJECT No. PM8976 05

DWG. No. D-1507

Rev. A

CANCEL PRINTS BEARING PREVIOUS

Layout: 0
Scale: 1:
Drawing File: ...M8976 - MF0 Paste Fill\Cadd\01\D-1507RB.dwg (rzakopcan)
Layer



LEGEND

- - - OUTLINE OF PROPOSED TAILINGS DAM

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES. INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.

NOT FOR CONSTRUCTION

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE: 0 100 m

CLIENT: BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

PROJECT: PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

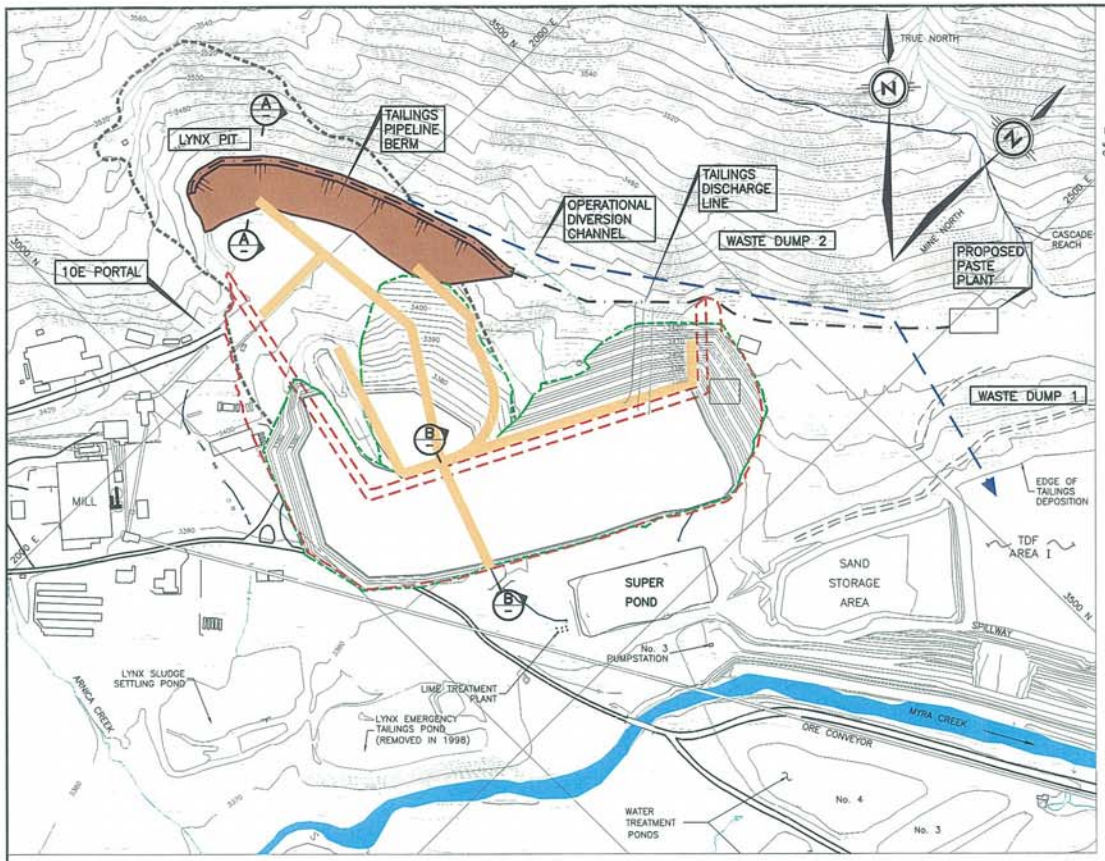
TITLE: EXCAVATION PLAN

PROJECT No. PM8976 05

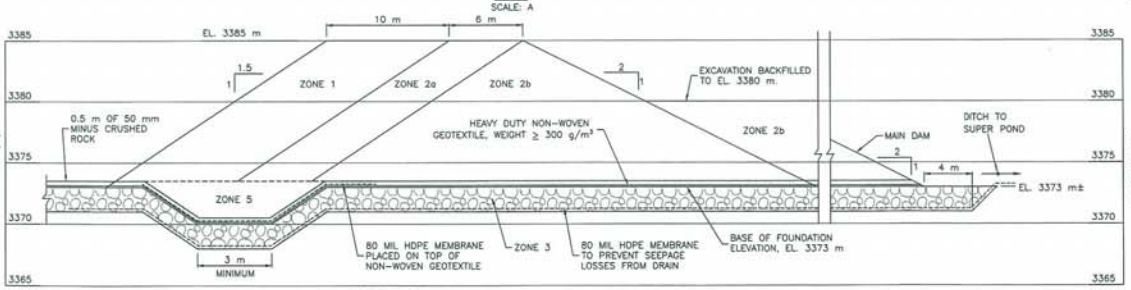
DWG. No. D-1508

Rev. A

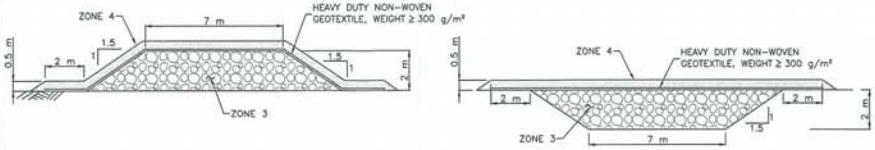
CANCEL PRINTS BEARING PREVIOUS



PLAN
SCALE: A

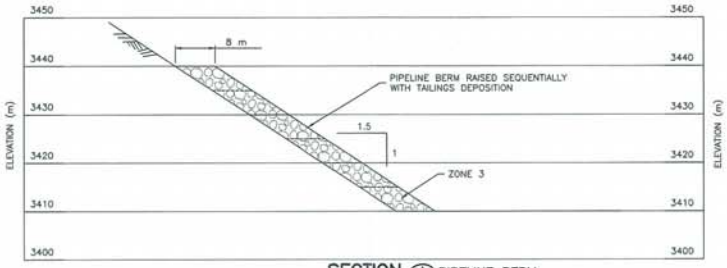


SECTION (B) DETAIL OF DRAIN BENEATH DAM
SCALE: D



DETAIL (1) TYPICAL DRAIN SECTION ABOVE GRADE
SCALE: C

DETAIL (2) TYPICAL DRAIN SECTION BELOW GRADE
SCALE: C



SECTION (A) PIPELINE BERM
SCALE: B

ZONE	MATERIAL
1	OXIDIZED WASTE ROCK, D_{MAX} = 300 mm, % FINES > 10
2a	RANDOM WASTE ROCK, D_{MAX} = 300 mm OVERBURDEN SOILS, D_{MAX} = 300 mm
2b	RANDOM WASTE ROCK, D_{MAX} = 600 mm OVERBURDEN SOILS, D_{MAX} = 300 mm
3	NEUTRAL ROCK, D_{MAX} = 300 mm, D_{10} = 25 mm
4	CRUSHED ROCK 50 mm MINUS
5	COMPACTED COLLUVIUM OR TILL D_{MAX} = 300 mm % FINES > 10%

LEGEND

- DRAINS (SEE DETAILS 1 AND 2)
- TAILINGS DELIVERY PIPELINE
- OUTLINE OF PROPOSED TAILINGS DAM
- EXCAVATION LIMITS

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES, INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE

SCALE D: 0 8 m
SCALE C: 0 5 m
SCALE B: 0 20 m
SCALE A: 0 100 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT
BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

PROJECT
PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

TITLE
FOUNDATION DRAINS
AND TAILINGS PIPELINE BERM
PLAN AND SECTIONS

PROJECT No. PM8976 05
DWG. No. D-1509
Rev. A

CANCEL PRINTS BEARING PREVIOUS

Scale: 1:
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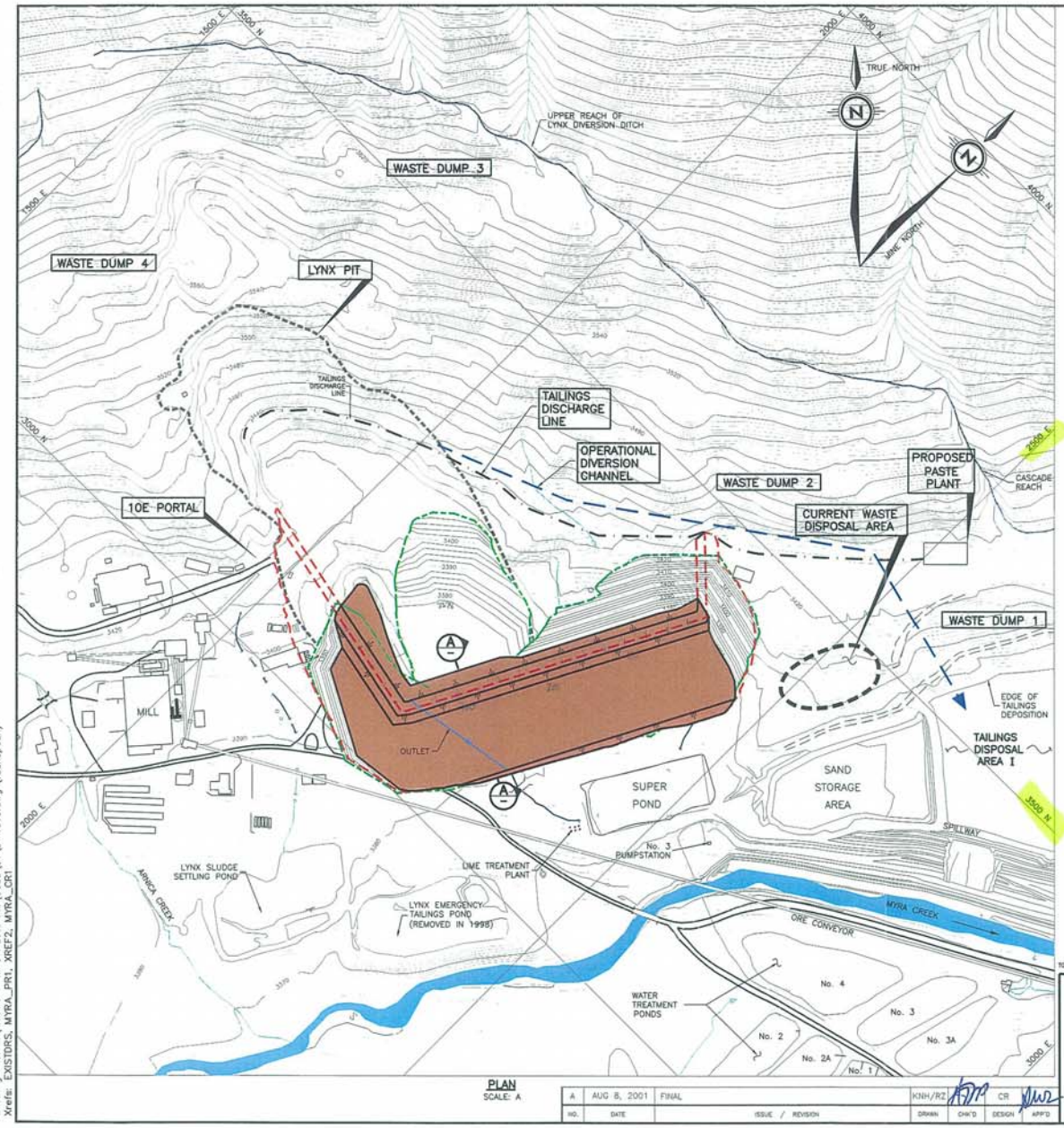
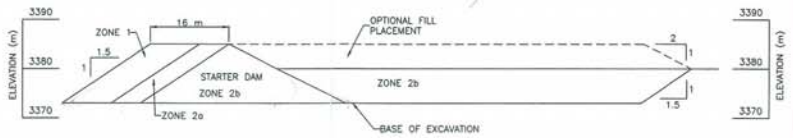
Xrefs: EXISTING_MYRA_PR1, XREF2, MYRA_OR1



PLAN
SCALE: A



SECTION A
SCALE: B

LEGEND

- OUTLINE OF PROPOSED TAILINGS DAM
- EXCAVATION LIMITS

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES, INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.

NOT FOR CONSTRUCTION

SCALE B: 0 20 m
SCALE A: 0 100 m

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT: BOLIDEN WESTMIN (CANADA) LTD. MYRA FALLS OPERATION

KLOHN CRIPPEN

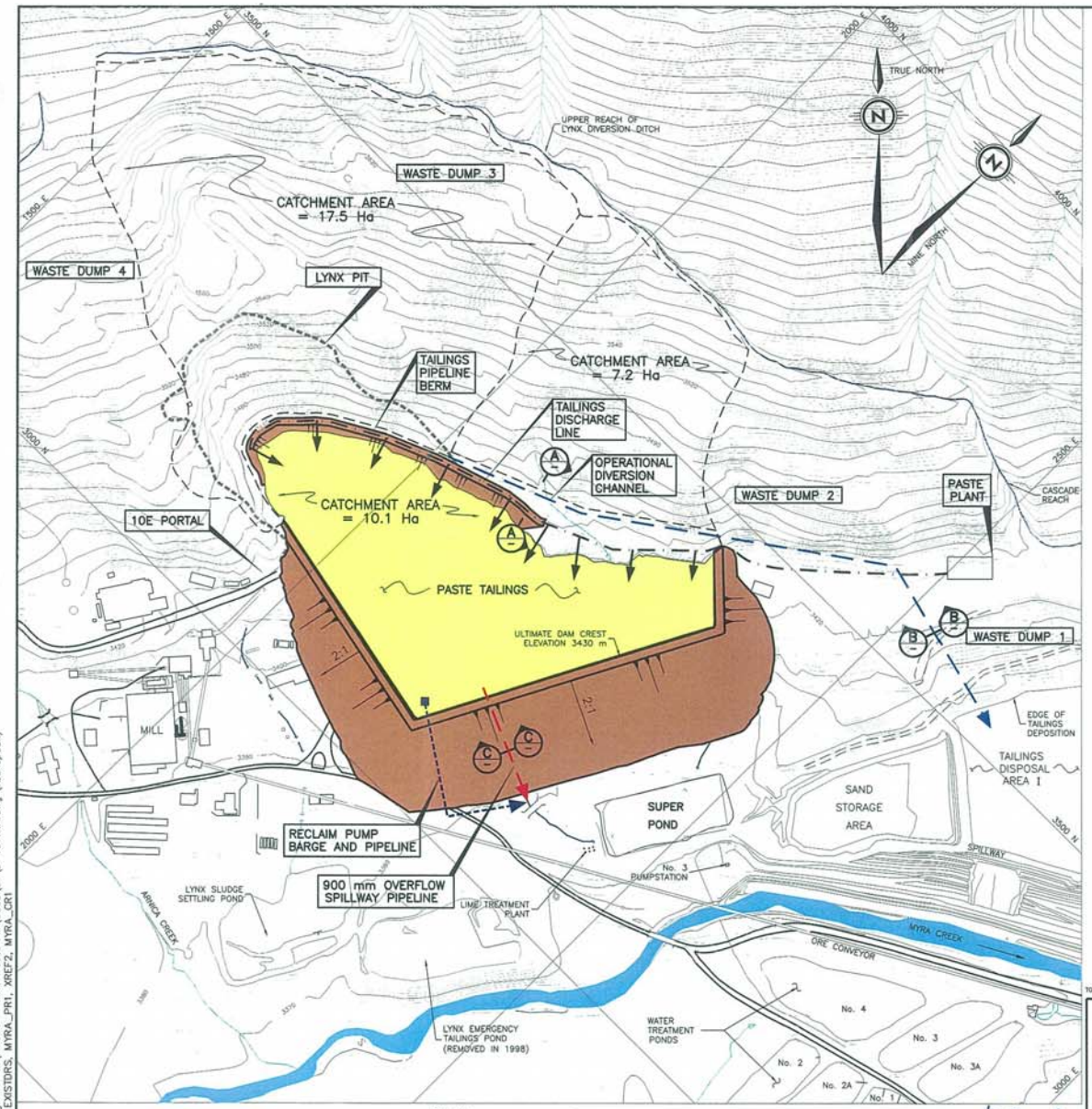
PROJECT: PASTE FILL PROJECT LYNX PIT TAILINGS FACILITY

TITLE: STARTER DAM LAYOUT

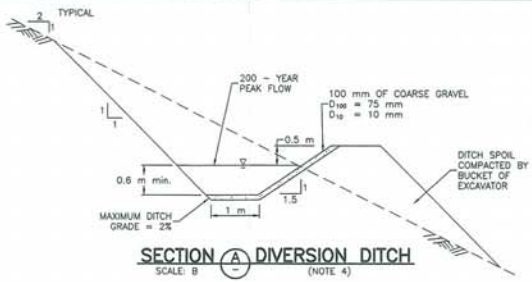
PROJECT No. PM8976 05 | DWG. No. D-1510 | Rev. A

CANCEL PRINTS BEARING PREVIOUS

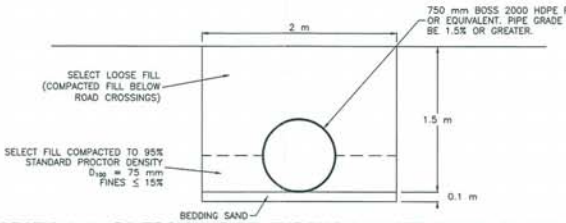
Scale: 1a
Drawing File: ...\PM8976 - MFO Paste Fill\Cadd\01\D-1510.dwg (rzakopcan)
Xrefs: EXISTDRS, MYRA_PR1, XREF2, MYRA_CR1



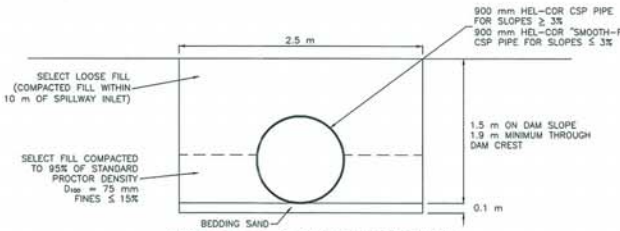
PLAN
SCALE: A



SECTION (A) DIVERSION DITCH
SCALE: B (NOTE 4)



SECTION (B) DIVERSION PIPE THROUGH WASTE DUMP TO TAILINGS AREA 1
SCALE: C



SECTION (C) SPILLWAY PIPELINE
SCALE: C (NOTES 5 AND 6)

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFD AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.
4. ROUTE OF DIVERSION DITCH TO BE FIELD FITTED. MAXIMUM DITCH SLOPE = 2%.
5. STANDARD END SECTION TO BE PROVIDED AT SPILLWAY INLET TO REDUCE INLET HEAD LOSSES.

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE C: 0 1 m
SCALE B: 0 2 m
SCALE A: 0 100 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT: BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

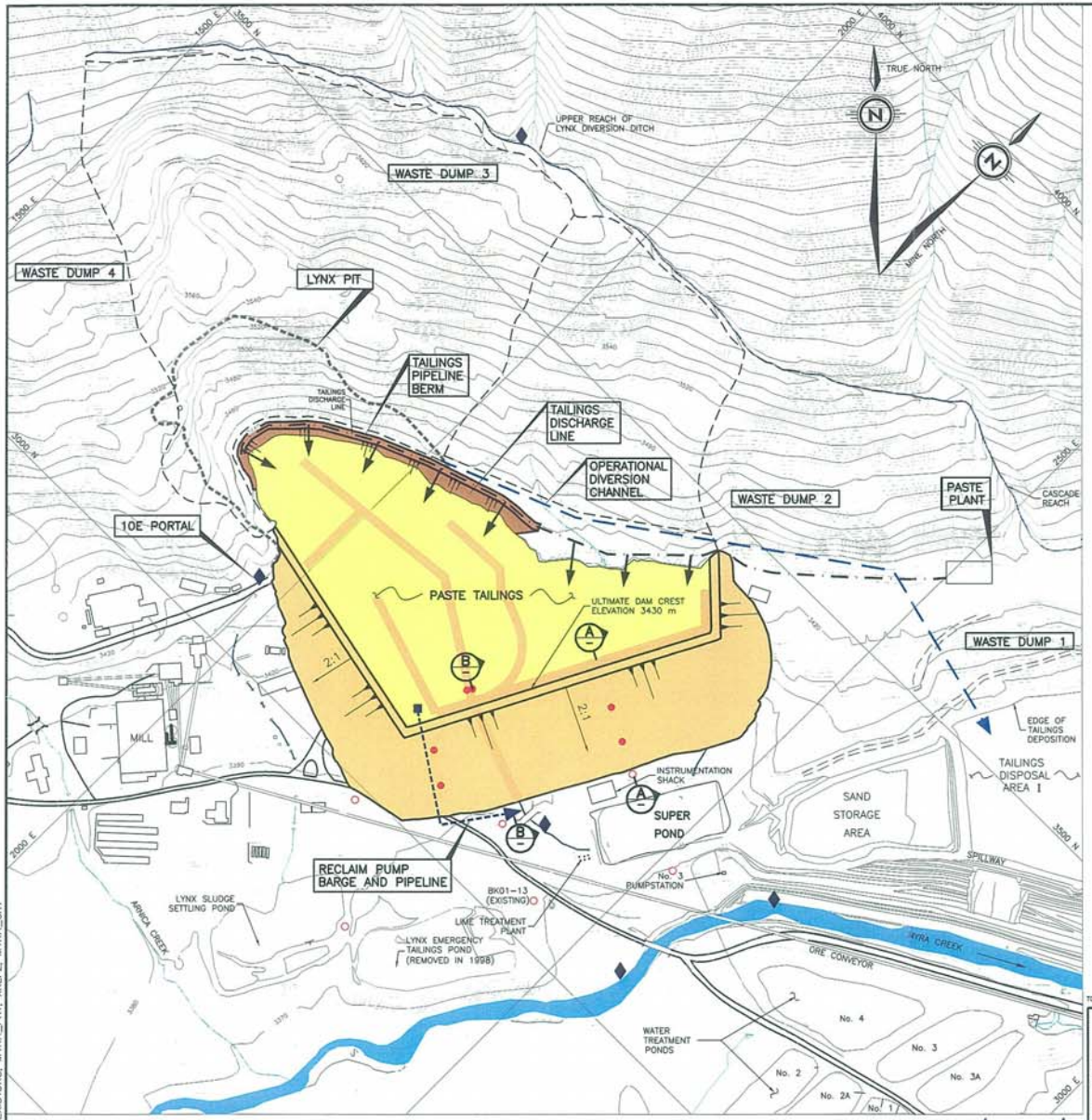
PROJECT: PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

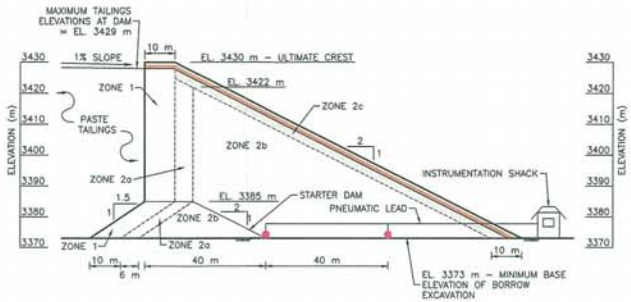
TITLE: DIVERSION DITCH AND OVERFLOW SPILLWAY PIPELINE

PROJECT No.: PM8976 05
DWG. No.: D-1511
Rev.: A

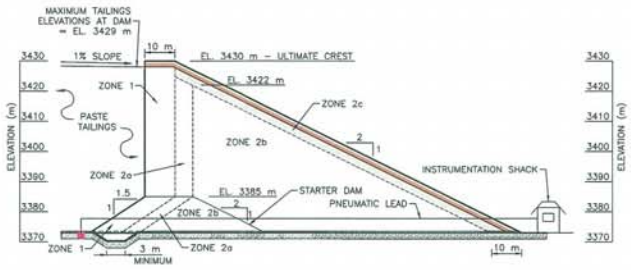
CANCEL PRINTS BEARING PREVIOUS

Scale: 1=100'
Drawing File: M:\M8976 - MFO Paste Fill\Cadd\01\D-1511RA.dwg (rzakopcan)
Xrefs: EXISTDRS, MYRA_PR1, XREF2, MYRA_CR1





DETAIL (A) PNEUMATIC PIEZOMETERS IN DAM SHELL
SCALE: B



DETAIL (B) PNEUMATIC PIEZOMETERS IN UNDERDRAIN
SCALE: B

LEGEND:

- PNEUMATIC PIEZOMETER
- MONITORING WELL
- SURFACE WATER SAMPLING POINTS
- UNDERDRAIN

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METRES.
2. TOPOGRAPHY BASED ON AERIAL SURVEY FLOWN IN SEPT. 1992, EXCEPT EMBANKMENT FACE PLANIMETRY WHICH IS BASED ON 1996 AND 1997 LAND SURVEY BY PARALLEL GEO-SERVICES INC. TOPOGRAPHY OF LYNX PIT AREA AND WASTE DUMP 1 UPDATED IN 2001 BY MFO AND G.QUARMBY AND MERGED INTO EXISTING CONTOURS.
3. AS-BUILT DETAILS FOR TDF SEISMIC UPGRADE PROJECT ARE NOT SHOWN.

NOT FOR CONSTRUCTION

TO BE READ WITH KLOHN-CRIPPEN REPORT DATED AUG 8, 2001

SCALE B: 0 40 m
SCALE A: 0 100 m

NO.	DATE	ISSUE / REVISION	DRAWN	CHK'D	DESIGN	APP'D
A	AUG 8, 2001	FINAL	KNH/RZ		CR	

CLIENT: BOLIDEN WESTMIN (CANADA) LTD.
MYRA FALLS OPERATION

KLOHN CRIPPEN

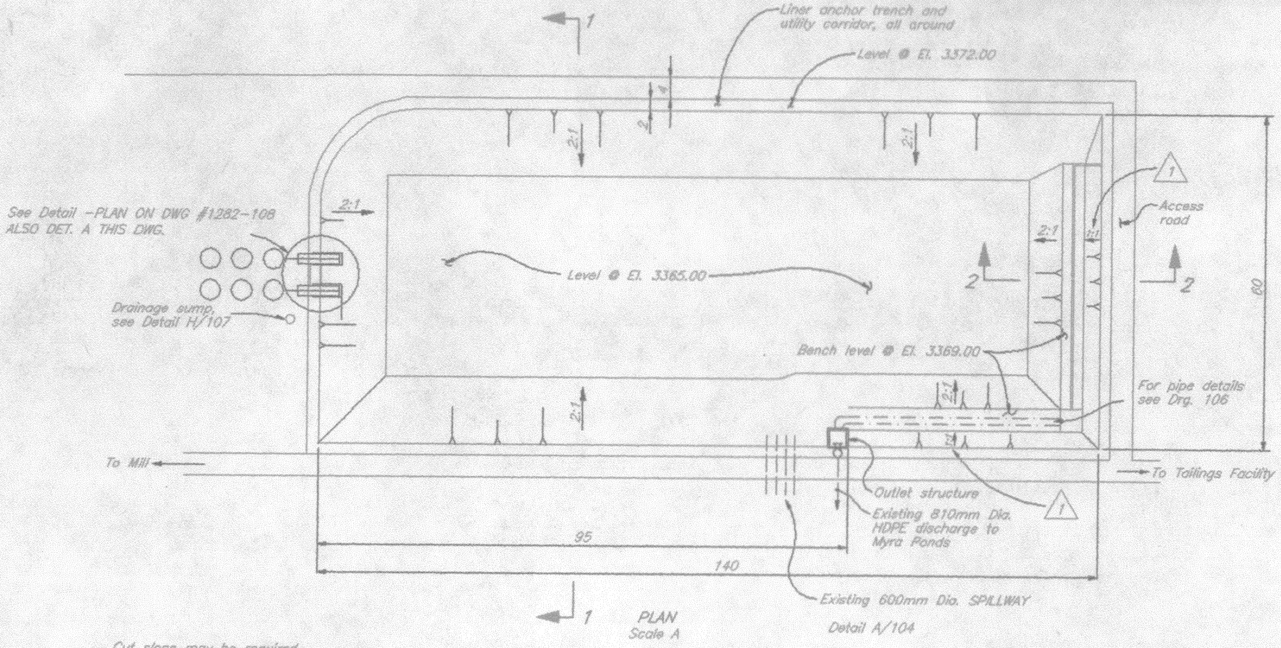
PROJECT: PASTE FILL PROJECT
LYNX PIT TAILINGS FACILITY

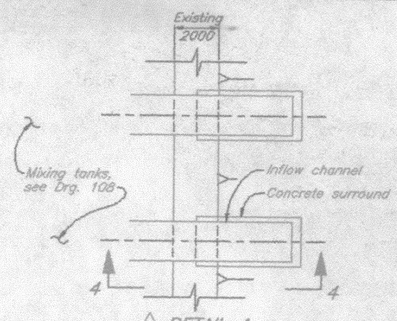
TITLE: INSTRUMENTATION PLAN AND DETAILS

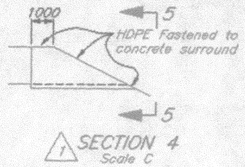
PROJECT No. PM8976 05 | DWG. No. D-1512 | Rev. A

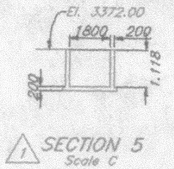
CANCEL PRINTS BEARING PREVIOUS

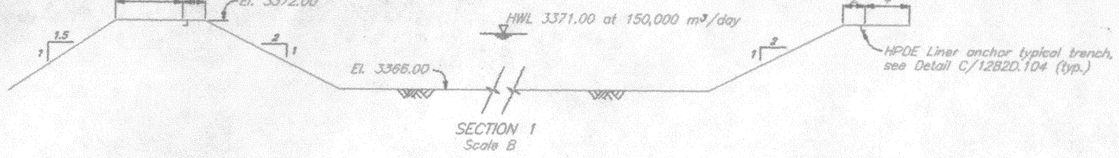
Scale: 1=1
Drawing File: M:\M8976 - MFO Paste Fill\Cadd\01\D-1512ra.dwg (rzakopcan)
Xrefs: EXISTORS, MYRA_PR1, XREF2, MYRA_CR1

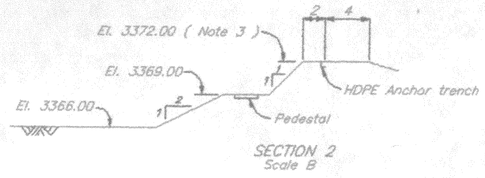




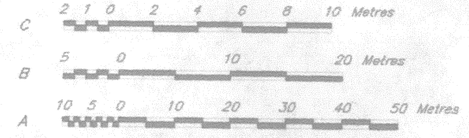








PIPEWORK PEDESTAL LAYOUT
SEE DWG. #1282D.106 FOR DETAILS



* SIGNATURES AND PROFESSIONAL SEAL ON FILED DRAWING

REFERENCE DRAWINGS	REVISIONS	REVISIONS
	2 JULY 93 REVISED AS BUILD	
	1 AUG. 25/'92 BERM GRADE CHANGE/ADD CHANNELS	
	0 AUG. 14/'92 ISSUED FOR QUOTATION	

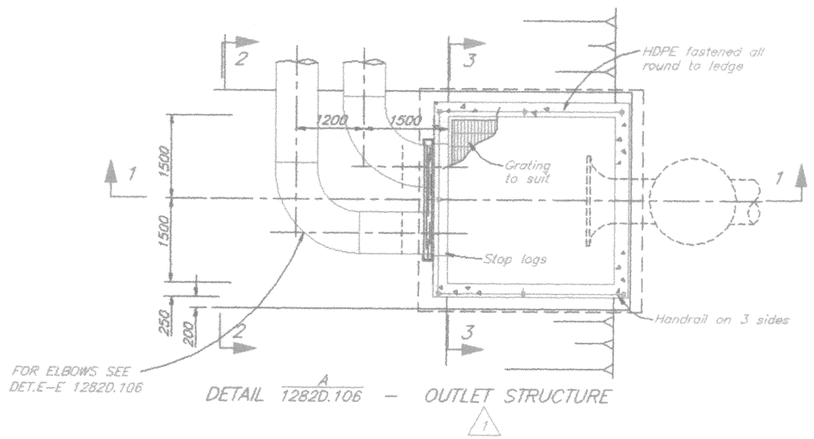
KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

WESTMIN RESOURCES LIMITED

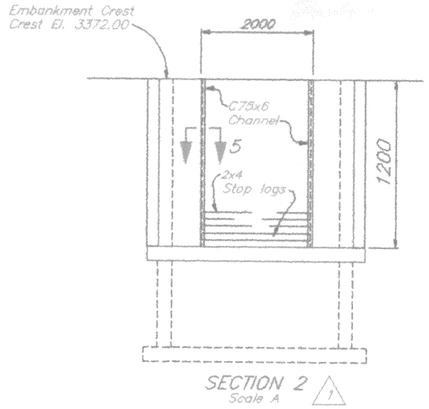
MYRA FALLS PROJECT

SUPER POND
PLAN AND SECTIONS

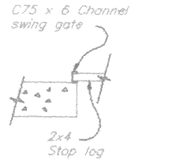
*	DESIGNED	HPD		
	DRAWN	W.A. Labrecke		
	CHECKED	*		
	APPROVED	*		
DATE AUG. 14, 1992	SCALE AS SHOWN	DRG. NO. 1282D.102	REV. 2	



DETAIL A 1282D.106 – OUTLET STRUCTURE



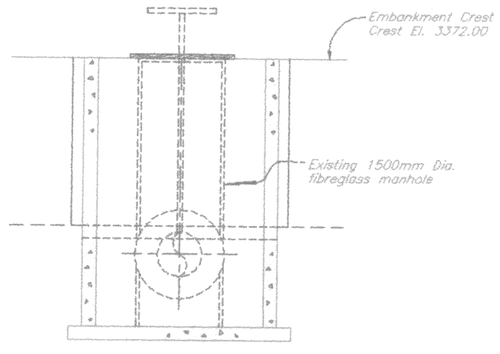
SECTION 2
Scale A



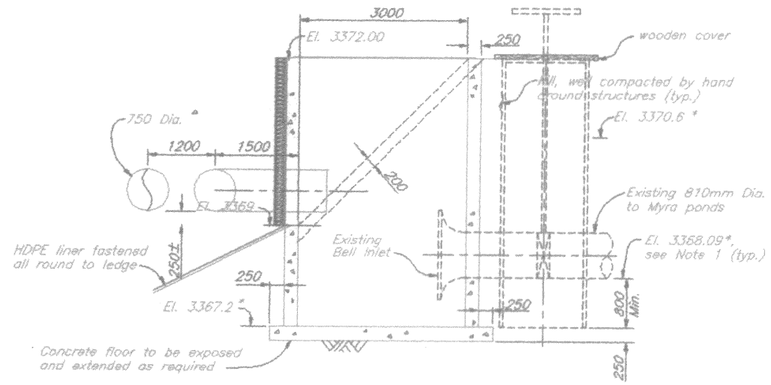
SECTION 5
NTS

NOTES

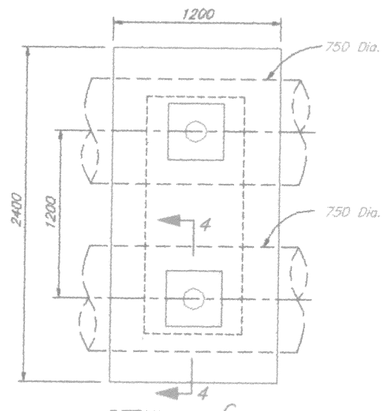
1. * El. 3367.2 (typ.) indicates elevation estimated (no survey data available)
2. Concrete:–
   - Concrete shall conform to CAN3-A23.1-M90 and CAN3-A23.2-M90
   - Cement shall be Type 50 (Sulphate Resistant)
   - Minimum concrete strength shall be 30 MPa at 28 days
   - Minimum blinding concrete strength shall be 15 MPa at 28 days
   - All concrete surfaces to which liner battened to be steel trowel finished with rounded and smooth edges
3. Reinforcement:–
   - Reinforcement bars shall be deformed bars to CSA G30.12 M Grade 400
   - Welded wire reinforcing fabric shall be to CSA G30.15
   - Minimum concrete cover to reinforcement shall be 50mm against formwork and 75mm against earth
   - All concrete to be reinforced with mesh or regular reinforcing bars
   - All reinforcement shall consist of 10mm bars at 200mm spacing each way
   - 200mm Thick walls to have a single layer of reinforcement placed in the centre of the section
   - 250mm Thick walls to have a layer of reinforcement at each face placed with the appropriate cover
   - The reinforcement shall be properly anchored and continuous at corners. Lap and anchorage length to be 400mm
4.
5. Dimensions in millimetres and elevations in metres



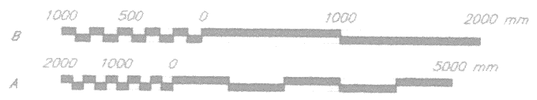
SECTION 3
Scale A



SECTION 1
Scale A



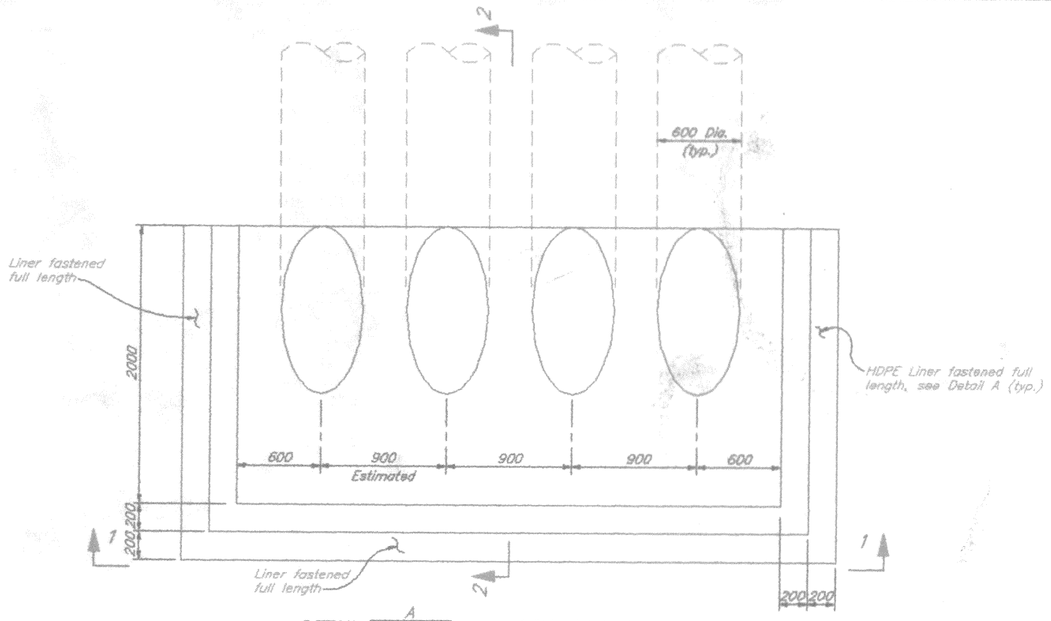
DETAIL C 1282D.106
(5 REQUIRED)
Scale B



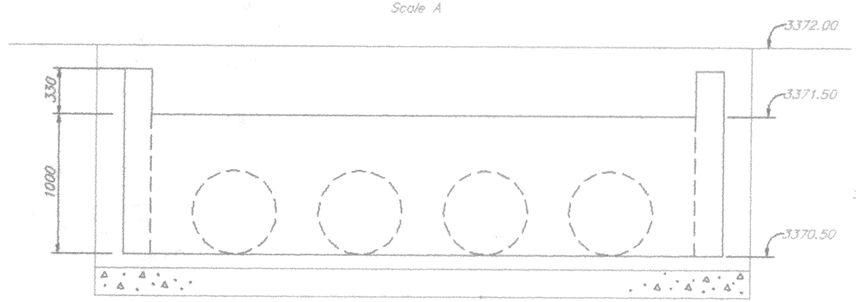
2 JULY 93 REVISED AS BUILD
1 AUG. 25/'92 OUTLET STRUCTURE MODIFIED
0 AUG. 14/'92 ISSUED FOR QUOTATION

KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C.	WESTMIN RESOURCES LIMITED
HPD VY/W.A.L. * *	MYRA FALLS PROJECT SUPER POND DETAILS SHEET 1 OF 2
DATE AUG. 14, 1992 SCALE AS SHOWN DRG. NO. 1282D.103 REV. 2	

REFERENCE DRAWINGS | REVISIONS | REVISIONS



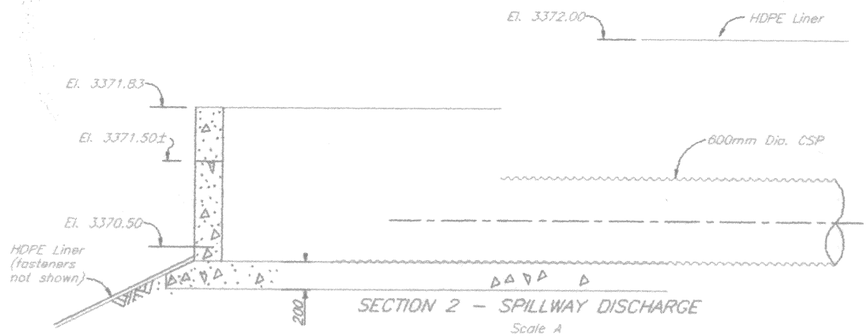
DETAIL $\frac{A}{1282D.102}$ – SPILLWAY PLAN
(4 x 600 Dia. CULVERTS)
Scale A



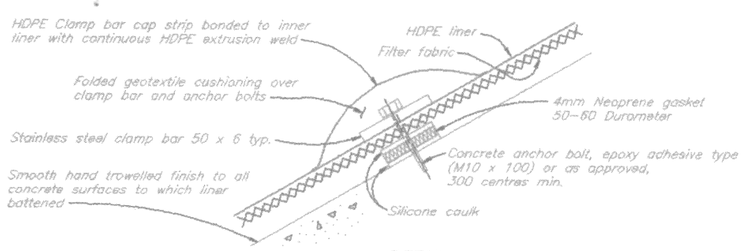
SECTION 1
Scale A

NOTE

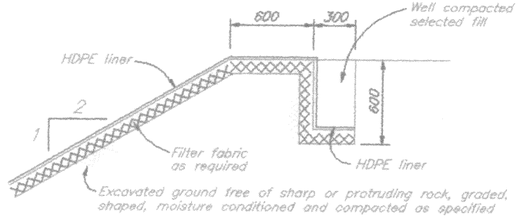
All concrete surfaces to which liner battened to be steel trowel finished with rounded corners and smooth edges.



SECTION 2 – SPILLWAY DISCHARGE
Scale A



DETAIL
TYPICAL LINER FASTENER – SCHEMATIC
(NTS)



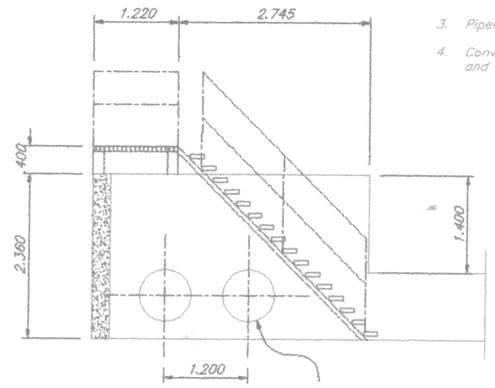
DETAIL $\frac{C}{1282D.102}$
SCHEMATIC – TYPICAL LINER ANCHOR TRENCH
Scale A

A 1000 500 0 1000 2000 mm

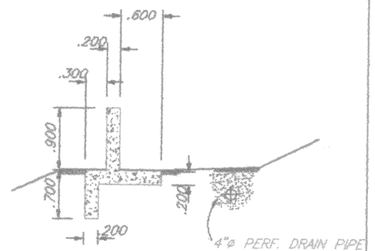
REFERENCE DRAWINGS	REVISIONS	1 JULY 93 REVISED AS BUILD REVISIONS	KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C. DESIGNED HPD DRAWN VY/W.A.L. APPROVED DATE AUG. 14, 1992 SCALE AS SHOWN DRG. NO. 1282D.104 REV. 1	WESTMIN RESOURCES LIMITED MYRA FALLS PROJECT SUPER POND DETAILS SHEET 2 OF 2

NOTES

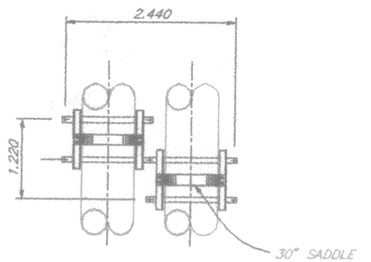
1. All bolts and fasteners to be stainless steel.
2.
3. Pipelines to be installed with grade of not less than -0.25%
4. Conveyance pipe support "leg" and "foot" to be located, and welded in place in the field trimmed to suit



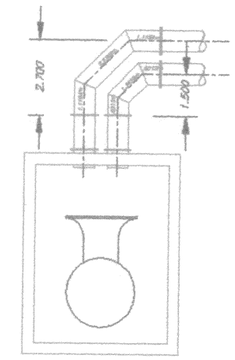
DETAIL A-A
Scale B



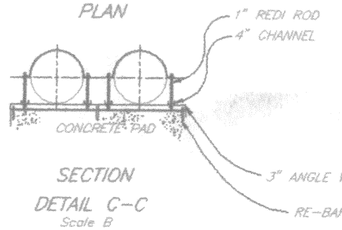
DETAIL B-B
Scale B



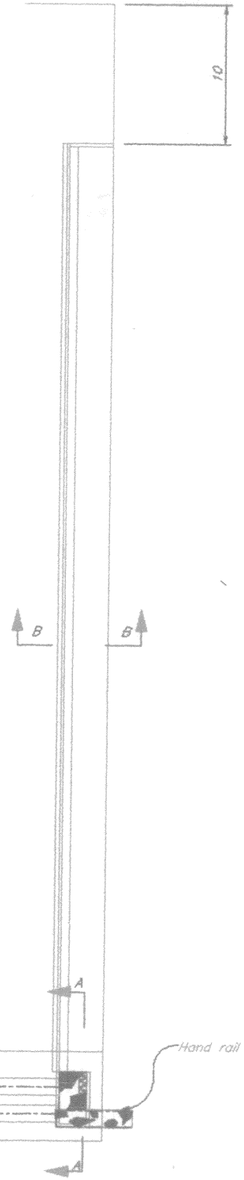
PLAN

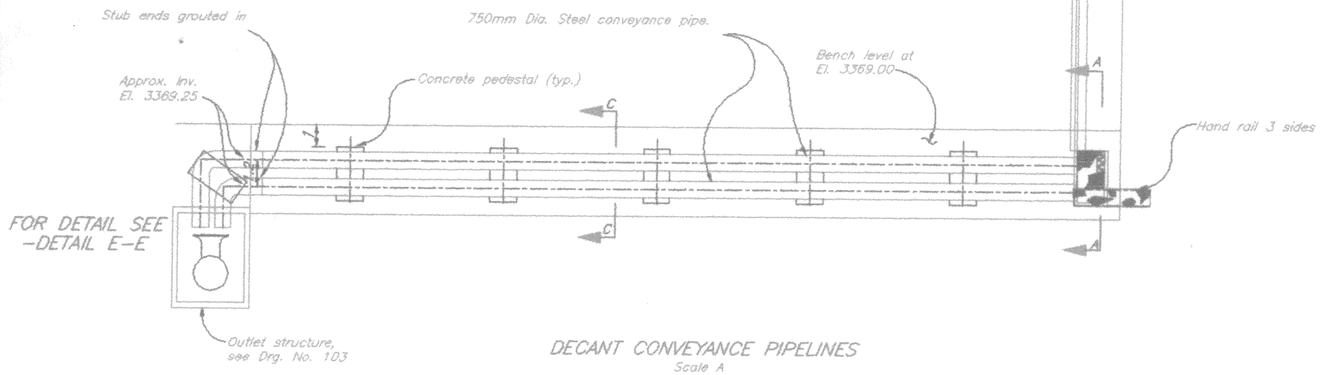


DETAIL E-E
Scale A x 2



SECTION
DETAIL C-C
Scale B





DECANT CONVEYANCE PIPELINES
Scale A

B 500 0 1000 2000 mm

A 5 0 10 Metres

* SIGNATURE AND PROFESSIONAL SEAL IN THE ORIGINAL

REFERENCE DRAWINGS	REVISIONS	REVISIONS
		2 JULY 12/'93 REVISED AS BUILD
		1 AUG. 25/'92 DIMENSIONS CHANGED
		0 AUG. 14/'92 ISSUED FOR QUOTATION

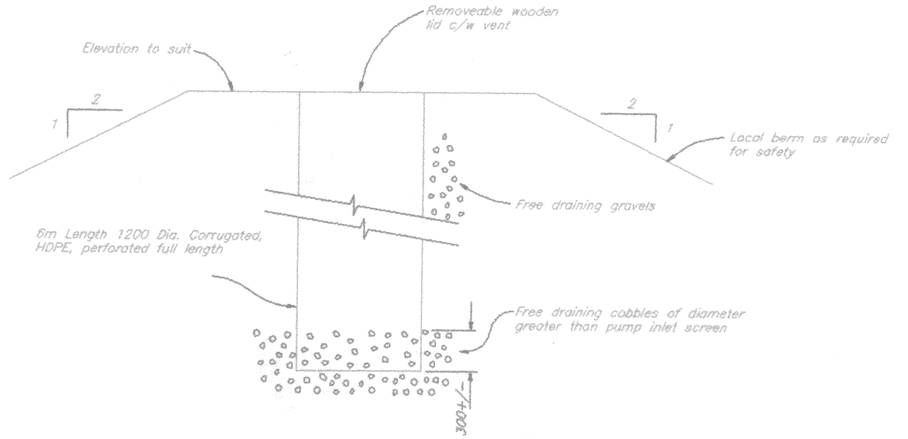
KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS - VANCOUVER, B.C.		WESTMIN RESOURCES LIMITED
	DESIGN HPD	MYRA FALLS PROJECT
*	DRAWN W.A.Laroda	SUPER POND PIPING DETAILS SHEET 2 OF 2
	CHECKED *	
	APPROVED *	
DATE AUG. 14, 1992	SCALE AS SHOWN	DRG. NO. 1282D.106 REV. 2

NOTES

1.

2.

3. Submersible pump for drainage sump to be selected for capacity of 4 l/s at 8m TDM.



DETAIL $\frac{H}{1282D.102}$ – DRAINAGE SUMP

Scale B

B 1000 500 0 1000 2000 mm

A 10 5 0 10 20 m

REFERENCE DRAWINGS	REVISIONS	REVISIONS
		1 JULY 93 REVISED AS BUILD
		0 AUG. 14/'92 ISSUED FOR QUOTATION

KNIGHT AND PIESOLD LIMITED
CONSULTING ENGINEERS – VANCOUVER, B.C.

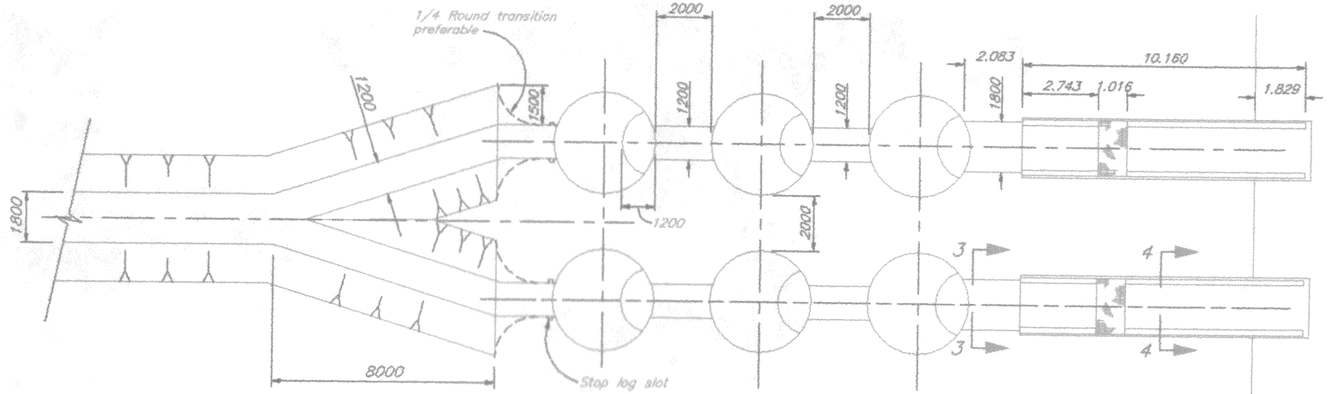
DESIGNED HPD
DRAWN VKY
CHECKED
APPROVED

WESTMIN RESOURCES LIMITED

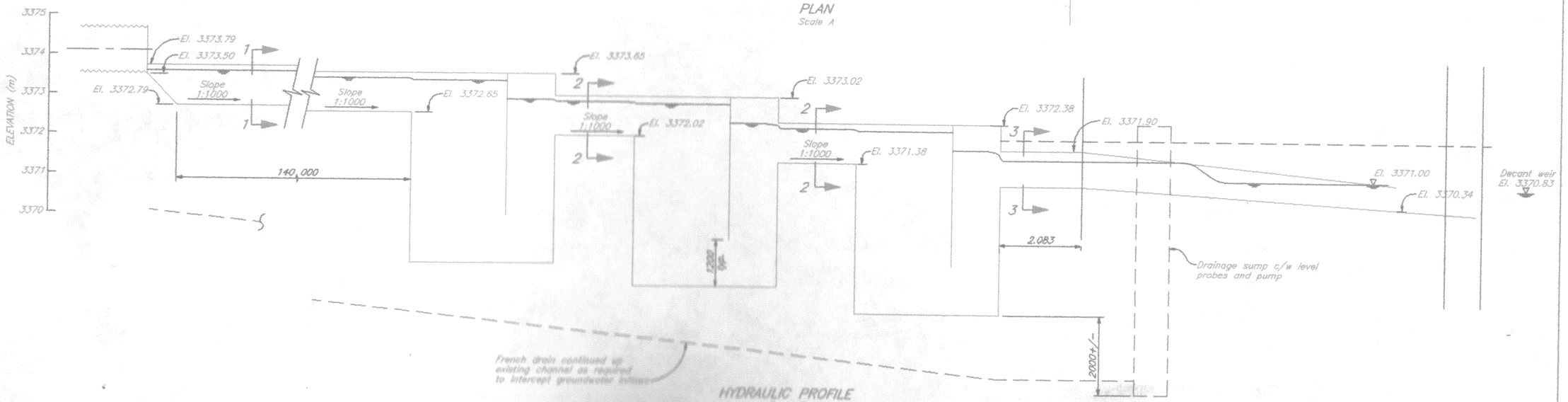
MYRA FALLS PROJECT

SUPER POND
MISCELLANEOUS DETAILS

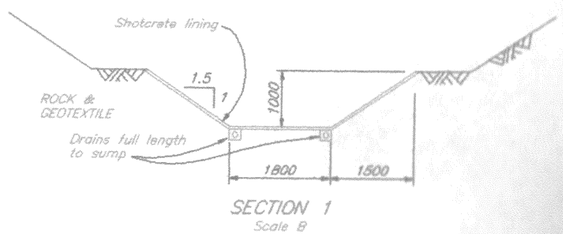
DATE AUG. 14, 1992 SCALE AS SHOWN DRG. NO. 1282D.107 REV. 1



PLAN
Scale A

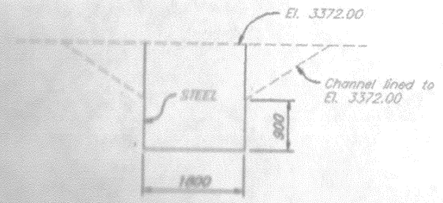


HYDRAULIC PROFILE
Scale B



SECTION 1
Scale B

SECTION 2
Scale B



SECTION 3
Scale B

B 1 0.5 0 1 2 3 4 5 Metres

A 2 1 0 2 4 6 8 10 Metres

KNIGHT AND PIESOLD LIMITED CONSULTING ENGINEERS – VANCOUVER, B.C.		WESTMIN RESOURCES LIMITED
	DESIGNED HPD/DJB	MYRA FALLS PROJECT
	DRAWN V.A.Labrada	SUPER POND MIXING TANKS
	CHECKED	
	APPROVED	
DATE AUG. 25, 1992	SCALE AS SHOWN	DRG. NO. 1282D.108 REV. 1

REFERENCE DRAWINGS

NO.	DATE	REVISIONS
1	JULY 93	REVISED AS BUILT

Appendix II

Photographs of TDF and Key Components

Plate 1: Myra Creek with TDF slope and riprap armouring

View looking downstream of Myra Creek with TDF slope on left and overland conveyor on right.

Plate 2: Amalgamated Paste Area

A) South paste berm with spillway swale

B) Paste deposition point on north bank

C) SE corner of Paste Area

D) NW corner with pond and sludge storage area

Plate 3: TDF Decants

Area I Strip Decant

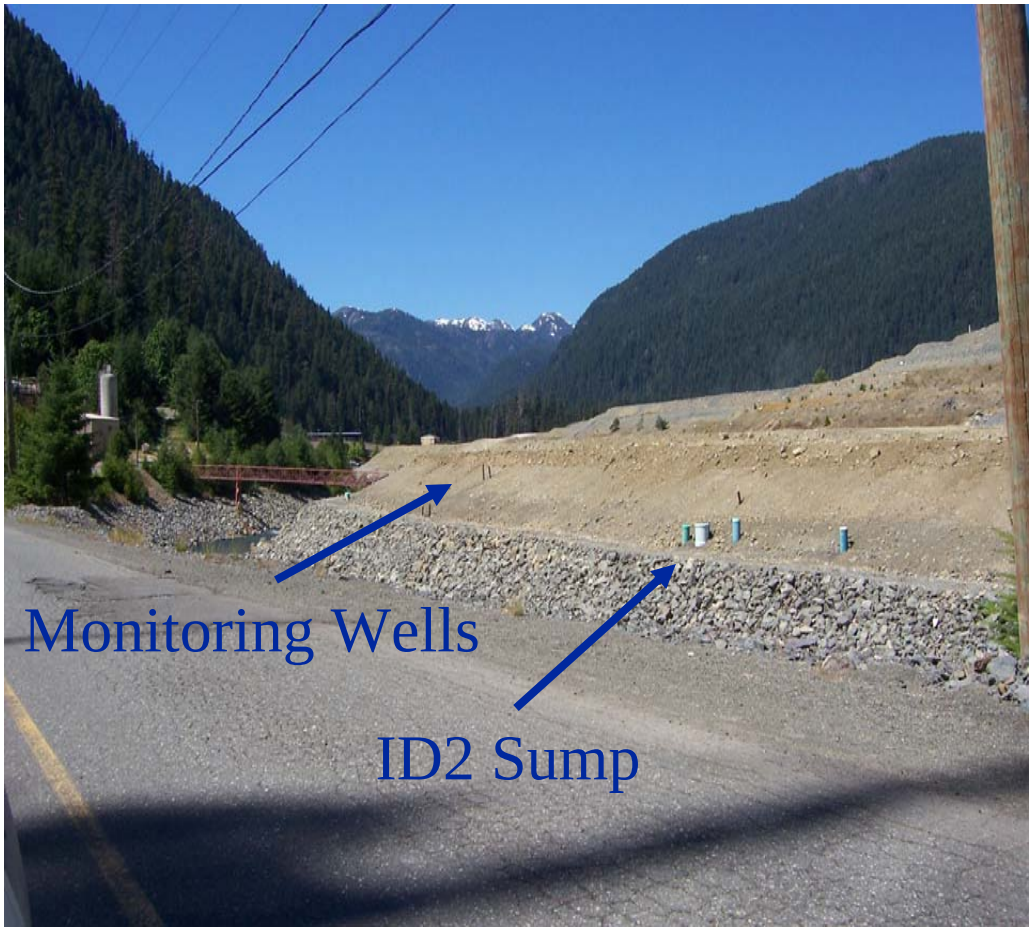
Amalgamated Paste Area Decant – SW corner

Plate 4: Paste Plant

Plate 5: Diversion Ditch

Plate 6: New Outer Drain 0+850 to 0+1350 - Pipe Installation

A) Outer drain access pipes



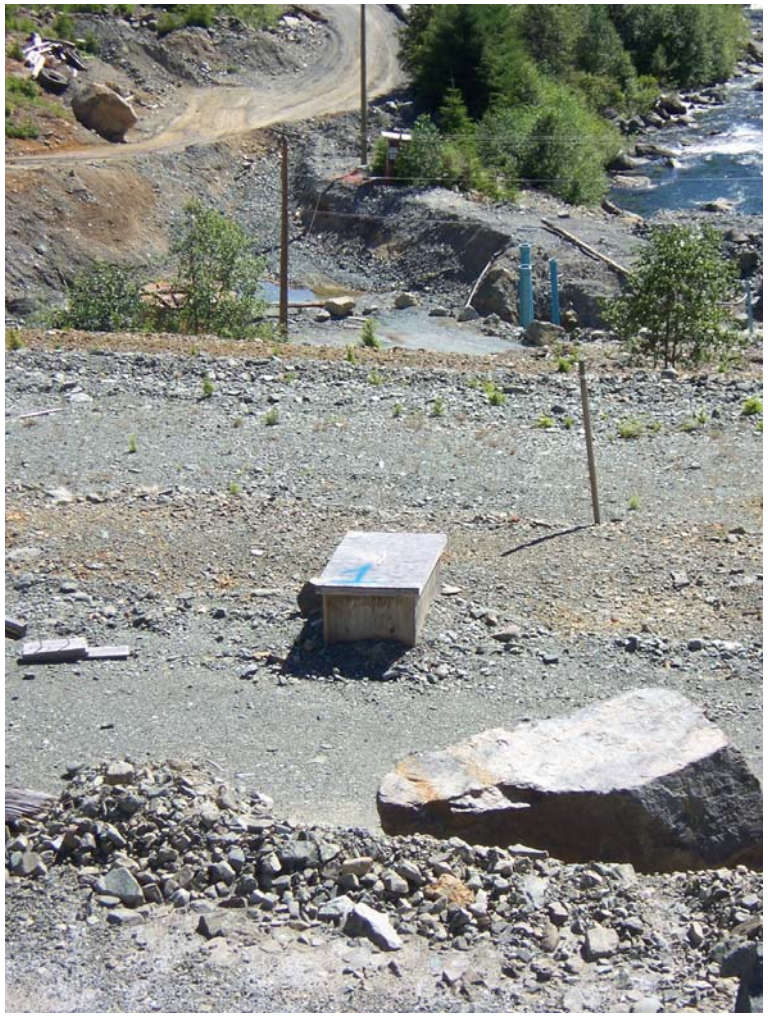
B) Outer drain conveyance pipes

Plate 7: TDF Slope & Myra Creek Flood Protection

A) Riprap armouring for 1:1000 year flood protection

B) New TDF seismic upgrade berm slope 2:1

Plate 8: TDF movement monitoring instruments



A) Extensiometer #1 of 7 measuring cracks on the outer berm of the TDF

B) Survey markers to measure settling on the TDF

Plate 9: Piezometer Monitoring Huts

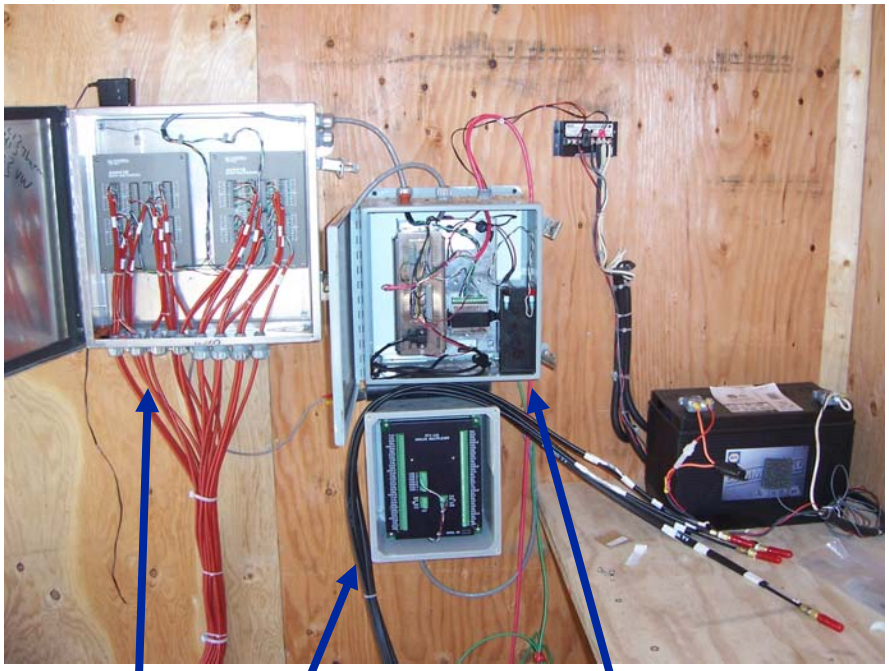
A) Piezometer Hut A @ 0+350

B) Piezometer Hut B @ Paste Berm

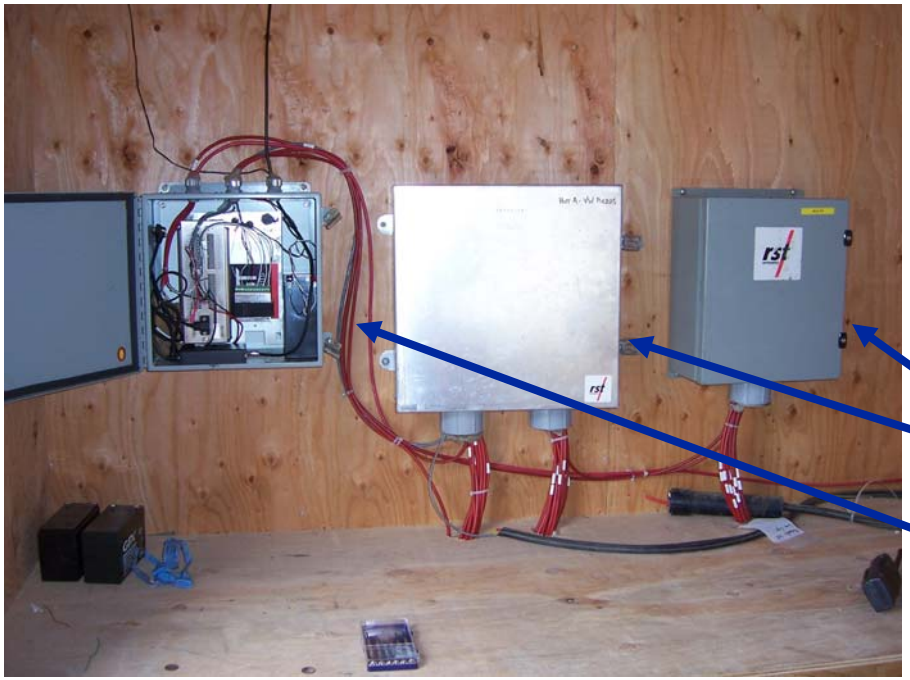
C) Piezometer Hut C @ 0+1300

Plate 10: Instrument Panels in Piezometer Huts

B) Hut C Instrument boxes



A) Hut A Instrument boxes



Multiplexers

Dataloggers & Radios

Plate 11: Pipe bridges across Myra Creek

Red Pipe Bridge 0+1000 – conveys sand to backfill plant and overflow water from backfill plant to paste area.

Grey Pipe Bridge 0-25 – conveys Super Pond discharge to Polishing Ponds and Sludge from Polishing Ponds to Paste Area during pond cleaning.

Plate 12: Sand Reclaim Area

Photos taken from the Paste Berm looking West.

Plate 13: No. 4 Pumphouse

A) Pumphouse at eastern abutment of TDF

B) Inside No.4 Pumphouse – pump starter controls

Plate 14: TDF and Paste Berm Spillway Construction

Seismic Berm Spillway

Paste Berm Spillway Swale

Plate 15: New Pumphouse #4

Appendix III

Inspection and Reporting Forms

PROVINCE OF BRITISH COLUMBIA
Ministry of Energy and Mines

Mines Branch

ADVICE OF GEOTECHNICAL INCIDENT OR UNUSUAL OCCURRENCE

PART A: To be completed by mine management to advise the Inspector of Mines of a geotechnical event or unusual occurrence.

GENERAL INFORMATION

Name of Mine: _____ Number and Type of Mine: _____

Mining Company: _____ Location: _____

Manager: _____ Appropriate Contact: _____

Phone: _____ Fax: _____ Phone: _____

Part of Mine Involved/Affected: _____

Date of Event: _____ Probable Time: _____

Summary of Incident: _____

_____

_____

DETAILS OF EVENT

Conditions at Site Preceding Event (weather, shutdown, etc.): _____

_____

Volume or Mass Involved: _____

Detailed Description of Incident (provide sketch): _____

_____

_____

Damage or Consequences: _____

_____

Actions Taken by Mine: _____

_____

_____

ADVICE OF GEOTECHNICAL INCIDENT OR UNUSUAL OCCURRENCE

PART B: To be completed by the Inspector of Mines if the geotechnical event or occurrence is considered by him to be a dangerous occurrence, warranting follow-up.

ENQUIRY

Engineering Report Requested? _____

Report from Mine (including plans and section) attached? _____ Coming? _____

Investigation Required by Branch Geotechnical Engineer? _____

Notes: _____

_____

_____

Inspection District: _____ Inspector (name): _____

Date: _____ Signature: _____

Initials and Date Seen: _____

FOLLOW-UP

_____

_____

_____

_____

_____

_____

_____

nvi MINING LTD.
MYRA FALLS OPERATIONS

SPILL REPORT

* Please fill in all items and forward to your immediate supervisor and the Environmental Department same day

Date & Time of Spill	
Material Spilled	
Amount Spilled	
Location of Spill	
Cause of Spill	
Area Affected by Spill	
Impact Assessment	
Action Taken	
Key Personnel Involved	
Spill Reported To	
Description/Comments	

Date: _____ **Filled Out by:** _____

POST – EARTHQUAKE INSPECTION REPORT

All parts of this inspection report should be completed. Adverse conditions should be described. Additional information may be put on attached pages

INSPECTION DETAILS

Inspector Name: _____

Inspector Position: _____

Inspection Date/Time: _____

Weather Conditions: _____

Earthquake Details:

Location: ☐ _____

Magnitude: ☐ _____

ADDITIONAL COMMENTS

_____

_____

_____

_____

INSPECTION POINT LOCATIONS		* RATING LEGEND
1. Tailings Disposal Facility		S = Satisfactory (Meets the intended purpose)
2. Thelwood Hydro Penstock		F = Fair (Meets intended purpose, some maintenance req'd)
3. Tennent Hydro / Penstock		P = Poor (May not meet intended purpose, repair / modify)
4. Mill Facility & Camp		U = Unsatisfactory (Will not meet intended purpose- repair)
5. HW Headframe & Lynx		N = Not inspected
6. Bridges & Roads		NA = Not applicable
7. Superpond & Myra Ponds		
8. Power Poles and Lines		
9. Backfill Plant		
10. Paste Plant		
11. Communication Systems		
12. Diesel & Propane System		
13. Freshwater Tanks		
14. Pumphouses (#3 & #4)		
15. Diversion Ditch		

POST FLOOD INSPECTION CHECKLIST

Boliden Westmin (Canada) Ltd.
Myra Falls Operation

Date: _____
Time: _____
Inspected By: _____
Flood Period: _____
Approximate High Water Elevation: _____

River Crossing Structures

Inspect footings for:

- Movement of rip rap downstream.
- Exposure of finer gravel.
- Scour holes.
- Damage to footings.
- Increased exposure of footings.

Location	Observations:
Red Pipe Bridge	
White Pipe Bridge (near conveyor)	
Ore Conveyor	
Power Poles	

Myra River Channel

When water recedes, has there been a noticeable change in the channel form or bank materials?
For example:

- Loss of rip rap along the banks.
- Loss or movement of boulder clusters.
- Change in riffle shape.
- New scour holes in the channel bed.
- Exposure of underlying finer gravel material.
- Evidence of bank slumping, scouring, or oversteepening.
- Erosion of the channel bed at downstream end of Myra Creek (near 1+ 400)

Location	Observations:
Right Bank[1]	
Left Bank	
Channel Bed	
Riffles	
Boulder Clusters	

1. Location of bank when facing downstream. At MFO, the right bank is also the east bank.

Berm

When the water recedes from the top of the berm on the left bank, is there a noticeable change in its appearance?
For example:

- Cracking along the crest the berm.
- Evidence of scour or slumping along the toe of the tailings embankment (> 1m high).
- Evidence of scour on the top or along the crest.
- Potholes due to settlement or scour of fine grained sediment.

Location	Observations:
Berm Surface	
Toe of Tailings Embankment	

MYRA FALLS TAILINGS DISPOSAL FACILITY – INSPECTION REPORT

All parts of this inspection report should be completed. Adverse conditions should be described. Additional information may be put on attached pages

INSPECTION DETAILS

Inspector Name: _____

Inspector Position: _____

Inspection Date/Time: _____

Weather Conditions: _____

Reason for Inspection:

Routine ☐

Special Condition ☐

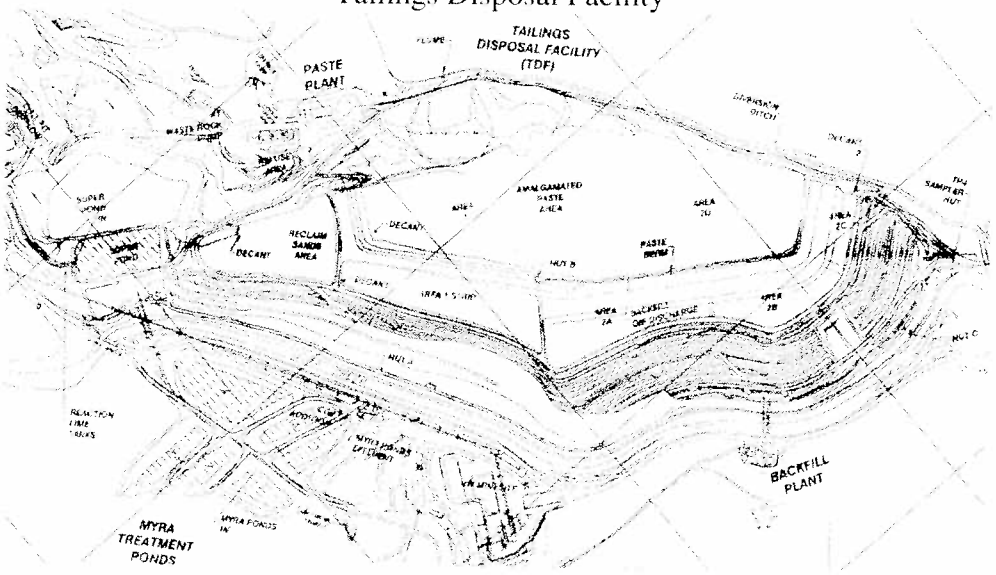
ADDITIONAL COMMENTS

_____

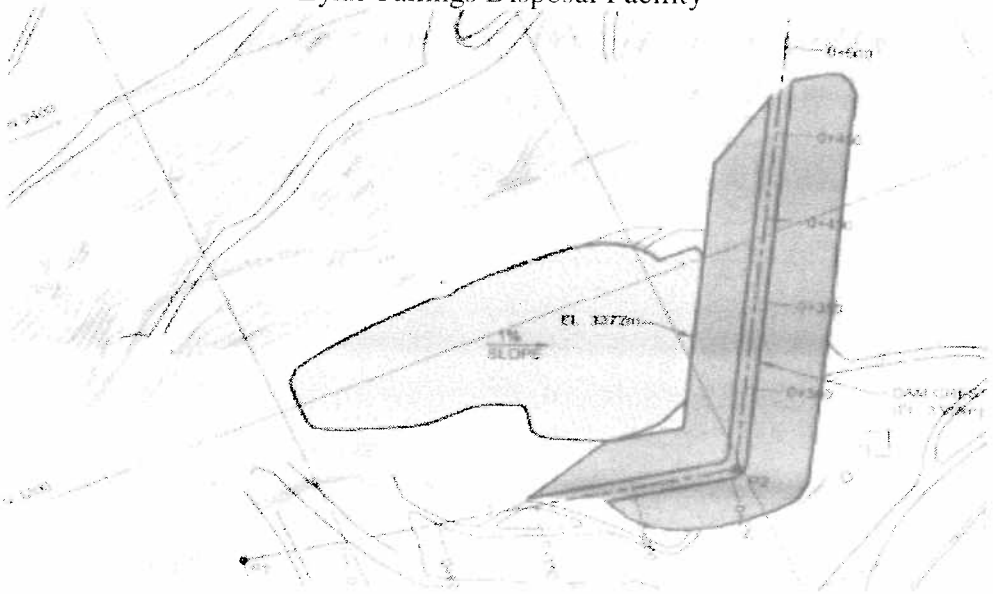
_____

_____

Tailings Disposal Facility



Lynx Tailings Disposal Facility



MYRA FALLS TAILINGS DISPOSAL FACILITY – INSPECTION REPORT

INSPECTOR NAME: _____ **DATE:** _____

INSPECTION POINT / ITEMS	CONDITION	
	RATING	REMARKS / DESCRIPTIONS
Tailings Dam Crest	S F P U N NA	
Surface Cracks - Transverse		
Surface Cracks - Longitudinal		
Settlement / Depressions		
Erosion or Gully Channels		
Spillway Inspection	S F P U N NA	
Invert opening clear?		
Riprap coverage adequate?		
Tailings Dam Slope and Toe	S F P U N NA	
Surface Erosion		
Surface Settlement / Depressions		
Sinkholes		
Cracks / Slope Movement/Bulging		
Seepage / Wet Areas		
Other Unusual Conditions		
Amalgamated Paste Area	S F P U N NA	
Active Tailings Placement? If yes, show on map		
Pond Water Elevation (Top of decant is 3390.3)		
Depth of water at decant inlet and clarity		
Inlet opening clear?		
Sand Storage Area–Pond to Crest Distance > 10 m?		
TDF Strip	S F P U N NA	
Distance between water and outer embankment > 20m?		
Decant inlet opening clear?		
Depth of water at decant inlet and clarity?		
Lynx Diversion Ditch	S F P U N NA	
Ditch Clear? No infill material?		
Any Ditch Damage?		
Signs of Ditch Overtopping?		
Flow Conditions in Ditch (m^3/s)		
Paste Berm Crest	S F P U N NA	
Surface Cracks - Transverse		
Surface Cracks - Longitudinal		
Settlement / Depressions		
Erosion or Gully Channels		
Lynx TDF	S F P U N NA	
Sink holes or depressions evident in the tailings?		
Sump pump currently pumping?		
Ponded water evident on paste tails? if yes, how deep?		
Is water flowing into the pit? If yes, show on map		
Evidence of slope failure into the Lynx TDF?		
Active Tailings Placement? if yes, show on map		

*** RATING LEGEND (see next page)**

S = Satisfactory (Meets the intended purpose)

F = Fair (Meets intended purpose, but some maintenance needed)

P = Poor (May not meet intended purpose, repair or modify)

U = Unsatisfactory (Will not meet intended purpose, repair or modify)

N = Not inspected

NA = Not applicable

Additional Comments:

_____

_____

_____

_____

_____

_____

SUPERPOND & MYRA PONDS - INSPECTION REPORT

All parts of this inspection report should be completed. Observations should be described and marked on drawing. Additional information may be put on attached pages.

Date/Time: _____

Inspector Name: _____

Inspector Position: _____

Weather Conditions: _____

Reason for inspection: **Routine:** ☐ **Special: (note reason)** ☐

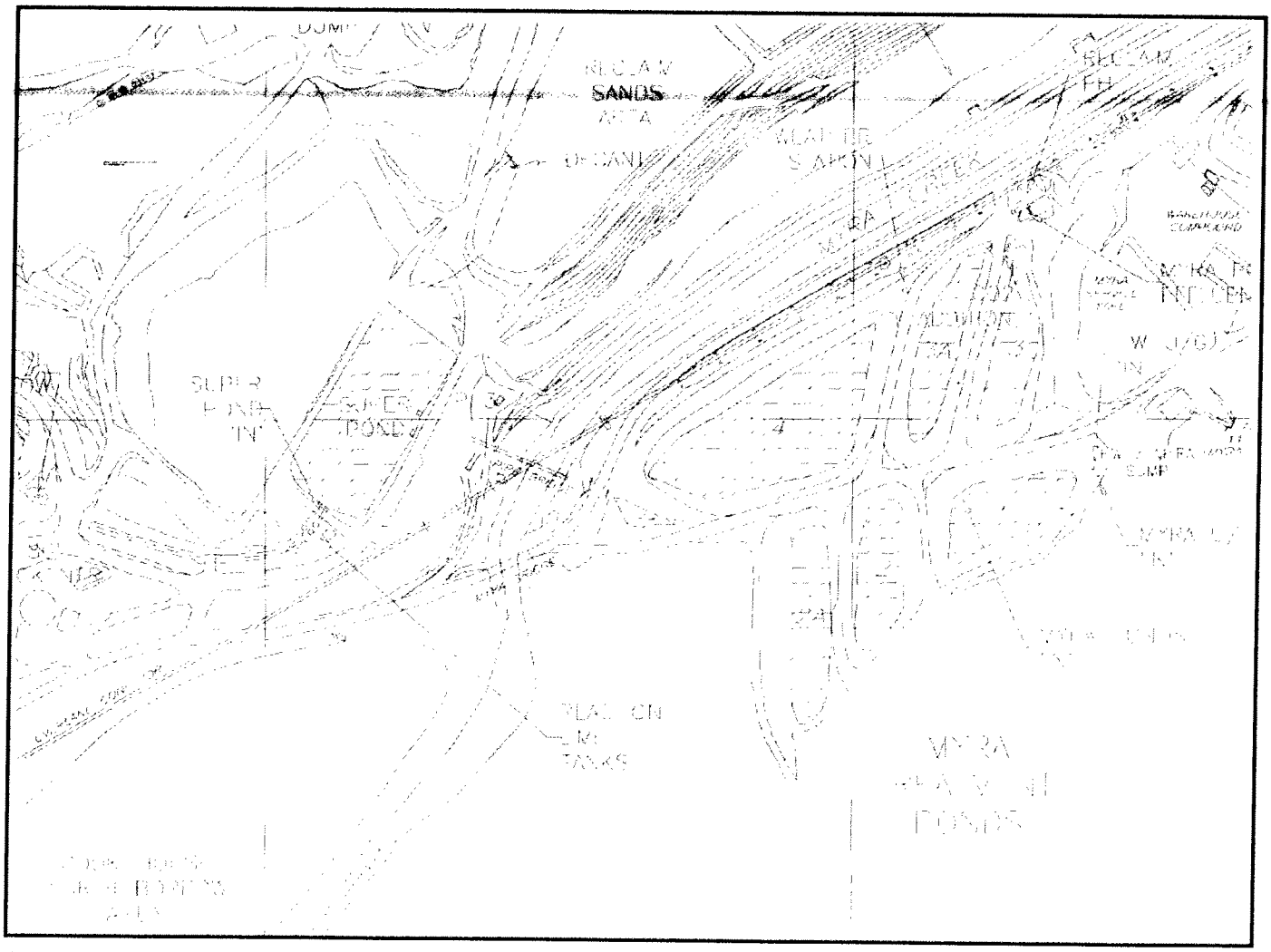
Rating Legend:

S = Satisfactory (Meets Purpose)
F = Fair (Some Maintenance Required)
P = Poor (Plan to Repair or Modify)
U = Unsatisfactory/Unsafe (Repair ASAP)
NI = Not inspected
NA = Not applicable

		Comments?	Rating:
1. Superpond Input Ditch	Shotcrete ok? Y N Debris in ditch? Y N		
2. Superpond Input Pipes	Leaks? Y N Dirty flow? Y N		
3. Superpond Reaction Tanks	#1 pH: #2 pH:		
4. Superpond Flump Pump	Running? Y N Traversing? Y N Hours:		
5. Superpond Liner and Freeboard	Tears in liner? Y N (if yes, locate on diagram)		
6. Superpond Outflow	Screen free of debris? Y N Screen ok? Y N pH:		
7. Superpond Emergency Outflow	Open? Y N Debris? Y N		
8. Overflow pipes	Leaks in truss or carbridge pipes? Y N		
11. #25 Sump	Pump working? Y N Debris in sump? Y N		
12. Myra/HW Sump	Overflowing? Y N Pump working? Y N		
13. Myra #1 pond	Freeboard:____cm pH: Sludge level:		
14. Myra #2 pond	Freeboard:____cm pH: Sludge level:		
15. Myra #2A pond	Freeboard:____cm pH: Sludge level:		
16. Myra #3 pond	Freeboard:____cm pH: Sludge level:		
17. Myra #3A pond	Freeboard:____cm pH: Sludge level:		
18. Myra #4 pond	Freeboard:____cm pH: Sludge level:		
19. Myra Final Outflow	#1 pH: #2 pH: Turbid? Y N Flume level:____cm		
20. CO_2 system	CO_2 level: ____ CO_2 on? Y/N Emergency backup in place Y/N		
21. Myra and Superpond berms	Erosions or seeps? Y N		

SUPERPOND & MYRA PONDS - INSPECTION REPORT

Notes:



DIVERSION CHANNEL MONITORING

minimum requirement monthly

LOCATION

INSPECTION RECORD

UPPER THIRD

OBSTRUCTION	DAMAGE	POTENTIAL PROBLEMS	STABILITY	WORK REQUIRED

DETAILS

MIDDLE THIRD

OBSTRUCTION	DAMAGE	POTENTIAL PROBLEMS	STABILITY	WORK REQUIRED

DETAILS

LOWER THIRD

OBSTRUCTION	DAMAGE	POTENTIAL PROBLEMS	STABILITY	WORK REQUIRED

DETAILS

CULVERT & BRIDGE

OBSTRUCTION	DAMAGE	POTENTIAL PROBLEMS	STABILITY	WORK REQUIRED

DETAILS

COMMENTS /CONCERNS

REPAIRS OR MAINTENANCE PERFORMED

DATE

SIGNATURE

REF.DIVMONIT.WK4

TAILINGS & WATER TREATMENT REPORT

NVI MINING LTD.
MYRA FALLS OPERATIONS

Date: _____ Shift: A B C D

Operator _____ D/S [ ] N/S [ ]

		Myra O/F		80 FT BUILDING		SUPER POND			
		Co_2 Auto/Man	Co_2 Flow	BACKFILL % SOLIDS	NUMBER OF CYCLONES OPEN	LIME SET POINT #1	LIME SET POINT #2	DRAINS % OPEN INNER	DRAINS % OPEN OUTER
CO_2 Tank Level Please record once per shift	8:00								
	10:00								
	12:00								
	2:00								
	4:00								
	6:00								

		Time:	8:00	10:00	12:00	2:00	4:00	6:00	OPERATORS COMMENTS
SUPER POND Maintain Inflow of 10.0 pH	# 1 INFLOW	11.5							
		11.0							
		10.5							
		10.0							
		9.5							
		9.0							
	# 2 INFLOW	11.5							
		11.0							
		10.5							
		10.0							
		9.5							
		9.0							
Maintain Outflow of 9.5 pH	OUTFLOW	10.5							
		10.5							
		10.0							
		9.5							
		9.0							
		8.5							
MYRA PONDS	INFLOW	10.5							
		10.0							
		9.5							
		9.0							
		8.5							
Maintain 9.0 PH	OUTFLOW	I/A values							
		10.0							
		9.5							
		9.0							
		8.5							
		8.0							

CIRCUIT CHECKS:

(Ensure each area is visually inspected during every round and make note of any concerns.

SUPER POND SCREENS _____
#25 SUMP LEVEL _____
#4 PUMP HOUSE LEVEL _____
BACKFILL O/F LINE _____
DIVERSION DITCH _____
LYNX PIT PUMP _____
ALL DECANTS _____
BACKFILL LINES _____
FLUMP LINES _____
RED BRIDGE ALL LINES _____

BUFFER CHECKS	
BUFFER	Meter reading
10pH	
7pH	
Time meter buffed	

Flump Hours	

Chlorine

Bottle 1: reserve operating empty
Bottle 2: reserve operating empty
Flow Level (lbs/day) _____
Free Cl reading (ppm) _____

MYRA OUTFLOW TOTALISER	

IMMEDIATELY REPORT TO SUPERVISOR ANY ITEMS/AREAS NOT CHECKED

COMMENTS: _____

Supervisor: _____

nvi MINING LTD
MYRA FALLS OPERATIONS

PASTE PLANT OPERATORS REPORT SHEET

Date _____ **Shift:** A B C D

Operator _____ D/S ☐

N/S ☐

CALL BED LEVEL AND SLUMP TO CONTROL ROOM WHEN TAKEN

Record Values every 4 hours		9:00	1:00	5:00
Thickener	Bed Level			
(manual)	U/F % solids			
	Floc addition rate			
Paste Mixer	Hydrolic temp.			
	Operating pressure			
	Strokes per min.			
(manual)	Slump (inches)			
	Paste fine KPA			
	Oil pressure MPA			
Paste Pump Operating?:		**360**	**370**	

Comments: _____

Circuit Check

A thorough circuit check including the following list is to be completed once per shift. Please make note of any concerns observed and report to your Shift Supervisor immediately.

	Comments
Area on thickener bridge	
Check slurry feed box is not building up with solids and O/F flappers clear	
Check that the thickener decant water is clean.	
Clean bed level probe	
Thickener Underflow pumps	
Full visual	
Disc filter	
Check for any damaged filter bags, record info	
Wipe boot level indicator eye	
Check that the agitator gland water has an operating pressure of 5 PSI	
Boot agitator visual	
Conveyor belt	
Check conveyor for misalignment, spillage and eventual rubber damages	
Full visual	
Check that belt scrapper is working properly	
Check all skirting	
Maintain clean pan under conveyor	
Paste Mixer	
Check for any leakages and heavy vibrations	
Check hydraulic tank level	
Check lines, fittings, pumps for leaks	
Check for continuous overflow from water box (clear/dirty)	
Hose off,wipe level probe on hopper	
Floc Mixing	
Check that the flock is available, replace bag if needed	
Full visual - Full visual - sounds	
Sump Pumps	
Thickener underflow, Paste pump sump, Floc sump	
Check for any unnecessary vibrations	
Check that level sensors are in operation	
Air Dryer	
Full visual	
Atlas Copco and Sullair Compressors	
Full visual	
Vacuum Pump	
Full visual	
Gland and Process water pumps	
Full visual	

Operator Signature: _____

Shift Supervisor Signature: _____

Appendix IV

Piezometer Procedures

Piezometer Monitoring Procedures (Huts A, B, & C)

Table of Contents

* Note: For background information regarding Procedures 3, 4 & 5 find the support manuals (Loggernet Datalogger Support Software Instruction Manual and the MitiGator Seismic Switch Reference Manual) which can be found in the second drawer down in the file cabinet in the Environmental Technologist's office in the Lynx building.

** Also note: Important piezometer files for MFO, Klohn Crippen, Mike O'Kane etc. are maintained on the Mfy-sys-dc01 server in an electronic folder known as:

Mfo-sys-dc01\Mill\Users\Gavin Dirom\Enviro Data\Env Lab\TDF_Soil_Huts_ABC

*** Huts A and C house piezometer monitoring equipment for the Tailings Dam Facility (TDF). Hut A houses piezos that are monitoring Area I of the TDF, while Hut C piezos monitor Area II. Hut A & C are located on the lower TDF access road. Hut A is located at 0+350 m downstream from the west side of the TDF. Hut C is located at 0+1200. Hut B is a small raised box with a solar panel located on the paste berm midway along the Amalgamated Paste Area. For further orientation see the map in Figure X.

Procedure 1: Vibrating Wire (VW) Red Box Procedure

Equipment required: - "Red box" Geokon microprocessor vibrating wire readout box (complete with charged battery and loose electrodes)
- Tool box w\screwdrivers and wrench
- Worksheets for recording data (see attached example)
- Keys for Hut A & C
- Gas tester
- Radio
- thermometer & barometer

- Record date, temperature and barometric pressure on data record sheet
- Connect electrode cable to transducer
- Switch box "ON", switch to "A" or "B" display mode (depending on conversion you'd like)
- Within Hut A, B or C find the RELAY MULTIPLEXER wall unit
- In Hut A & C, note there are three separate relay units, labeled 1 to 3. The left one is #1, the right one is #2, and the top, smaller box is #3
- Begin reading #1 unit at the #1 piezometer contact - place one electrode into the L2 contact & one into H2 contact simultaneously - note: black and red electrodes can be switched between L2 and H2 – doesn't matter. NOTE: For Hut B, the contacts used are L1 & H1 for VW readings.
- Record VW readout in "usec" for each piezometer
- Continue to #2 piezometer and repeat for all piezometers connected to #1 unit
- Move to #2 unit and repeat procedure starting at #1 piezometer

Converting VW manual Red Box readings to Campbell Units (so that one can compare download data to manual data):

Table 1-1: *Converting Red Box values into Campbell Scientific (CS) units*

Operation	Result
Take the Display 'A' value (eg.) Piezo C-29E equals	572.3 usec
Squaring (x^2) this values equals	327,527.29
Inverse this number and multiply by 1,000,000 equals	3.05
Campbell Scientific (CS) Datalogger Value equals	3.1

- Input the calculated CS number as a raw entry into the respective piezometeric head formula (eg. input this value for C-29E into the piezoC.xls raw data spreadsheet)
- Then update data sheet as in Procedure 8. Compare values to recent download numbers.

Procedure 2: Thermistor "THERM" Reading Procedure

Equipment required: - Ohm meter or Multimeter
- Tool box w\screwdrivers and wrench
- Worksheets for recording data (same as above)
- Keys for Hut A &C
- thermometer & barometer

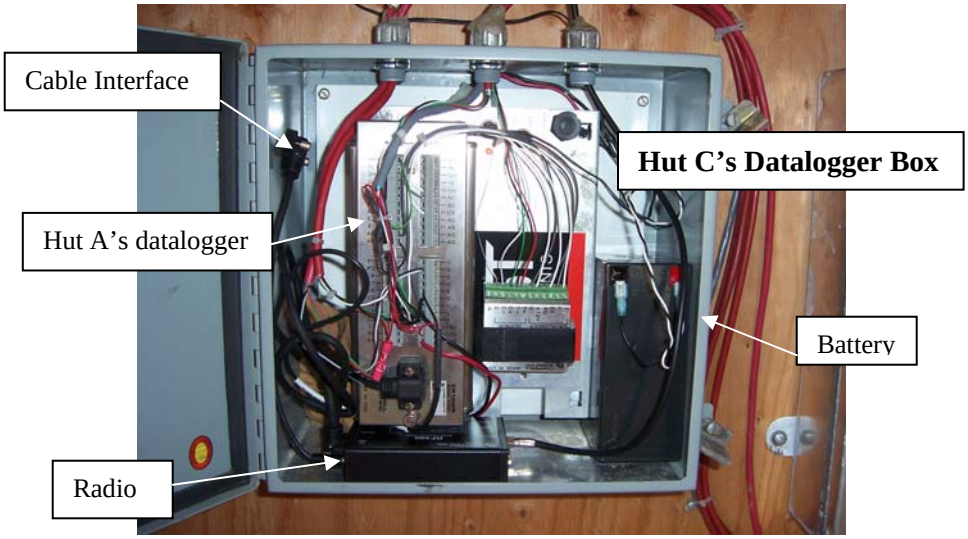
- Record date, temperature and barometric pressure onto data record sheet
- Open same RELAY MULTIPLEXER unit as above in Hut A, B or C
- Connect positive and negative electrodes to multimeter
- Switch multimeter power "On"
- Set Ohm reading at 20 ohms level
- Begin reading #1 piezometer as above except touch electrodes to L1 and H1 contacts – NOTE: For Hut B, use contacts labelled L2 & H2.
- Record readout in "ohms" and continue to next piezometer as before

Procedure 3: Datalogger Downloading Procedure (Huts A, B, & C)

Equipment required: - Portable computer (the Fujitsu Lifebook laptop w\Loggernet 3.2 software, located in the Environmental Technologist's office in the Lynx Building)
- SC32 cable interface (should be in the bottom drawer of the Environmental Technologist's desk)
- Keys for Hut A & C and gas tester (located in Mill Control Room)
- Flat-head 'standard' screwdriver

Huts A and C house piezometer monitoring equipment for the Tailings Dam Facility (TDF). Hut A houses piezos that are monitoring Area I of the TDF, while Hut C piezos monitor Area II. Hut A & C are located on the lower TDF access road. Hut A is located at 0+350 m downstream from the west side of the TDF. Hut C is located at 0+1200. Hut B is a small raised box with a solar panel located on the paste berm midway along the Amalgamated Paste Area. For further orientation see the map in Figure X.

- Follow the Sampling and Pumping Enclosures procedures for entry into Hut A & C;
- Once at the Hut, find the small, grey, wall-mounted datalogger box (see photo below), labeled . Open the box – you may need a flat-head screwdriver.



- Start laptop-press ON. Allow the computer to boot up, it'll take a few minutes….wait until it's done before connecting to the logger.

- Remove the radio transmitter from the black 9-pin SC32A interface connected to the data logger and connect the laptop computer to the datalogger using the same interface. Alternatively, one can connect the SC32A directly to the datalogger port on the CR10 logger.
- Find Loggernet 3.2 (window icon located on screen) – double click icon to begin software program. Once started, click on the CONNECT button.
- Choose the appropriate station name from the Station List (eg. Hut C-direct if one is downloading in Hut C)
- Click the button labelled CONNECT to station - software will automatically connect to the CR10 datalogger.
- Check that the datalogger time, laptop time and actual time are synchronized
- Collect data using the buttons COLLECT or COLLECT ALL
- Download the .DAT file to the specified default folder or create a new folder using the Browse function before downloading the data.
- DISCONNECT from the station, CLOSE SESSION and then close down Loggernet 3.2
- Disconnect the SC32A download cable from the storage module and the laptop. Close the door to the wall mounted datalogger box.
- OPEN MS-Excel (window icon located on screen). OPEN the recently downloaded .DAT file (eg. Hut C-direct.dat) which is now located and saved in the folder: C:\campbellsci\loggernet\
    - Remember when attempting to OPEN a .DAT file that one needs to change the File Type selection to 'All Files' to view the list of .DAT files. Select the appropriate corresponding .DAT file.
    - Use the Text Import Wizard when converting a .DAT file to Excel format: In Text Import Wizard click on the NEXT button, then check off the COMMA delimited box, then click on the FINISH button.
    - Confirm that the last row's download date shown in Column C (eg. Table 3-1) is correct. Note that the day is represented in Julian Days, see conversion sheets at end of this procedure for date conversions (eg. Julian Day 190 = July 9th). Also note that if you're downloading before 12:00 noon, the download date will show yesterday's date, since the program is set to

download once per day at NOON. If you want to download an instantaneous piezometer reading then follow the trick found at the end of this procedure.

Table 3-1: *Example of an Excel spreadsheet with recently converted comma delimited data, note that in practice only the column headers (A…CW) will actually be shown - column titles are shown here only for explanation purposes.*

	A	B	C	D	E	F……AK	AL	AM…..CW
	Station Code	Year	Julian Day	Time of Data Collection	Seconds per Download	Piezometer THERM Values Columns as listed above…	Piezo V.W. Value C.S. Value	Piezo V.W. Column values continue as above….
1	2	2001	190	1200	32.13	7.11	3.63	cont…….
2	2	2001	191	1200	32.25	7.16	3.82	cont…….
3	2	2001	192	1200	32.25	7.11	3.76	cont…….
4	2	2001	193	1200	32.13	7.13	3.75	cont…….
5	2	2001	194	1200	32.13	7.16	3.84	cont…….
6	2	2001	195	1200	32.13	7.15	3.64	cont…….
7	3	2001	196	1045	32.13	7.13	3.66	cont…….
8	2	2001	196	1200	32.14	7.15	3.65	cont…….
9	2	2001	197	1200	32.13	7.13	3.69	cont…….
10	2	2001	198	1200	32.55	7.13	3.54	cont…….

- Note if the Station Code reads a code ‘3’ instead of a code ‘2’(eg., see Table 3-1 Column A, Row 7). A code ‘2’ indicates a regular noon download occurred, whereas a ‘3’ indicates a seismically triggered event has been recorded at the time indicated.
- SAVE AS a new Excel file (eg.) C_Day_0319-01.xls. Save the file into the Hut Data folder (eg. C:\campbellsci\loggernet\2001\C_Day_0319-01.xls).
- CLOSE down the file. CLOSE down MS-Excel.
- SHUT-DOWN the Computer

**** YOU'RE DONE!!**

- Repeat the same procedure with Hut A and B dataloggers.

**** TRICK FOR DOWNLOADING INSTANTANEOUS DATA**

- Click on ports and flags. When the new window opens click flag 1. This will trigger the datalogger to take a reading from each piezometer. After the readings are done click on the collect button and download the data.

Or alternatively,

- Change the time on your laptop to just before noon (eg. 11:58am) before connecting to the datalogger. Do this by clicking on the time display on your laptop's screen – located in the bottom right corner of your screen. Then re-set the time as to just before noon.
- Now when you connect to the datalogger, the CLOCK SYNCHRONIZATION display in Loggernet will show that the laptop and logger times are out of sync. Now press SET DATALOGGER CLOCK – the logger will re-set its clock to the laptop time and you will have tricked the datalogger program into taking an apparent "noon" download. Now download again as before. Be sure to note the actual time of download and then re-set the clocks on both your laptop and the datalogger.

Procedure 4: Testing or Adjusting Seismic Triggers

Equipment required: - Portable computer w\PC208Wv3.1 downloading software
- SC32 cable interface
- Keys for Hut A & C

If one suspects that the triggers are not working, then boot test by:

- Take note of the time, then gently kick the trigger's concrete block, proceed down to the hut and listen for the 'clicking' noises of the VW piezos 'plucking' (The datalogger should be

recording this action). This procedure can take up to 20 minutes to finish. Often one can go to the next hut and initiate a test, then return later to download.

- Download the test trigger event as in Procedure 3.

If the logger has not recorded anything, then test that the logger is operational or re-set the triggers to a lower threshold setting. Re-test with your boot.

- See pg. 24 of the Seismic Switch Reference Manual for adjusting trigger threshold levels.
  Note: The MitiGator Seismic Switch Reference Manual can be found in the second drawer from the top in the file cabinet in the Environmental Technologist's office located in the Lynx building.

Procedure 5: Pneumatic Piezometer Reading

Equipment required: - Nitrogen tank case w\fully pressurized tank ~1200 psi
- High pressure connect line w\pressure gauge
- Toolbox w\screwdrivers & wrench
- Worksheets for recording data
- Thermometer & barometer
- Keys for Hut A & C

- Record date, temperature & barometric pressure
- Within Huts A & C there are four pneumatic piezometers. The piezometer tubing for each instrument is bundled together with the other three piezometers. One side of each tube has a fitting that connects to the nitrogen tank case, the other side is the return line and should not be connected to anything (however, it does need to have the cap removed).
- The piezometer lines are labeled with white label tape (i.e., C-3P).
- connect piezometer to the nitrogen case,
- turn open main valve at nitrogen tank and flip TANK ON switch
- ensure pressure gauges are accurate by lightly tapping glass
- charge line by flipping the PIEZO BY-PASS toggle up,

- notice an increase in the large-faced, low pressure gauge - allow pressure to climb, max. 30psi
- when pressure stops climbing flip the PIEZO BY-PASS toggle back down,
- tap low pressure gauge to bring reading down and record this “settled” pressure
- flip toggle-switches off and continue on to next piezometer, repeat charging procedure
- when done switch TANK to OFF position,
- close main tank valve, disconnect charge line.

Procedure 6: Piezometer Data Interpretation - How to Include New Data and Update Charts

- OPEN in Excel the raw data file either on the hard drive (if downloaded directly from the datalogger at c:\campbellsci\loggernet) or on the network (if downloaded via the radio network at Mfo-sys-dc01\mill\users\Gavin Dirom\enviro data\env lab\hut data).
- OPEN the Excel spreadsheet that corresponds to the raw data (e.g. piezoC.xls for the example file above. This spreadsheet can be found in the folder: Mfo-sys-dc01\mill\users\Gavin Dirom\enviro data\env lab\TDF_soil_huts_ABC\piezo monitoring & TDF inspections\
- COPY new raw data into the piezoC workbook’s first worksheet labeled ‘hut_c’ (the first sheet in piezoC.xls) – copy the new data by selecting the appropriate rows that correspond to the new download dates.
- PASTE the new data to the empty rows beneath the existing data – BE CAREFUL not to overwrite the existing data!!
- ‘Piez_C’ (the third sheet in piezoC.xls) converts the raw field data into a piezometeric head or a piezometeric elevation.
- HIGHLIGHT columns A through AF in the bottom row of the existing data. COPY this row and PASTE it down into as many rows as there is of new data – the row number at the bottom of the hut_c sheet will be the same as the row number on the piez_C sheet. You can also check to make sure the dates correspond.
- The graphs will update automatically as long as the source data and x-scale are maintained, if the graphs have not updated then:

Update the graphs by:

- Open each sheet in piezoC.xls containing graphs.
- Highlight a series.
- In the formula box up top, change the data row number to include the new data rows.

  (e.g):

  =SERIES("C-4E",Piez_C!$C$3:$C$1249,Piez_C!$J$3:$J$1249,2)

  becomes

  =SERIES("C-4E",Piez_C!$C$3:$C$1311,Piez_C!$J$3:$J$1311,2)

  this will incorporate the additional 62 rows of data from sheet Piez_C

- Repeat for all of the series on all of the sheets – if there is trouble clicking on a certain series you can shuffle between them using the arrow keys.
- The x-axis may need to be extended to incorporate the new data, if so double right click on the x-axis and increase scale maximum value – the number represents the number of days so try increasing it by 100 and see if that is enough.
- Check source of any erratic data. Delete any obviously erroneous data from the piez_C sheet. When in doubt leave it.
- Save piezoC.xls
- Repeat process for piezoA.xls and piezoB.xls
- Send files to KC, as required.

Appendix V

Supporting and Reference Documents

SUPPORTING AND REFERENCE DOCUMENTS

1. MFO REPORTS AND USER MANUALS

Emergency Management Program by NVI, last updated December 1, 2010
Document contains 1) Emergency Preparedness Plan and 2) Emergency Response Plan.
LOCATIONS OF COPIES: Controlled Distribution – A distribution list can be found in the introduction of the manual.

MFO TDF Emergency Preparedness Plan by SteveJan Consultants for MFO, dated June 2003
This plan provides detailed information on dealing with emergencies at the Tailings Disposal Facility and contact information
LOCATIONS OF COPIES: Mill Supt, Environ Coordinator, Mill Shifters, Surface Supervisor

MFO TDF Operations File, by MFO Environmental Superintendent
It includes records of:
• Correspondence with geo-technical consultants;
• Government correspondence;
• Monitoring records; survey data, completed inspection records and field notes
LOCATIONS OF COPIES: Environmental Superintendent's office

MFO Environmental Procedures Manual, by MFO Environmental Staff
It includes detailed procedures on paper work, documentation, sample takings, reporting, and environmental monitoring of the TDF.
Last updated June 2007
Section 4.1 deals with procedures relating to the TDF including:
• Overview of TDF instrumentation;
• Piezometer installation;
• Seismic trigger setpoint adjustments;
• Instrumentation Hut Data Downloading;
• Pneumatic readings;
• Creek measurements;
• Surveying requirements
LOCATIONS OF COPIES: Environ Technician's office & Environmental Superintendent's Office

Myra Falls TDF Annual Inspection Review-Final Report,
by AMEC Earth & Environmental for MFO, latest update for 2009 was issued in April, 2010.
It presents an annual review of the construction, operation and stability of the TDF
It includes elements such as:
• Results of previous year's construction, operation and maintenance;
• Results of instrumentation and monitoring records;
• Recommended remedial work to address deficiencies and concerns;
• Recommended changes to any procedures for on-going operation
LOCATIONS OF COPIES: Mill Supt, Surface Supervisor and Environmental Superintendent

Westmin Resources Limited Myra Falls Operations Tailings Disposal Facility – Operations Manual, by Knight Piesold Consulting Engineers, July 1997.
The manual is the original TDF OMS manual. It provides historical guidelines for the operation, maintenance, monitoring and on-going construction requirements for the Tailings Disposal Facility.
LOCATIONS OF COPIES: Environmental Superintendent's office.

Boliden (Canada) Limited Myra Falls Operations Tailings Disposal Facility – Operations, Maintenance & Surveillance Manual, by SteveJan Consults, 2003.
The manual is the predecessor to the current TDF OMS manual. It provides historical guidelines for the operation, maintenance, monitoring and on-going construction requirements for the Tailings Disposal Facility.
LOCATIONS OF COPIES: Environmental Superintendent's office

2. Environmental Department Library – TDF Reports
Copies of all consultant reports on the Tailings Facility are stored in the library room in the mill offices area. Ones that have not been stated above include:
TDF Background Reports;
TDF Design Reports;
As-Built Reports;
Annual Inspection Reports;
Site Investigations Reports;
Long Term Tailings Management Plans;
Paste Tailings Background Reports;
Impoundment Design Reports;
Risk Assessments;
Paste Tailings Program;
TDF Seismic Upgrade Project;
LOCATIONS OF COPIES: Environmental Library in the Lynx Building

3. Mill Department Posted TDF Drawings and other Aids
Reference Materials in Mill Office Conference Room:

- Background reports on Paste Project by PSI, Schwing, etc.
- Oversize Site Drawings: Plan Views and Layouts of TDF, Ponds, Water Treatment System, etc posted on flipchart

4. Manager of Millings TDF Files
Copies of MFO records of TDF operation, maintenance and surveillance, consultants reports as well as correspondence with consultants and regulatory agencies are stored in the Manager of Millings office and on his computer.
LOCATIONS OF COPIES: Manager of Milling office

5. Reference Documents Used in this Manual and other Useful Documents

Developing Operation, Maintenance and Surveillance Manuals for Tailings and Water Management Facilities, by the Mining Association of Canada, http://www.mining.ca/www/media_lib/MAC_Documents/omsguideeng.pdf

Dam Safety Guidelines, by Canadian Dam Association, January 1999, Appendix X in this manual

A Guide to the Management of Tailings Facilities, by the Mining Association of Canada, September 1998,
http://www.mining.ca/www/media_lib/TSM_Documents/TSM_Publications/tailingsguide.pdf

Inspection and Maintenance of Dams-Dam Safety Guidelines, 1998, by B.C. Ministry of Environment, Lands and Park-Water Management Branch,
http://www.env.gov.bc.ca/wsd/public_safety/dam_safety/cabinet/inspection.pdf

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Appendix VI

British Columbia Dam Safety Regulation (2000)

And

Canadian Dam Association (CDA)
Dam Safety Guidelines (2007) Table of Contents

B.C. Reg. 44/2000 Deposited February 10, 2000
O.C. 131/2000

Water Act

1.1.1 BRITISH COLUMBIA DAM SAFETY REGULATION

Contents

1.1.1.1 Definitions

1 In this regulation:

"Act" means the *Water Act*;

"dam" means

(a) a barrier constructed across a stream, or

(b) a barrier constructed off-stream and supplied by diversion of water from a stream,

for the purpose of enabling the storage or diversion of water, and includes all works which are incidental to or necessary for the barrier;

"dam owner" means, with respect to a dam, any or all of the following:

(a) the person who holds the current licence or is required to hold a licence for the dam;

(b) the person who last held a licence for the dam, including a licence that has been suspended, cancelled, abandoned or terminated;

(c) if there is no person to whom paragraph (a) or (b) applies, the owner of the land on which the dam is located or the person who had the dam constructed;

"dam safety officer" means an engineer or officer who is designated in writing by the comptroller as a dam safety officer;

"emergency preparedness plan" means a plan prepared by a dam owner under section 3 (2) (a) that describes the actions the dam owner proposes to take in the event of an emergency at a dam;

"height" means the vertical distance to the top (crest) of a dam measured,

(a) in the case of a dam across a stream, from the natural bed of the stream at the downstream outside limit of the dam, or

(b) in the case of a dam that is not across a stream, from the lowest elevation at the outside limit of the dam;

"instrumentation" means, but is not limited to, survey monuments and stations, inclinometers, extensometers, piezometers or measuring weirs;

"maintain" or **"maintenance"** means the performance of those tasks required to keep the dam in good operating condition;

"operation, maintenance and surveillance manual" means a manual prepared by a dam owner under section 3 (2) (b) that describes the dam owner's operation, maintenance and surveillance procedures for the dam;

"professional engineer" means a person registered, and in good standing, as a professional engineer under the Engineers and Geoscientists Act;

"volume of water" means the total storage volume of the reservoir at full supply level measured in accordance with one of the following:

(a) between the natural bed of the stream and the spillway crest;

(b) between the upstream outside limit of the dam and the spillway crest;

(c) if a low level outlet is excavated to an elevation lower than the general foundation of the dam, between the bottom of that outlet and the spillway crest.

1.1.1.2 Application

2 (1) This regulation applies to all of the following:

(a) a dam 1 metre or more in height that is capable of impounding a volume of water greater than 1 000 000 m3;

(b) a dam 2.5 metres or more in height that is capable of impounding a volume of water greater than 30 000 m3;

(c) a dam 7.5 metres or more in height;

(d) a dam that does not meet the criteria under paragraph (a), (b) or (c) but has a downstream consequence classification under Schedule 1 of low, high or very high.

(2) This regulation does not relieve a dam owner from any other requirements that may be imposed under the Act, the Water Regulation or any other applicable enactment.

1.1.1.3 Operation and maintenance of a dam

3 (1) A dam owner must operate and maintain a dam in accordance with all of the following:

(a) this regulation;

(b) any applicable licence or approval;

(c) any order that is made under the Act;

(d) the emergency preparedness plan that has been prepared and accepted in accordance with subsection (2) (a);

(e) the operation, maintenance and surveillance manual that has been prepared and accepted in accordance with subsection (2) (b).

(2) A dam owner must, in the form and manner and within the time period specified by the comptroller or regional water manager, prepare and submit to a dam safety officer, for acceptance by the dam safety officer, the following:

(a) if the downstream consequence classification under Schedule 1 is high or very high, an emergency preparedness plan;

(b) if the downstream consequence classification under Schedule 1 is low, high or very high, an operation, maintenance and surveillance manual.

(3) Subsection (2) applies whether or not there is a term or condition in an approval granted or licence issued that requires the preparation of such a plan or manual for the dam.

(4) A dam owner must ensure that the dam is adequately safeguarded to prevent unauthorized operation of the dam by someone other than the dam owner or an agent of the dam owner.

1.1.1.4 Alteration of a dam

4 (1) Any alteration, improvement or replacement to all or any part of a dam must be authorized by an approval, licence or order.

(2) Subsection (1) does not apply to an alteration, improvement or replacement for the purpose of

(a) maintaining the dam as authorized under section 3, or

(b) addressing a hazardous condition under section 8.

(3) A dam owner must submit to a dam safety officer, on completion of the alteration, improvement or replacement, a report on the work and the manner in which any such alteration, improvement or replacement to all or any part of the dam was performed.

1.1.1.5 Inspection

5 A dam owner must do all of the following:

(a) carry out an inspection of a dam on the frequency applicable to the downstream consequence classification for the dam as set out in Schedule 2 in order to assess the condition of the dam during the construction, operation or alteration of the dam;

(b) record the results of every inspection performed under paragraph (a);

(c) repair any safety hazard revealed by an inspection, if authorized to do so by an approval, licence or order or as authorized under this regulation.

1.1.1.6 Reporting

6 (1) A dam owner must, when an inspection is carried out under section 5 or when any other inspection is carried out with respect to a dam,

(a) submit to a dam safety officer, in the form and manner and within the time period specified by the dam safety officer,

(i) the record of inspection required by section 5 (b), and

(ii) the results and analysis of any test or measurement taken including, but not limited to,

(A) instrumentation readings and analysis,

(B) visual records or observations,

(C) drawings,

(D) soil, aggregate and concrete test results, and

(E) any other test results, and

(b) promptly submit to a dam safety officer the record of inspection required by section 5 (b) if the inspection reveals a potential safety hazard.

(2) A dam owner must submit to a dam safety officer, if requested by the dam safety officer, the original or clear copies of the following documentation required for the design, construction or alteration of the dam:

(a) all design notes, drawings and specifications;

(b) hydraulic, hydrologic, geological and geotechnical data;

(c) reports and other similar documentation.

1.1.1.7 Dam safety review

7 (1) If required by Schedule 2, a dam owner must have a professional engineer, experienced in dam safety analysis, do a dam safety review and prepare, in the form and manner and within the time period specified by the comptroller or regional water manager, a dam safety report.

(2) The dam owner must submit to a dam safety officer a copy of the dam safety report prepared by the professional engineer who carried out the dam safety review under subsection (1).

1.1.1.8 Hazardous conditions at a dam

8 If conditions exist which are or are likely to be hazardous to a dam, or if conditions may reasonably be anticipated to cause a dam, or any part of a dam, or any operation or action at or in connection with a dam, to be or become potentially hazardous to public safety, the infrastructure or works, other property or the environment, a dam owner must promptly do all of the following:

(a) if an emergency preparedness plan exists, modify the operation of the dam, or any part of the dam, in accordance with the emergency preparedness plan;

(b) if an emergency preparedness plan does not exist, operate the dam in a manner, and initiate any remedial actions, that will

(i) safeguard the public,

(ii) minimize damage to the infrastructure or works or to other property, including that not owned by the dam owner, and

(iii) minimize damage to the environment;

(c) contact the Provincial Emergency Program continued under the Emergency Program Act;

(d) notify a dam safety officer, or the comptroller or regional water manager, of

(i) the nature of the existing or anticipated conditions,

(ii) all things done by the dam owner to rectify the conditions, and

(iii) the time and exact nature of any information or warning of existing or anticipated conditions issued to any person under this section;

(e) inform local authorities, and persons who may be in immediate danger from the potential failure of the dam, of the nature of the existing or anticipated conditions and, if necessary, advise those persons who may be in immediate danger to vacate and remove any property from the endangered area;

(f) modify the operation of the dam to minimize or prevent damage which may be caused by the failure of the dam, and undertake any other hazard response activity required by a dam safety officer or engineer or by the comptroller or regional water manager.

1.1.1.9 Suspension of normal operation or removal of a dam

9 (1) A dam owner must give the comptroller or regional water manager at least 60 days written notice before undertaking any of the following activities:

(a) removing all or a significant part of a dam;

(b) decommissioning or abandoning a dam;

(c) stopping the normal operation of a dam for a period of time longer than one year.

(2) The dam owner must prepare, and submit to a dam safety officer for approval,

(a) a plan respecting an activity under subsection (1) (a) or (b), or

(b) if required by the dam safety officer, a plan respecting an activity under subsection (1) (c).

(3) The dam owner must, at least 14 days before the date on which the work is expected to commence, notify a dam safety officer before commencing any work under the approved plan.

(4) The dam owner must submit to a dam safety officer, on the completion of the work performed under the approved plan, a report on the work and the manner in which it was performed.

(5) The dam owner must undertake any further actions that the comptroller or regional water manager requires to alleviate any adverse consequences to any person, the infrastructure or works, other property or the environment that may be affected by any work performed on the dam.

(6) An approval under subsection (2) respecting the decommissioning of a dam is subject to the *Environmental Assessment Act* and to approvals, if any, required under that Act.

1.1.1.10 Information and evaluation

10 (1) A dam owner must, if requested by a dam safety officer, provide the following information in order to evaluate the condition or hazard potential of a dam:

(a) information with respect to the dam including, but not limited to,

(i) foundation investigation results,

(ii) design details and as-built plans,

(iii) construction records,

(iv) operation manuals,

(v) records of instrumentation,

(vi) inspection reports,

(vii) safety reports, and

(viii) inundation studies and emergency preparedness plans;

(b) information with respect to the nature of the land and the stream, and the use of the land and the stream, downstream from or adjacent to the dam or reservoir, including the hydraulic, hydrologic, geological and geotechnical characteristics and the uses of the land and stream;

(c) information with respect to the watershed upstream of the dam.

(2) The information requested under subsection (1) must be submitted to a dam safety officer, in the form and manner and within the time period specified by the comptroller or regional water manager.

(3) The dam owner must conduct any inspection, investigation, survey or test that is necessary to provide the information required by subsection (1).

1.1.1.11 Instrumentation

11 A dam owner must do all of the following:

(a) install any instrumentation necessary to adequately monitor the performance of a dam;

(b) monitor, maintain or replace instrumentation installed at a dam to ensure continuity of readings;

(c) submit instrumentation readings and evaluations to a dam safety officer, in the form and manner and within the time period specified by the dam safety officer;

(d) submit, to a dam safety officer for approval by the dam safety officer,

(i) notice of any planned modifications to, changes to or removal of the instrumentation at least 60 days before the proposed modification, change or removal, or

(ii) an annual plan outlining intended changes to the instrumentation.

1.1.1.12 Expert opinion

12 (1) If, based on information submitted in respect of a dam or related works, the comptroller or regional water manager considers that a question has arisen as to what is proper practice for resolving an issue involving a dam or related works, the comptroller or regional water manager may require a dam owner to retain an expert, satisfactory to the comptroller or regional water manager, with qualifications and experience as follows:

(a) in the case of a dam, in dam design, construction and analysis;

(b) in the case of related works, in hydraulic, hydrological, geological, geotechnical, mechanical or structural engineering or other appropriate disciplines.

(2) The expert retained under subsection (1) must provide a report to the comptroller or regional water manager on the issue.

Schedule 1

(sections 2 (1) (d) and 3 (2))

Downstream Consequence Classification Guide

Rating	Loss of Life	Economic and Social Loss	Environmental and Cultural Losses
VERY HIGH	Large potential for multiple loss of life involving residents and working, travelling and/or recreating public. Development within inundation area (the area that could be flooded if the dam fails) typically includes communities, extensive commercial and work areas, main highways, railways, and locations of concentrated recreational activity. Estimated fatalities could exceed 100.	Very high economic losses affecting infrastructure, public and commercial facilities in and beyond inundation area. Typically includes destruction of or extensive damage to large residential areas, concentrated commercial land uses, highways, railways, power lines, pipelines and other utilities. Estimated direct and indirect (interruption of service) costs could exceed $100 million.	Loss or significant deterioration of nationally or provincially important fisheries habitat (including water quality), wildlife habitat, rare and/or endangered species, unique landscapes or sites of cultural significance. Feasibility and/or practicality of restoration and/or compensation is low.
HIGH	Some potential for multiple loss of life involving residents, and working, travelling and/or recreating public. Development within inundation area typically includes highways and railways, commercial and work areas, locations of concentrated recreational activity and scattered residences. Estimated fatalities less than 100.	Substantial economic losses affecting infrastructure, public and commercial facilities in and beyond inundation area. Typically includes destruction of or extensive damage to concentrated commercial land uses, highways, railways, power lines, pipelines and other utilities. Scattered residences may be destroyed or severely damaged. Estimated direct and indirect (interruption of service) costs could exceed $1 million.	Loss or significant deterioration of nationally or provincially important fisheries habitat (including water quality), wildlife habitat, rare and/or endangered species, unique landscapes or sites of cultural significance. Feasibility and practicality of restoration and/or compensation is high.
LOW	Low potential for multiple loss of life. Inundation area is typically undeveloped except for minor roads, temporarily inhabited or non- residential farms and rural activities. There must be a reliable element of natural warning if larger development exists.	Low economic losses to limited infrastructure, public and commercial activities. Estimated direct and indirect (interruption of service) costs could exceed $100 000.	Loss or significant deterioration of regionally important fisheries habitat (including water quality), wildlife habitat, rare and endangered species, unique landscapes or sites of cultural significance. Feasibility and practicality of restoration and/or compensation is high. Includes situations where recovery would

			occur with time without restoration.
VERY LOW	Minimal potential for any loss of life. The inundation area is typically undeveloped.	Minimal economic losses typically limited to owner's property not to exceed $100 000. Virtually no potential exists for future development of other land uses within the foreseeable future.	No significant loss or deterioration of fisheries habitat, wildlife habitat, rare or endangered species, unique landscapes or sites of cultural significance.

Schedule 2

(sections 5 (a) and 7 (1))

Minimum Inspection Frequency and Dam Safety Review Requirements

Item	Very High Consequence	High Consequence	Low Consequence	Very Low Consequence
Site Surveillance (a)	WEEKLY	WEEKLY	MONTHLY	QUARTERLY
Formal Inspection (b)	SEMI-ANNUALLY	SEMI-ANNUALLY or ANNUALLY	ANNUALLY	ANNUALLY
Instrumentation	AS PER OMS * MANUAL	AS PER OMS * MANUAL	AS PER OMS * MANUAL	N/A
Test Operation of Outlet Facilities, Spillway Gates and other Mechanical Components	ANNUALLY	ANNUALLY	ANNUALLY	ANNUALLY
Emergency Preparedness Plan	UPDATE COMMUNICATIONS DIRECTORY SEMI-ANNUALLY	UPDATE COMMUNICATIONS DIRECTORY SEMI-ANNUALLY	UPDATE COMMUNICATIONS DIRECTORY ANNUALLY	N/A
Operation, Maintenance & Surveillance Plan	REVIEW EVERY 7 - 10 YEARS	REVIEW EVERY 10 YEARS	REVIEW EVERY 10 YEARS	REVIEW EVERY 10 YEARS
Dam Safety	EVERY 7-10	EVERY	(d)	(d)

Review (c)	YEARS (d)	10 YEARS (d)		

* Operation, Maintenance, and Surveillance Manual.

(a) Site surveillance may consist of visual inspections and/or monitoring of automated data acquisition systems. Reduced frequencies of visual inspections may be determined by seasonal conditions.

(b) Formal Inspections are intended as more thorough inspections performed by the appropriate representative of the owner responsible for safety surveillance.

(c) A Dam Safety Review involves collection of all available dam records, field inspections, detailed investigations and possibly laboratory testing. It then proceeds with a check of structural stability and operational safety of the dam, beginning with a reappraisal of basic features and assumptions. The level of detail required in a Dam Safety Review should be commensurate with the importance and complexity of the dam, as well as the consequences of failure.

(d) Dam owners must conduct an annual review of conditions downstream of their dam and notify a dam safety officer if the downstream consequence classification level increases. The downstream consequence classification guide is shown in Schedule 1.

[Provisions of the *Water Act*, R.S.B.C. 1996, c. 483, relevant to the enactment of this regulation: section 46 (1) and (2) (d), (f), (h) and (i)]

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Canadian Dam Association Dam Safety Guidelines

TECHNICAL BULLETINS

1. Inundation, Consequences, and Classification for Dam Safety
2. Surveillance of Dam Facilities
3. Flow Control Equipment for Dam Safety
4. Public Safety and Security Around Dams (DRAFT)
5. Dam Safety Analysis and Assessment
6. Hydrotechnical Considerations for Dam Safety
7. Seismic Hazard Considerations for Dam Safety
8. Geotechnical Considerations for Dam Safety
9. Structural Considerations for Dam Safety

Ministry of Energy & Mines

GUIDELINES FOR ANNUAL DAM SAFETY INSPECTION REPORTS

Reference:

Health, Safety and Reclamation Code for Mines in British Columbia (Code) Section 10.5.3: *The manager shall submit an annual dam safety inspection report prepared by a professional engineer on the operation, maintenance and surveillance of the tailings and water management facilities and associated dams to the chief inspector.*

This Code reference applies to every operating and closed mine in BC.

The report shall provide the following information:

1. Executive Summary

   (a) Classification of the dam(s) in terms of Consequence of Failure in accordance with Table 2-1 of the CDA Dam Safety Guidelines (2007).

   (b) Significant changes in instrumentation and/or visual monitoring records.

   (c) Significant changes to dam stability and/or surface water control.

   (d) For major impoundments, as defined in Part 10 of the Code, a current Operation, Maintenance and Surveillance (OMS) Manual is required. The annual report shall indicate the latest revision date of the OMS manual.

   (e) For tailings dams classified as High, Very High, or Extreme Consequence, an Emergency Preparedness Plan (EPP) is required. The annual report shall indicate the latest revision date of the EPP document.

   (f) Scheduled date for the next formal Dam Safety Review in accordance with Table 5-1 of the CDA Dam Safety Guidelines (2007). Formal Dam Safety Reviews are required every 5 to 10 years (depending on consequence classification) and differ from annual dam safety inspections. The requirements for Dam Safety Reviews are included in Section 5 of the CDA Dam Safety Guidelines. Dam Safety Reviews may be conducted by the Engineer of Record with third party review, or by an independent third party with involvement of the Engineer of Record.

2. Summary of past years' construction (if any) with a description of any problems and stabilization.

3. Plan and representative cross sections.

4. Site photographs.

5. Review of climate data.

6. Water balance review.

7. Freeboard and storage availability (in excess of the design flood).

8. Water discharge system, volumes, and quality.

9. Seepage occurrence and water quality.

10. Surface water control and surface erosion.

11. Instrumentation review including:

    (a) Phreatic surfaces and piezometric data.

    (b) Settlement.

    (c) Lateral movement.

The report shall be submitted by a qualified geotechnical engineer registered as a Professional Engineer (P.Eng.) in British Columbia. The professional engineer will be deemed the Engineer of Record for the facility unless another engineer is identified within the Dam Safety Inspection report as having this responsibility.

Note, this document modified from the original by George Warnock, P.Eng. (Manager, Geotechnical Engineering) in August 2013. Original prepared by Chris Carr, P.Eng. (former Manager) in February 2002.

Appendix VII

Historical Data

Table IV-1 Operational Status of Plane A Vibrating Wire Piezometers

PIEZOMETER NUMBER	TIP ELEVATION (M)	THERMISTOR STATUS	TRANSDUCER STATUS	PIEZOMETER STATUS
A-0E (Myra Creek)	-	-	-	Destroyed August 1999 by berm construction.
A-2E	3352.90	o.k.	o.k.	o.k.
A-4E	3352.73	o.k.	o.k.	o.k.
A-5E	3357.91	o.k.	o.k.	o.k.
A-6E	3358.44	o.k.	o.k.	o.k.
A-8E	3358.52	o.k.	o.k.	o.k.
A-9E	3359.24	o.k.	o.k.	o.k.
A-10E	3359.82	o.k.	o.k.	o.k.
A-12E	3359.90	o.k.	o.k.	o.k.
A-13E	3360.90	o.k.	o.k.	o.k.
A-14E	3360.92	Dead	o.k.	o.k. - used thermistor data for A-10E
A-16E	3361.11	o.k.	o.k.	o.k.
A-17E	3364.50	o.k.	o.k.	o.k.
A-18E	3364.26	o.k.	o.k.	o.k.
A-20E	3364.15	o.k.	o.k.	o.k.
A-25E	3371.40	o.k.	o.k.	o.k.
A-26E	3371.20	o.k.	o.k.	o.k.
A-27E	3371.40	o.k.	o.k.	o.k.
A-28E	3372.65	Dead	o.k.	o.k.
A-29E	3372.43	Dead	o.k.	o.k.
A-30E	3372.33	o.k.	o.k.	o.k.
A-31E	3375.33	o.k.	o.k.	o.k.
A-32E	3375.18	o.k.	o.k.	o.k.
A-33E	3374.97	o.k.	o.k.	o.k.

Table IV-2 Operational Status of Plane B Vibrating Wire Piezometers

PIEZOMETER NUMBER	TIP ELEVATION (M)	THERMISTOR STATUS	TRANSDUCER STATUS	PIEZOMETER STATUS
B-1E	3375.49	o.k.	o.k.	o.k.
B-5E	3365.13	o.k.	o.k.	o.k.

Table IV-3 Operational Status of Plane C Vibrating Wire Piezometers

PIEZOMETER NUMBER	TIP ELEVATION (M)	THERMISTOR STATUS	TRANSDUCER STATUS	PIEZOMETER STATUS
C-2E	3348.00	o.k.	o.k.	o.k.
C-5E	3357.59	Dead	o.k.	o.k. - used thermistor data from C-13E
C-6E	3351.23	Dead	o.k.	o.k. - used thermistor data from C-10E
C-8E	3350.02	Dead	o.k.	o.k. - used thermistor data from C-4E
C-10E	3354.78	o.k.	o.k.	o.k.
C-12E	3353.02	o.k.	o.k.	o.k.
C-13E	3356.41	o.k.	o.k.	o.k.
C-14E	3356.26	Dead	o.k.	o.k. - used thermistor data from C-10E
C-16E	3356.20	Dead	o.k.	o.k. - used thermistor data from C-12E
C-17E	3350.66	o.k.	o.k.	o.k.
C-18E	3362.00	o.k.	o.k.	o.k.
C-20E	3362.00	o.k.	o.k.	o.k.
C-21E	3363.12	o.k.	o.k.	o.k.
C-22E	3362.93	o.k.	o.k.	o.k.
C-24E	3362.71	o.k.	o.k.	o.k.
C-29E	3369.80	o.k.	o.k.	o.k. but no data reported
C-30E	3369.53	o.k.	o.k.	o.k.
C-31E	3369.50	o.k.	o.k.	o.k.
C-32E	3372.30	o.k.	o.k.	o.k.
C-33E	3372.21	-	-	Not Functioning
C-34E	3372.17	o.k.	o.k.	o.k.
C-35E	3374.20	o.k.	o.k.	o.k.
C-36E	3374.10	o.k.	o.k.	o.k.
C-37E	3374.10	o.k.	o.k.	o.k.
C-OE-A	3351.10	-	-	Destroyed in August 1999 by berm construction
A-13(O/D)	3349.10	-	-	Destroyed
A-14L	3347.10	Dead	o.k.	o.k.
A-14R	3346.80	Dead	o.k.	o.k.

Table IV-4 Manual Readings on Pneumatic Piezometers

	HUT A								
Date	25-Apr-02	23-Oct-02	6-Feb-03	17-Jul-03	20-Jan-04	12-May-04	24-Sep-04	13-Sep-05	23-Dec-05
Technician	GD	GD	GD	GD	GD	GD	GD		BC
A-3P	4.8	4.6	6	5.1	6.1	4.8	5.5		8.5
A-7P	>30	>30	>30	>30	>30	>30	>30		
A-11P	3.8	3.3	3.7	3.4	4.2	3.7	3.6		4.3
A-19P	3.8	2.9	3.6	3.2	3.8	3.6	3.3		4.3
Notes	7P plug likely	7P plug likely	7P plug likely	7P plug likely	7P plug likely	7P plug likely	7P plug likely		7P plug likely

	HUT C								
Date	25-Apr-02	23-Oct-02	6-Feb-03	17-Jul-03	20-Jan-04	12-May-04	24-Sep-04	13-Sep-05	23-Dec-05
Technician	GD	GD	GD	GD	GD	GD	GD	DP	BC
C-3P	4.4	3.2	3.1	3.6	4.4	3.8	3.6	3.3	3.7
C-7P	10.8	5.2	15	2.8	11.6	3.1	Plugged	Plugged	Plugged
C-11P	5.1	3.8	4.6	4	4.6	3.3	3.8	3.2	6.3
C-15P	3.2	1.9	3.3	2.6	3.2	3	2		3.2
C-19P	1	0.8	1.2	1	1.4	1.4	1		4.0
Notes	19P unstable	19P unstable	19P unstable	19P unstable	19P unstable	19P unstable	15P & 19P unstable	15P & 19P unstable	15P & 19P unstable

Table IV-5 - Weekly Maximum Readings For Piezometers Along Instrumentation Planes A, B and C

INSTRUMENTATION PLANE A

PIEZOMETER	WARNING THRESHOLD LEVEL I (see note 1)		WARNING THRESHOLD LEVEL II (see note 1)		7-Jan	14-Jan	21-Jan	27-Jan	4-Feb	11-Feb	18-Feb	25-Feb	11-Mar	14-Mar	22-Mar	1-Apr	8-Apr	15-Apr	22-Apr	5-May	18-May	27-May	9-Jun	17-Jun	24-Jun	30-Jun	7-Jul	15-Jul	21-Jul	26-Jul	17-Aug	22-Aug	2-Sep	9-Sep	28-Sep	17-Oct	26-Oct	4-Nov	10-Nov	17-Nov	24-Nov	2-Dec	**2005 MAXIMUM**
A-2E	El. 3359.5 m		El. 3359.9 m		3357.55	3357.48	3358.94	3358.75	3358.22	3357.83	3357.59	3357.43	3357.86	3357.67	3357.44	3357.96	3358.59	3358.02	3358.18	3357.87	3357.90	3358.30	3357.68	3357.58	3357.52	3357.51	3357.56	3357.49	3357.33	3357.31	3357.29	3357.25	3357.26	3357.20	3357.13	3358.51	3358.07	3358.41	3358.84	3358.14	3357.87	3357.76	3358.94
A-4E	El. 3358.5 m		El. 3259.0 m		3356.88	3356.80	3358.42	3358.15	3357.57	3357.11	3356.89	3356.74	3357.15	3356.97	3356.76	3357.30	3357.95	3357.31	3357.51	3357.15	3357.20	3357.65	3356.98	3356.90	3356.82	3356.83	3356.87	3356.78	3356.64	3356.62	3356.62	3356.55	3356.59	3356.52	3356.45	3357.85	3357.36	3357.78	3358.16	3357.44	3357.15	3357.06	3358.42
A-5E		3.0		3.5	1.80	1.43	2.91	2.90	2.80	2.26	1.78	1.46	2.19	2.02	1.42	2.37	2.98	2.77	2.58	1.86	1.51	2.60	1.61	1.42	1.34	1.44	1.64	1.78	1.60	1.42	1.07	1.02	0.97	0.94	0.79	2.59	2.46	2.90	3.05	2.74	2.42	2.59	3.05
A-6E		2.3		2.8	1.93	1.65	2.50	2.58	2.37	2.10	1.87	1.68	1.87	1.91	1.64	1.88	2.42	2.25	2.21	1.83	1.78	2.29	1.73	1.67	1.62	1.67	1.75	1.82	1.71	1.64	1.49	1.44	1.46	1.46	1.36	2.24	2.07	2.45	2.48	2.25	2.11	2.08	2.58
A-8E		8.8		11.7	2.15	1.83	1.93	1.94	1.95	2.00	1.99	1.91	1.80	1.82	1.90	1.95	2.05	1.97	1.59	1.92	2.20	1.93	2.00	2.08	2.00	1.99	2.04	2.01	1.99	1.94	2.04	2.03	2.09	2.12	2.07	2.11	2.12	2.28	2.19	1.96	2.18	2.21	2.28
A-9E		2.5		3.0	1.43	1.09	2.34	2.27	2.28	1.82	1.42	1.13	1.76	1.69	1.12	1.86	2.44	2.28	2.04	1.39	1.15	2.08	1.24	1.08	1.03	1.13	1.31	1.45	1.26	1.14	0.68	0.63	0.57	0.57	0.36	2.10	1.91	2.38	2.34	2.17	1.90	2.04	2.44
A-10E		1.8		2.3	1.98	1.56	2.29	2.42	2.35	2.16	1.87	1.65	1.81	1.88	1.59	1.82	2.28	2.21	2.12	1.79	1.77	2.17	1.72	1.66	1.53	1.57	1.66	1.79	1.64	1.55	1.39	1.32	1.35	1.38	1.18	2.10	1.98	2.37	2.28	2.18	2.15	2.10	2.42
A-12E		8.3		11.1	-0.34	-0.60	-0.23	-0.07	-0.32	-0.40	-0.47	-0.57	-0.52	-0.48	-0.57	-0.49	-0.29	-0.40	-0.48	-0.57	-0.42	-0.32	-0.57	-0.56	-0.64	-0.64	-0.63	-0.59	-0.69	-0.71	-0.78	-0.80	-0.77	-0.77	-0.86	-0.56	-0.64	-0.42	-0.49	-0.61	-0.54	-0.60	-0.07
A-13E		2.6		3.1	2.32	1.88	2.71	2.84	2.83	2.51	2.13	1.92	2.31	2.33	1.91	2.32	2.80	2.84	2.61	2.15	1.91	2.64	1.97	1.93	1.83	1.95	1.99	2.22	2.05	1.89	1.61	1.46	1.52	1.55	1.23	2.65	2.54	2.93	2.84	2.73	2.57	2.60	2.93
A-14E		1.8		2.3	1.55	1.24	1.84	1.98	1.85	1.65	1.37	1.17	1.32	1.46	1.16	1.45	1.80	1.72	1.62	1.26	1.26	1.64	1.19	1.14	1.17	1.16	1.20	1.32	1.14	1.09	0.92	0.90	0.96	0.99	0.79	1.61	1.49	1.89	1.80	1.70	1.66	1.56	1.98
A-16E		7.9		10.5	3.06	2.75	3.08	3.23	2.97	2.89	2.88	2.81	2.83	2.84	2.80	2.82	3.05	2.97	2.86	2.77	2.90	3.02	2.83	2.78	2.68	2.67	2.71	2.69	2.65	2.60	2.56	2.54	2.60	2.63	2.42	2.73	2.73	3.00	2.91	2.82	2.91	2.81	3.23
A-17E		1.0		1.5	1.12	0.81	0.90	0.90	0.91	0.96	0.95	0.87	0.76	0.77	0.86	0.89	0.99	0.91	0.80	0.84	1.10	0.82	0.90	0.98	0.88	0.87	0.91	0.89	0.84	0.80	0.89	0.86	0.92	0.94	0.87	0.92	0.92	1.07	0.98	0.75	0.98	1.01	1.12
A-18E		2.0		2.5	2.10	1.79	2.40	2.41	2.34	2.09	2.00	1.78	2.05	1.99	1.77	2.10	2.42	2.27	2.09	1.82	1.77	2.18	1.80	1.73	1.70	1.92	1.81	1.94	1.82	1.70	1.48	1.46	1.52	1.47	1.24	2.28	2.21	2.50	2.41	2.26	2.18	2.13	2.50
A-20E		6.8		9.1	1.62	1.34	1.49	1.64	1.54	1.49	1.47	1.36	1.40	1.41	1.39	1.45	1.58	1.50	1.40	1.37	1.59	1.53	1.42	1.44	1.33	1.32	1.37	1.38	1.30	1.22	1.20	1.18	1.24	1.23	1.13	1.42	1.39	1.60	1.47	1.31	1.43	1.42	1.64
A-25E		3.9		4.4																																							0.00
A-26E		8.4		9.7	5.36	5.08	5.16	5.21	5.21	5.23	5.26	5.18	5.00	5.01	5.10	5.16	5.26	5.18	5.07	5.11	5.37	5.09	5.17	5.25	5.15	5.14	5.18	5.16	5.11	5.07	5.12	5.07	5.05	5.04	4.87	5.09	5.09	5.27	5.18	4.99	5.21	5.24	5.37
A-27E		8.3		9.5	6.39	6.11	6.19	6.24	6.25	6.30	6.29	6.21	6.03	6.04	6.12	6.19	6.25	6.21	6.10	6.14	6.40	6.17	6.20	6.28	6.18	6.17	6.21	6.19	6.15	6.10	6.15	6.13	6.19	6.18	6.11	6.15	6.19	6.29	6.24	6.05	6.28	6.31	6.40
A-28E		2.0		2.5	0.56	0.29	0.41	0.42	0.43	0.48	0.47	0.40	0.24	0.21	0.30	0.37	0.46	0.38	0.28	0.32	0.61	0.34	0.42	0.50	0.44	0.44	0.48	0.45	0.45	0.41	0.50	0.48	0.53	0.56	0.53	0.57	0.58	0.76	0.67	0.48	0.71	0.78	0.78
A-29E		8.2		9.5																																							0.00
A-30E	ru = 0.34	8.6	ru = 0.39	9.9	3.44	3.29	3.37	3.62	3.54	3.40	3.35	3.27	3.49	3.46	3.42	3.57	3.63	3.55	3.41	3.29	3.62	3.71	3.42	3.35	3.24	3.11	3.07	3.21	3.01	2.84	2.56	2.46	2.56	2.34	2.23	3.29	3.25	3.43	3.34	3.31	3.13	3.16	3.71
A-31E		6.0		6.9	1.82	1.51	1.58	1.61	1.61	1.65	1.64	1.56	1.44	1.45	1.52	1.57	1.66	1.58	1.48	1.50	1.76	1.50	1.56	1.64	1.54	1.53	1.56	1.54	1.49	1.45	1.54	1.50	1.56	1.59	1.52	1.57	1.58	1.72	1.64	1.41	1.64	1.68	1.82
A-32E	ru = 0.34	6.4	ru = 0.39	7.4	2.27	2.04	2.11	2.27	2.21	2.16	2.13	2.05	2.11	2.11	2.13	2.22	2.31	2.24	2.11	2.04	2.32	2.26	2.14	2.14	2.04	1.96	1.97	2.03	1.90	1.77	1.67	1.61	1.69	1.59	1.47	2.13	2.11	2.25	2.18	2.04	2.05	2.08	2.32
A-33E	ru = 0.34	6.6	ru = 0.39	7.5	3.16	2.98	2.99	3.09	3.03	2.97	2.95	3.04	3.24	3.21	3.25	3.30	3.27	3.17	3.02	3.06	3.76	3.49	3.26	3.20	3.07	2.97	2.92	2.92	2.78	2.64	2.47	2.38	2.41	2.25	2.25	2.77	2.79	2.86	2.87	2.76	2.63	2.68	3.76

INSTRUMENTATION PLANE C

PIEZOMETER	2005 WARNING THRESHOLD LEVEL I (see note 1)		2005 WARNING THRESHOLD LEVEL II (see note 1)		7-Jan	14-Jan	21-Jan	27-Jan	4-Feb	18-Feb	25-Feb	28-Feb	11-Mar	22-Mar	1-Apr	8-Apr	15-Apr	22-Apr	5-May	18-May	24-May	27-May	9-Jun	17-Jun	24-Jun	30-Jun	7-Jul	15-Jul	21-Jul	26-Jul	17-Aug	22-Aug	2-Sep	9-Sep	28-Sep	17-Oct	26-Oct	4-Nov	10-Nov	2-Dec	9-Dec	16-Dec	23-Dec	**2005 MAXIMUM**
C-2E	El. 3352.6 m		El. 3353.0 m		3337.45	3337.33	3338.93	3338.53	3338.02	3337.49	3337.26	3337.29	3337.69	3337.32	3338.00	3338.64	3337.77	3338.23	3337.71	3337.67	3338.63	3338.25	3337.60	3337.57	3337.57	3337.57	3337.46	3336.75	3337.17	3337.23	3337.31	3337.12	3337.20	3337.88	3337.04	3338.51	3337.81	3338.45	3337.83	3338.14	3337.43	3337.43	3339.06	3339.06
C-8E	El. 3355.9 m		El. 3356.6 m		3354.05	3353.68	3354.95	3355.25	3354.82	3354.00	3353.81	3353.75	3354.03	3353.73	3354.11	3354.92	3354.68	3354.76	3354.00	3353.78	3354.68	3354.67	3354.00	3353.81	3353.67	3353.53	3353.45	3353.23	3353.15	3353.20	3353.17	3353.12	3353.04	3354.38	3349.65	658.46	unstable	unstable	unstable	unstable	unstable	unstable	unstable	3355.25
C-5E		1.8		2.3	0.78	0.27	0.86	1.43	1.41	0.73	0.40	0.48	0.62	0.45	0.70	1.51	1.41	1.21	0.59	0.37	0.86	1.13	0.58	0.39	0.26	0.12	0.18	0.09	0.01	-0.21	0.03	0.12	0.18	0.83	-1.86	0.59	0.69	1.45	1.31	1.38	0.35	0.37	0.77	1.51
C-6E		6.2		6.7	5.13	4.75	5.56	6.08	5.80	5.06	4.88	4.84	4.95	4.81	5.03	5.79	5.68	5.75	5.05	4.87	5.41	5.54	4.93	4.89	4.62	4.62	4.43	4.22	4.28	4.19	4.05	4.00	3.94	5.40	3.82	4.45	4.69	5.85	5.65	5.74	4.86	4.78	5.39	6.08
C-10E		2.5		3.0	1.06	0.68	1.53	2.23	2.07	1.13	0.81	0.76	0.89	0.73	0.97	1.91	1.93	1.88	1.00	0.65	1.26	1.66	0.86	0.81	0.54	0.40	0.46	0.51	0.56	0.48	0.46	0.54	0.46	1.24	0.42	0.36	0.33	1.86	1.73	1.79	0.80	0.84	1.23	2.23
C-12E		5.8		6.3	3.28	2.89	4.13	4.27	3.94	3.23	3.02	2.97	3.27	3.08	3.35	4.22	3.94	3.89	3.21	2.97	3.97	3.94	3.07	3.02	2.87	2.73	2.64	2.42	2.33	2.38	2.35	2.16	2.22	3.47	1.98	3.08	3.35	4.34	3.97	4.01	3.06	3.08	3.99	4.34
C-13E		0.6		1.1	0.33	0.35	0.40	0.43	0.40	0.40	0.35	0.30	0.43	0.40	0.38	0.38	0.40	0.21	0.40	0.33	0.26	0.26	0.27	0.22	0.34	0.21	0.27	0.32	0.24	0.29	0.26	0.34	0.27	0.24	0.21	0.19	0.11	-0.85	0.04	0.12	0.03	0.19	0.18	0.43
C-14E		2.2		2.7	1.26	1.15	1.48	2.05	1.89	1.20	0.87	1.09	1.23	1.20	1.18	1.58	1.75	1.83	1.20	1.25	1.33	1.47	1.06	1.14	1.14	1.14	1.20	1.25	1.30	1.22	1.33	1.28	1.34	1.31	1.27	1.30	1.23	1.84	1.78	1.82	1.00	1.03	1.30	2.05
C-16E		5.6		6.1	2.89	2.79	3.73	4.16	3.69	2.98	2.77	2.72	2.88	2.83	2.82	3.83	3.55	3.64	2.96	2.87	3.43	3.68	2.82	2.77	2.62	2.62	2.39	2.31	2.22	2.14	2.10	2.20	1.97	3.22	2.20	2.31	2.57	3.08	3.66	3.62	2.81	2.69	3.03	4.16
C-17E		4.0		4.5	2.30	2.01	3.03	3.22	3.03	2.37	2.07	1.98	2.35	2.12	2.60	3.31	2.96	3.07	2.37	2.14	2.90	2.95	2.29	2.12	2.06	1.89	1.78	1.54	1.59	1.59	1.44	1.31	1.28	2.67	1.14	2.33	2.51	3.34	3.04	3.20	2.17	2.09	2.99	3.34
C-18E		1.6		2.1	-0.17	-0.63	0.27	0.39	0.27	-0.27	-0.50	-0.51	-0.11	-0.45	-0.03	0.46	0.27	-0.15	-0.36	-0.63	0.22	0.17	-0.37	-0.56	-0.69	-0.88	-1.36	-1.08	-1.48	-1.20	-1.90	-2.58	-2.44	-0.12	-3.06	-0.45	-0.27	0.34	0.08	0.13	-0.64	unstable	0.59	0.59
C-20E		3.7		4.2	2.06	1.78	2.78	2.98	2.69	2.15	1.82	1.81	2.22	1.97	2.30	2.88	2.69	2.63	1.97	1.70	2.64	2.59	1.88	1.78	1.64	1.55	1.42	1.34	1.30	1.22	0.97	0.83	0.80	2.21	0.51	2.25	2.24	2.87	2.59	2.60	1.77	1.76	2.47	2.98
C-21E		0.4		0.9	0.22	0.06	0.17	0.27	0.16	0.16	0.11	0.11	0.12	0.15	0.12	0.33	0.23	0.24	0.15	0.12	0.16	0.22	0.08	0.17	0.03	-0.04	0.09	0.01	0.14	0.06	0.17	0.12	0.11	0.13	-0.11	0.16	0.16	0.28	0.15	0.28	0.06	0.08	0.14	0.33
C-22E		0.8		1.3	0.68	0.29	0.51	0.56	0.55	0.50	0.44	0.51	0.42	0.50	0.53	0.67	0.55	0.49	0.49	0.65	0.43	0.53	0.49	0.56	0.42	0.41	0.46	0.38	0.43	0.35	0.42	0.37	0.42	0.49	0.34	0.55	0.52	0.59	0.49	0.56	0.31	0.46	0.52	0.68
C-24E		1.0		1.5	0.95	0.58	0.83	0.87	0.82	0.78	0.71	0.78	0.68	0.76	0.76	0.92	0.81	0.76	0.77	0.92	0.69	0.81	0.76	0.83	0.69	0.68	0.73	0.65	0.69	0.61	0.71	0.66	0.71	0.76	0.61	0.79	0.77	0.86	0.76	0.83	0.59	0.74	0.78	0.95
C-29E		7.2		8.2	-434.58	-621.42	-174.28	-281.85	0.70	-211.49	-415.40	-116.69	-137.33	-559.34	-84.06	-92.83	5.12	-606.32	-158.50	-95.29	5.30	-5.45	-120.68	-293.52	2.10	3.96	-46.67	-106.98	-109.19	-225.76	-243.86	-4.62	-0.76	4.76	3.12	5.41	5.19	5.56	5.31	5.33	4.67	4.60	5.52	5.56
C-30E		9.7		11.2	6.27	5.93	6.65	6.96	6.69	6.20	5.99	5.90	6.34	6.08	6.30	6.68	6.57	6.48	6.00	5.66	6.52	6.53	5.96	5.79	5.70	5.49	5.31	5.59	5.40	5.19	5.50	5.45	5.39	6.26	4.91	6.78	6.76	7.03	6.94	6.90	6.37	6.30	6.69	7.03
C-31E	ru = 0.39	10.6	ru = 0.44	12.0	8.44	8.22	8.64	9.06	8.72	8.33	8.12	8.04	8.34	8.13	8.26	8.55	8.53	8.43	8.05	7.81	8.35	8.48	7.90	7.82	7.76	7.57	7.47	7.62	7.44	7.32	7.77	7.80	7.66	8.22	7.04	8.44	8.49	8.73	8.69	8.69	8.25	8.14	8.41	9.06
C-32E		5.2		6.0	1.94	1.48	2.14	2.13	2.10	1.79	1.56	1.60	1.85	1.61	1.93	2.19	2.05	1.95	1.61	1.62	2.08	1.99	1.56	1.56	1.38	1.37	1.39	1.39	1.40	1.32	1.43	1.38	1.44	1.79	-1.37	0.41	0.47	0.59	0.57	0.59	0.21	0.07	0.37	2.19
C-34E	ru = 0.34	5.6	ru = 0.39	6.5	3.99	3.70	4.20	4.55	4.32	3.93	3.67	3.64	4.02	3.77	3.98	4.23	4.21	4.03	3.61	3.40	4.07	4.08	3.53	3.45	3.39	3.15	3.01	3.32	3.06	2.86	3.56	3.55	3.41	3.78	5.26	5.85	5.70	5.98	5.78	5.85	5.49	5.57	5.92	5.98
C-35E		6.1		7.0	1.86	1.49	2.29	2.44	2.29	1.92	1.50	1.46	2.06	1.68	2.15	2.40	2.30	2.12	1.56	1.25	2.16	2.17	1.56	1.39	1.26	1.01	0.82	1.23	0.91	0.71	1.06	1.01	1.06	1.90	0.26	2.25	2.27	2.45	2.35	2.37	1.85	1.77	2.13	2.45
C-36E	ru = 0.34	5.7	ru = 0.39	6.5	2.97	2.72	3.27	3.53	3.39	2.90	2.61	2.69	3.04	2.90	3.00	3.25	3.27	3.09	2.66	2.48	3.13	3.02	2.54	2.50	2.48	2.24	2.17	2.46	2.14	1.94	2.77	2.72	2.54	2.75	1.53	3.21	3.27	3.44	3.40	3.43	3.07	2.99	3.11	3.53
C-37E	ru = 0.34	5.7	ru = 0.39	6.5	4.89	4.78	5.23	5.39	5.10	4.84	4.66	4.74	4.87	4.72	4.69	4.82	4.85	4.79	4.46	4.38	4.84	4.84	4.45	4.41	4.27	4.13	4.06	4.24	4.03	3.95	4.18	4.13	4.06	4.56	3.74	4.77	4.77	4.94	4.87	4.90	4.52	4.42	4.81	5.39

INSTRUMENTATION PLANE B

PIEZOMETER	2005 WARNING THRESHOLD LEVEL I (see note 1)		2005 WARNING THRESHOLD LEVEL II (see note 1)		7-Jan	14-Jan	21-Jan	27-Jan	4-Feb	8-Mar	4-Apr	8-Apr	15-Apr	22-Apr	5-May	18-May	9-Jun	17-Jun	24-Jun	30-Jun	7-Jul	15-Jul	26-Jul	17-Aug	22-Aug	2-Sep	9-Sep	9-Sep	28-Sep	17-Oct	26-Oct	4-Nov	10-Nov	17-Nov	24-Nov	1-Dec	23-Dec	**2005 MAXIMUM**
B-1E	ru = 0.40	10.10	ru = 0.50	12.6	4.80	5.03	4.80	4.68	4.56	7.95	6.15	5.80	5.52	5.18	7.35	7.75	5.27	5.03	4.80	4.80	4.80	4.68	4.92	6.49	6.49	4.99	4.63	4.63	5.92	5.94	5.94	5.95							7.95
B-5E	ru = 0.20	4.76	ru = 0.30	7.1	0.07	0.07	0.07	0.08	0.08	1.69	0.21	0.21	0.19	0.22	1.57	1.57													0.28	0.43	0.33	0.35							1.69

NOTES:
1) meters of pressure head
2) OES - below outer embankment slope
3) LTB - lower 1/3 of upstream tailing beach deposits
4) UTB - upper 2/3 of upstream tailings beach deposits

LEGNED:
- Exceeds Warning Threshold Level I
- Exceeds Warning Threshold Level II

Table IV-6: TDF Piezometer Records
A-OE, A-2E, A-4E

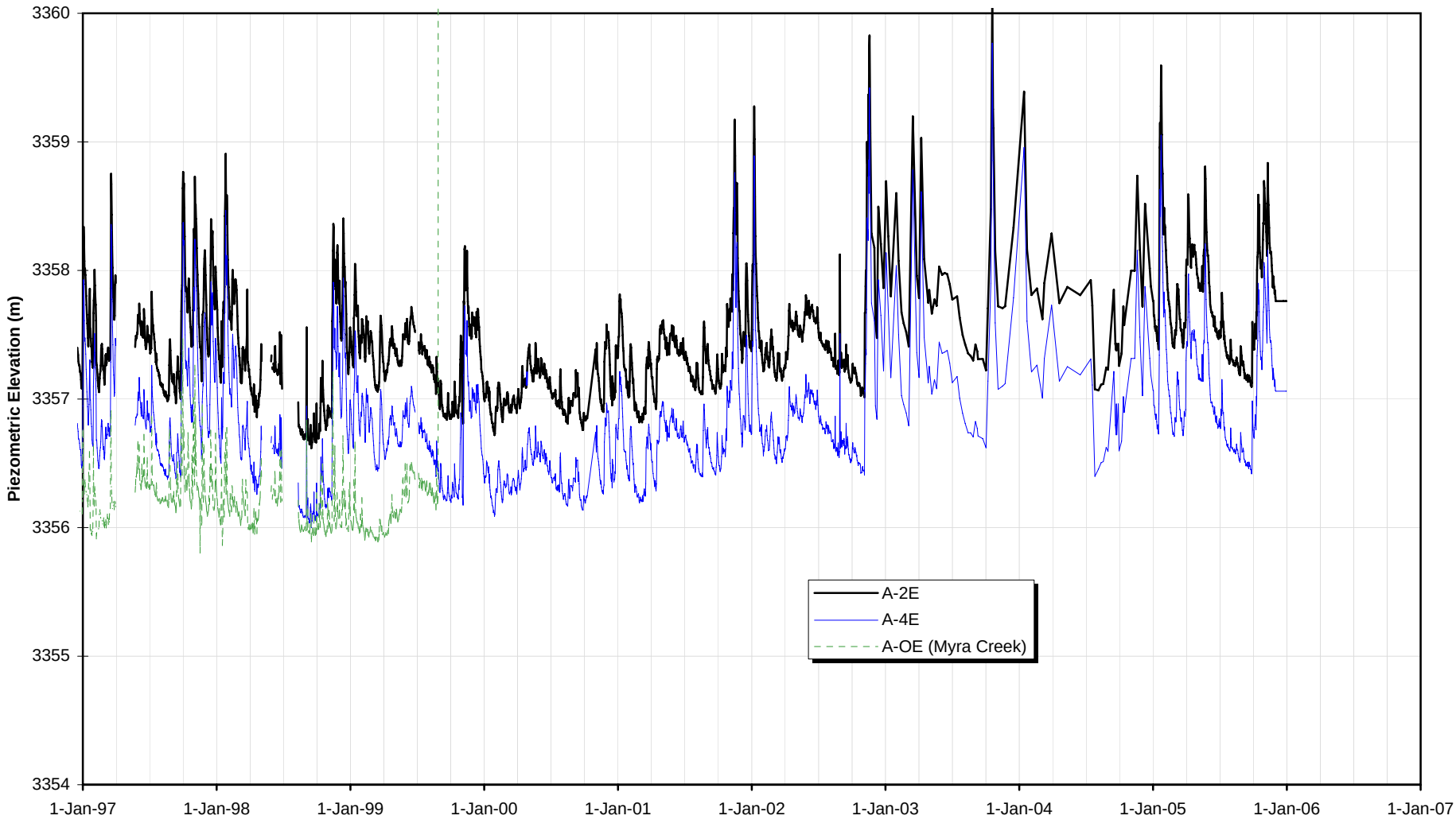


Table IV-7: TDF Piezometer Records
A-8E, A-12E, A-16E, A-20E

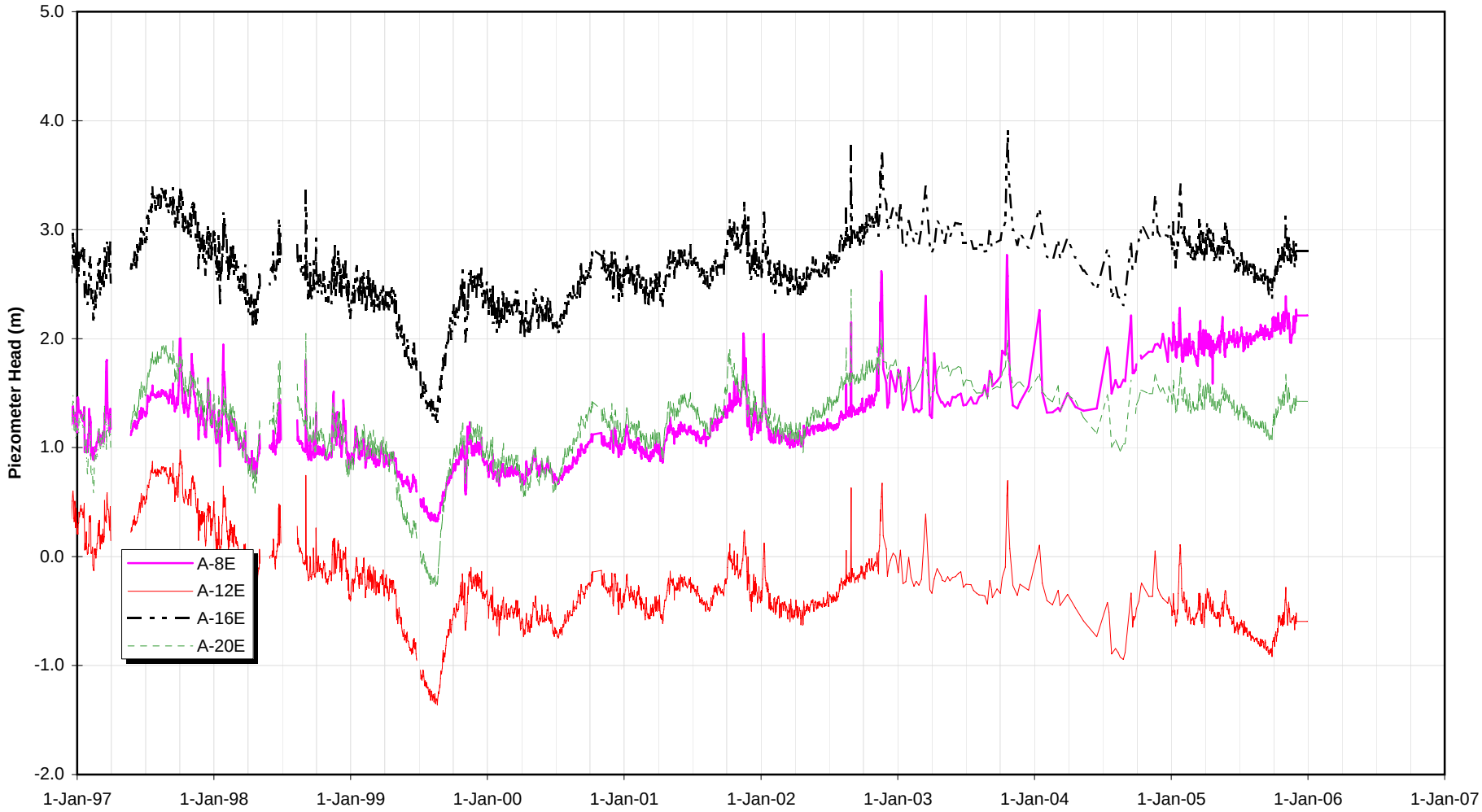


Table IV-8: TDF Piezometer Records
A-6E, A-10E, A-14E, A-18E

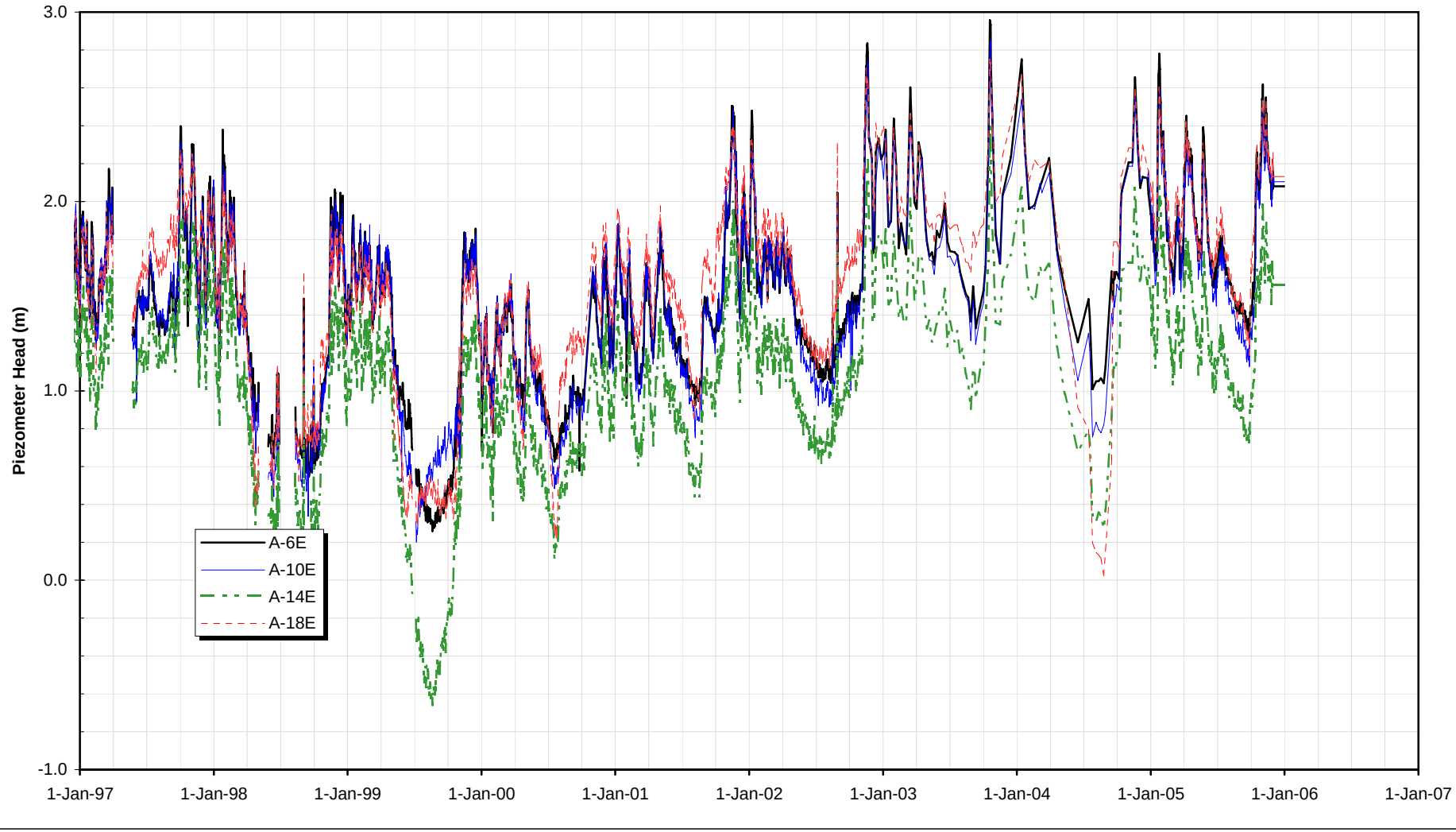


Table IV-9: TDF Piezometer Records
A-5E, A-9E, A-13E, A-17E

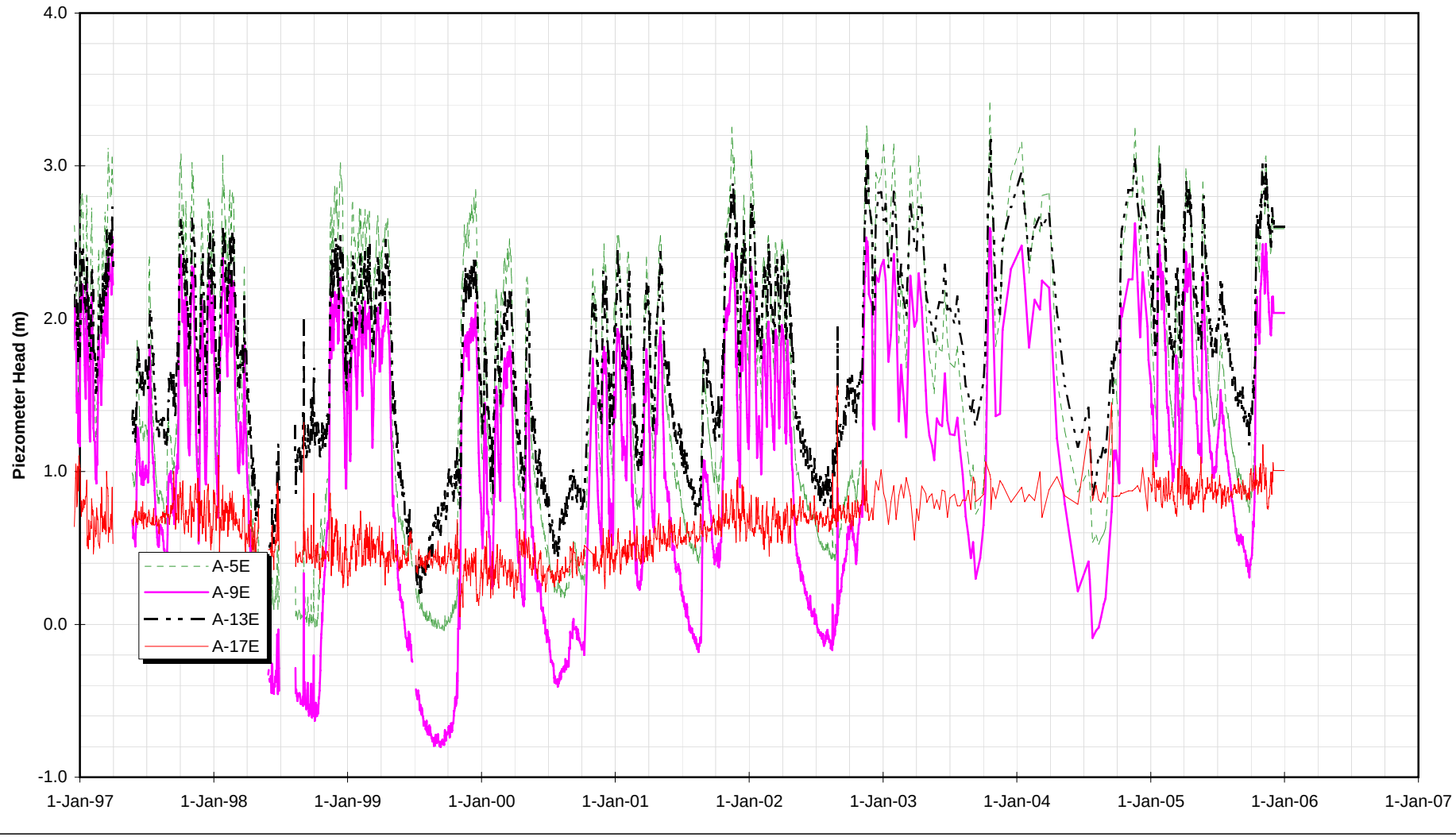


Table IV-10: TDF Piezometer Records
A-28E, A-30E

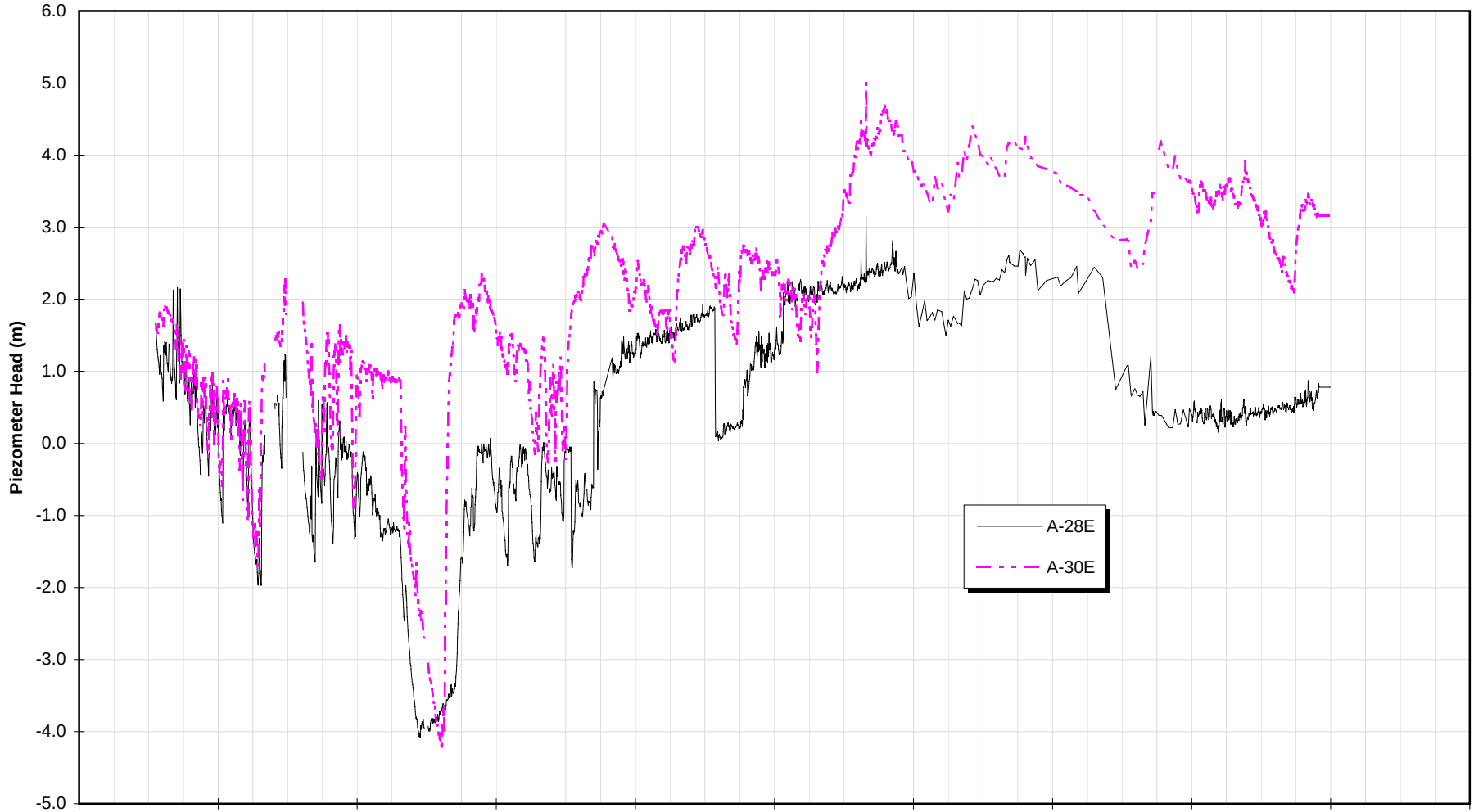


Table IV-11: TDF Piezometer Records
A-26E, A-27E

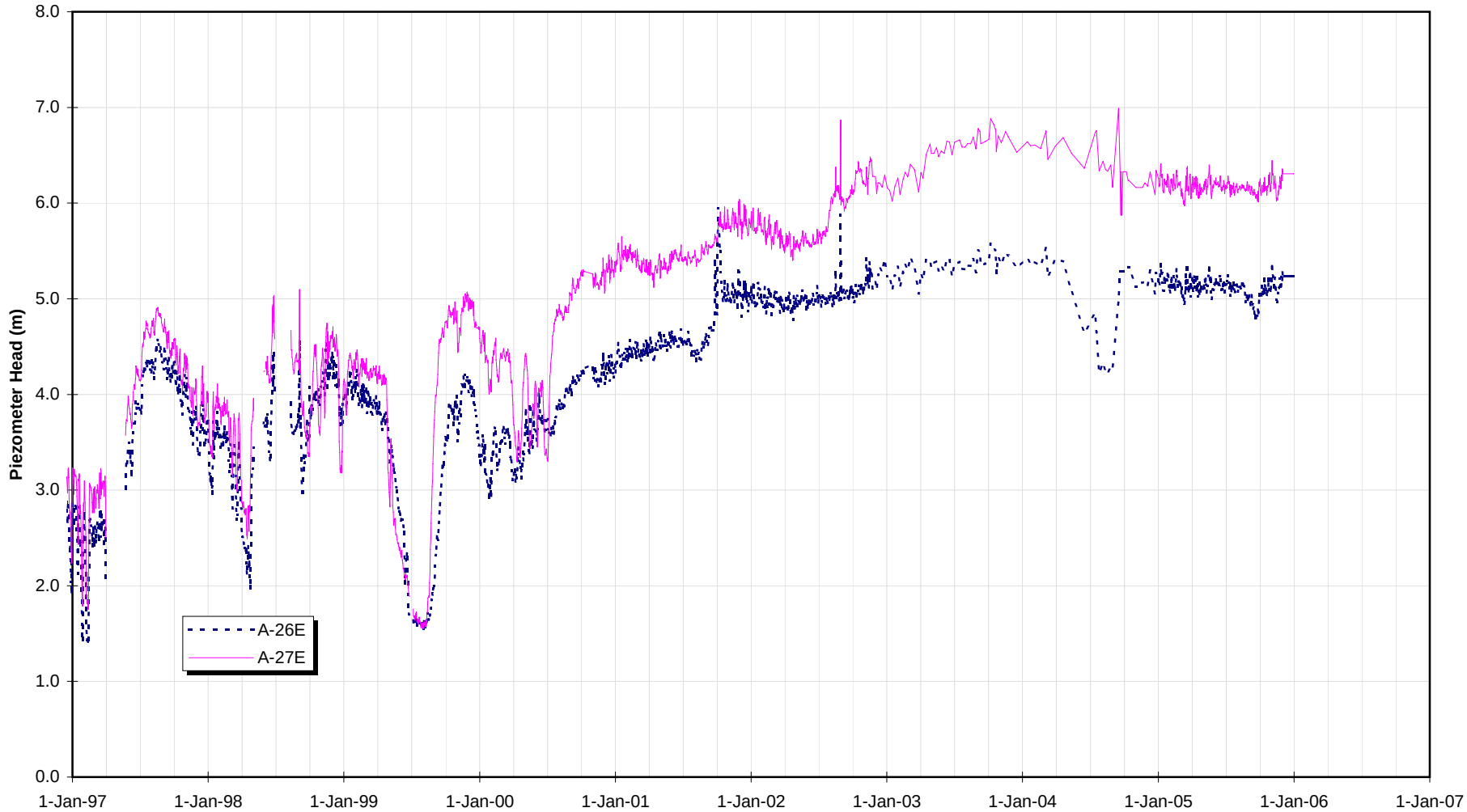


Table IV-12: TDF Piezometer Records
A-31E, A-32E, A-33E

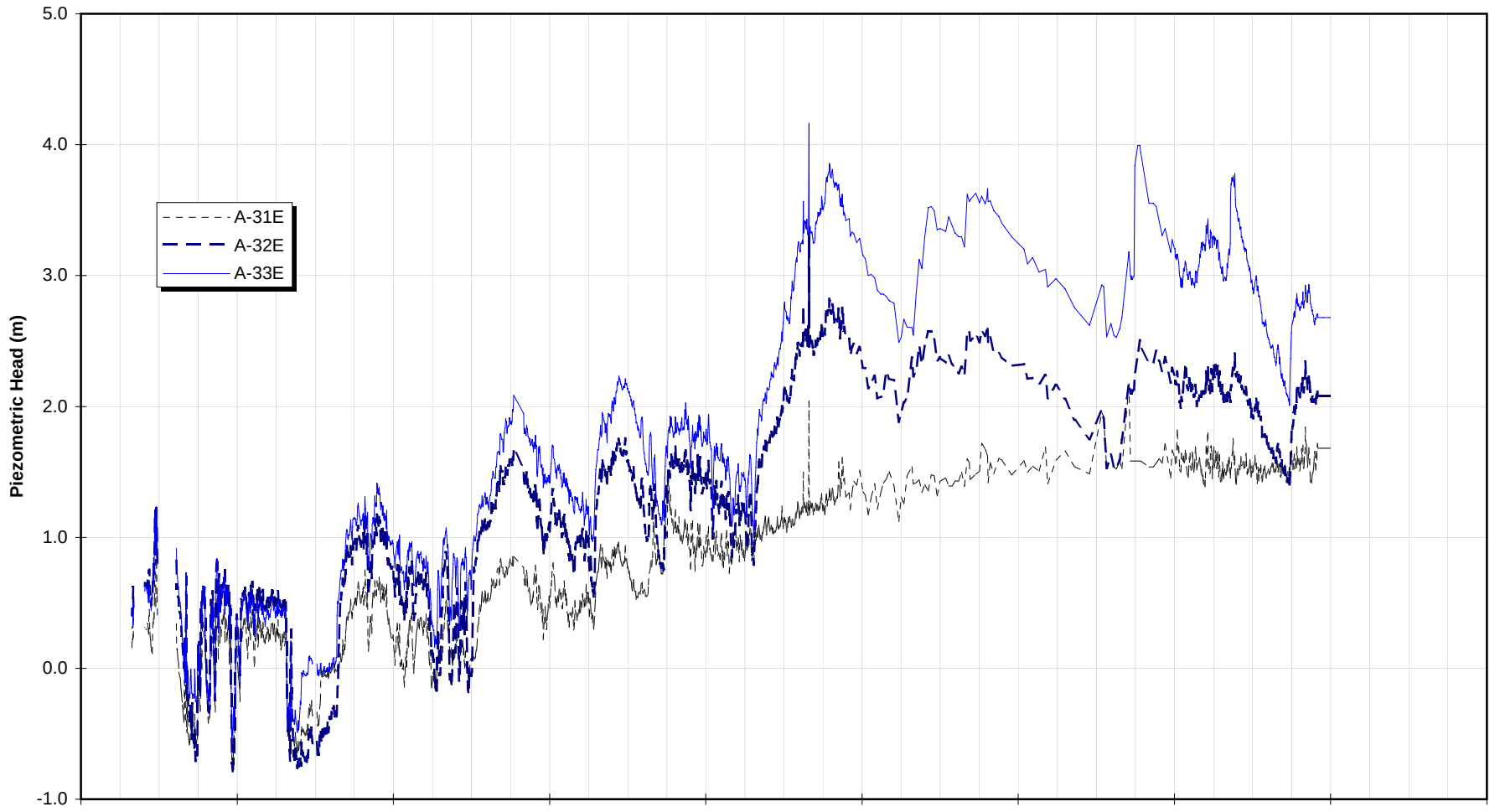


Table IV-12
N:\M\M07632\A52 - 2005 Consulting Services\500 Deliverables\03-2005 Annual Review Report\Draft Report\Appendix IV - Piezometer Tables and Plots\Table IV-6 to IV-12.xls

Table IV-13: TDF Piezometer Records
B-1E & B-5E

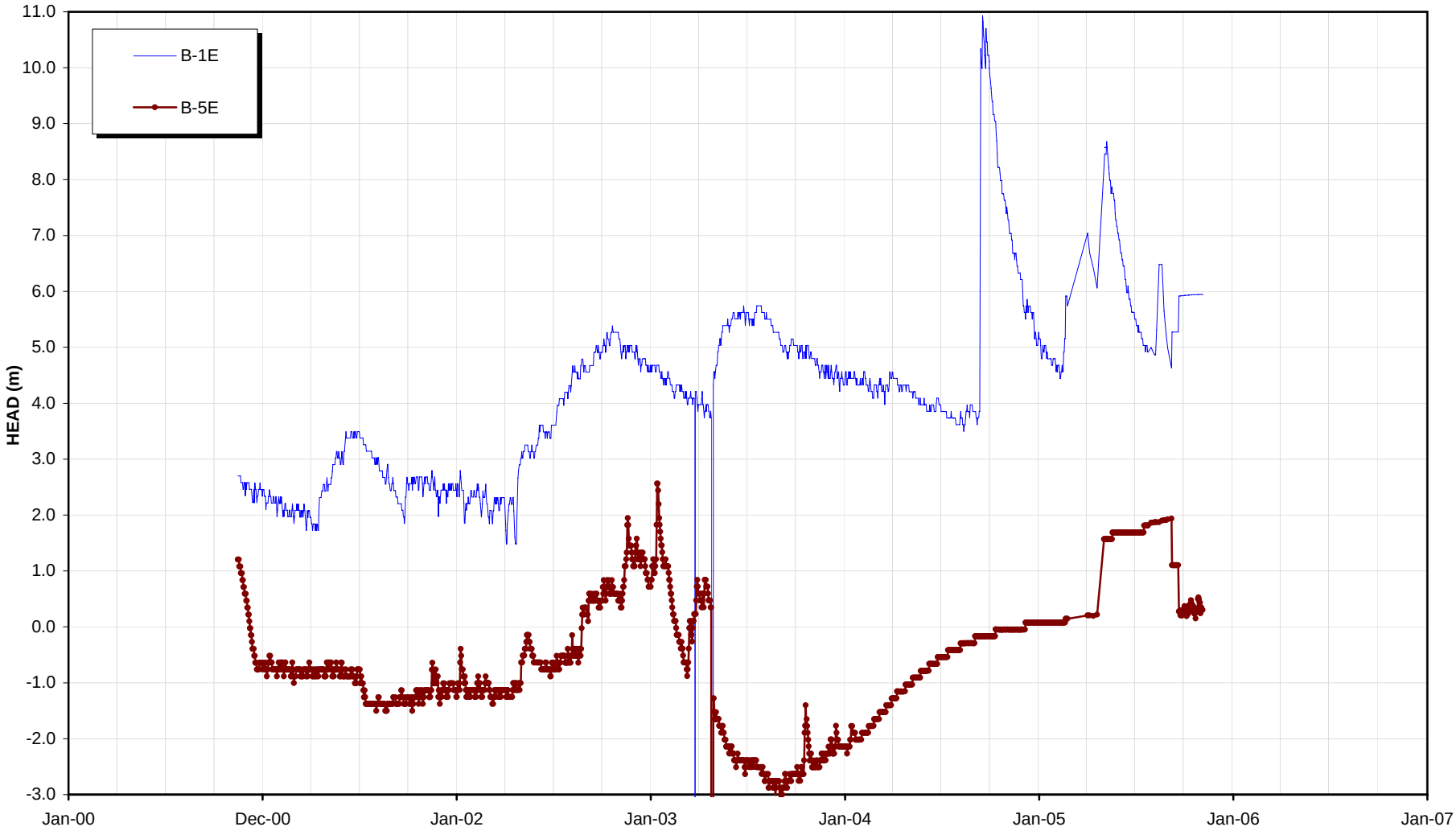


Table IV-14: TDF Piezometer Records
C-2E, C-8E, C-0E-A, A-14L, A-14R, A-13(O/D)

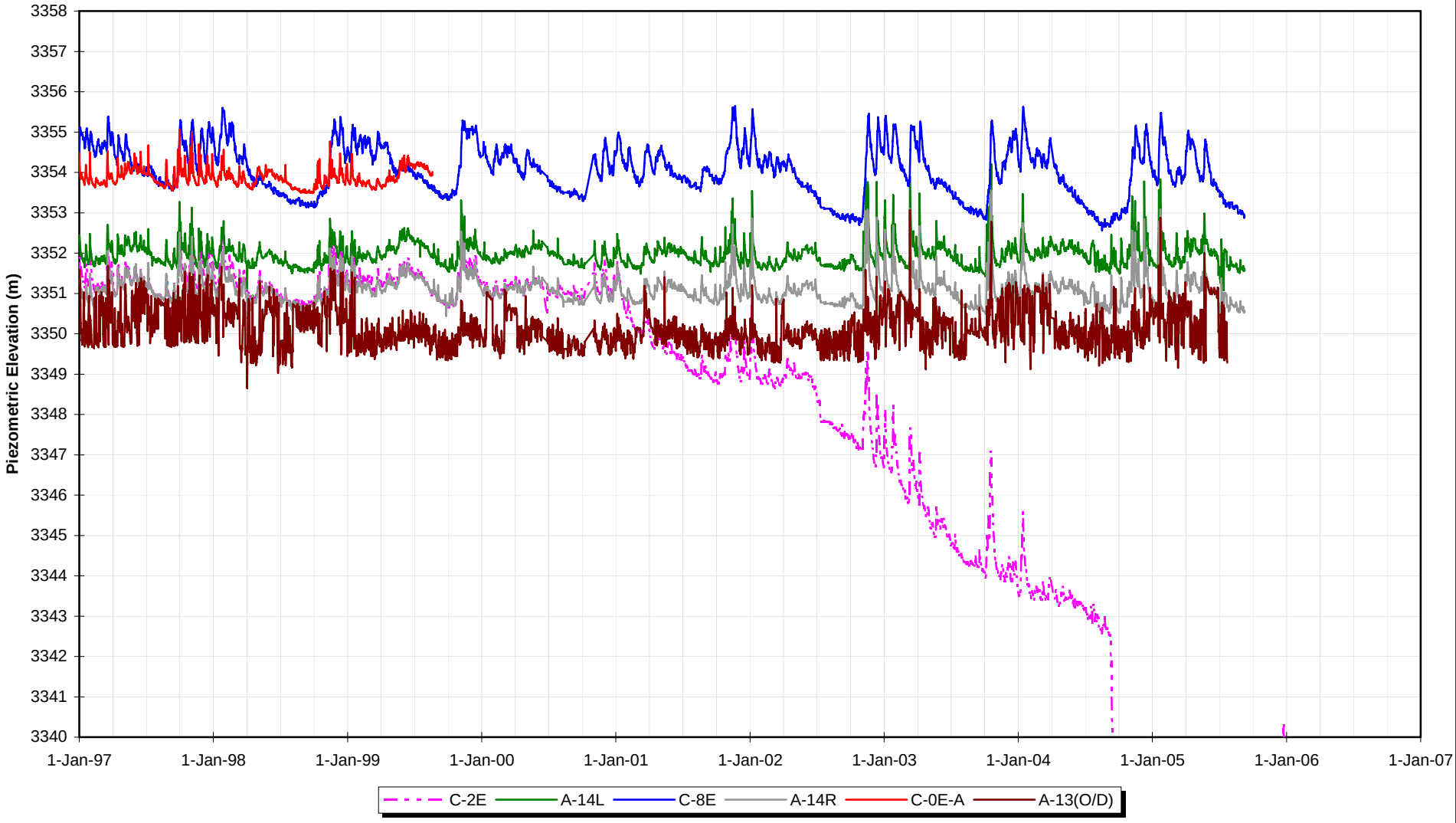


Table IV-14
N:\M\M07632\A52 - 2005 Consulting Services\500 Deliverables\03-2005 Annual Review Report\Draft Report\Appendix IV - Piezometer Tables and Plots\Table IV-14 to IV-20.xls

Table IV-15: TDF Piezometer Records
C-12E, C-16E, C20-E, C24-E

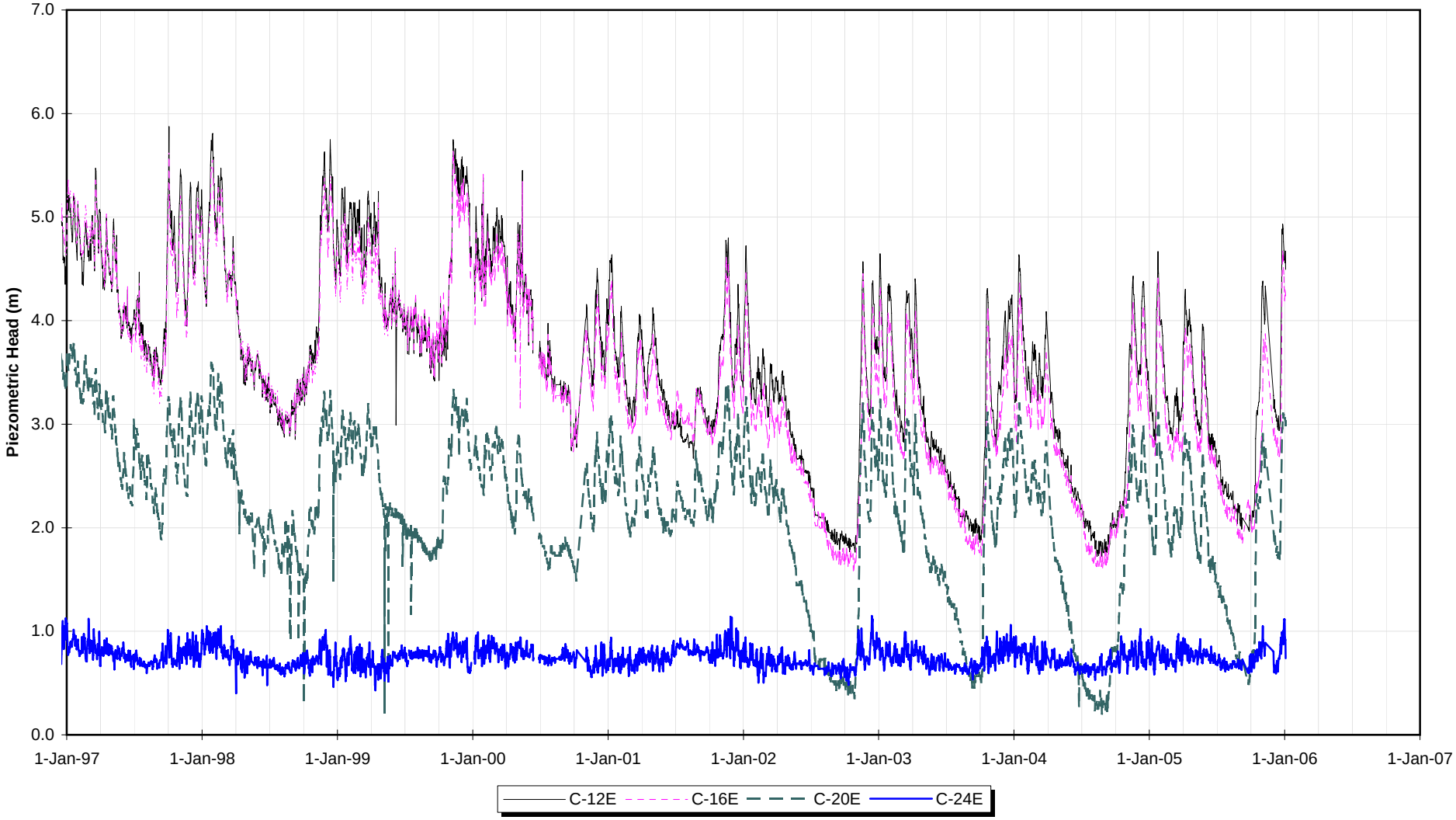


Table IV-16: TDF Piezometer Records
C-30E, C-31E

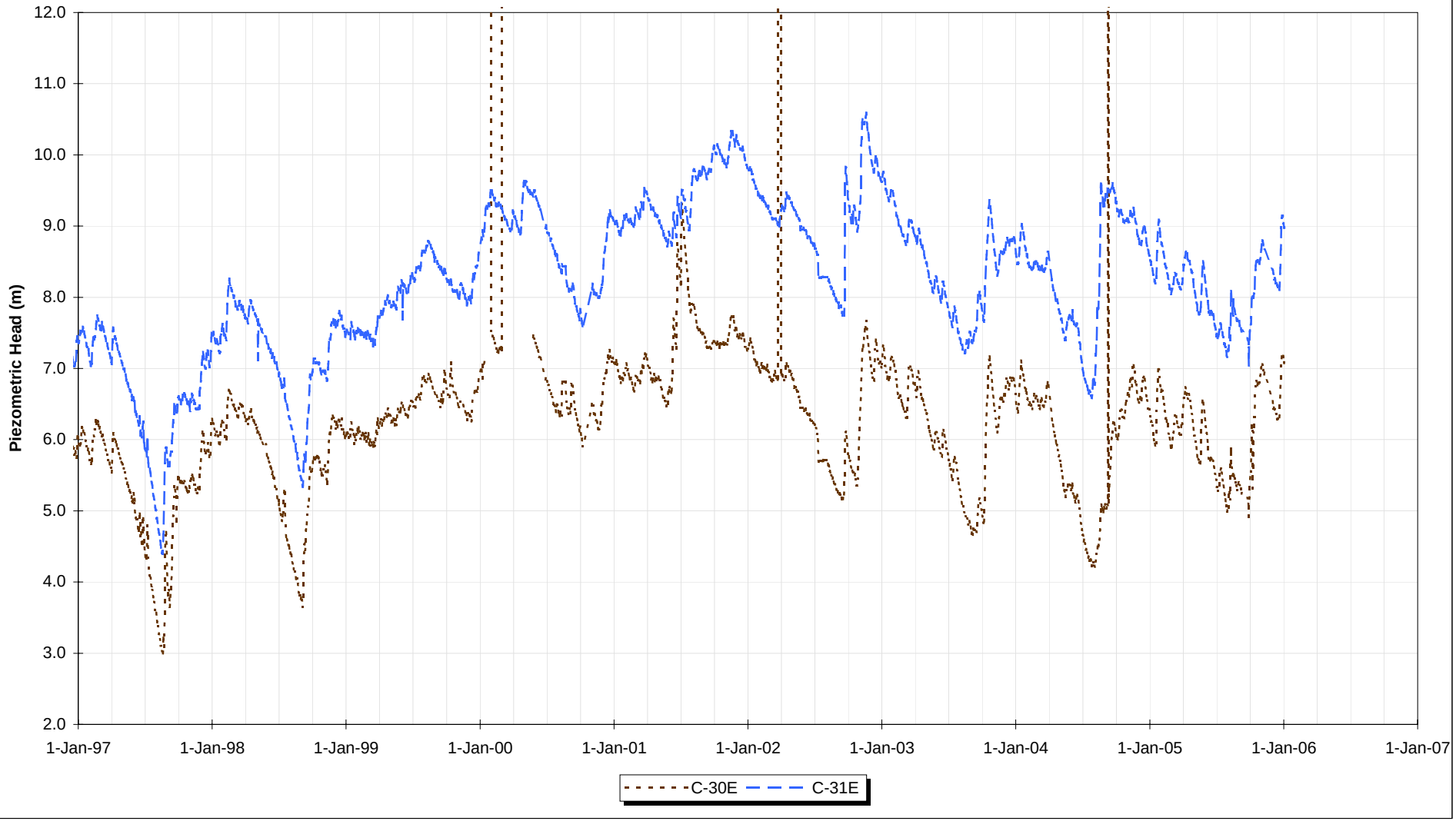


Table IV-17: TDF Piezometer Records
C-6E, C-10E, C-14E, C18-E, C22-E

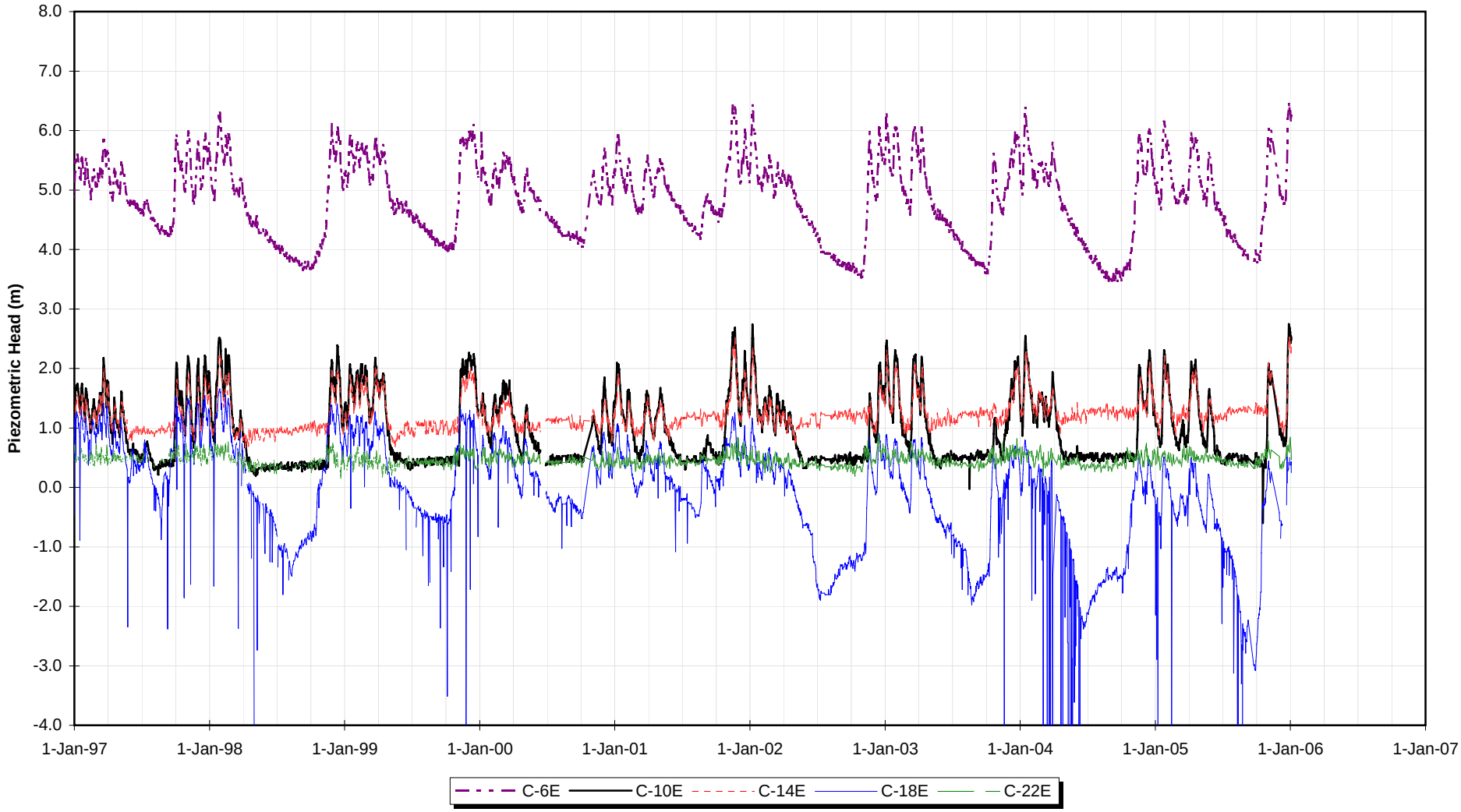


Table IV-18: TDF Piezometer Records
C-5E, C-13E, C17-E, C-21E

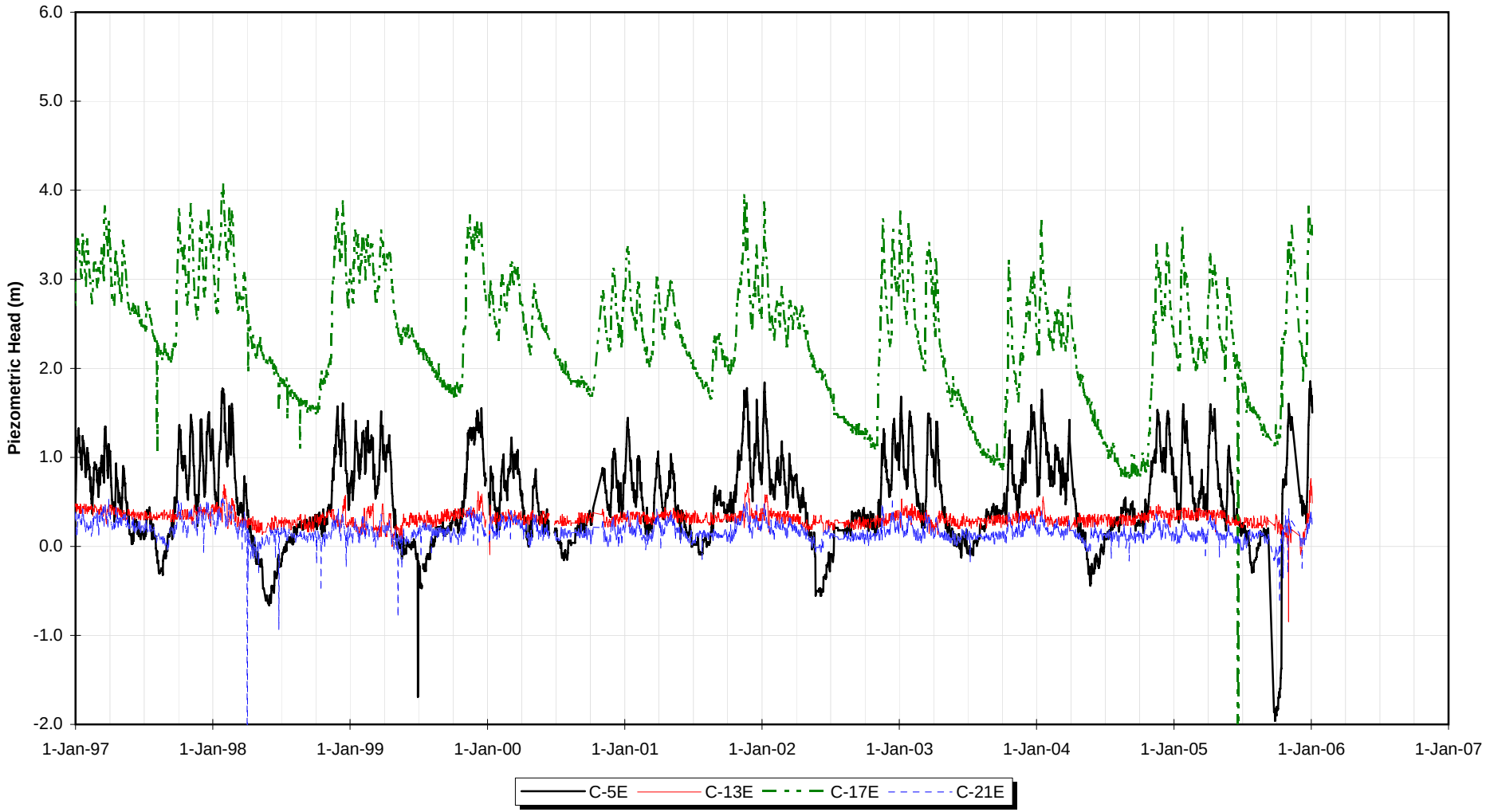


Table IV-19: TDF Piezometer Records
C-32E, C-34E

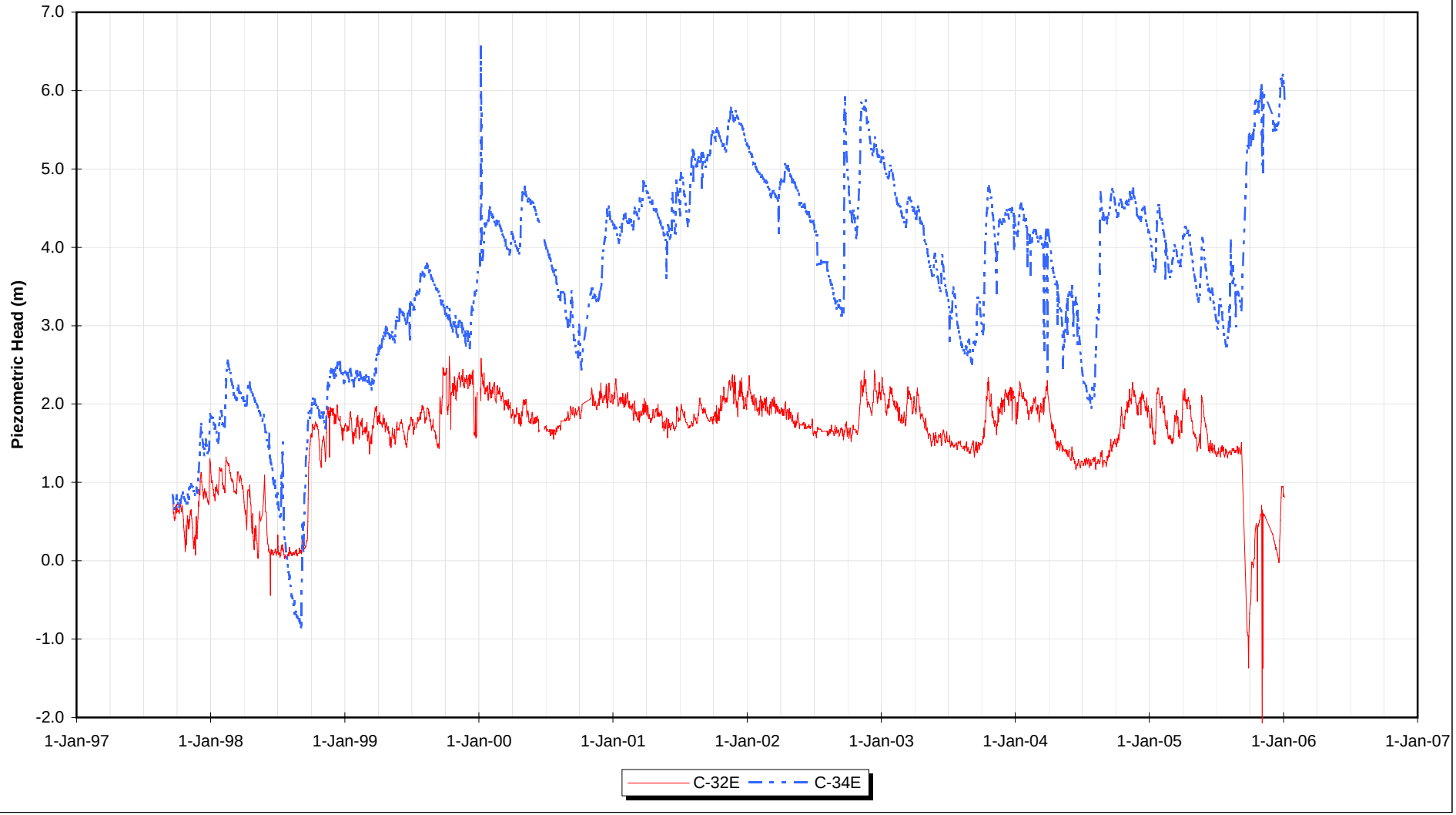


Table IV-20: TDF Piezometer Records
C-35E, C-36E, C-37E

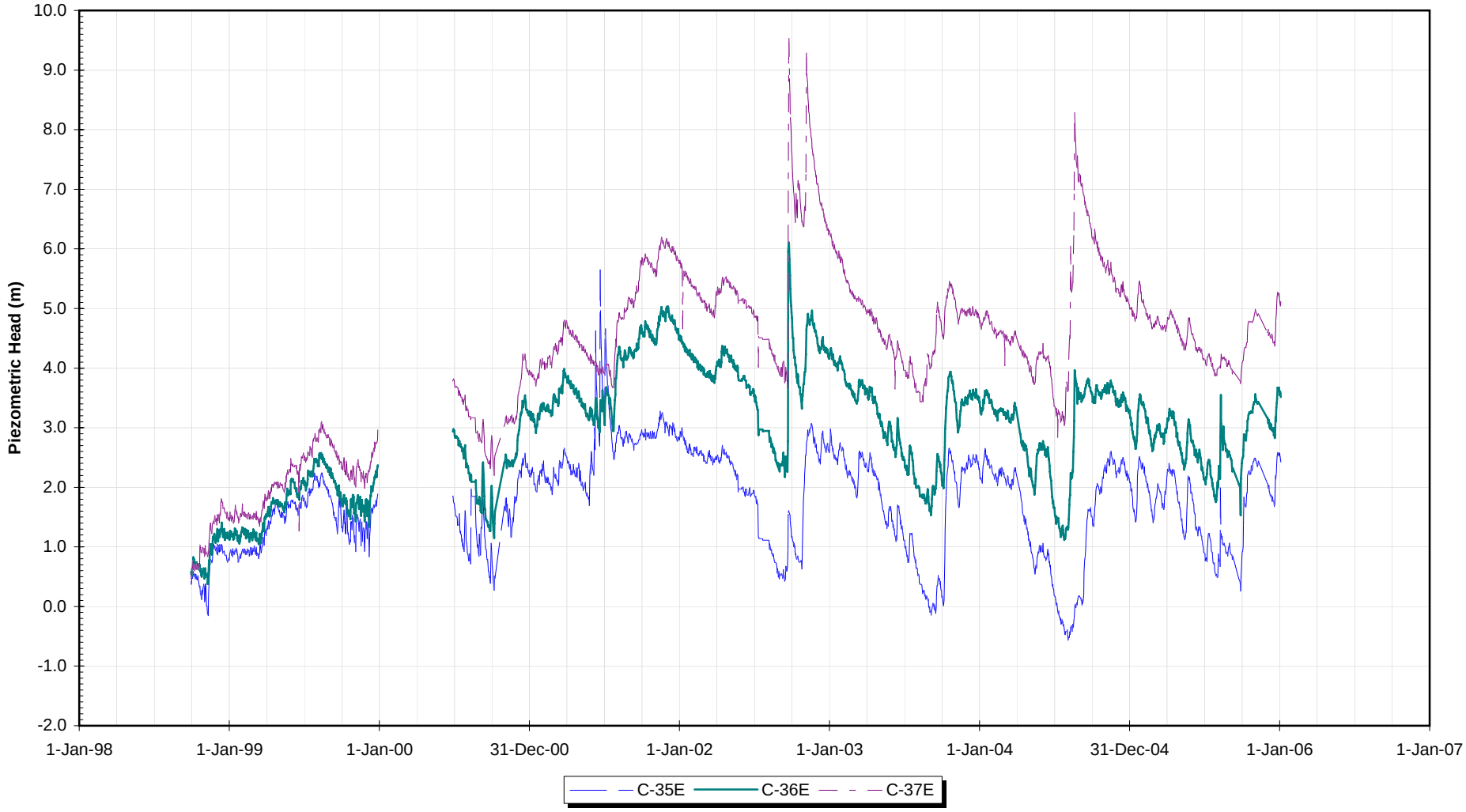


Table IV-21: Area II Paste Berm
Phreatic Surface Level

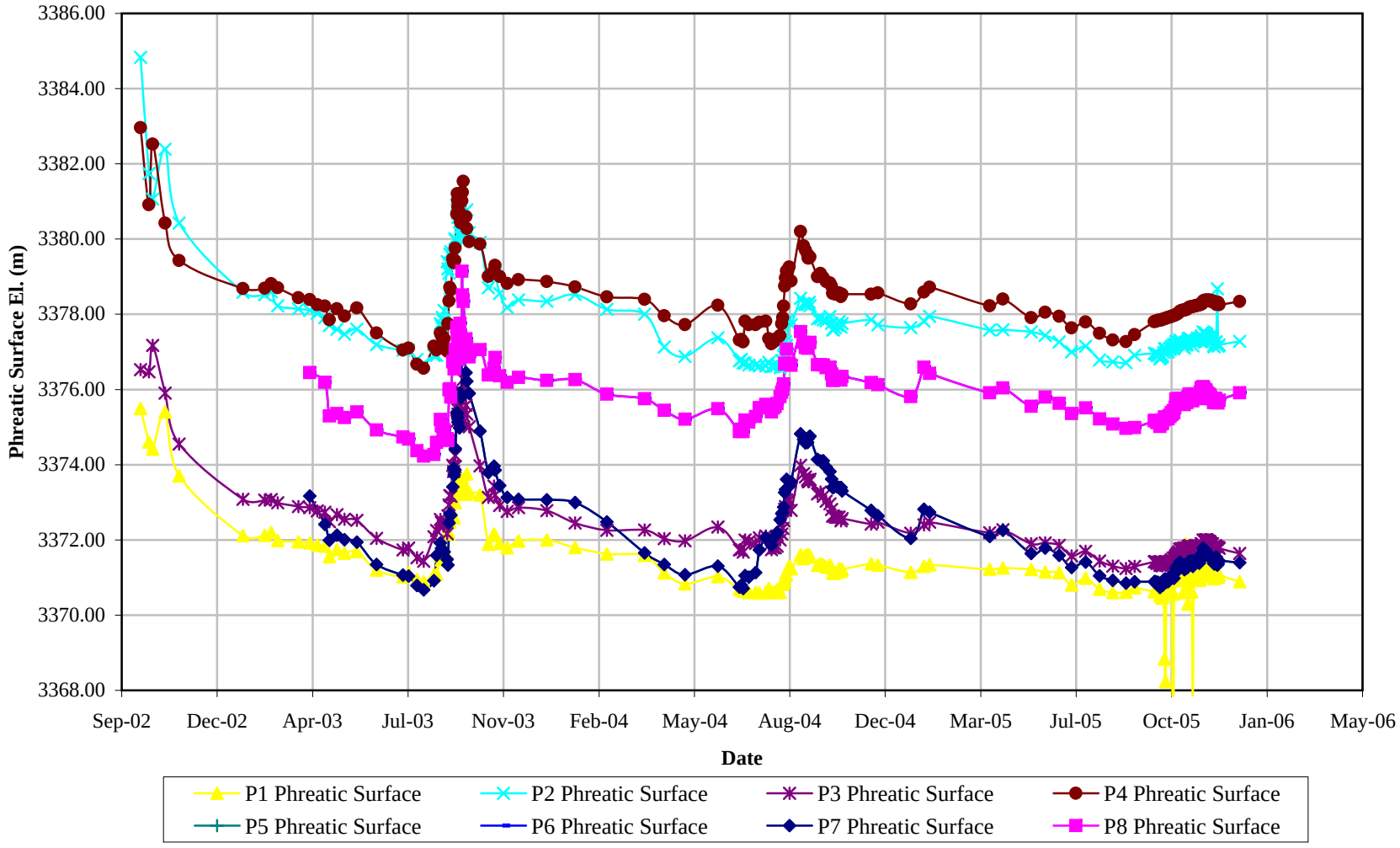


Table IV-22: Area I Paste Berm
Phreatic Surface Level

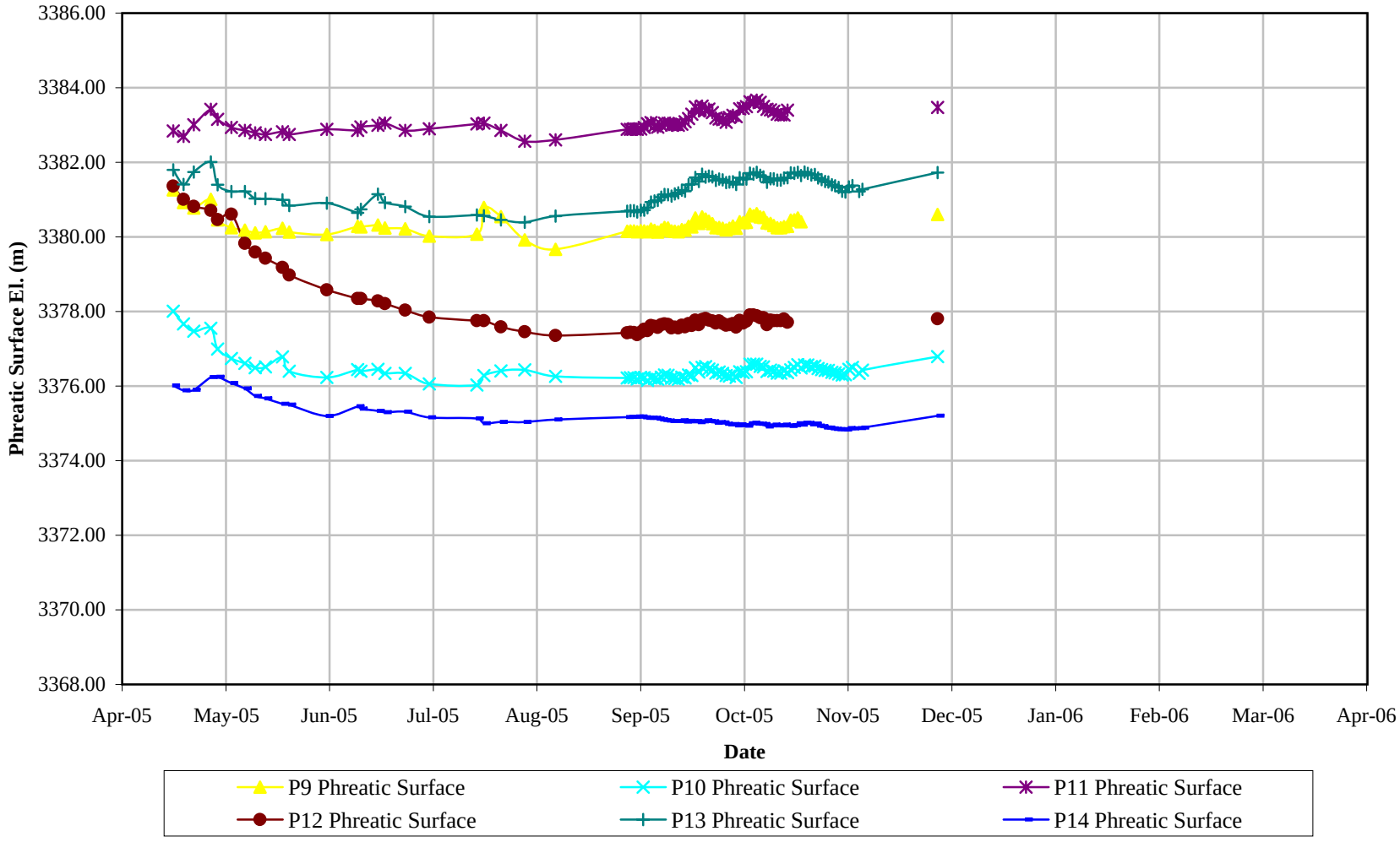


Table IV-23: GROUNDWATER WELLS - WATER LEVELS (2002 - 2005)

Measurements Down (in m) From Standpipe Collar

Inspection Dates	29-Jan-02	25-Apr-02	23-Oct-02	6-Feb-03	10-Apr-03	17-Jul-03	10-Mar-04	5-May-04	11-Feb-05	19-Jul-05
Historical Groundwater Standpipe Piezometers										
P-7	3.30	3.38	3.81	2.89	n/a	3.11	n/a	2.79	3.02	3.65
P-8 (by HW)	7.00	7.10	7.31	6.80	n/a	6.95	n/a	6.75	6.98	7.35
P-9	2.47	2.58	3.43	2.10	n/a	2.36	n/a	2.38	2.76	buried
P-10	2.11	2.23	2.58	1.87	n/a	2.08	n/a	2.05	2.14	2.2
A1 (O/D) E/A	7.03	7.10	7.26	6.84	n/a	6.98	n/a	6.96	destroyed	destroyed
A2R	5.61	5.65	5.97	5.40	n/a	5.49	n/a	5.55	destroyed	destroyed
A7R	5.57	5.62	5.43	5.10	n/a	5.18	n/a	5.48	5.00	5.32
3RE	6.94	7.00	7.27	6.90	n/a	7.02	n/a	6.91	destroyed	destroyed
A14L	6.18	6.25	6.48	6.20	n/a	6.31	n/a	6.15	6.30	6.13
A14R	9.02	8.16	8.42	8.30	n/a	8.24	n/a	8.88	9.20	8.19
Standpipe Piezometers from KC Site Investigations Spring 2001										
BKS01-01	29.85	30.77	28.55	n/a	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
BK01-13A	9.01	9.10	8.75	8.19	n/a	8.56	n/a	9.25	9.00	10.1
BK01-13B	8.99	9.09	8.74	8.20	n/a	8.57	n/a	9.24	8.99	10.3
BKS01-11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	28.62	28.9
HDPE MANHOLE	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14.30	
3 per Year Access Chamber; Water Levels in Outer Drain Vent Pipes										
AC-01	2.39	2.48	1.95	2.21	See K.Crippen	2.23	2.16	2.45	removed	removed
AC-05	2.78	3.38	2.35	1.33	field notes	1.56	3.40	2.85	removed	removed
AC-10	3.02	3.26	2.64	2.60	and report by	2.78	2.88	3.15	n/a	n/a
AC-14	2.68	2.85	2.20	1.77	Franky Li	1.85	2.09	2.80	n/a	n/a
ID2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8.36	raised
										could not reach
Corresponding Creek Elevs. (Elevations Relative to Mine Grid)										
MC@AC1	n/a	3355.39	n/a	3355.65	See K.Crippen	n/a	3355.82	n/a	n/a	
MC@AC5	n/a	3353.70	n/a	3353.99	field notes	n/a	3354.20	n/a	n/a	3355.53
MC@AC10	n/a	3350.73	n/a	3350.71	and report by	n/a	3350.87	n/a	n/a	3353.84
MC@AC14	n/a	3349.55	n/a	3349.16	Franky Li	n/a	3349.24	n/a	n/a	3350.57
Survey Method										3348.84

Table V-2 - Tailings Berm Settlement - Area II - Line 1
(MPT401, 402, 403, 356, 404, 405)

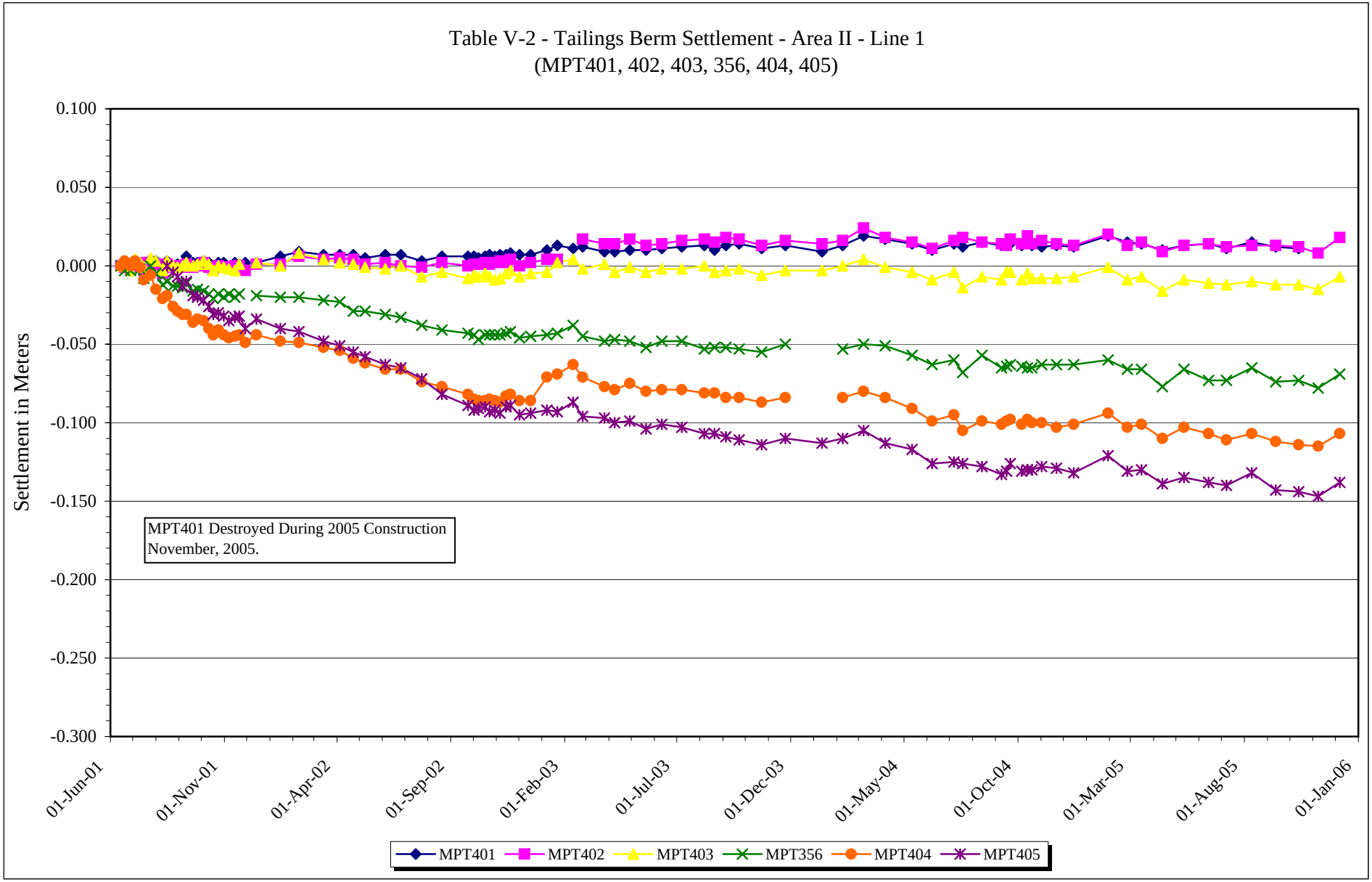


Table V-2_Area2-Line1
N:\M\M07632\A52 - 2005 Consulting Services\500 Deliverables\03-2005 Annual Review Report\Draft Report\Appendix V - Surface Monument Plots\TableV-1 to V-7.xls

Table V-3 - Tailings Berm Settlement - Area II - Line 2
(MPT330, 333, 355, 357, 406,)

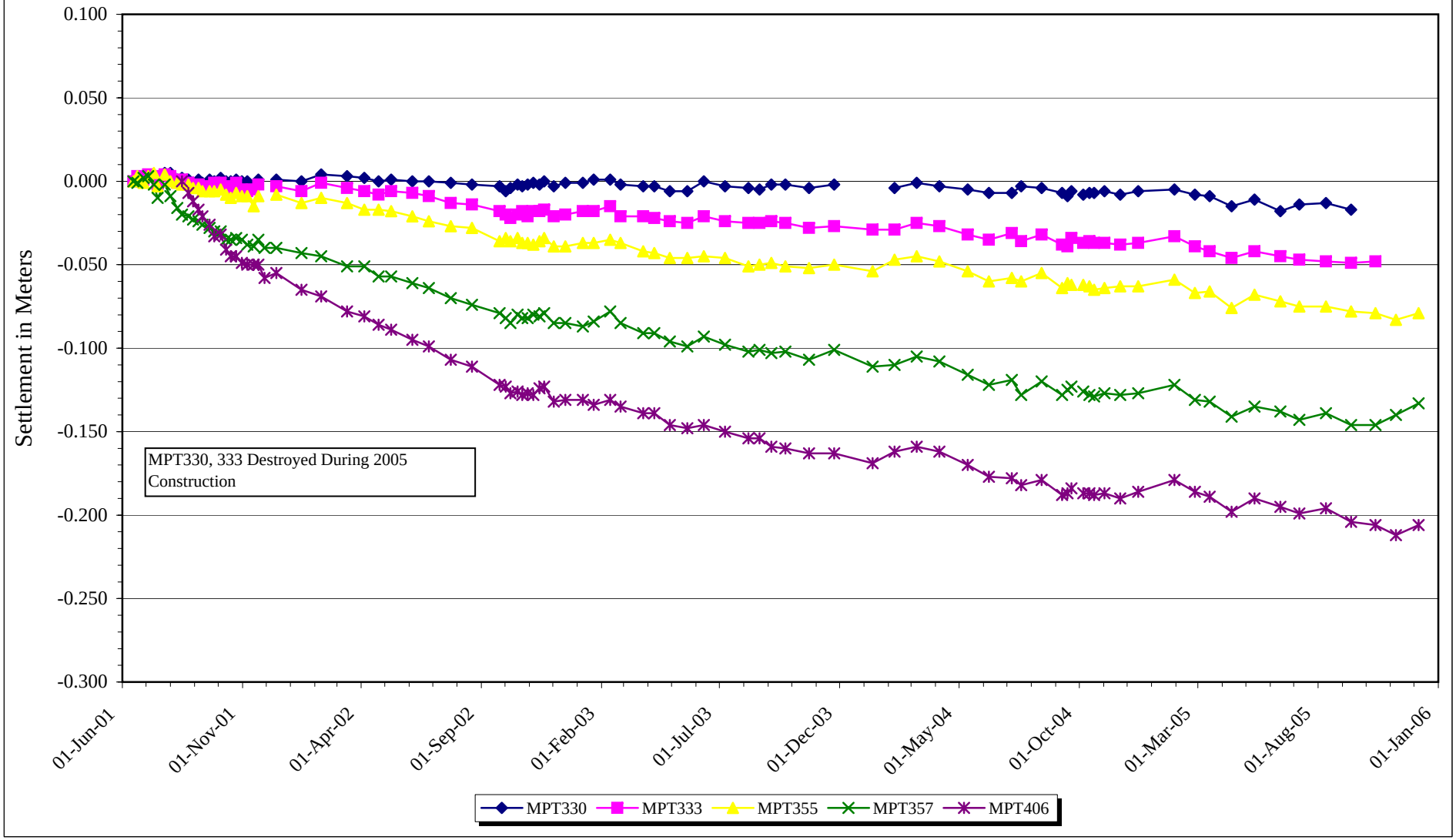


Table V-4 - Tailings Berm Settlement - Area II - Line 3
(MPT400, 332, 354, 358, 407)

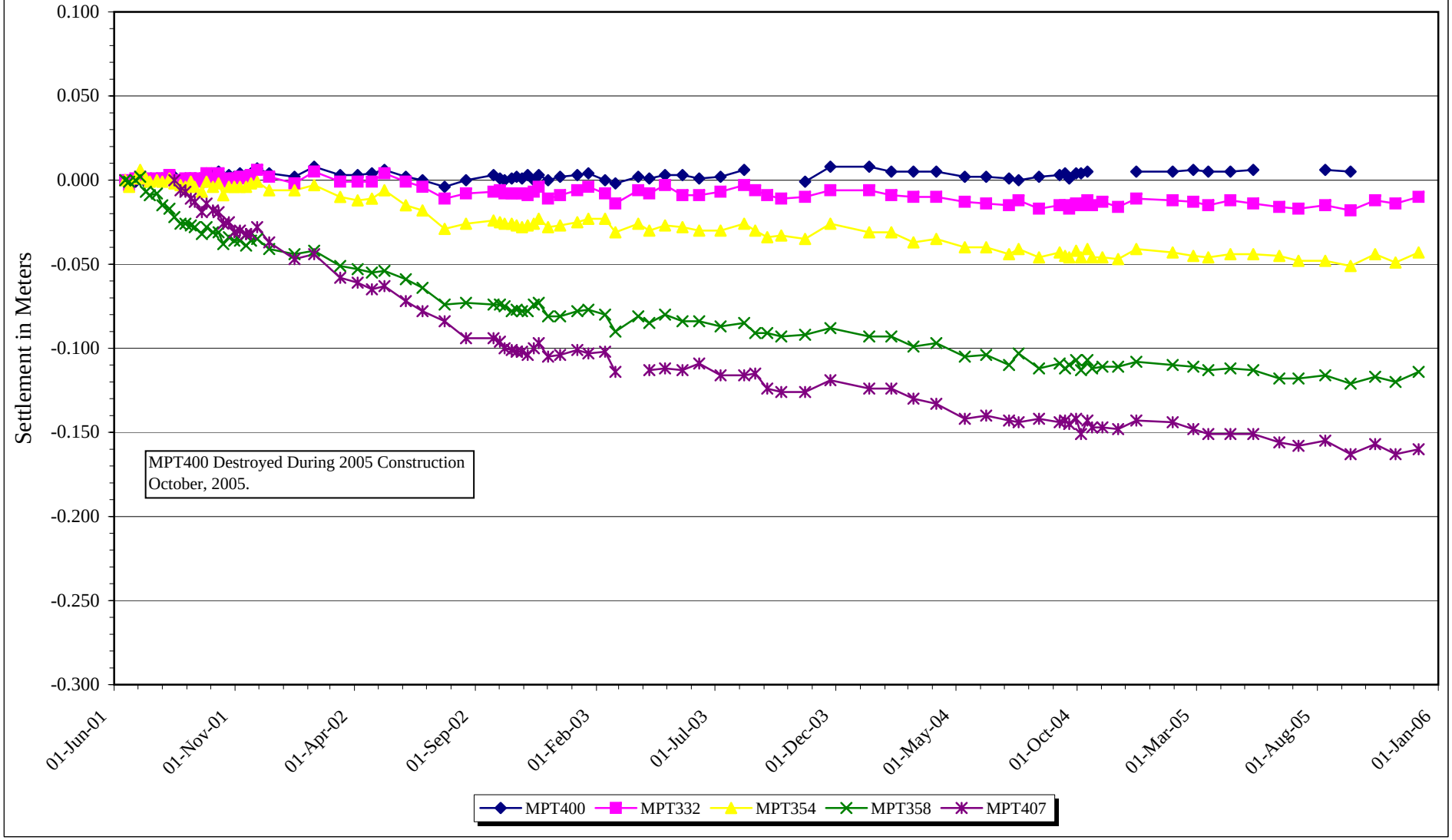
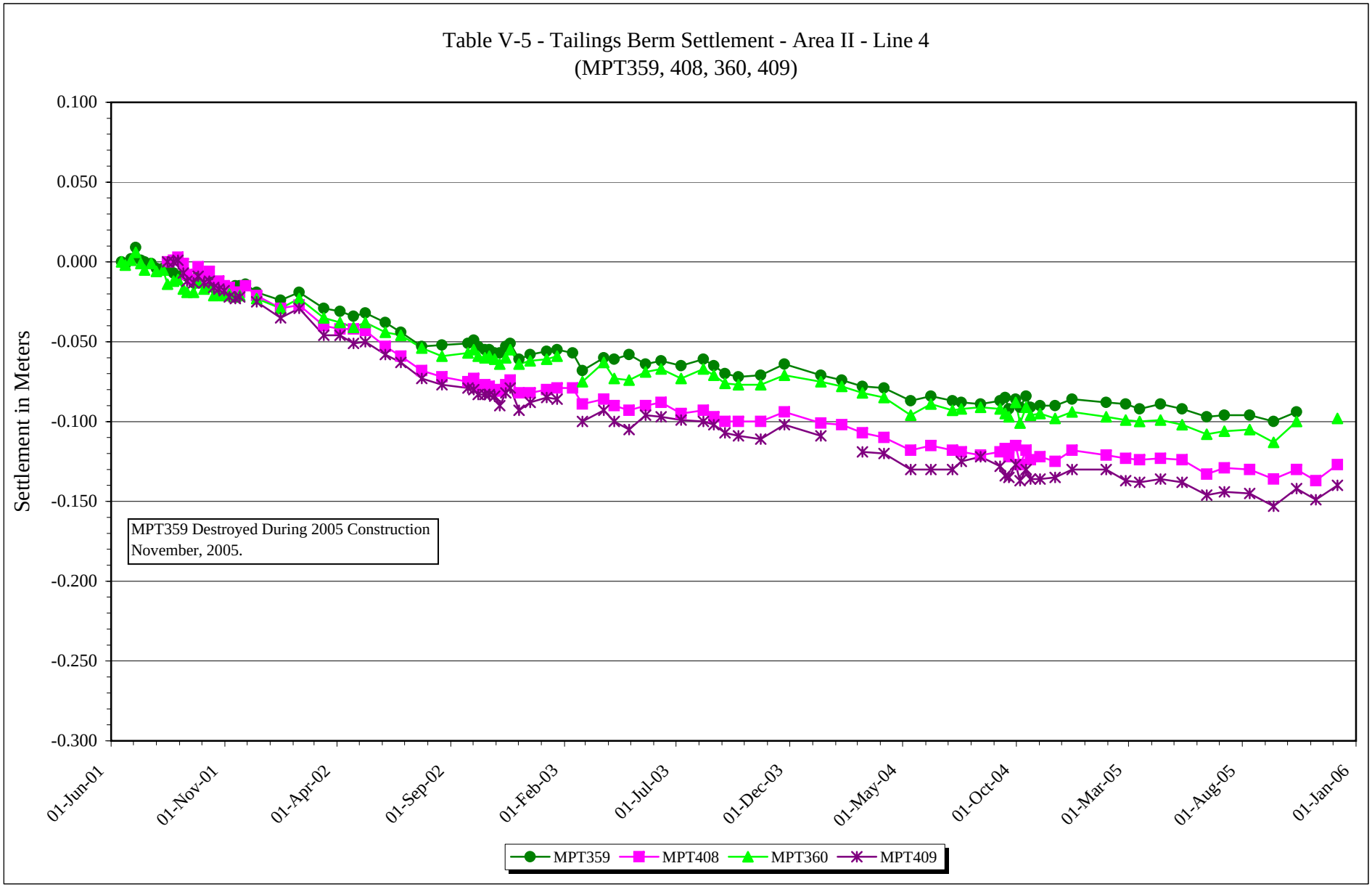


Table V-5 - Tailings Berm Settlement - Area II - Line 4
(MPT359, 408, 360, 409)



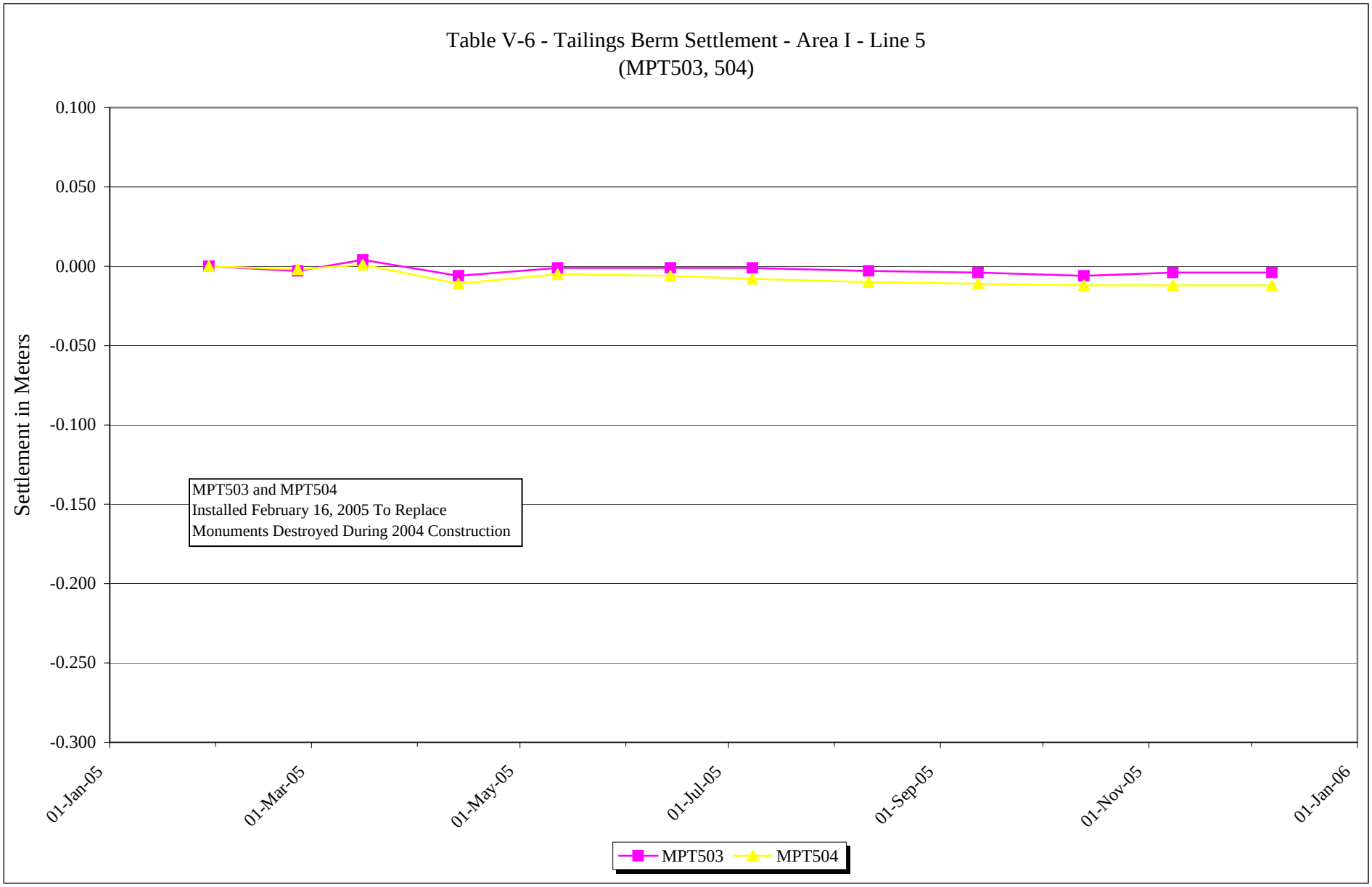
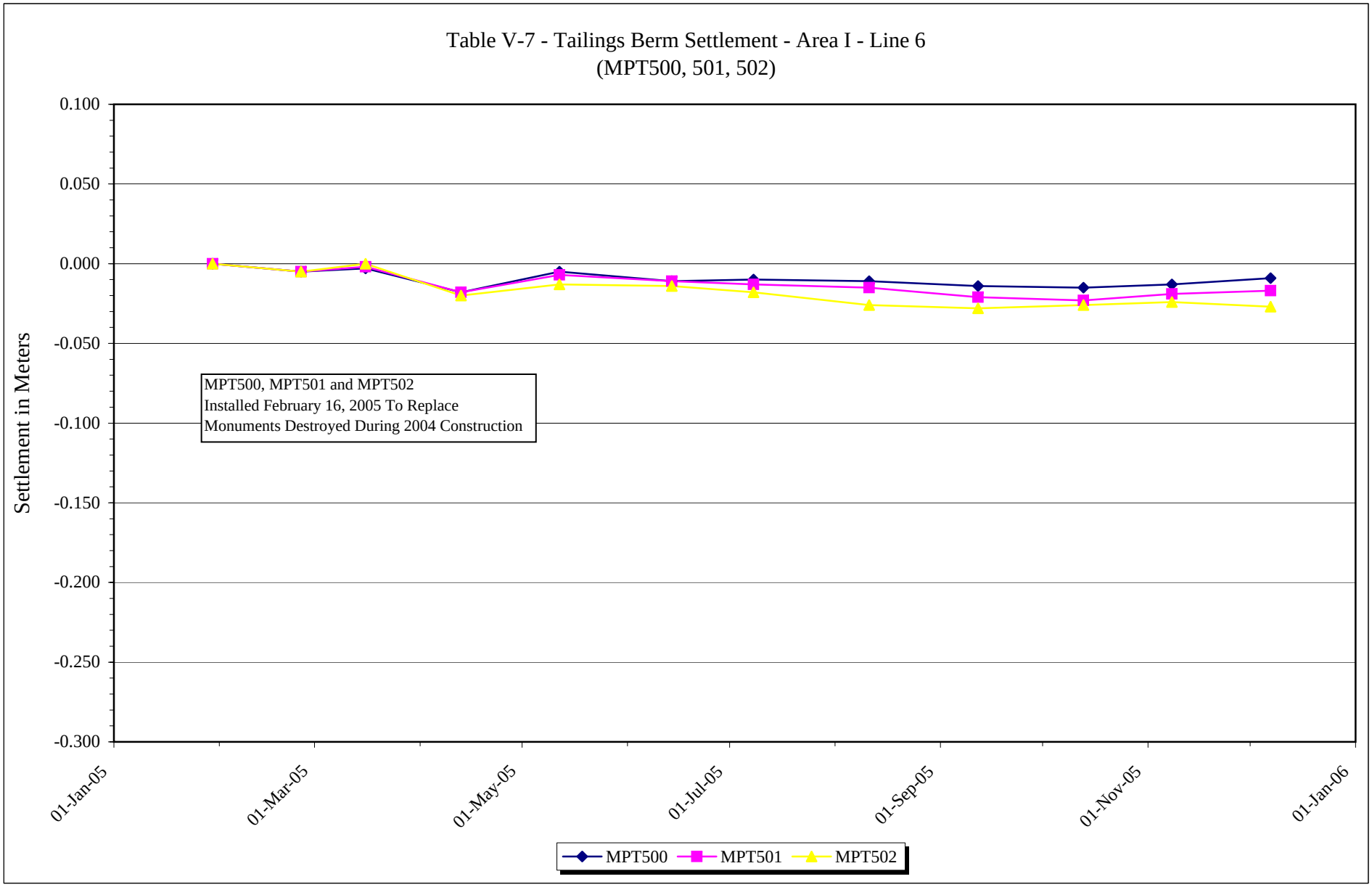


Table V-6_Area1-Line5
N:\M\M07632\A52 - 2005 Consulting Services\500 Deliverables\03-2005 Annual Review Report\Draft Report\Appendix V - Surface Monument Plots\TableV-1 to V-7.xls

Table V-7 - Tailings Berm Settlement - Area I - Line 6
(MPT500, 501, 502)



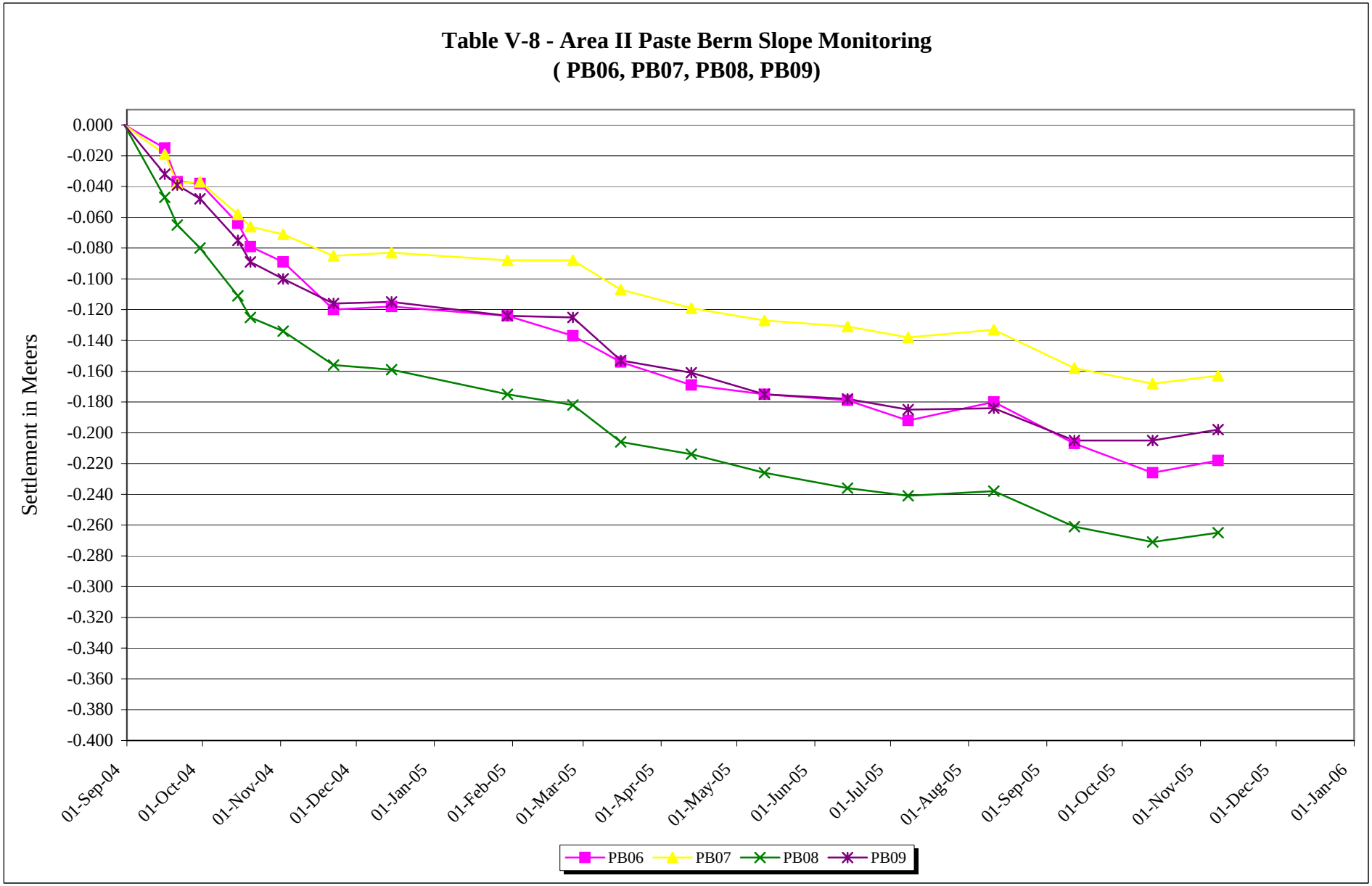


Table V-8 - Slope Graph
N:\M\M07632\A52 - 2005 Consulting Services\500 Deliverables\03-2005 Annual Review Report\Draft Report\Appendix V - Surface Monument Plots\TableV-8.xls

Appendix VIII

Underground Flood Emergency

nyrstar Myra Falls		**Control number**		**NVI-370**
		✓ **Classification**	**Pertains to :**	
		- Policy	E	Q	OH&S
		X - Procedure	Yes	Yes	Yes
Subject: **Underground Flood Emergency**		- Work instruction		
		✓ - Form	**N/A**	
		- Other (describe):		

Revision number	**Date of revision** September 16, 2009	**Date of 1st issue**
Originating department: Loss Control & Safety	**Prepared by:** S. Wuschke Title: Signature:	**Approved by:** Robert Behrendt Title: VP&GM Signature:
Reviewed by: Co-Chair OHSC _____ Mine Dept._____ Co-Chair OHSC _____ LC & T Dept._____		Page **1 of 5**

1.0 PURPOSE:

1.1 The purpose of this policy is to ensure the safe and orderly evacuation of the underground mine workings in the case of a flood inundation emergency.

1.2 Myra Falls is committed to providing a safe and healthy work environment for all our employees.

1.3 This procedure will cover, the emergency flood warning system, procedures upon receipt of the warning, action to be taken by crews underground and by the emergency command centre group.

2.0 SCOPE:

2.1 This procedure applies to all Myra Falls work locations and their employees and Contractors/ Sub-Contractors and visitors.

3.0 DEFINITIONS:

3.1 **Flood inundation:**. An uncontrolled flooding of the mine workings with water & / or slurry that could harm persons underground.

3.2 **Stench alarm:** The stench release system into compressed air and the ventilation air stream to warn personnel underground that there is an emergency.

3.3 **High water rate of rise alarm:** .An alarm signal received by mill control that water levels in Lynx 15 / Phillips Ramp sump are rising faster than they can be controlled.

3.4 **Refuge station:** Emergency shelter facilities strategically located in the underground mine complex, where personnel can take refuge. The facility has communications, emergency air and water.

4.0 RESPONSIBILITY:

4.1 The underground flood emergency and the initiate stench procedures will be reviewed by the General Manager, JOHSC Co-Chairs and Loss Control Manager to ensure compliance with legislative standards.

4.2 Supervision will be entrusted with the enforcement of this policy/procedure.

4.3 Employees, contractors and visitors will be informed of the policy and the adherence to this policy will be part of their work commitment. Failure to follow this policy may lead to disciplinary action.

5.0 PROCEDURE

Should indications of an uncontrolled flood inundation event be detected by instrumentation at the Lynx 15 bulkhead and Phillips Reach sump alarm a signal will automatically be sent to Mill Control. The Phillips reach sump has high sump instrumentation that will cause pumps to start. The first high sump signal will cause the first stage of dewatering pumps to start, if these pumps cannot keep up another high sump indication will be triggered which will start the second stage of dewatering pumps.

In the bulkhead there are three automatic valves. If the rate of water level rise in the sump exceeds 300 mm / minute, the three automatic valves will close and a flood alarm will register at mill control.

The flood alarm will be triggered in a second manner. Should the pressure reading behind the bulkhead reach 20 psi the alarm will register at mill control.

Duties of Mill Control

5.1 Upon receipt of a flood alarm (rate of rise exceeds 300 mm / per minute and / or the water pressure behind the bulkhead reaches 20 psi) from the Lynx 15 bulkhead / Phillips Reach sump, Mill Control will immediately call the Hoistman of the nature of the alarm and to stand-by for confirmation to initiate the stench alarm. Mill Control will confirm the situation by checking the live camera display. With the alarm and the live camera display showing high water and inflow Mill Control will request that the Hoistman trigger the stench / underground alarm system. If the live camera display is off line or not functioning Mill Control will request that the Hoistman initiate the stench system.

5.2 The Mill Control operator will standby for further instructions.

Duties of the Hoistman

5.3 The Hoistman upon being notified (call 253) of a possible flood emergency will stand-by for confirmation.

5.4 Upon confirmation by Mill Control the Hoistman will initiate the stench alarm, and follow the procedure starting at line 5.2 of NVI 118 – Initiate Stench.

5.5 The Hoistman will notify the supervisor in charge as per NVI 118 – Initiate Stench.

5.6 The Hoistman will standby for further instructions.

Duties of the Supervisor

5.7 The Supervisor shall without delay implement the emergency plan as per an underground fire and ensure that key personnel are notified. Initially the Supervisor in charge shall assume the position of chair of the Emergency Command Group until relieved.

5.8 The Supervisor in charge will call the refuge stations and notify the personnel of the nature of the emergency as soon as possible, starting with the 18-155 refuge, then calling refuges from the lower levels on up.

5.9 When personnel are accounted for or when deemed prudent and necessary the Supervisor will order the evacuation of personnel from the refuge stations to the closest shaft station. The shaft crew will hoist personnel from the lowest levels first.

5.10 If possible a man carrier is to be dispatched to move personnel to shaft stations.

Personnel Underground

5.11 Personnel underground shall upon detecting the stench warning follow the established emergency protocol, immediately stop work and proceed to the nearest refuge station. Escape routes shall be kept clear to facilitate the use of a man carrier to evacuate personnel expeditiously. Do not block access by improper parking.

5.12 A supervisor, first person in, or other responsible person shall take charge of the refuge station and immediately compile a list of persons in the refuge station and those that arrive.

5.13 Follow instructions posted in the refuge station and in the Employee Health and Safety Handbook.

5.14 The person in charge of the refuges station will be called by the emergency command team mine coordinator and advised of the nature of the emergency, in this case possible flood inundation and obtain the names of personnel in the refuge station and if anyone is missing.

5.15 When personnel have been accounted for the mine coordinator will advise the person in charge of the refuge station to evacuate and have personnel proceed immediately to the nearest shaft station. The person in charge of the refuge station shall carry the list of names of accounted for personnel and deliver it to the stench warning coordinator on the surface.

5.16 Should time be of the essence and there are unaccounted for personnel, prior to leaving the refuge station the person in charge shall ensure that a sign at the refuge station is placed to advise any straggling personnel that there is a flood emergency and that they must call first aid 318 and advise or leave a message stating their name, their location, the time and the shaft station that they intend to proceed to and then proceed to that shaft station immediately after leaving the message.

5.17 The stench warning coordinator shall take the roll of persons who have reported and advise about any possible missing persons.

5.18 Upon reaching the shaft stations the person in charge of the refuge station shall confirm that all persons that left the station are accounted for and then call the mine coordinator to advise that they are ready for pick up.

5.19 The mine coordinator will then advise the Hoistman and the Cagetender to begin retrieving personnel starting at 26 level and working up.

5.20 Upon reaching the surface personnel shall remove their tag from the board, report directly to their supervisor in the beat room and await instructions.

5.21 Those persons with current mine rescue training are to then report to the mine rescue coordinator.

6.0 COMMUNICATIONS:

6.1 The Loss Control and Training Department personnel are responsible for communicating this procedure to all personnel involved in defining requirements.

7.0 TRAINING REQUIREMENTS:

7.1 New employee hiring orientation

7.2 All regular employees, contractors and visitors.

8.0 RECORDS:

8.1 Not Applicable

9.0 RELATED DOCUMENTATION:

9.1 New Employee Orientation Checklist

9.2 Employee Health and Safety Handbook

9.3 NVI 118 – Initiate Stench

9.4 Current Phone List

10.0 REFERENCES

Not Applicable

I have read and understood the Myra Falls Operations Standard and Operating Procedure **Underground Flood Emergency**, and have demonstrated to the satisfaction of the supervisor/instructor who has co-signed below my signature that I am able to apply the requirements of this procedure in the field.

Employee/Contractor Signature: _____ Date: _____

Employee No.: _____

Supervisor's/Instructor's Signature: _____ Date: _____

Loss Control & Training Department Rep: _____ Date: _____

NOTE:

i. The sign-off is to be filed in the Loss Control & Training Department
ii. The employee/contractor is to receive a copy of the procedure