P. DOWNEY AND ASSOCIATES

INDEPENDENT TECHNICAL REPORT

on the

NorthMet Project

Located in N-E Minnesota, USA, near the town of Babbitt

Technical Update of the NorthMet Project Incorporating the established Cliffs-Erie crushing/milling/concentration facilities with the Hydrometallurgical processes described in the May 2001 Pre-feasibility study.

for

POLYMET MINING INC.

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July 2004

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GLOSSARY OF TERMS

Au	Gold
Co	Cobalt
Corps	United States Army Corps of Engineers
Cu	Copper
Definition Study Estimate	Early Estimate of Capital and Operating Costs
DNR	The Minnesota Department of Natural Resources
EIS	Environmental Impact Statement
Fleck	Fleck Resources
G & A	General and Administrative
IMC	Independent Mining Consultants Inc. of Tucson
IPGMT	International PGM Technologies Ltd.
Lakefield	Lakefield Research Limited
NRRI	Minnesota Natural Resources Research Institute
NaHS	Sodium Hydrosulphide
Ni	Nickel
North	North Limited
NSR	Net Smelter Return
PASI	Penguin Automated Systems Inc.
PCA	Pollution Control Agency of Minnesota
PGM	Platinum Group Metals
PlatSol™ Process	Patented Pressure Oxidation Leach Process
PolyMet	PolyMet Mining Corp.
RC	Reverse Circulation Drilling
Rio Tinto	Rio Tinto Limited
SO2	Sulphur Dioxide
SRK	SRK Consulting
SX-EW	Solvent Extraction and Electro-Winning
The Company	PolyMet Mining Corp.
The Project	NorthMet Project
USX	US Steel

3. Summary

PolyMet Mining Corporation ("PolyMet") is currently reviewing development options for their wholly owned NorthMet project located in St. Louis County, Minnesota.

The NorthMet Project (the "Project") is a large, polymetallic disseminated magmatic sulphide deposit containing copper, nickel, palladium, platinum, cobalt, gold and silver. It is located in northern Minnesota, USA, close to the Canadian border in the Duluth Complex (the world´s fourth largest layered mafic intrusive complex) and is approximately ten kilometers from large LTV Steel's Mine (now called "Cliffs-Erie") iron ore mill/concentrator with its established infrastructure. The Duluth Complex is a similar geologic setting to the very large Ni-Co-PGM Noril'sk deposit in Russia. NorthMet is one of the largest undeveloped nonferrous metals projects in North America. The geological resource at a 0.2% copper cut-off amounts to greater than 900 million tons containing low grades of copper, nickel, cobalt, platinum group metals ("PGM's"), silver and gold.

The NorthMet deposit was originally targeted for copper and nickel values. With low grades and poor quality concentrates, NorthMet and other neighbouring deposits remained undeveloped. The key to advancing the NorthMet project was the development of a propriety hydrometallurgical process for the treatment of a bulk concentrate on site. This single step process, now trademarked as the PlatSol™ Process, has the advantage of extracting the PGM's in addition to the base metals. After dissolution of the metals in the PlatSol™ Process step of the process, they can then be individually extracted on site - thereby avoiding dependence on off-site smelters. A successful pilot plant using the PlatSol™ Process on NorthMet ores was completed at Lakefield Research in 2000. An independent Pre-feasibility study was subsequently completed in April 2001 under the supervision of Independent Mining Consultants ("IMC") of Tuscon, Arizona with input from several international consulting firms including AMEC Mining and Metals ("Amec").

This study, for a 50,000 tonnes per day ("tpd") mine, demonstrated unacceptable project economics due to low mined grades and high capital costs. Subsequently, due to funding restraints, PolyMet was not able to optimize the study. The reader is requested to refer to the PolyMet Pre-feasibility study of April 2001 which can be found on the SEDAR website.

In March 2003, new management took over PolyMet to complete optimization work and to study ways of improving project economics. A new technical program, supervised by the author, and a project execution strategy was completed in July 2003. Recommendations included:

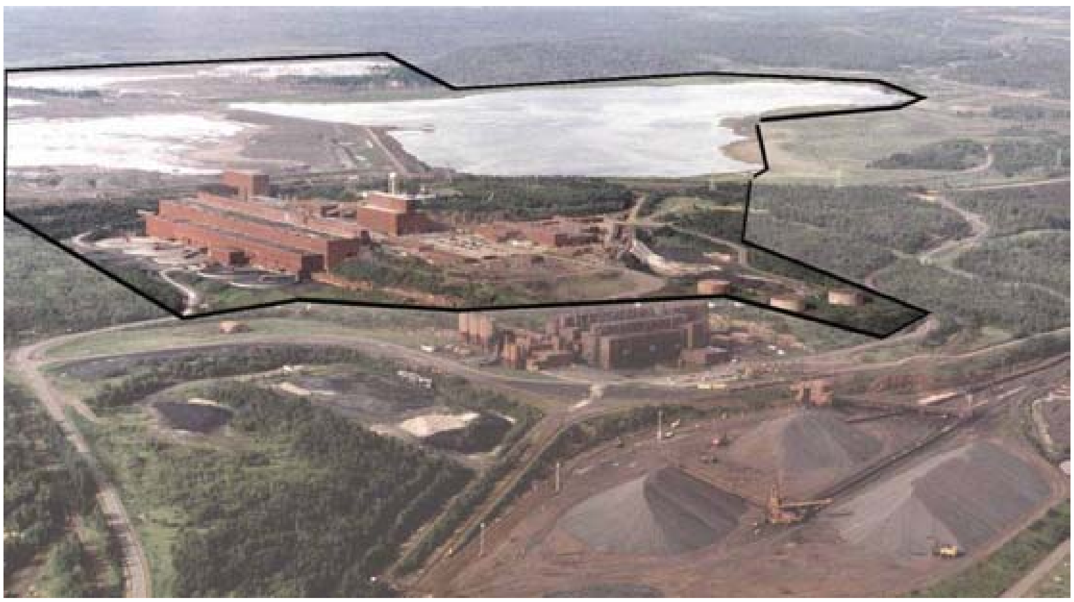
- Re-working the mining data base to produce a mine plan at the 25,000 tpd level to increase mined head-grade.
- Simplification of the process circuits by only producing copper metal on site and producing separate PGM's and nickel hydroxide concentrates for off-site treatment.
- Acquiring the nearby Cliffs-Erie mothballed crusher/mill/concentrator and all of the land needed for stockpiles, tailings disposal, water supply and storage. This

facility also provides preferential electricity rates and includes a fully established infrastructure of roads, rail, warehouses, offices, workshops and spare parts. See Figure 3.1.

- Utilizing a mining contractor, to avoid up front capital on the mining fleet.

This rework of the Pre-feasibility material indicated that a technically simpler project, with lower daily tonnage, higher grades and considerably lower up front capital could result in a viable economic project. PolyMet subsequently completed an option agreement with Cleveland Cliffs Inc. to acquire key buildings, land and equipment from the recently closed Cliffs-Erie mill/concentrator.

Figure 3.1 - Aerial photograph of the Cliffs-Erie facilities:



The area within the black line has been optioned by PolyMet

Cliffs-Erie was built in 1955 and processed 100,000 tpd of taconite ore prior to closure in 2000.

This report deals mainly with the option agreement dated February 16, 2004 whereby PolyMet has the right to acquire certain key assets of the Cliffs-Erie process plant and infrastructure (outlined in the above photograph) which are located within 10 km of PolyMet's proposed open pit. The focus of this report is on the integration of the established Cliffs-Erie infrastructure plus existing crushing, milling and flotation circuits with a new hydrometallurgical plant for on site metal recovery. In addition certain process simplifications have been made to the 2001 Pre-Feasibility. The 2001 study was based on producing nickel and cobalt metal. The current flowsheet is based on production of separate nickel metal hydroxides and PGM hydroxides, thereby greatly simplifying the process circuit.

No new work has been done on geology, exploration or resource definition. However certain relevant sections of the 2001 PolyMet Pre-feasibility study have been included for ease of reference.

Re-use of this "brownfields" facility and its established infrastructure could, by current estimate, enable (fully loaded) capital cost savings of approximately US$196 million, based on the figures produced for the 2001 Pre-Feasibility Study. The elimination of the circuits to produce nickel metal and a cobalt salt on site could also reduce up-front capital by approximately $60 million and use of a mining contractor could reduce the pre-production capital by approximately $95 million in capital costs based on the 2001 Pre-feasibility. Together these approaches should reduce technical risk and financial exposure.

The scoping level capital required for an initial 25,000 tpd operation is estimated to be US$235 million with an expected accuracy range of +30%/-20%. The capital costs were completed by Penguin Automated Systems Inc. ("PASI") for the mill and infrastructure which were supervised and reviewed by the author. The mining capital costs are based on the original Pre-Feasibility study completed by IMC and updated to reflect a smaller tonnage throughput and contract mining.

The estimated operating cost is US$ 10.44/tonne of ore based on first quarter 2004 dollars. These costs reflect the current mine plan with mining by contractor. The costs also reflect the simplified flowsheet and current power costs for the Cliffs-Erie facility. A contingency of 5% has also been included. The operating costs exclude the selling costs, shipping and smelting costs associated with the products.

The scoping study is based on measured indicated and inferred resources that are considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as mineral reserves. Therefore there is no certainty that the results produced by this scoping study will be realized.

The results of this scoping study do indicate that the NorthMet project, integrated with the existing Cliffs-Erie, facilities, shows sufficient potential to be carried forward into the next phase of engineering, a feasibility study. The purpose of the feasibility will be to examine further all aspects of the project and establish with greater accuracy its technical and economic viability.

This conclusion is based on the resource data and order-of-magnitude capital and operating costs presented in this study.

4. Introduction and Terms of Reference

The author was initially retained in 2000-2001 by PolyMet to review the pre-feasibility study completed for PolyMet in April 2001 and conduct a technical audit of process and infrastructure matters on behalf of PolyMet at that time. The author has therefore been intimately involved with the project with particular reference to process development of the new PlatSol™ Process, the mining program and the infrastructure required for the initial planned development. No further technical work was conducted on the NorthMet project between the completion of the 2001 Pre-feasibility and this report.

The author was retained by PolyMet in 2001 to conduct a technical audit of the processing aspects of the Pre-feasibility study and visited the project site at that time. The PlatSol™ Process was developed at Lakefield Research, Ontario, under the supervision of Messrs O'Kane, Dreisinger, Fleming and Feron; who subsequently became the patent holders of PlatSol™. Amec (formerly Agra Simons - Mining & Metals group) of Vancouver, B.C., was the company responsible for developing the engineering parameters of the process as well as infrastructure aspects for the 2001 Pre-feasibility study. Ore resource calculations, mine plan and mine capital and operating costs were completed by IMC.

PolyMet subsequently retained the author in May 2003 to conduct an assessment of the project whereby the infrastructure, material transport, crushing, milling and flotation elements of the original Amec study were to be replaced by the established Cliffs-Erie plant and infrastructure. The author either directly produced the new project data or supervised the work of other specialists. The results of this technical program are contained in this interim report.

IMC was also retained in May 2003 to re-examine their resource data base, established for the 2001 Pre-feasibility study, and requested to produce a new mine model for a reduced production rate. This work is included as Appendix I.

A scoping study by PASI was completed in April 2004 and is included as Appendix II to this report. The PASI study integrated the existing front end of the Cliffs-Erie plant and infrastructure with new hydrometallurgical plant at the Cliffs-Erie site. Capital and operating costs were updated to March 2004.

5. Disclaimer

Amec was the company responsible for developing the engineering parameters of the process as well as infrastructure aspects for the 2001 Pre-feasibility study. Ore resource calculations, mine plan and mine capital and operating costs, were completed by IMC. A scoping study by PASI was completed in April 2004 and is included as Appendix II to this report.

The author visited the NorthMet site in 2001 as part of his responsibility in completing an audit review of the process and infrastructure work conducted by Amec Engineering Co. The costs reported here have been updated to March 2004. In the recalculation of mineable grade, IMC used operating costs prepared by P. Downey and Associates but did not factor in the improved capital costs in terms of determining mineable tonnage.

The author has relied on the data that was made available to him by, Lakefield Research, AMEC, IMC, PASI, the 2001 Pre-feasibility Study, and does not take any responsible for any errors or omissions. Reports that contain information relevant to this report are listed in item 23. The material supplied and that in the public domain, combined with personal knowledge-observations were sufficient to allow a comprehensive examination of the NorthMet Project.

P. Downey and Associates has no propriety interest in the technology described here and does not own any equity stake in PolyMet.

6. Property Description and Location

6.1 Areas and location

The NorthMet project is located in northern Minnesota, USA, close to the Canadian border, in the Duluth Complex. See Figure 6-1. The NorthMet Project is located in the Great Lakes region of North America, near the town of Babbitt, Northern Minnesota, USA. The area is approximately 65 km from the Canadian border and 75 miles from a bulk materials dock on Lake Superior. Materials and supplies may be brought in by an extensive rail and road network accessing destinations across North America.

The proposed NorthMet open pit lies immediately south of the mined out Cliffs-Erie taconite iron ore open pits and about 10 km to the N-S-E of the Cliffs-Erie plant. The Minnesota Iron Range extends for approximately 200 km, east to west, and the iron formations dip gently to the south at about 5 degrees. At the eastern end of the range, south of the town of Babbitt, there are certain magmatic deposits which overlie the iron formations. The deposits are low grade and polymetallic- typically 0.4% copper; 0.12% nickel; 0.05 grams per tonne (g/t) gold; 0.08 g/t platinum and 0.36 g/t palladium.

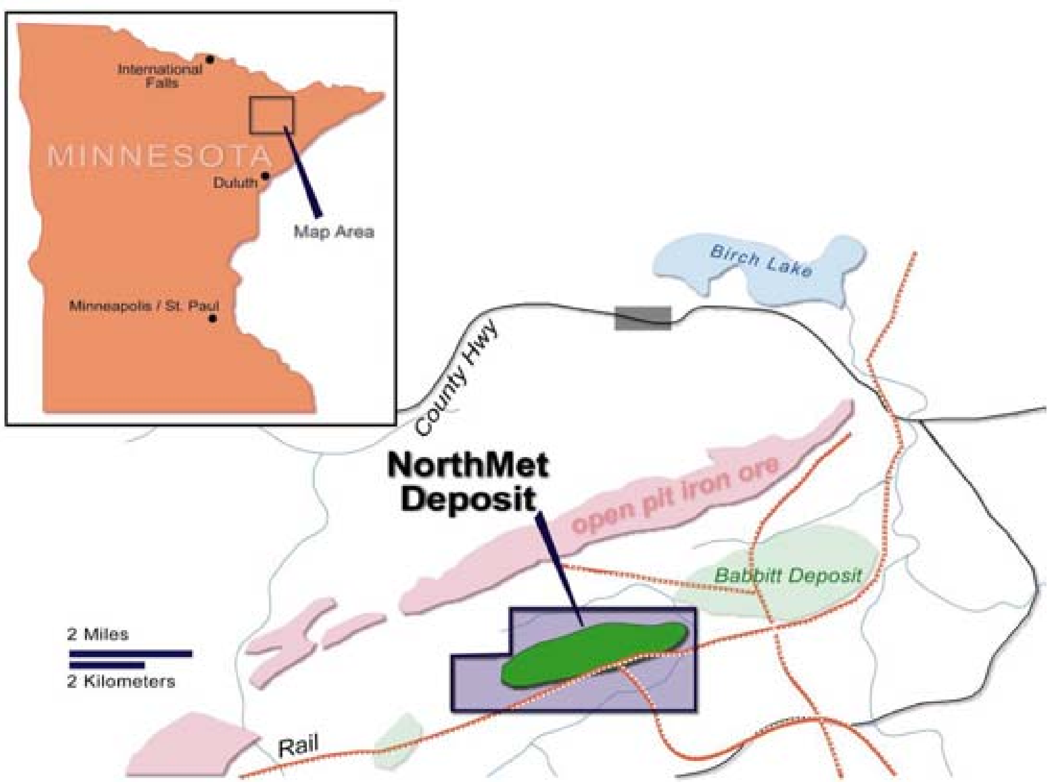


Figure 6.1 - Location of NorthMet Project

6.2 Ownership

The underlying mineral rights are owned by US Steel Corp and a 3% NSR royalty applies to production from the project. Most of the surface land is controlled by the US Forestry Service ("USFS"). The rights to the project are held by PolyMet's US subsidiary, PolyMet Mining Inc.

In 1989, PolyMet (as Fleck Resources) acquired a twenty year renewable lease for the mineral rights to the NorthMet deposit from USX-see Figure 6.2. The lease is subject to a yearly lease payment before production and then to a 3 to 5% sliding scale Net Smelter Return royalty based on the value of the ore. The lease payments prior to production are considered advance royalties and will be credited to the production royalty.

The USFS acquired the surface rights to the NorthMet property from USX in the 1930's and, at present, the USFS remains the surface rights owner of most of the NorthMet property. USX retained the mineral rights and the right to explore and mine on the site. As a result of this retention, while the USFS is the surface rights owner for most of the NorthMet Property, they cannot prohibit mining on the site. LTV Steel Mining Company/Cliffs Erie Mining Company owns portions of sections 10, 11 and 12 near their private railroad. However, it may be beneficial for the Project to enter into land swap arrangements with the USFS to simplify the permitting process and to allow the project access to lands for waste rock stockpiling. The use of the existing Cliffs-Erie abandoned pits for waste storage from the Northmet mine could obviate such forestry issues and this will be evaluated during the feasibility study. US regulations require an equivalent value of land to be swapped for the land to be used by the Project. The USFS has indicated to PolyMet their willingness to carry out such a land swap. Costs for completing land swap arrangements have not been included in Estimates of Capital Costs.

As both the Environmental Impact Statement ("EIS") and permitting of the project will be subject to the arrangements of the land swap, PolyMet believes that this land swap with USFS should be completed in conjunction with the Bankable Feasibility Study. PolyMet therefore intend to commence those negotiations with USFS early in the Bankable Feasibility Study timetable.

Table 6.2 - Land Swap

Task	**Cost (US$ Million)**	**Start (Month Number)**	**Timing (Months)**
US Forest Service Land Swap	**3.5**	**1**	**24**

Figure 6.3 shows surface owners in the area of the potential NorthMet pit and waste dumps. Information on the land map was compiled from preliminary work done by North Mining and from the St. Louis County Land Atlas and Plat Book (1996).

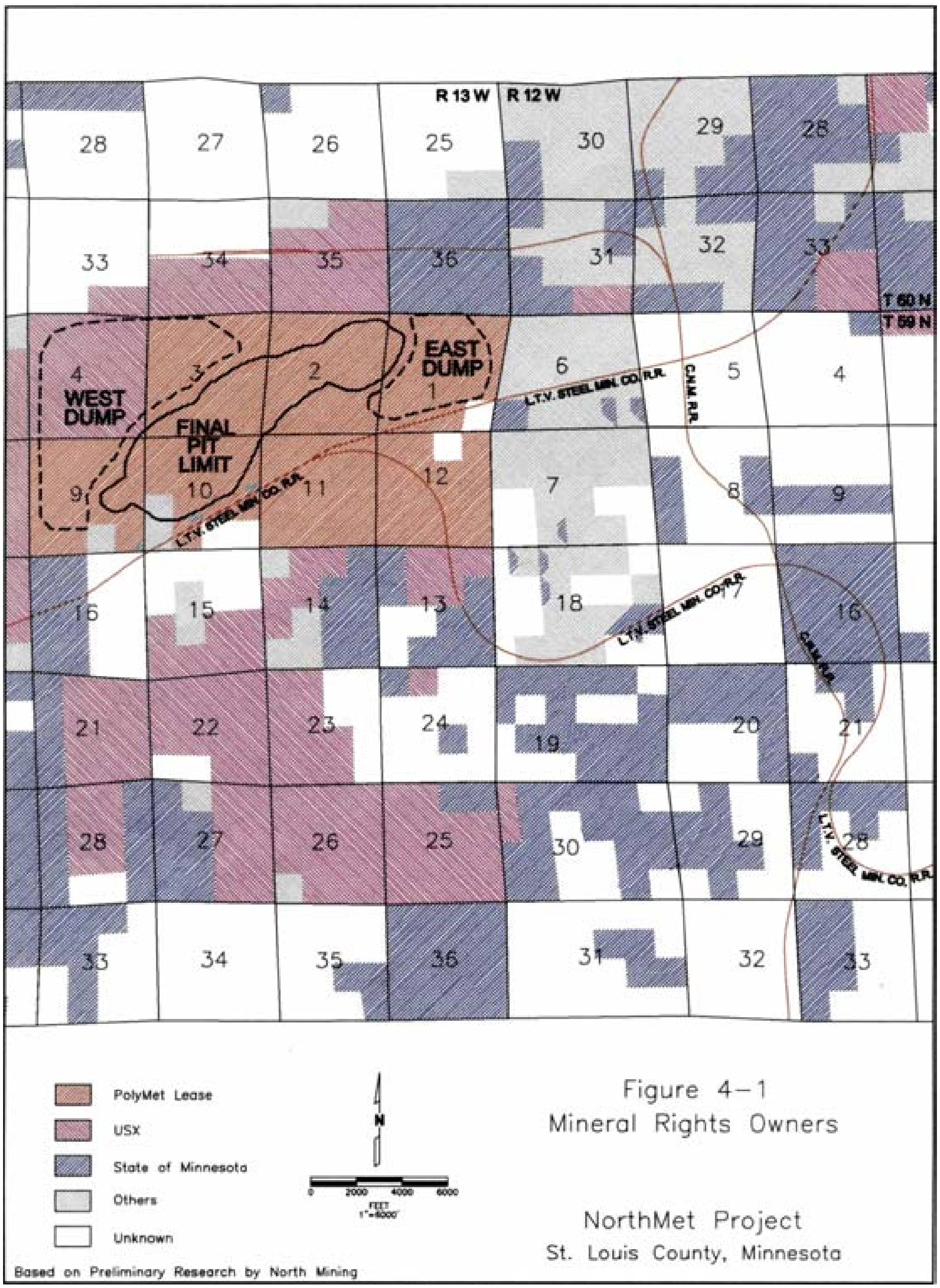


Figure 6.2 – Mineral Rights Owners

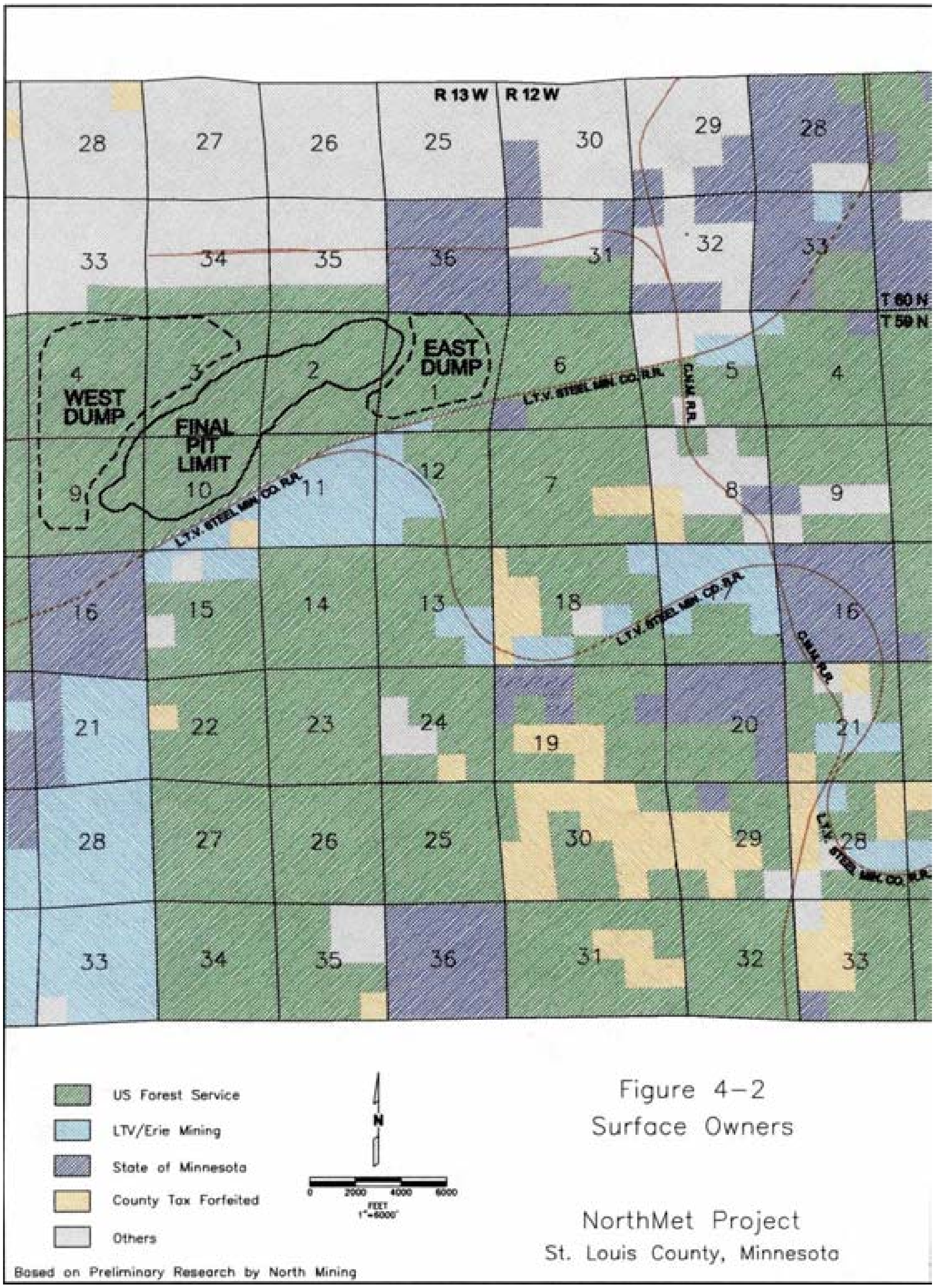


Figure 6.3 – Surface Owners

6.3 Environmental

During the Pre-feasibility study, PolyMet had on staff a number of environmental consultants to coordinate both the environmental studies and the permitting required to bring the NorthMet Project to production. No cultural sites were identified either from a review of existing data and literature, or from aerial photographs. The neighboring Babbitt Project (also called Minnmax) completed a full EIS which was filed as a public document by then operator Amax Mining and this study did not produce any significant findings. NorthMet completed their-own preliminary Baseline Environmental Study in April 2000. This study addressed:

- Wildlife Usage, including threatened and endangered wildlife;
- Preliminary Wetlands Survey;
- Ground Water Quality; and
- The Development of the Geochemical Study Plan.

No evidence was found of any threatened or endangered animals in the area. The area was identified as a major wetland area with some 70% of the land being classified as wetlands. The wetlands that will be disturbed by operations at NorthMet will have to be replaced on at least a 1:1 ratio in terms of the existing wetland mitigation scheme. The practice of replacing wetlands is well established in the area and this can be a relatively high ongoing operating cost for a project. The use of the extensive tailings and water storage areas which are part of the Cliffs-Erie deal should mitigate most of such costs. Disturbance of the wet lands in the open pit area would be the most affected area.

Table 6.3 - Estimated NorthMet Wetlands Mitigation Requirements

Area		Acres
Pit		1020
Rock Dump West -	CE Pit back fill	0
Rock Dump East -	CE Pit back fill	0
Flotation Tailings Dam -	CE permitted site	0
Hydro-Metallurgical Residue Dam -	CE existing	0
Plant and Roads -	CE existing	0
Total		**1020**
Wetlands Mitigation Requirement at 70%		**714**

In terms of the Federal and State Wetland Mitigation legislation, the NorthMet Project must replace any wetlands disturbed on the NorthMet property on at least an acre for acre basis. Initial surveys undertaken have shown 70% of the NorthMet open pit area is classified as wetlands. Land use estimates from the 2001 Pre-feasibility study by Steffen Robertson & Kirsten ("SRK") and IMC are given in Table 6.3. The use of Cliffs-Erie obviates almost all of the previous requirements from the 2001 study.

The option to use key lands and impoundments in the Cliffs-Erie deal lessens the original estimates of the Wetlands Mitigation requirements. These are currently considered to be limited to the open pit area of 1020 acres. Wetlands Mitigation is a key step in bringing the NorthMet Project into production. With this reduced Wetlands Mitigation scope the costs will now be part of the required project capital and not an up-front cost component within the Bankable Feasibility Study.

The major steps, estimated costs and timetable required to complete all environmental matters to obtain the necessary State and Federal permits are generally described in Table 6.4 below. The use or re-use of the Cliffs-Erie site will obviate much of the costs and requirements projected in the 2001 Pre-feasibility study since critical items like tailings areas are already included.

The land swap with USFS has been included separately in the cost and timing estimates given in Table 6.4. While it could have a significant impact on the EIS and permitting process, the early completion of this land swap should simplify and accelerate the EIS and permitting process

.

Ground water quality was also found to be very good. Given the extensive waterways and related fishing activities in Minnesota, there are exceptionally low State limits (0.0013 micrograms/litre) for mercury discharges. There was no evidence of mercury in the NorthMet ore body, and process and pilot plant test work to date have not shown any mercury in tailings or residues.

During the Bankable Feasibility Study, further geochemical work on the waste rock and various process plant tailings and residues should be conducted to test for their acid forming and metal release potentials under normal climatic conditions. This work will determine storage and disposal solutions for mine and plant waste, tailings and residues.

In order to enable the timely completion of project permitting and meet Federal and State environmental requirements, the EIS process will be initiated during the Bankable Feasibility Study. The Pertinent aspects of the permitting process must be constantly monitored during the feasibility study. A draft EIS will be released for public comment prior to completion of the Bankable Feasibility Study. Subject to the satisfactory completion of the EIS, the Project will then apply to obtain the necessary construction and operating permits to develop the Project. The EIS will include the following:

- Collection of all Baseline data for submission to EIS team;
- Development and submission of Plan of Operation;
- Minnesota Department of Natural Resources ("DNR") selection and appointment of sub-contractor (environmental consultants) to prepare EIS;
- Sub-contractor preparation of draft EIS;
- Draft EIS released for public comment;
- Final EIS prepared and issued;
- Federal Findings of No Significant Impact and Record of Decision;
- Awarding of State Environmental Permits.

6.4 Permits

The major permits required by the Project are:

- Plan of Operations/Environmental Impact Statement;
- Mining and Reclamation Permit (Mining and Closure Plan) issued by the DNR;
- Air Emissions Permits (one for construction and one for operations) issued by Pollution Control Agency of Minnesota ("PCA");
- State Wetlands Review;

- Minnesota Non Ferrous Mine Permit and Five Year Operating Plan;
- Storm Water Permit;
- 401 Water Quality Certification;
- Water Discharge Permits (Surface and Ground Water) issued by PCA; and
- 404 Wetlands Mitigation Permit issued by the United States Army Corps of Engineers ("Corps").

As the project moves forward PolyMet will need to work with the relevant agencies to amend existing permits where required for use on the base metal operations at NorthMet and Cliffs-Erie.

Table 6.4 - NorthMet EIS and Permitting Cost and Timing Estimates

Task	**Cost (US$ Million)**	**Start (Month Number)**	**Timing (Months)**
Baseline Study	0.45	1	6-10
Plan of Operations	0.15	6	2
Preparation of Draft EIS	0.30	11	12
Preparation of Final EIS	0.60	23	6
Major Permits	0.40	8	22-29
Federal Record of Decision		30-32	1
Total	**1.90**		**34**

As can be seen from Table 6.4, the expected time line from start to receipt of the required permits for the operations could be approximately 3 years at an estimated cost of US$1.90 million. This excludes any cost of land acquisition or swapping for wetlands mitigation and the estimated cost of US$3.5 million for the USFS land swaps.

The political climate in Minnesota is favourable for permitting of a new mining operation. The communities in the Iron Ore Range have been badly affected by the recent mine closures, and the existing labour force is seeking employment. Officials throughout the Minnesota state government have indicated a strong desire to replace the lost income and jobs and to assist in getting new economic development underway in the area.

7. Accessibility, Climate, Local Resources, Infrastructure & Physiography

7.1 Topography, elevation and vegetation

The surrounding country is flat lying with some low rolling hills. Much of the terrain has relatively poor drainage, with numerous lakes and wetlands. Much of the NorthMet pit is covered with poor quality second growth timber and the land is generally of a marshy nature and poorly drained.

The deposit is within 10 km of the Cliffs-Erie crusher/mill/concentrator facility. The project area is essentially flat and at an elevation of around 490m above sea level.

7.2 Access, towns and transport

The large iron ore mines in the area have been developed since the mid 1950's and the NorthMet project lies immediately adjacent to one of these mines. As such, there exists, fully developed transportation, infrastructure and communication systems close to the NorthMet property. A well maintained system of road and rail transport allows shipment in of supplies and export of finished product. The property is located 95 km by rail to a harbour on Lake Superior and certain materials for the NorthMet project will be subject to marine transport.

The NorthMet property is located close to various townships that served the iron ore mines. With the closure of certain taconite operations, there is a sizeable and trained workforce available in the immediate area. The nearby town of Hoyt Lakes was built specifically for the Cliffs-Erie operation.

The acquisition of the Cliffs-Erie site will provide greater than 80% of infrastructure required for the development of the project, including excellent road and rail access and low cost industrial power. The Cliffs-Erie rail tracks and established roads run alongside the planned NorthMet pit and a new spur and rail load-out facility will link to this existing rail infrastructure.

The electrical distribution and sub-stations from the main feed at the plant site are fully operational and will be used for the PolyMet project. Water permits also exist for the Cliffs-Erie facility. The town of Babbitt, 10 km to the north of NorthMet, and Hoyt Lakes 10 km to the south have the community infrastructure to support the requirements of the NorthMet workforce.

Reclaim water, utilities and services, compressed air supply, power supply and distribution, offices, warehousing and laboratories will all be provided for by existing facilities at the Cliffs-Erie plant site. New assay laboratory equipment will be purchased for the NorthMet project.

7.3 Climate

The northern Minnesota climate is continental, characterized by wide variations in temperature. The temperature in Babbbit (10 miles north of the property) averages -14ºC (7ºF) in January and 19ºC (66ºF) in July. The average annual precipitation is 28 inches with about 30% during the months of November and April and 70% from May through October.

8. History

The NorthMet Project was discovered by US Steel Corp. ("USX") in 1969. Originally, it was thought to be a high-grade, underground copper-nickel resource. Drilling in the 1970's demonstrated that it was in fact a high tonnage, low grade deposit, amenable to open pit mining. The grade improved at depth. The inability to produce separate clean nickel or copper concentrates led to further process evaluation and development. At that time there was no recognition of any contained PGM's.

The Minnesota Department of Natural Resources ("DNR") subsequently discovered that PGM's were associated with the nickel and copper in the resource. In 1989, Fleck Resources ("Fleck") acquired a 20-year renewable mining lease over the property from USX and commenced an investigation into the potential for mining and recovering copper, nickel and PGM's. Fleck re-assayed pulps and rejects from previous drilling to obtain data on PGM's. The encouraging potential to produce extra revenue attracted joint venture partners (Nerco and Argosy Mining) who assisted in identifying and quantifying the PGM values. However these companies were not able to develop a metallurgical process that could economically produce separate acceptable concentrates for sale to a smelter, or economically extract the contained metals from a bulk concentrate.

In the mid-90's, Fleck began investigating the use of hydrometallurgical processes, including bio-leaching and pressure oxidation, to determine the benefit to the Project. Fleck Resources changed its name to PolyMet Mining Corporation in 1998 and focused on a hydrometallurgical extractive technology. This led to the development of the PlatSol™ Process in 1998. The operating conditions of the PlatSol™ Process are such that the copper, nickel, cobalt and precious metals are all placed in solution in a single operation. Since the initial PlatSol™ Process testwork, the process has evolved and testwork on concentrates other deposits around the world led to improved recoveries of PGMs from the 92% level to 97%.

In July 2000, PolyMet entered into a joint venture arrangement with North Limited ("North"), a major Australian mining company, to progress the NorthMet Project to commercial production. Under the joint venture arrangement, North had the opportunity to ultimately earn an 87.5% interest in the PolyMet Project through funding and production of a Bankable Feasibility Study and funding 100% of the total capital costs to develop the project.

In August 2000 Rio Tinto Limited ("Rio Tinto") completed an on-market takeover of North. Subsequently, Rio Tinto decided not to proceed with the NorthMet project and PolyMet exercised its 30-day pre-emptive right, under a "change of control" clause, to terminate the joint venture arrangement. Consequently, PolyMet has regained a 100% interest in the NorthMet Project.

Following completion of the metallurgical pilot plant work in November 2000, PolyMet commissioned a Pre-Feasibility Study on the project in November 2000, based on the PlatSol™ Process. This study was completed in April 2001. The Pre-Feasibility Study was for a 50,000 tpd operation. The economics of this project were found to be unacceptably low and required a high up front capital expenditure. No further work was done until March 2003, when new management took over the company and commenced a detailed review of the project.

9. Geological Setting

9.1 Regional Geology

The geology of northeastern Minnesota is predominantly Precambrian in age. Approximately 1.1 billion years ago, intra-continental rifting resulted in mafic volcanics and associated intrusions along a portion of the Midcontinent Rift System, which extends through the Lake Superior Region to Kansas (Figure 9.1). The rift system is characterized by a gravity high and the thinning or absence of continental crust.

The Midcontinent Rift consists of three parts: thick lava flows, intrusive rock and overlying sedimentary rock. The volcanic sequences are generally tholeiitic to sub-alkaline flood basalts derived from a mantle source. Minor felsic to intermediate flows exhibit crustal contamination. There are three major intrusive complexes: the Coldwell Complex of Ontario, the Mellen Complex along the south shore of Lake Superior and the Duluth complex along the north shore. The sedimentary rocks are mainly fluvial red beds filling the rift structure. The Duluth Complex (Figure 9.2) is the host of NorthMet mineralization. The complex lies along the projection of the Great Lakes Tectonic Zone, an Archean suture zone, the Archean Vermilion Fault and the Early Proterozoic shelf margin. It extends in an arcuate belt from Duluth to the northeastern tip of Minnesota. Emplacement of the intrusion appears to have been along a system of northeast-trending normal faults that form half-grabens stepping down to the southeast (Figure 9.3). The magma was intruded as sheet-like bodies along the contact between the Early Proterozoic sedimentary rocks of the Animikie Group and the basaltic lava flows of the North Shore Volcanic Group.

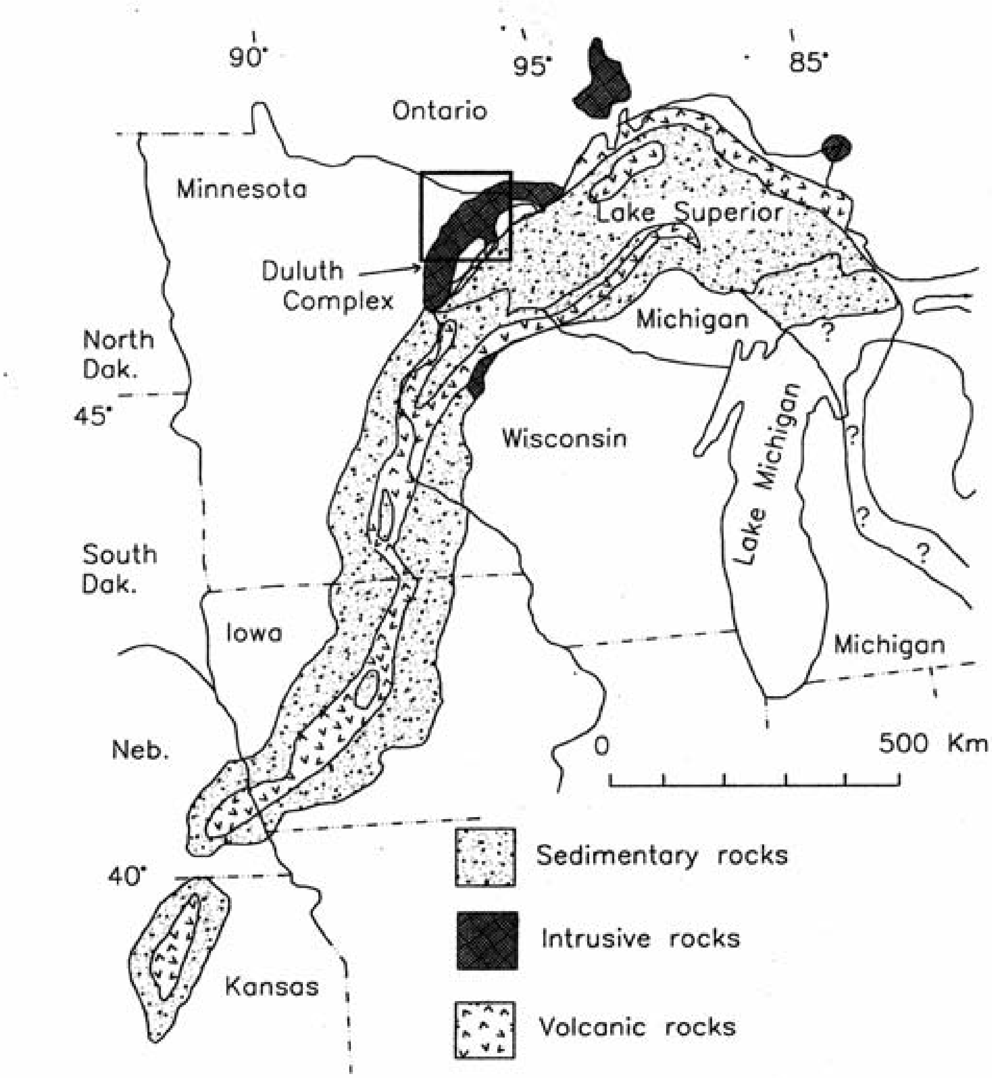


Figure 7-1: Extracted from the NorthMet Pre-Feasibility Study.
The midcontinent rift system.

Figure 9.1 – Midcontinent Rift System

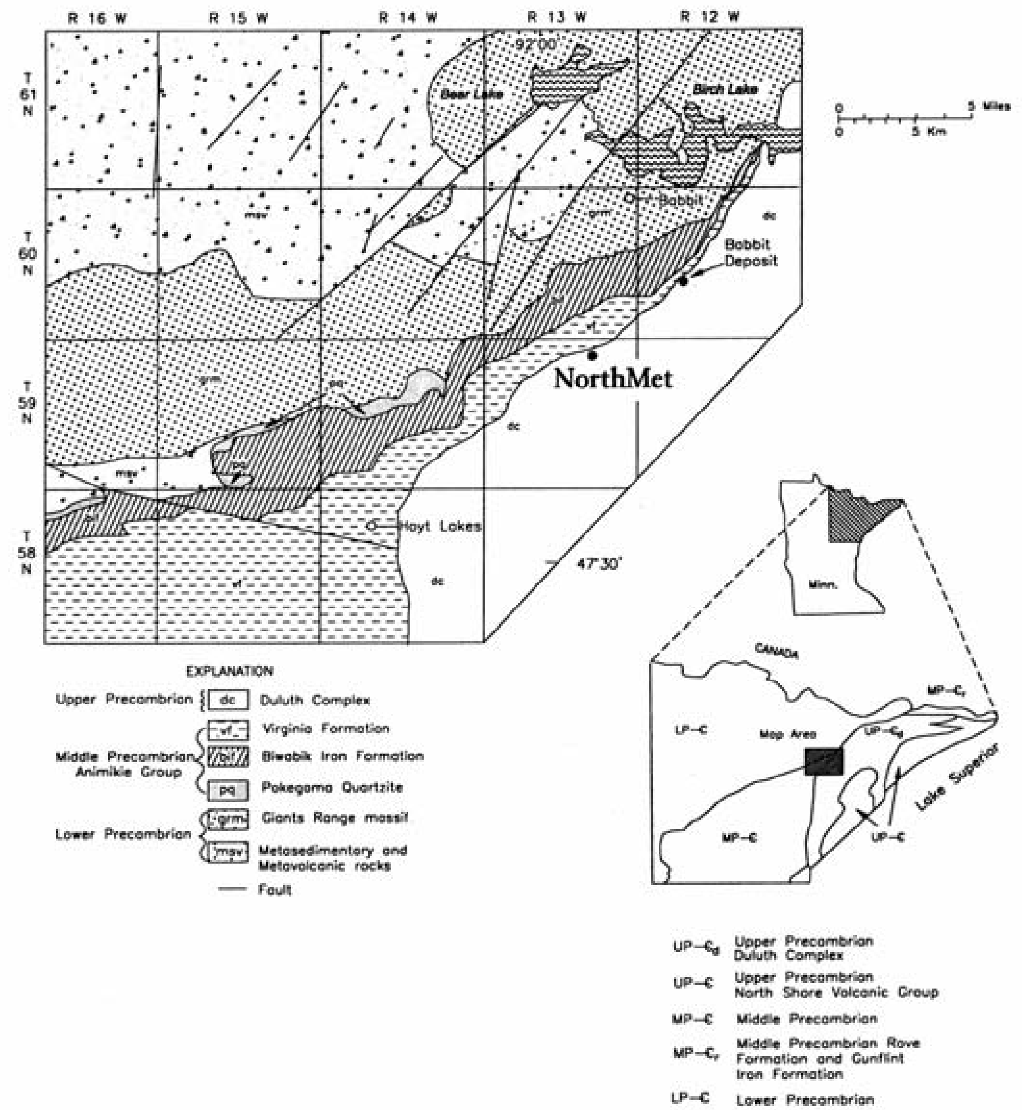


Figure 7-2 : Extracted from the NorthMet Pre-Feasibility Study.
Regional Geology of the NorthMet area. Scale c. 1:500,000.

Figure 9.2 - Regional Geology

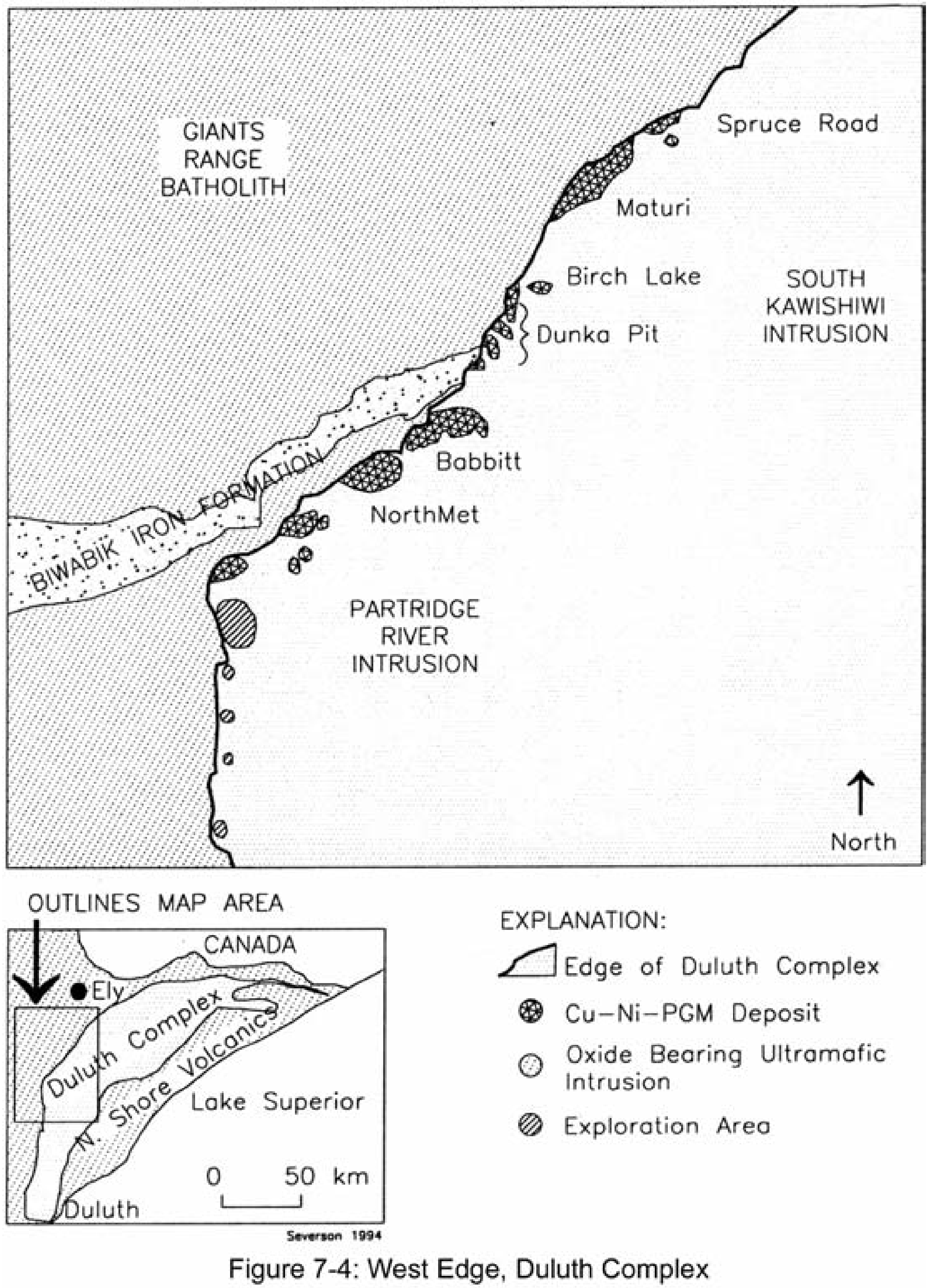


Figure 9.3 – West Edge Deluth Complex

9.2 Local Geology and Deposit Description

9.2.1 Rock Types

The Duluth Complex is represented by the Partridge River Intrusion in the NorthMet area. The intrusion consists of light to dark gray troctolitic rock varying from troctolitic anorthosite to augite troctolite, with thin layers of melatroctolite or picrite. The rock types are classified by percentage of plagioclase, olivine and clinopyroxene. The melatroctolite layers tend to be fine grained with distinct layering. The Partridge River Intrusives have been sub-divided into seven lithologic units (Figure 9.4):

- Unit 7 and Unit 6 – texturally homogeneous plagioclase-rich troctolite, each with a persistent ultramafic base. Unit 6 contains a mineralized horizon in the southwestern portion of NorthMet which is relatively enriched in PGM's relative to copper. Units 6 and 7 are each about 400 ft. thick.
- Unit 5 – coarse grained anorthositic troctolite (300 ft.) grading down to Unit 4.
- Unit 4 – homogeneous augite troctolite and troctolite, with a less persistent ultramafic horizon. The contact between 4 and 5 is difficult to establish and the two units may actually be a single unit.
- Unit 3 – the most easily recognized unit because of its mottled appearance due to olivine oikocrysts. It is fine grained troctolitic anorthosite to anorthositic troctolite. Average thickness is 250 ft. but locally can be up to 500 ft.
- Unit 2 – homogeneous troctolite with abundant ultramafic units and a generally persistent basal ultramafic. This unit shows the most variation in thickness and may be absent entirely.
- Unit 1 – the most heterogeneous unit, both texturally and compositionally. Grain size is generally coarser at the top of the unit and fines downward. The unit contains abundant inclusions of the footwall rock and is noritic towards the base. This is the main sulfide bearing unit. Two ultramafic layers are generally present. Unit 1 is probably the result of multiple pulses of magma injection. Average thickness is about 450 ft.

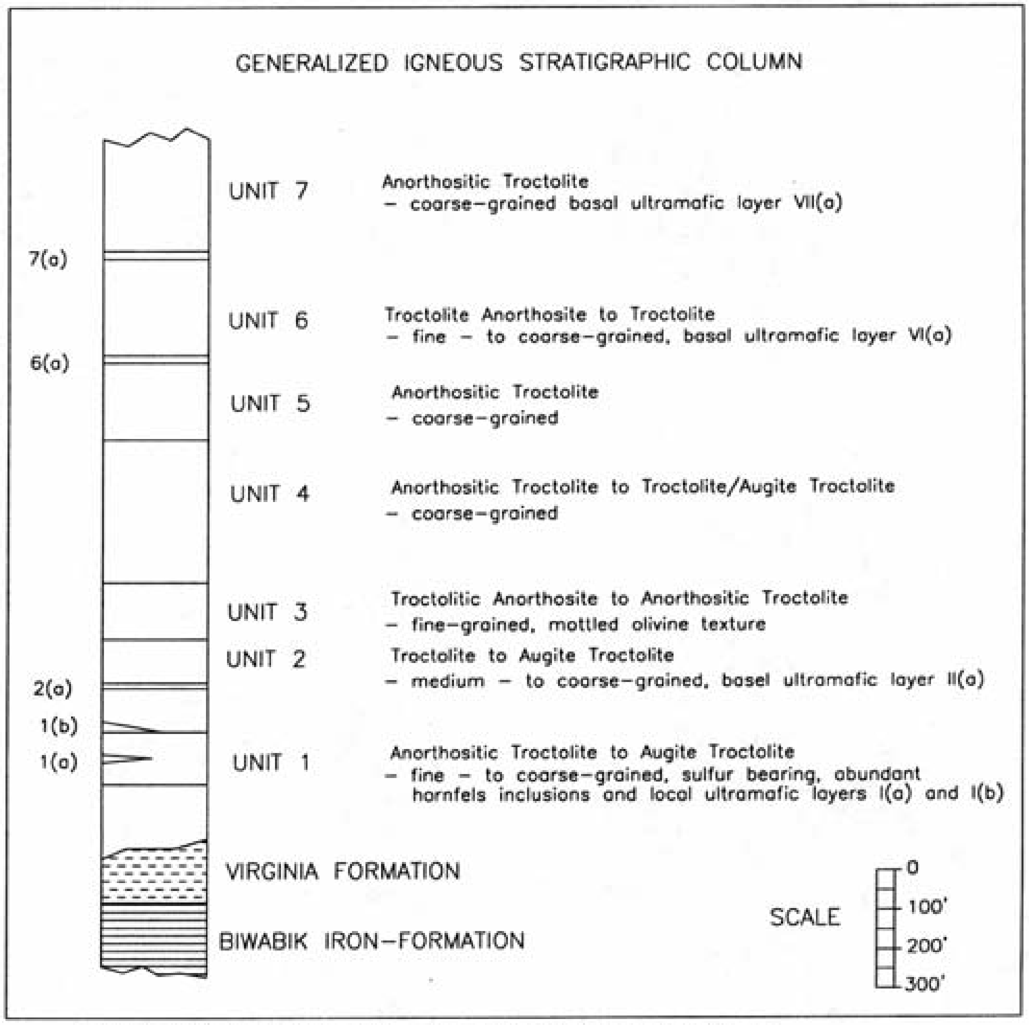


Figure 7-5: Generalized igneous stratigraphic column for the NorthMet deposit, taken from Geerts, 1991.

Figure 9.4 – Generalized Igneous Stratigraphic Column

The footwall consists of Proterozoic sedimentary rocks of the Animikie Group, which resulted from a single depositional sequence in a transgressive sea. The oldest formation, the Pokegama Quartzite, represents well sorted clastic material deposited on a stable shelf. The Biwabik Iron Formation contains alternating sequences of ferruginous chert and slate. The Iron Formation has been extensively studied because of its importance to the iron mining industry and contains several members and sub members. The youngest formation is the Virginia Formation, consisting of argillite and graphitic argillite with interbeds of greywacke, siltstone and minor calc-silicate. The Virginia Formation appears to decrease in thickness from the surface contact with the Duluth Complex toward the interior of the Complex to the southeast. Inclusions of the Virginia Formation, as biotite hornfels, can be found in all units, but are especially abundant in Unit 1.

9.2.2 Structure

The general trend of the sedimentary rocks at the NorthMet deposit is to strike to the east-northeast and to dip to the southeast about 15-25°, and the Partridge River Intrusion appears to follow this general trend. Two east-northeast trending faults have been identified through the construction of cross sections. The faults are steeply dipping and normal in character; offset ranges from negligible to 600 ft. down to the southeast. A third major fault has been identified in the western portion of the area and can be traced to the Northshore Mine in the north. Movement on this fault is down to the east. Numerous other faults can be identified in the cross-sections, but offset is small and they lack continuity. The cross-sectional view shows considerable offset in the more southerly fault, and less offset on the more northerly fault. This relationship can vary over the strike of the deposit.

10. Deposit Types

There are two types of mineralization related to the rift system: hydrothermal and magmatic. The hydrothermal deposits include native copper in basalts and sedimentary interbeds, such as on the Keewenaw Peninsula, sediment-hosted copper sulfide and native copper, represented by the White Pine Mine of Michigan, copper sulfide veins in volcanics and polymetallic veins (Ag-Ni-Co-As-Bi) in volcanics. The magmatic deposits include Cu-Ni-PGM mineralization and Ti-Fe mineralization in the Duluth complex, uranium and rare earth elements in carbonatites and Cu-Mo in breccia pipes. More locally (Figure 10.1), the magmatic deposits lie along the northwestern contact of the Duluth Complex with the underlying sediments and Giants Range Batholith. NorthMet and the Babbit (or Minnamax) deposits are the largest of the Cu-Ni-PGM mineralization.

The majority of the rock at NorthMet is unaltered, with minor alteration found along fractures and micro-fractures. Alteration consists of serpentine, chlorite and magnetite replacing olivine, uralite and biotite replacing pyroxene, and sausserite and sericite replacing plagioclase. As would be expected in a magmatic deposit of this type, sulfide mineralization does not appear to be directly related to alteration.

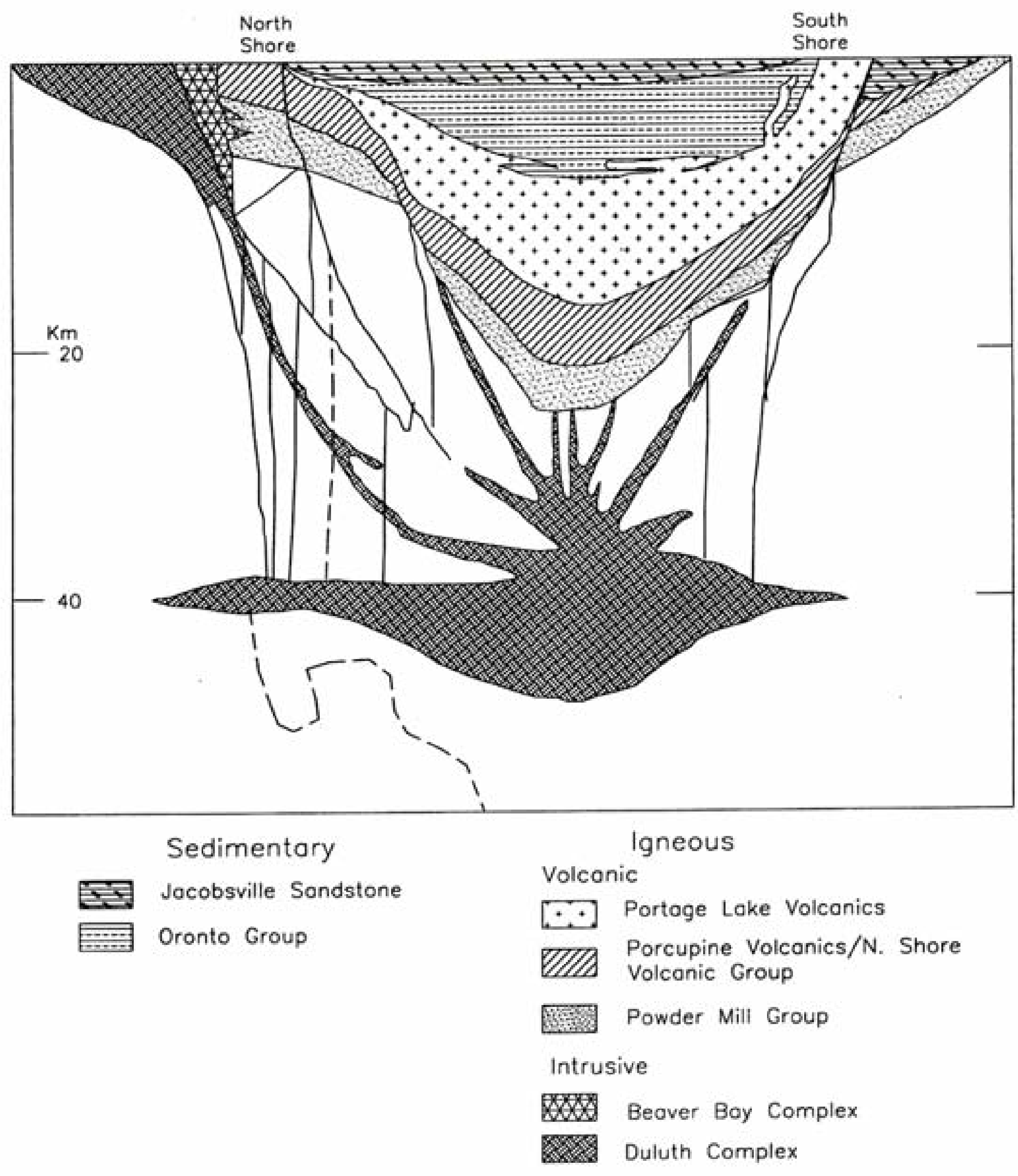


Figure 7-3: Generalized Cross-Section
Mid Continent Rift System

Figure 10.1 – Midrift Cross Section

11. Mineralization

The metals of interest at NorthMet are copper, nickel, cobalt, platinum, palladium, gold and lesser amounts of rhodium and ruthenium. In general, the metals are positively correlated with copper mineralization; cobalt is the main exception. Mineralization occurs in four horizons throughout the NorthMet property. Three of these horizons are within basal Unit 1 and in some drill holes the horizons are indistinguishable from each other. The thickness of each of the three horizons varies from 5 to more than 200 feet. Unit 1 mineralization is found throughout the deposit. A less extensive mineralization zone is found in Unit 6 and it is relatively enriched in PGM's compared to Unit 1.

Sulfide mineralization consists of chalcopyrite, cubanite, pyrrhotite and pentlandite with minor bornite, violarite, pyrite, sphalerite, galena, talnakhite, mackinawite and valleriite. Sulfide minerals occur mainly as blebs interstitial with plagioclase, olivine and augite grains, but also occur within plagioclase and augite grains, as intergrowths with silicates, or as fine veinlets. The percentage of sulfides varies from trace to about 5%. Palladium, platinum and gold are associated with the sulfides.

12. Exploration

Exploration has been on-going on the NorthMet property since the 1960's by various companies. The stage of exploration has advanced through several drill programs sufficient to complete a resource estimate and a Pre-feasibility study. Detailed discussion of the drill programs are addressed in Item 13 – Drilling.

Prospectors first discovered copper and nickel near Ely, Minnesota about 20 miles north of NorthMet in the 1940's. Subsequently, Bear Creek Mining Company conducted a regional exploration program resulting in the discovery of the Babbitt or Minnamax deposit (northeast of NorthMet and within the Duluth Gabbro). US Steel (USX) stated an exploration program in the Duluth Complex in the late 1960's and over the next few years frilled 112 core holes into the NorthMet property (then called Dunka Road). USX investigated the deposit as a high-grade, underground copper-nickel resource, but it was considered to be uneconomic due to lower than expected copper and nickel grades, and the inability to produce separate, clean nickel and copper concentrates. At this time, there was no recognition of any contained platinum (PGM's) or gold in the deposit.

In 1987, the Minnesota Natural Resources Research Institute ("NRRI") published data suggesting that a large resource of platinum group minerals or PGM's could be contained within the base of the Duluth Complex. PolyMet leased the NorthMet property from USX in 1989. PolyMet re-assayed pulps and rejects from the previous USX drilling to obtain data on the PGM's.

Nerco Minerals and later Argosy Mining leased the property from PolyMet in the early 1990's. Work continued on the delineation of the contained PGM's and a few additional core holes were drilled. At that time there was no metallurgical process that could economically produce either (a) separate, clean copper and nickel concentrates for sale to a smelter, or (b) economically extract the various contained metals from a bulk concentrate.

From 1998 to present, PolyMet has conducted three drilling programs totaling 87 holes for approximately 49,500 ft. of core and reverse circulation drilling. The third drilling program (13 holes for about 9,000 ft.) was completed in December, 2000.

13. Summary of Drilling Programs

No further drilling has occurred since the 2001 Pre-Feasibility Study however; the following is included for reference purposes.

Table 13.1 summarizes the drilling campaigns for the NorthMet property. Figure 13.1 and 13.2 summarize the drill campaigns. The US Steel drilling which was done during the late 1960's. The original US Steel work was based on a copper/nickel underground mining scenario. US Steel's assaying did not include the PGM's.

In 1989, PolyMet (then Fleck Resources) entered into a 20-year renewable lease with US Steel for the NorthMet (then Dunka Road) deposit. At that time, PolyMet did some logging and considerable re-assaying, including gold and PGM assays, but did not drill additional holes.

Nerco Mineral Co. leased the property from PolyMet during 1990 and drilled 4 holes (2 were unsampled metallurgical holes) and did a resource calculation as part of an evaluation of the property. Nerco allowed their option to expire during 1991.

Table 13.1: Summary of Drilling Programs

Company	Drilling Type	No. of Holes	No. of Feet	Assay Intervals
US Steel	BX Core	112	133,909	5,037
Nerco(met only)	BQ Core	2	842	167
1998 PolyMet	RC	14	6,370	1,274
1999 PolyMet	BTW Core RC Mixed Core/RC	3 18 3	2,476 9,300 2,660	455 1,868 534
2000 PolyMet	BTW Core RC	16 20	10,714 8,980	1,984 1,798
PolyMet Total		74	40,500	7,913
TOTAL		**188**	**175,251**	**13,117**
	Core Total RC Total Mixed Total	133 52 3	147,941 24,650 2,660	7,643 4,940 534

During 1998, 1999 and 2000, PolyMet did considerable additional RC core drilling, as shown in Table 13.1. Much of this drilling was to supply material for metallurgical testing, as well as resource definition.

Table 13.1 shows that the drilling through October 2000 consists of 133 core holes for 147,941 ft., 52 RC holes for 24, 650 ft. and 3 mixed holes (initial RC followed by core) for 2,660 ft. PolyMet drilled 13 core holes in November-December 2000 that are not included in this Pre-feasibility study.

Figure 13.3 is a map showing the locations of the US Steel and PolyMet drilling. The NERCO holes are also posted, but they are not obvious since they twinned US Steel holes. The map shows that the PolyMet drilling is mostly in the area where the deposit is near the surface (since the deposit strikes about N57°E and dips 25° to 36°SE. The only deep drilling is provided by the US Steel holes.

Figure 13.4 shows a cross section of the deposit with the rock type geology included. It can be seen that the geologic interpretation consists of 20° dipping rock units offset by near vertical faulting. Copper grades are also shown on the section.

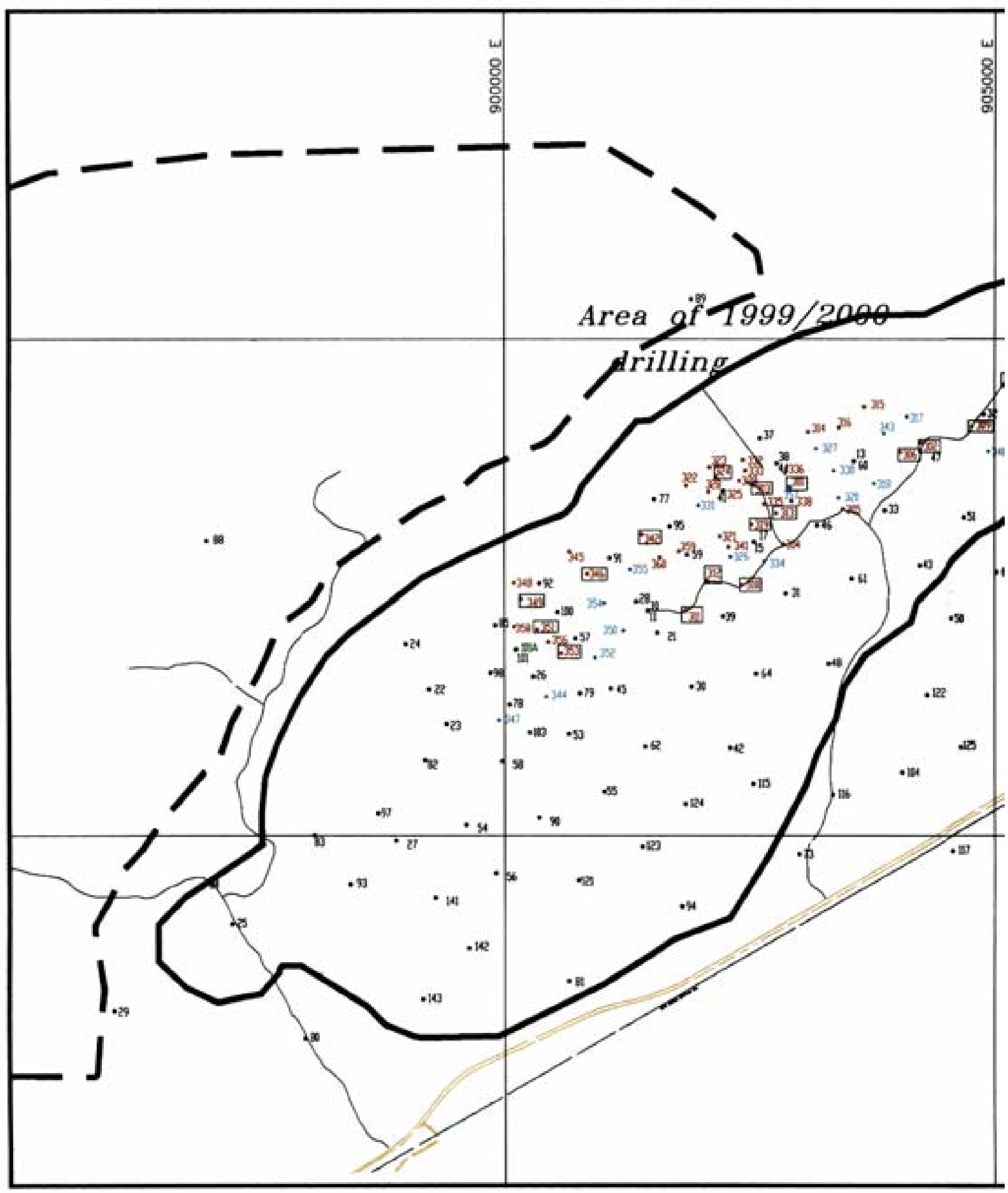


Figure 13.1 – Area 1999 - 2000 Drilling

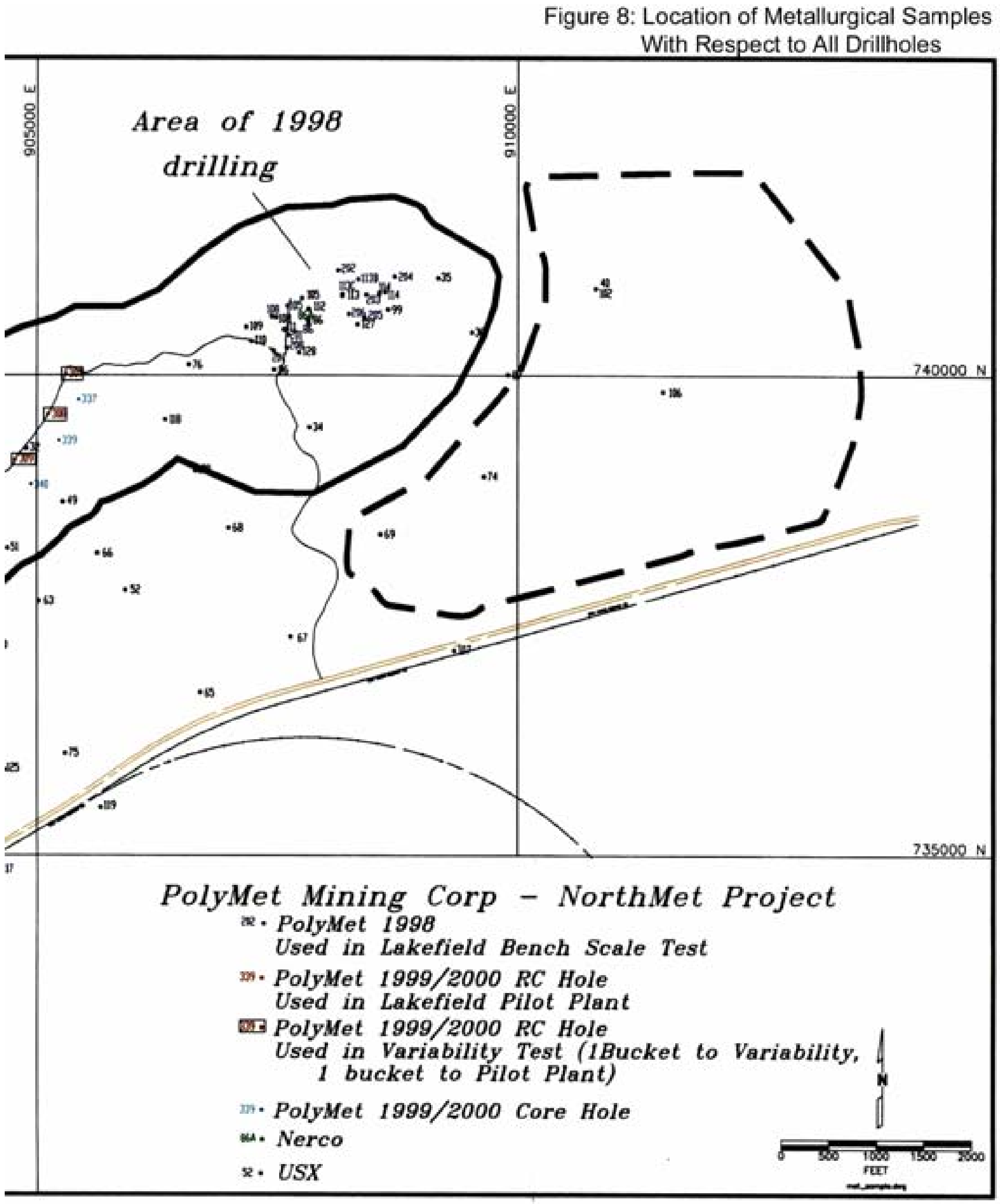


Figure 13.2 – Location of Metallurgical Samples

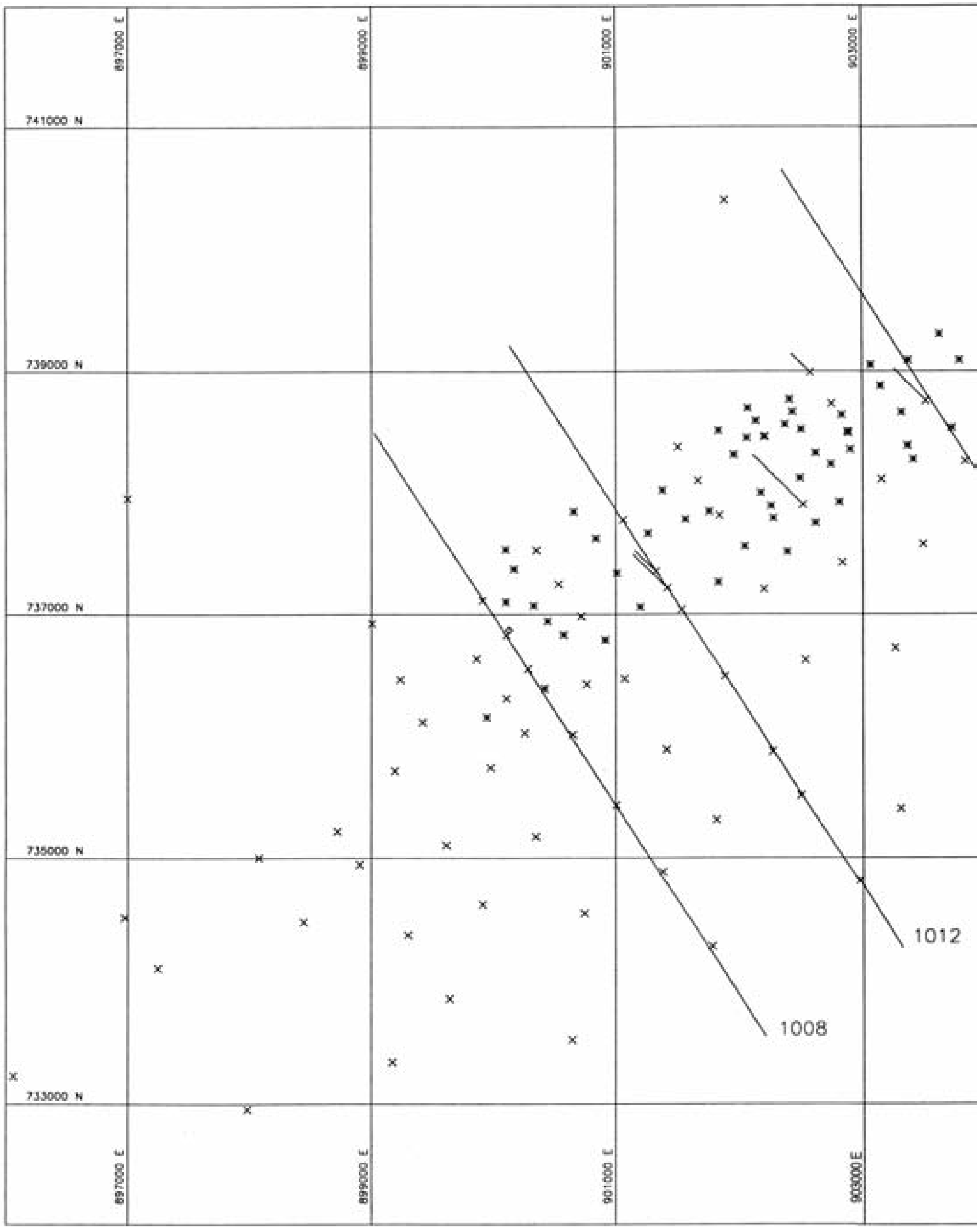
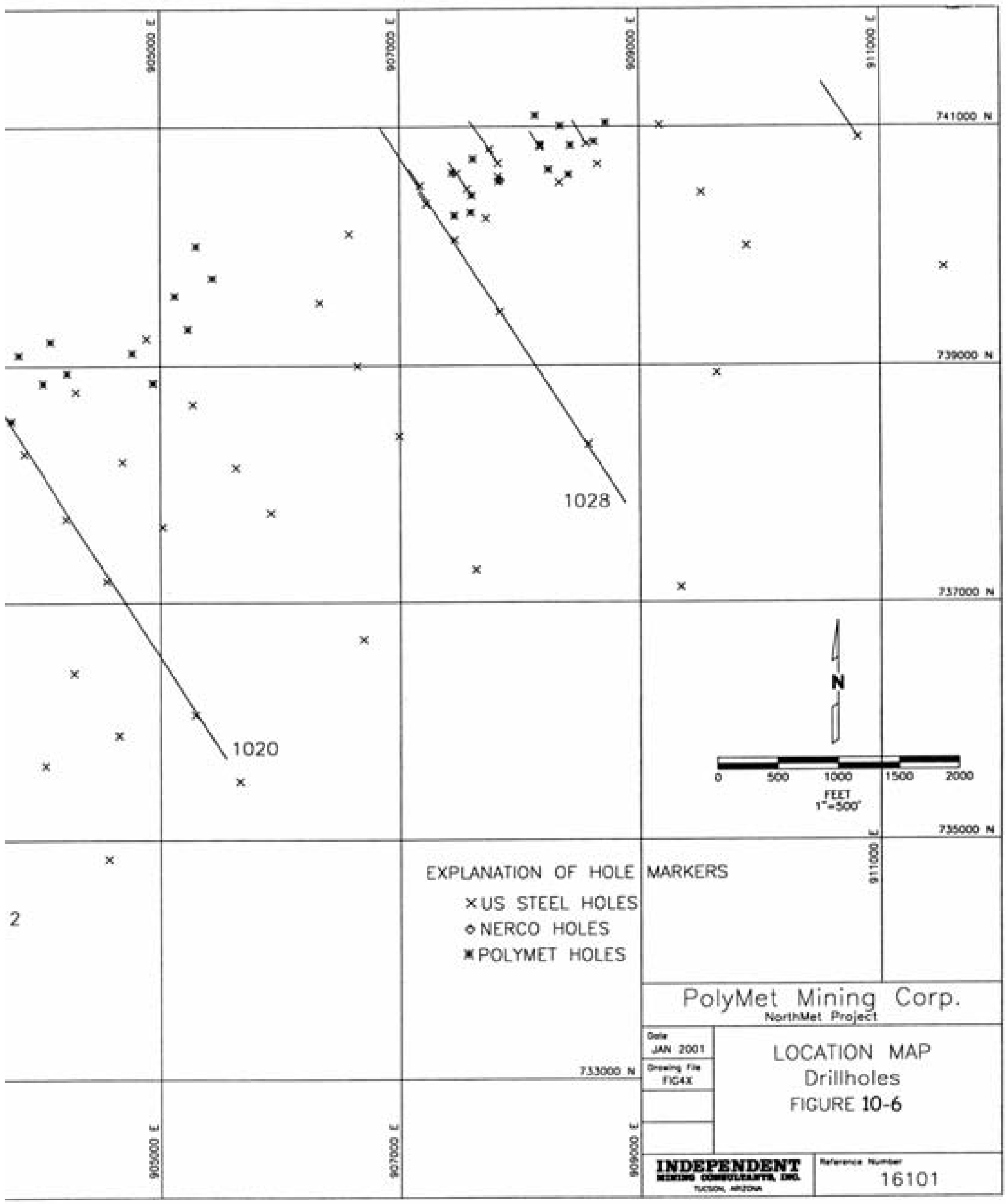


Figure 13.3 – US Steel and PolyMet Drilling


905000 E
907000 E
909000 E
911000 E
741000 N
739000 N
737000 N
735000 N
733000 N
1028
1020
2
N
0
500
1000
1500
2000
FEET
1"=500'
EXPLANATION OF HOLE MARKERS
US STEEL HOLES
NERCO HOLES
POLYMET HOLES
PolyMet Mining Corp.
NorthMet Project
Date
JAN 2001
Drawing File
FIG4X
LOCATION MAP
Drillholes
FIGURE 10-6
INDEPENDENT
MINING CONSULTANTS, INC.
TUCSON, ARIZONA
Reference Number
16101

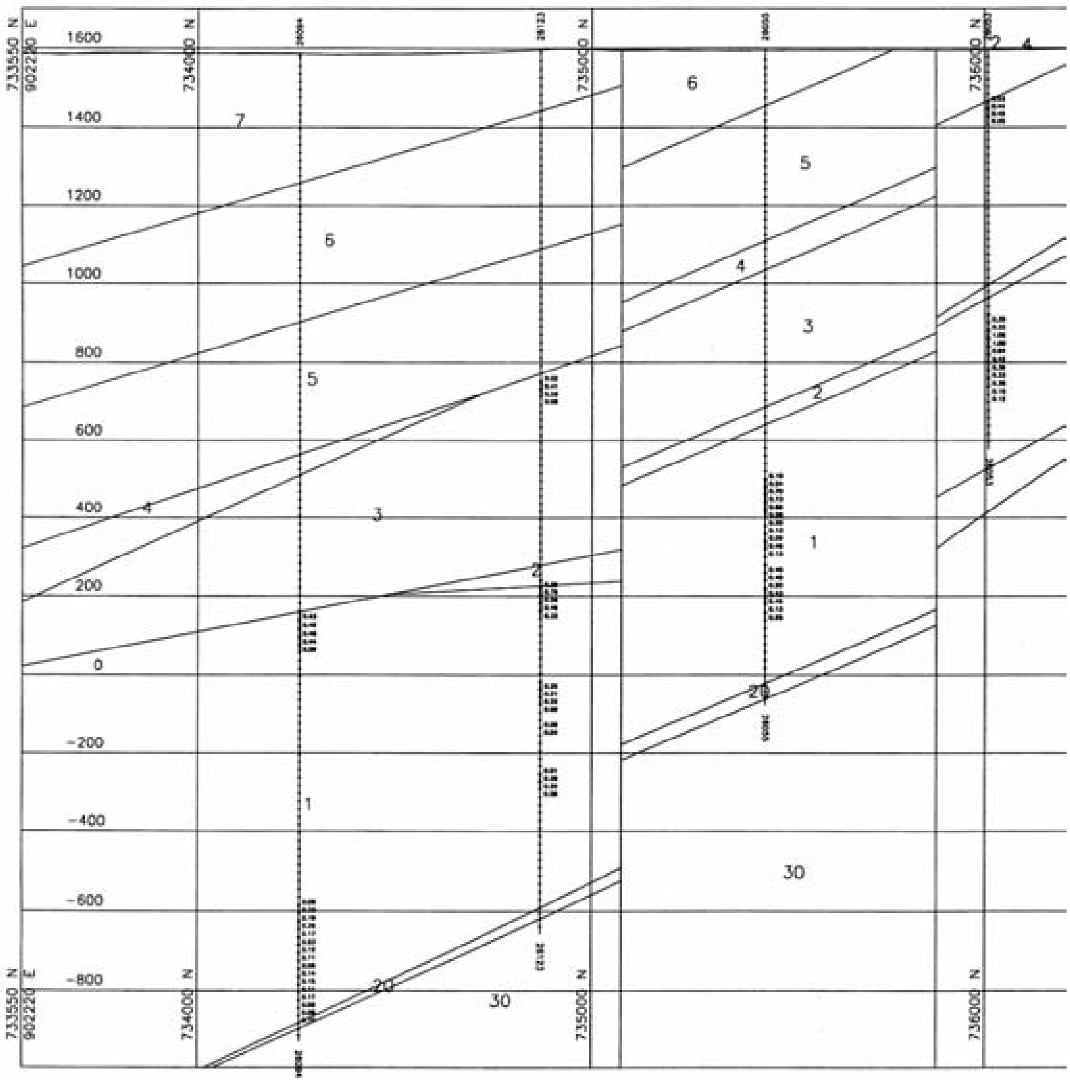
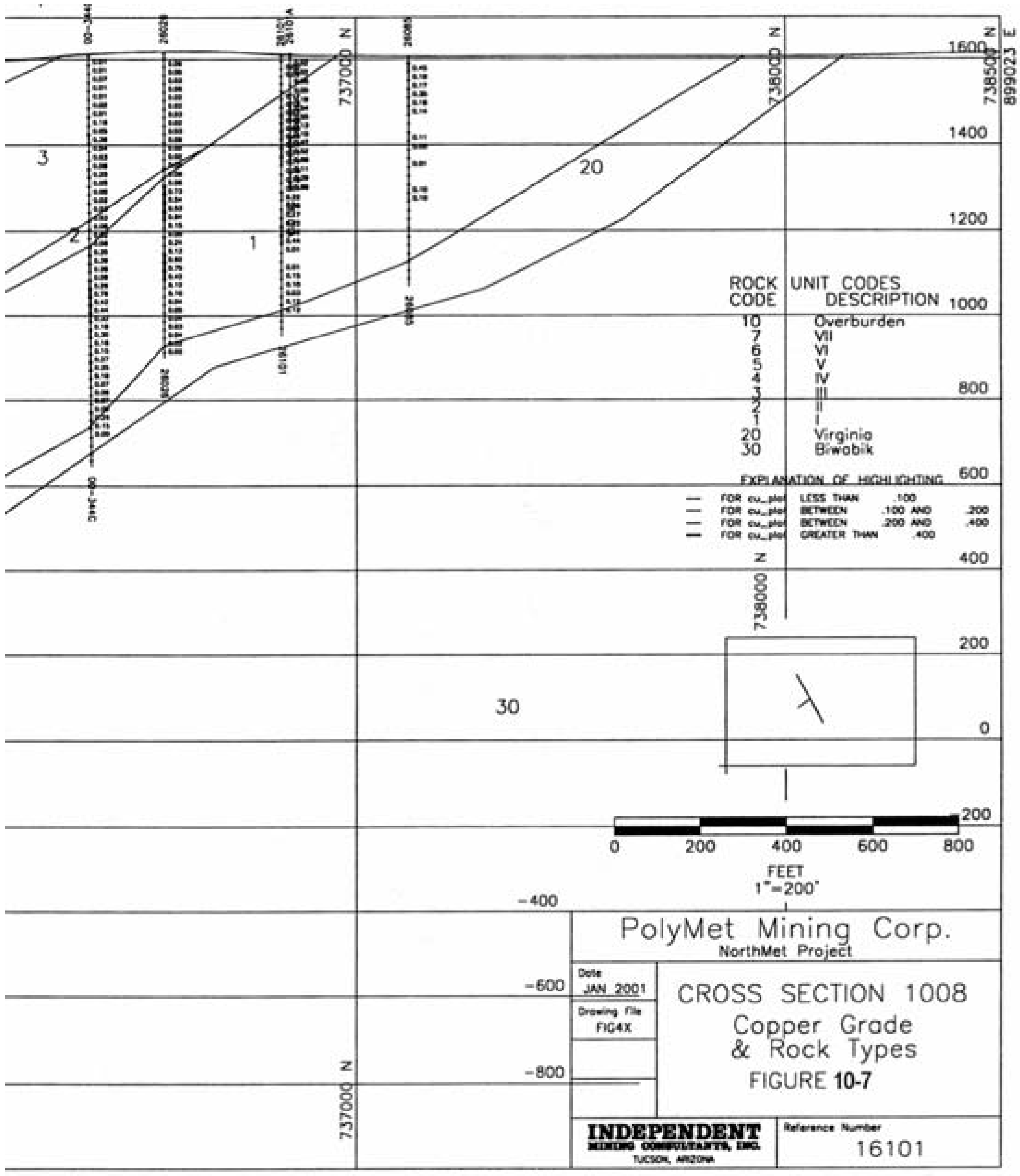


Figure 13.4 – Cross Section Drill Holes



ROCK CODE
UNIT CODES DESCRIPTION
10 Overburden
7 VII
6 VI
5 V
4 IV
3 III
2 II
1 I
20 Virginia
30 Biwabik
EXPLANATION OF HIGHLIGHTING
FEET
1"=200'
PolyMet Mining Corp.
NorthMet Project
Date JAN 2001
Drawing File FIG4X
CROSS SECTION 1008
Copper Grade & Rock Types
FIGURE 10-7
INDEPENDENT MINING CONSULTANTS, INC.
TUCSON, ARIZONA
Reference Number 16101

14. Sampling Method and Approach

This was reported on in the 2001 Pre-Feasibility Study. There is nothing further to report.

15. Sample Preparation, Analysis and Security

This was reported on in the 2001 Pre-Feasibility Study. There is nothing further to report.

16. Data Verification

This was reported on in the 2001 Pre-Feasibility Study. There is nothing further to report.

17. Adjacent Properties

This section is not applicable to PolyMet as it does not own any adjacent properties.

18. Mineral Processing and Metallurgical Testing

18.1 Process Technology

The PlatSol™ Process metallurgical extraction process was developed in 1998/99 at Lakefield Research Ltd. In May 2000, a continuous, fully integrated pilot plant testing program was initiated at Lakefield to demonstrate this hydrometallurgical extraction process for the NorthMet Project.

Both bench and pilot plant testwork for NorthMet used mineralized material obtained from reverse circulation ("RC") drilling samples. A total of 26 tonnes of RC cuttings was used for the bench tests and a further 33 tonnes of RC cuttings was used for the pilot plant tests. For the pilot plant tests, the 33 tonnes of RC cuttings were milled to the prescribed fine grind size and concentrated into a bulk concentrate of 839 kg using flotation. This bulk concentrate, combined with the remaining concentrate from the bench tests, was treated in an autoclave under the PlatSol™ Process operating conditions.

The PlatSol™ Process entails an autoclave operating at 225^{o}C with 100 psi oxygen over pressure. The addition of a small amount of chloride creates a unique leaching environment whereby all the base metals (copper, nickel and cobalt) and precious metals (gold, silver, platinum, palladium, etc.) are brought into solution in one step. The ability to recover the PGM's into solution is what makes the PlatSol™ Process unique and patentable. The metals can then be recovered sequentially from the solution, commencing with the PGM's.

The precious metals (PGM's, silver and gold) are precipitated using sodium hydro-sulphide. The copper recovery uses well established solvent extraction and electro-winning ("SX-EW") techniques. In its new approach, PolyMet has elected not to recover nickel metal on site. The process circuits have been dramatically simplified to convert the remaining metals in solution after copper SX/EW (dominantly nickel with small amounts of cobalt, copper and zinc) into a nickel concentrate. PolyMet is currently planning to produce a nickel hydroxide which is a precipitate. The precipitate will be filtered, dried and shipped off-site to a metal refinery. Production of nickel sulphide is an alternative to hydroxide.

In general, mineral recoveries and values for the bulk concentrate produced in the pilot plant confirmed the results obtained in the bench top testwork. Nickel recovery in the flotation concentrate was lower than expected. Mineralogical testwork showed that this was due to nickel in association with silicates which is not amenable to flotation recovery. Overall flotation and hydrometallurgical recoveries for the pilot plant tests are given in Table 18.1.

Table 18.1 - Pilot Plant Metal Recoveries

	Percent			**Grams/Tonne**		
	Cu	Ni	Co	Au	Pt	Pd
Ore Grade	0.43	0.12	0.009	0.05	0.08	0.36
Flotation						
Conc. Recovery	93.7	69	42	75.7	76.9	79.6
Conc. Grade	14.6	3.1	0.15	1.4	2.3	10.4
PlatSol™ Process						
Process Recovery	98.1	96.9	92	88.4	95	93.6
Overall Recovery	91.9	66.9	38.6	66.9	73.1	74.5

PolyMet has attempted to keep the new operation as simple as possible. The crushing, grinding and flotation processes proposed for the NorthMet Project are tried and tested and are used extensively in other processing plants worldwide. The Cliffs-Erie mill concentrator which functioned efficiently prior to shut down in 2001 will be utilized for these process steps. Similarly, the SX-EW process which will be used to produce cathode copper on site is industry standard.

Copper will be the only metal produced on the NorthMet site. Since copper is the largest contributor to revenue, the project is being characterized as a copper project - with important credits obtained from nickel and the PGM's. The PGM's are recovered first and precipitated as sludge immediately prior to copper SX/EW. After copper extraction, the metals remaining in solution are principally nickel with small amounts of copper, cobalt and zinc. This solution is first treated to remove iron. Magnesium oxide is then added which causes the remaining metals to precipitate as the hydroxide. When filtered and dried, nickel hydroxide concentrate can be shipped off - site for treatment in an established facility. This eliminates the complex circuits for nickel and cobalt recovery described in the original 2001 flow sheet. The objective is to start the project with minimum technical risk. .

The proposed autoclave circuit for the pressure oxidation process at NorthMet is similar to several other operations - principally the gold autoclaves operating at Barrick's mines in Nevada and a new copper project at Phelps Dodge's Bagdad operation in Arizona.

The PlatSol™ Process uses relatively low levels of chloride in the leach solution which allows efficient leaching of the PGM's and precious metals (gold and silver) as well as the base metals. Process recoveries of PGM's in the 2000 pilot plant have been improved from approximately 94% to 98% in recent test programs. International PGM Technologies Ltd. ("IPGMT"), an Ontario, Canada, corporation developed the PlatSol™ Process and has patented the technology in a number of countries. PolyMet has an agreement with IPGMT for the use of this technology, free of any royalty charge.

The PlatSol™ Process performed well during the continuous, fully integrated pilot plant operations conducted in 2000. The simultaneous leaching of base and precious metals in the autoclave from the bulk concentrate was confirmed. Optimum operating conditions established in the pilot plant were:

- % solids 10.5 – 11%
- temperature 225° C
- oxygen overpressure 100 psi
- retention time 120 minutes
- chloride concentration 9 g/l

Under the optimized operating conditions tested in the autoclave, the leach efficiencies obtained for all the pay metals, with the exception of gold, were either equal to or better than those achieved in bench testing in 1999.

19. Mineral Resource and Mineral Reserve Estimates

19.1 Resource estimates and categorization

The resource estimates were completed by Independent Mining Consultants Inc. of Tucson ("IMC") for the 2001 Pre-feasibility study and the May 2003 re-statement for a lower tonnage higher grade pit are shown in Table 19.1, below. IMC used the assumptions detailed in Appendix I to prepare the estimates in this summary and their May 2003 report is included as Appendix I. It should be noted that in this mine modeling, completed in May 2003, IMC did not factor in the benefit of reduced capital by use of the Cliffs-Erie facilities because this had not been finalized at the time. In their limited review, at lower daily tonnages, IMC also did not introduce smaller scale mining equipment for a selective mining approach. They continued to use the same scale of equipment as described in the 50,000tpd (2001) Pre-feasibility study with attendant high dilution factors. For this 2003 technical update, IMC were directed to produce a mine plan with smaller daily tonnage, reduced mine life - all in an attempt to obtain higher metal grades.

The pit resource completed by IMC has a maximum 50 degree pit wall slope angle. IMC's estimates show a measured, indicated and inferred resource of 139 million tonnes. There is the potential to add to this resource base, as the deposit is open at both ends and at depth (see Appendix I).

The drilling to date has been adequate to complete the Pre-feasibility level work required for mine planning. It is proposed to complete further in-fill drilling, sufficient to establish a mineable pit reserve, as part of a Bankable Feasibility Study.

Table 19.1

Status	Ktonnes Above Cutoff	% Of	Average Grades								Total Ktonnes	Waste To Ore Ratio
			NSR	CuEq	Cu	Ni	Co	Pd	Pt	Au		
		Total	US$/t	%	%	%	g/t	G/t	%	g/t		
Geologic Resource												
Measured	315,618	33.05%	11.82	0.847	0.333	0.086	66.00	0.298	0.081	0.042		
Indicated	295,601	30.96%	12.76	0.914	0.338	0.087	61.39	0.336	0.094	0.049		
Inferred	343,509	35.99%	13.16	0.943	0.347	0.088	58.88	0.355	0.096	0.050		
Total	954,738		12.59	0.903	0.333	0.087	62.01	0.330	0.090	0.047		
Preliminary Pit Resource												
Measured, Indic & Inferred	139,145	100%	10.00	0.97	0.40	0.11	0.009	0.361	0.133	0.082	720,770	4.18:1

20. Other Relevant Data and Information

20.1 Mining

The original mine plan for the Pre-feasibility study of 2001 was for a mining rate of 20,075 ktons per year (55,000 tpd for 365 days). This plan was modified for the current update to 9,125 ktonnes per annum (25,000 tpd for 365 days). The mine is scheduled to operate 360 days per year. The new mine plan is based on using a mine contractor to complete all mining operations with PolyMet staff supervising mine plan operations and mine geology.

Mine development will generally follow that outlined by IMC in the Pre-feasibility study with the exception that Phase 6 and 7 will only occur if metal prices and capital and operating costs warrant this development. The goal of the phases is to develop the mine in a logical order by commencing the mine with the higher grade material which also has a lower strip ratio. The mine plan will then progress to higher strip ratios. Phase 1 is in the northeastern part of the deposit with phase 2 in the southwestern portion. The remaining three phases will push the hanging wall south. Exits will be maintained to the south during all phases of mining so that access can be obtained to the rail load-out facility.

Waste rock will be stored in dumps located to the north and east of the main ore body. The waste dumps will be located outside of any potential ore body extensions should PolyMet decide to expand the pit. Waste facilities will be constructed in 7m lifts with an overall slope angle of 22° (2.5H:1V).

Mining operations will be carried out by a mining contractor. The contractor will provide all necessary fleet requirements for a turn-key mining operation based on the required annual mine production schedule. Work activities will include:

- Construction of the initial out-of-pit access roads from the pit area to the rail load-out facility and the mine rail spur and to the waste rock storage areas.
- Removal of all topsoil from the mine and waste storage areas. Replace topsoil on the waste storage areas at completion of mining as part of ongoing mine reclamation.
- Pre-production development required to expose ore for initial production.
- Mine and transport ore to the rail load-out facility.
- Maintain all mine work areas, in-pit haul roads, and external haul roads.
- Maintain waste storage areas.

The major mine fleet will consist of nine 185 t trucks, one $18m^3$ and one $11m^3$ loaders, two 23 m^3 shovels and two blasthole drills. Support equipment will include track dozers and motor graders to maintain road surfaces, dumps and operating benches.

Mining will be conducted year round based on three 8 hour shifts per day.

Mine operating costs are based on data from similar mining operations and contract mining costs. The costs cover all general labour and consumable costs, amortization of initial equipment capital investment, equipment depreciation and contractor profit.

The costs associated with PolyMet mine personnel and administration associated with direct mine operations are included separately within the operating cost section.

20.2 Process Plant

A revised process plant design has been completed by PASI. The revised flowsheets are based on a throughput of 25,000 tpd and utilizing the existing Cliffs-Erie crushing and grinding facilities. The flotation plant and all downstream process will be new but will generally utilize existing buildings and infrastructure within the Cliffs-Erie facilities as follows:

- one circuit of the rail dump pocket and the 60" gyrosphere crusher;
- the withdrawal feeder and the transfer conveyors to the coarse ore bins;
- 2-7' standard cone crushers and associated feeders;
- 4-7' short head cone crushers and associated feeders and screens;
- belt conveyors and tripper to the fine ore bins;
- 8 sets of rod/ball mill circuits;
- three regrind mills (two for concentrate regrind and one for limestone);
- ancillary facilities and offices;
- infrastructure including power supply and distribution; and
- tailing storage and reclaim water facility.

An overall mass balance was developed for the NorthMet process based on the hydrometallurgical mass balance provided by PolyMet, which set the feed headgrades and recoveries for copper, nickel, cobalt and PGM's at and a throughput of 9,125,000 tonnes per annum.

The development of the flowsheet and equipment sizing for the crushing, grinding and flotation process facilities was based on flowrates derived from this mass balance, plus process design criteria developed from the AMEC study and information by SGS Lakefield who were responsible for the pilot plant flotation trials. The flowsheet for the hydrometallugical facilities – pressure oxidation, solid-liquid separation, PGM recovery, copper SX/EW and nickel/cobalt hydroxide recovery – was derived primarily from the AMEC study with equipment resized accordingly for the new plant throughput. Testwork data from SGS Lakefield was reviewed for sizing of thickeners and filters.

Work indices used for crushing and grinding circuit calculations are estimates provided by SGS Lakefield based on limited grinding testwork.

Process Design Criteria

The detailed process design criteria is presented in Appendix II and the key criteria is summarized in Table 20.1.

Table 20.1 - Process Design Criteria Summary

Parameter	Design Criteria
Annual mill throughput	9,125,000 tonnes
Average daily mill throughput	25,000 tpd dry
Plant Availability	91.34%
Operating Hours per day	24
Hourly Throughput	1140 tph dry
Concentrate produced	703 tpd dry
Rod mill work index	14 kWh/t
Ball mill work index	17 kWh/t
Regrind work index	7.5 kWh/t
Feed size to flotation	200 micron
Feed size to pressure leach	15 micron
Pressure leach residence time	2 hours
Autoclave operating temperature	225 C
Autoclave operating pressure	475 psig
H_2SO_4 concentration	50-60 g/l
Cl concentration	10 g/l
Cu SX plant	2 extraction; 1 wash; 2 strip
Organic / Acid ratio	1.5:1
PLS Cu	18.4 g/l
Raffinate Cu	0.99 g/l
SX Cu recovery	94.62%
E/W current density	260 amp/m^2
Cathodes per cell	54
Total cells required	125

Process Description

The overall process flow is described in Figure 20.1.

Crushing

Run of mine ore will be delivered by rail to the Cliffs-Erie process plant and dumped into the primary crusher surge pocket. From the surge pocket, the ore will flow to a single existing 60″ by 89″ gyratory crusher set to produce a nominal coarse ore product with a P_{80} sizing of 6 inches. The existing secondary gyratory crushers will be removed and a surge pocket will be constructed allowing the crushed ore to discharge onto an existing apron feeder. The apron feeder will in turn discharge onto the exiting coarse ore surge bin feed conveyor. Ore from the coarse ore surge bin will discharge via the existing vibrating feeders onto existing belt feeders feeding two existing 7′ standard cone crushers. Each 7′ cone will discharge onto two existing vibrating feeders, each feeding an existing 6′ x 10′ vibrating screen. Screen oversize discharges into one of four existing 7′ shorthead cone crushers. The minus ¼″ discharge from the tertiary shorthead crushers will combine with the screen undersize onto the existing feed conveyor to the existing fine ore bin.

Grinding

Ore from the fine ore bin will discharge via existing vibrating and belt feeders to the existing rod and ball mill circuits. For the design throughput of 25,000 tpd, 8 of the existing 12 circuits will be utilized. Each rod mill will operate in open circuit, with the rod mill discharge feeding a ball mall in closed circuit with new hydrocylones. The grinding circuit will produce a flotation feed of 30% solids at a P_{80} sizing of 200 micron.

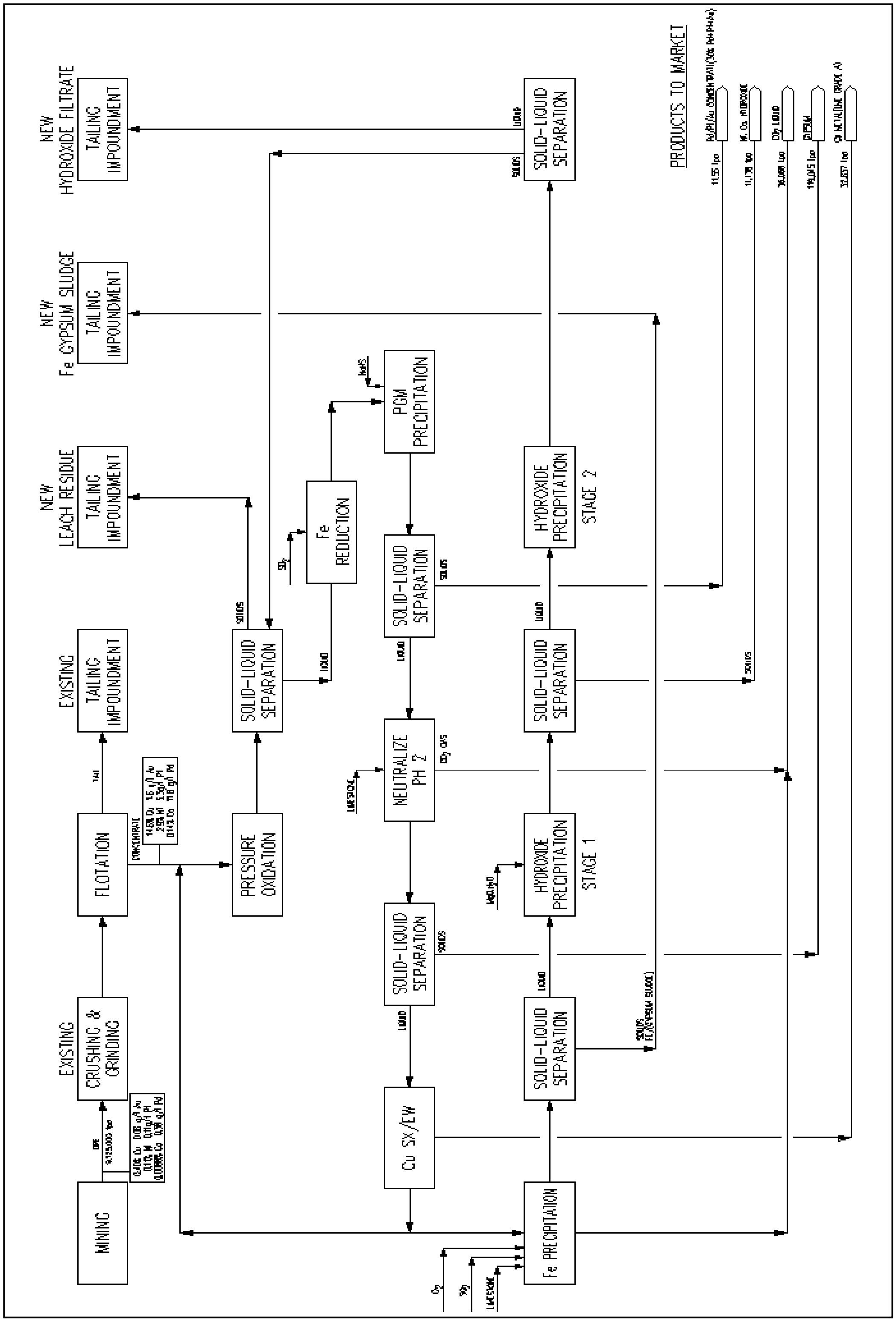


Figure 20.1 – Blocked Flowsheet

Flotation and Regrind

Cyclone overflow from the grinding circuits combine to feed a conditioning tank with a 5-minute retention time. The conditioner will feed a single bank of 4-160m^3 rougher tank cells providing a total residence time of approximately 8 minutes. Rougher discharge will feed 2 parallel banks of 5-160m^3 tank cells providing a residence time of 20 minutes.

Rougher concentrate combines with re-cleaner tail to feed the first cleaner flotation circuit. The cleaner flotation circuit will consist of a single bank of four 20m^3 conventional cells providing 16 minute retention time. Scavenger concentrate, mixed with cleaner tail, will be reground in an existing regrind ball mill to a target P_{80} of 30 micron prior to recirculation back to the conditioning tank. Cleaner concentrate will be fed to a single re-cleaner column cell, providing 16-minute retention time, for final concentrate cleaning. Cleaner concentrate will report to the concentrate regrind mill where the concentrate will be reground to the target P_{80} sizing of 15 micron, prior to pressure oxidation. A second existing regrind mill (using ceramic balls as grinding media to reduce iron contamination) will be used for this purpose.

Reground concentrate thickened to 50% solids and stored in a concentrate storage tank, which provides 12 hours of surge capacity between the flotation circuit and downstream hydrometallurgical processing.

Flotation tailings will be pumped to the existing Cliffs-Erie tailings impoundment. The flotation circuit reagents (MIBC, PAX, Flex 31, and WW1 752) are based on the AMEC study and was developed for effective base metal recoveries with associated high PGM recovery.

Pressure Leaching

Pressure Leaching is based on standard Autoclave technology and utilizes the patented PlatSol™ Process. Concentrate will be blended in the autoclave feed tank with sodium chloride prior to pumping into the autoclave at 50% solids. Recycled copper SX/EW raffinate will be pumped into the autoclave to maintain temperature control.

The two autoclaves will provide the required 2-hour residence time for the feed slurry. Each autoclave will have 6 compartments, and will be designed to operate at 225°C and approximately 475 psig. These pressures and temperatures are standard for autoclave design in the refractory gold ore/concentrate oxidation process. The NorthMet autoclave design will comprise a mild steel pressure vessel with a polymer-thermoplastic membrane corrosion barrier and two layers of acid resistant brick for thermal and abrasion resistance. This design follows the reported design of the Phelps Dodge copper concentrate autoclave at Bagdad, Arizona. The Phelps Dodge autoclave has been designed for temperatures up to 235°C and pressures of up to 4000 kPa.

The slurry is cooled to below 63°C via a single stage let down and slurry coolers prior to downstream metal extraction processes.

Leach Residue

Prior to metal recovery, the leach residue will be separated from the pregnant leach solution (PLS) to provide a high recovery of solute via filtration and washing of the leach residue. To accomplish this, the circuit will include a primary thickener followed by a pressure plate filter unit. A wash ratio of 4:1 will be used to maintain high solute recoveries. Autoclave residue filter cake will be re-pulped and fed to a scavenger flotation circuit to recover residual PGM's. The PGM concentrate will be re-circulated back to the feed end of the autoclave and the flotation tailing will be pumped to a new hydromet tailings impoundment constructed inside the existing tailings impoundment.

PGM Recovery

The PLS will be mixed with $S0_2$ to ensure total reduction of oxidized iron species in solution (Fe (III) is reduced by Fe (II) in solution by SO_2). The SO_2 will be produced by a packaged sulphur burner system. After ferric iron reduction, the solution will be processed through a two-stage pipe reactor system, with the addition of NaHS, to precipitate the platinum and precious metals. After filtration, the PGM precipitate will be releached in a sulfuric acid solution in a batch autoclave to leach any co-precipitated base metals (Cu, Ni, Co) and sulfur/sulfides to produce a high grade PGM precipitate for toll refining. Batch autoclave leach solution will be recirculated back to the PLS surge tank before precious metal recovery to ensure full recovery of valuable metals.

Neutralization

The PLS filtrate from the PGM precipitation system will require neutralization to pH 2 prior to copper solvent extraction. Filtered PLS will be pumped from the neutralization surge tank to the solution neutralization cascade that consists of three tanks with a total retention of 180 minutes. Limestone is added to maintain a pH of 2 and prepare the solution for copper solvent extraction.

The slurry exiting the precipitation tanks will be pumped to a thickener. Thickener underflow is filtered using an automatic plate and frame pressure filter package. The filter cake solids (saleable grade gypsum) will be discharged to a conveyor and stockpiled prior to re-sale.

Copper Solvent Extraction and Electrowinning

Copper PLS from the neutralization circuit will be stored in the copper SX feed tank providing 4 hours of surge capacity. PLS will be filtered to avoid crud formation in the SX circuit. The filtration will use multi-media pressure filters and the backwash will be returned to the gypsum thickener. Copper will be extracted from the PLS into an organic solution.

The extraction circuit consists of three mixer settlers, in which the aqueous feed and the barren organic flow counter-current to one another. Raffinate leaving the final extractor will report to the copper raffinate tank, from which solution will either be recirculated back to pressure oxidation for use as cooling liquid, or sent forward to bleed treatment.

Copper loaded organic is pumped from the first stage extractor to the loaded organic tank where entrained aqueous solution will have the chance to settle out. Solution recovered in this way will be collected in a sump at the bottom of the tank and periodically returned to the extraction circuit.

Loaded organic will be contacted, in a two-stage copper strip circuit, with lean electrolyte recycled from copper EW. The stripped organic will pass through to extraction, while the rich electrolyte will be pumped through organic recovery columns, and anthracite based multi-media filters to coalesce any residual organic, before discharging into the electrolyte recirculation tank.

Rich electrolyte will be trim heated to approximately 120°F before entering the tankhouse EW cells, using an indirect hot water heating system. A 125-cell tankhouse will provide the capacity required to harvest 33,000 tonnes per year of cathode copper.

Cathodes from the EW cells will be harvested on a daily basis, after a 7-day growth cycle. The copper sheets will be mechanically stripped from the stainless steel blanks using a standard fully automatic cathode washing and stripping machine. The stripping machine will also provide mechanical stacking, strapping, and weighing of the cathode bundles in preparation for shipping to market.

Nickel-Cobalt Hydroxide

Iron and aluminum must be removed from copper SX raffinate bleed solution before the extraction of nickel and cobalt.

In the first of three precipitation cascades, iron will be removed as goethite. In order for goethite to be formed, the bleed stream will be pre-heated to 170°F by direct steam injection into a tank with 45 minutes retention time. Direct injection will be used to negate the problem of gypsum scaling on the solution side of a shell and tube heat exchanger.

Hot solution from the pre-heat tank will enter the first of five tanks in the iron precipitation cascade. Limestone will be added to the first tank to neutralize free acid in the copper raffinate, and will result in gypsum precipitation. Air is sparged into tanks l, 2 and 5 to facilitate ferrous oxidation, allowing ferric precipitation as goethite. In the third and fourth tanks ferrous oxidation will be enhanced using a mixture of oxygen and sulfur dioxide. More limestone will be added to neutralize the acid generated by the goethite precipitation and maintain a discharge pH of 3.5. At this pH a significant percentage of the aluminum hydrolyses and precipitates while loss of the valuable metals (Ni, Co, Zn) is minimized.

Overflow from the fifth tank will be pumped to a thickener where the solids settle to a density of 40% by weight. A significant portion of the thickened underflow will be returned to the precipitation cascade, where the solids act as seeds to facilitate the growth of larger particles, which in turn improves settling and filtration characteristics. The balance of the thickener underflow will be filtered through a plate-type pressure filter. After washing to recover entrained nickel and cobalt, the cake will discharge into a tank where it is slurried with reclaim water and pumped to a new tailings impoundment on the existing tailings dam

Overflow from the iron thickener will be neutralized with magnesium oxide in two stirred tanks to precipitate a combined nickel/cobalt hydroxide. Slurry will discharge from the second tank into a thickener. Thickener underflow is filtered in a plate-type pressure filter. The filter cake will be collected and steam dried prior to bagging for dispatch to an off site nickel/cobalt refinery.

Thickener overflow will be treated with lime in two stirred tanks to precipitate any remaining valuable metal content. Slurry will discharge from the second tank to a thickener. Thickener underflow will be recycled back to the leach residue thickener. Thickener overflow will be pumped to a new tailings impoundment on the existing tailings dam.

The valuable metals (Ni, Co) will be redissolved under the strong acid conditions prevailing in the leach residue thickener.

Tailings

The existing tailings facility at Cliffs-Erie will be used to contain tailings products from the NorthMet process plant. Flotation plant tailings will form the bulk of the tailings products and will be discharged to the existing dam using the existing pumping and piping arrangement.

There will be three new hydromet tailings produced:

- leach residue flotation tailings,
- iron/aluminum gypsum sludge; and
- solution from the hydroxide precipitation circuit.

Each of these tailings will be contained in separate lined ponds constructed on the existing tailings dam. Each pond will have an initial capacity of 3 years storage.

Reagents

Included on the equipment list are the proposed reagent systems to support the process plant operations. Reagent systems included are:

- Limestone: Rail receipt and off-load, conveying, crushing and grinding, slurry storage and distribution loop. (An existing mill will be used for grinding.)
- MIBC: Bulk liquid storage and distribution.
- PAX: Mixing, storage and distribution.
- Flex 31: Bulk liquid storage and distribution.
- WW 1752: Bulk liquid storage and distribution.
- Flocculent: Mixing, storage and distribution
- Sulfuric Acid: Bulk liquid storage and distribution.
- NaHS: Bulk liquid storage and distribution.
- NaCl: Mixing, storage and distribution.
- MgO: Mixing, storage and distribution.
- CaO: Mixing, storage and distribution.
- Sulphur: Bulk storage, burner, distribution and SO_2 scrubbing.

Capital and Operating Cost Estimates

Estimates of capital and operating costs were generated at the Pre-feasibility level in the April 2001 Pre-Feasibility Study led by IMC. Since the project was taken over by new management in March 2003, four critical elements have been revised as follows:

1. Smaller higher grade mine plan.
2. Elimination of complex nickel cobalt recovery circuits and conversion to nickel hydroxide.
3. Securing the mothballed Cliffs-Erie Mill concentrator.
4. Use of a contract miner.

Based on the above, P. Downey and Associates, with the assistance of PASI and IMC, have revised the 2001 capital and operating costs and updated to current first quarter 2004 pricing.

Capital Costs

The revised capital is summarized in Table 20.2.

Table 20.2 - Revised Capital Cost Estimate

Description	**Totals (US$ Millions)**
Mining- using contract miner Crushing/Milling/Flot'n **(Existing Cliffs/Erie)** PlatSol™ Process- Copper SX/EW Plant	5.76 24.91 31.05 25.19
PGM Recovery Circuit	20.62
Nickel Hydroxide recovery circuits	6.00
Tailings, Water & Services **(Existing Cliffs-Erie)**	4.55
Plant Site Utilities & Facilities **(Existing Cliffs-Erie)**	12.59
Sub Total Direct Costs	**130.67**
Indirect Costs (Inc. Fees, working capital & 20% Contingency)	73.13
Other Acquisition-incl. land and infrastructure	31.00
Total Project Costs	**234.80**

The capital cost estimate includes the estimated direct cost for equipment, material and labour. In addition, cost estimates were developed for the project indirect costs including EPCM, start up, construction indirects, first fill, spares and contingency. The estimate was developed based on a site visit and inspection of existing equipment and facilities, and the following main sources of information:

- Contract Mining and Associated Services.
- Process Design Criteria by PASI.
- Process Flow Sheets.
- Facility General Arrangement Drawings.
- Electrical and Mechanical Equipment List.
- Budget Quotations from Equipment Suppliers.
- Current Labour and Material Costs for the Area.
- The AMEC Simons Mining & Metals 2001 Prefeasibility Report.

Operating Costs

The 2001 Pre-Feasibility Study estimate of operating costs included an owner operated mining fleet, an all new processing plant, infrastructure and G&A costs associated with the on-site production of a PGM concentrate, copper cathode, nickel cathode and cobalt sulphide.

The current revised project operating costs use the same basic project data updated to 2003 but are based on a simplified flowsheet whereby only copper cathode is produced on site. The revised operating costs also reflect a contract mining operation and use of the Cliffs-Erie crusher/mill/concentrator. The Cliffs-Erie facility also received a beneficial electrical power rate for the first 25 MW of usage and this rate has been carried in the current operating cost estimate. Labour rates are based on data available from Minnesota Iron Range mines. The operating cost estimates include a 5% contingency, as detailed in Table 20.3.

Table 20.3 – Revised Operating Cost Estimate

Cost Area	Annual Cost (US$ Millions)	Cost/Tonne Ore (US$/Tonne/Ore)
General & Administrative (“G & A”)	4,856,600	
Subtotal G & A	**4,856,600**	**0.53**
Mine		
Contract miner		
Sub Total Mine	**28,938,000**	**3.21**
Mill & Process		
Reagents & consumables	22,142,258	
Labour Costs	10,977,823	
Operating Supplies	400,000	
Maintenance Supplies	1,915,896	
Environmental	300,000	
Sub Total Mill & Process	**35,735,977**	**3.91**
Power	**16,746,886**	**1.84**
Total Operating Costs	**86,277,463**	**9.49**
5% Contingency	**4,313,873**	**0.95**
Total Operating Costs	**90,591,336**	**10.44**

The following items are not included in the direct cash operating cost estimate:

- Product delivery to smelters or copper cathode end users
- Selling and marketing costs
- Corporate overhead
- Depreciation, amortization and depletion
- Interest charges

Manpower requirements were estimated in detail for each area of the mine, process plant and administration. Allowances were made to cover vacations, sick time and other types of leave such as training.

The following Table 20.4 summarizes the overall manpower requirements for the operation. Salary and overhead costs were based on data from the recently closed Cliffs-Erie operation and from data from other similar sized operations.

Table 20.4 Manpower Requirements

Administration Staff		29
G& A Salaried		22
Process Plant Staff		27
Process Plant Salaried		140
Total		**218**

21. Interpretation and Conclusions

The results of this scoping level study indicate that the NorthMet project, as currently defined, shows sufficient potential to be carried forward to the next phase which is a feasibility study. The purpose of the feasibility study will be to examine all aspects of the project development and to establish with greater accuracy its economic and technical viability.

This conclusion is solely based on the resource data and the order of magnitude capital and operating costs developed for this study.

22. Recommendations

It is recommended that PolyMet proceed to the next stage of development of the NorthMet Project which is the Feasibility Study level stage. This will include sufficient drilling to bring the current resources to the reserve category. Additional test work will also be required to further refine the ore process prior to completion of a bankable Feasibility Study.

23. References

- Independent Mining Consultants, Inc., April 2001, NorthMet Project, Minnesota Pre-Feasibility Study
- AMEC Simons Mining & Metals, April 2001, Pre-Feasibility Report for the NorthMet Project Process Plant Facilities
- Penguin Automated Systems Inc., April 2004, NorthMet Project Processing Facilities Scoping Study
- Lakefield Research, February 1, 2001, A Pilot Plant Investigation into the Recovery of Copper, Nickel, Gold and PGM's from NorthMet Bulk Concentrate – Progress Report No. 1

24. The date of this report is July 22nd, 2004.

25. Additional Requirements for Technical Reports on Development Properties and Production Properties

There is no information to report for this item in the Pre-feasibility stage of exploration.

26. Illustrations

APPENDIX I

MINING – INDEPENDENT MINING CONSULTANT UPDATE REPORT

MAY 2003

MEMO

TO: Terry O'Kane, Bill Murray, Don Gentry
FROM: M. Hester, H. Welhener
DATE: May 25, 2003
SUBJECT: Project Summary

Summary

PolyMet Mining Corporation (PolyMet) requested that Independent Mining Consultants, Inc. (IMC) update the April 2001 mine pre-feasibility study with new economics and develop a scoping level trial mine production schedules. The project approach has shifted from processing the polymetalic ore to final metals on the property to generating three concentrates: copper, nickel-cobalt and a PGM. The copper concentrate would be further processed on site using SXEW to produce copper metal. The other two concentrates would be shipped off site for further processing.

Table 1 shows the new economic input parameters. The metal prices have changed from the 2001 study with increases for most of the metals except palladium, which dropped significantly. The new prices were incorporated into the cash flow of the 2001 study and show a large drop in the project economics (Tables 3 and 4).

The block model was updated to better reflect the selectivity near the NSR cutoff grade for the present economics. The 2001 model ore zones were based on a $4.00 NSR ore-waste boundary. The current economics have a $7.42 NSR internal cutoff grade. The ore-waste boundaries were re-set in the block model using a $6.00 NSR to better reflect selectivity at a higher NSR value.

Floating cones were run and the results are summarized on Table 5. Based on the cone geometries, five mining phases were designed, three in the southwest pit area and two in the northeast. Unlike the 2001 study, the two pit areas do not join. The sum of the five phases (the total pit) contains 176,199 ktons of measured, indicated and inferred ore using the $7.42 NSR/t cutoff grade, and 720,199 ktons of total material. The inferred class material is included in this scoping study to show the best potential of the project.

Preliminary production schedules were developed for 15,000 tpd and 25,000 tpd ore rates. The 25,000 tpd schedules show a better NPV during the early years of the trial schedules. Schedules at 25,000 tpd have an average mine life of 19 years and the 15,000 tpd schedules extend the mine life to 32 years.

Economic Parameters

Table 1 summarizes the economic parameters used for this study.

Table 1: Economic and Recovery Parameters	
Base Mining Cost Per Total Ton	$0.534
Lift Cost Per Total Ton Per Bench Below 1580 Elevation	$0.009
Benches Mined Per Year / Annual Discount Rate	12 / 12%
G&A Cost Per Ore Ton	$0.51
Processing Cost Per Ore Ton	$6.91
Flotation Recoveries:	
Copper	93.7%
Nickel	69.0%
Cobalt	42.0%
Palladium	79.6%
Platinum	76.9%
Gold	75.7%
Copper Refining Cost Per Payable Pound	Included
Nickel/Cobalt Refining Cost Per Payable Pound	In Price
PGM Refining Cost Per Payable Ounce	$15.00
Process Recoveries (Payables):	
Copper	97.6%
Nickel	96.9%
Cobalt	92.0%
Palladium	94.0%
Platinum	95.0%
Gold	94.0%
Metals Prices:	
Copper Per Pound	$0.80
Nickel Per Pound (70% of $4.00)	$2.80
Cobalt Per Pound (70% of $10.00)	$7.00
Palladium Per Troy Ounce/Gram	$150 / 4.82
Platinum Per Troy Ounce/Gram	$600 / 19.29
Gold Per Troy Ounce/Gram	$350 / 11.25

The recovery, price, and processing cost parameters were provided by NorthMet personnel.

The mining cost was estimated by IMC based on the engineered cost estimate prepared for the Preliminary Feasibility Study (PFS). First, mining costs estimated for each mining year of that study were plotted against the average mining elevation to obtain the base and lift (elevation related) components of the cost. Second, mining costs were examined by cost center (drilling, blasting, loading, hauling, auxiliary equipment, general mine, general maintenance, and mine supervision) and a fixed and variable component of each were extracted. These were used to scale the base mining cost from that of the 70 to 100 million annual tons of the preliminary study to the 40 to 50 million annual tons contemplated for this revised study. Third, the costs were escalated 2.5% per year for two years to obtain 2nd quarter 2003 US dollars. Overall mining cost is anticipated to be about \$0.60 per ton for this revised study, about the same as the average for the PFS. The expected higher cost of the lower mining rate is countered by the elimination of the longest truck hauls off the back end of the larger project.

The table also shows a time value of money component of the parameters that was used with some of the floating cones. For these cones, a mining rate of 12 benches per year and an annual interest rate of 12% were assumed for a discounting factor of 1% per mining bench. This was used to discount the revenues and costs as a function of pit depth. For the PFS the maximum advance rates were about 10 benches per year from a mining phase.

An NSR value was calculated for each block and used in the floating cones, tonnage tabulations, and production scheduling. Table 2 shows the factors applied to each metal for the PFS and for this current study. The NSR for each block for the current study was calculated as:

$$
\begin{aligned}
\text{NSR} \;=\;& 14.63 \text{ x copper (\%)} &+\;& 37.44 \text{ x nickel (\%)} \\
+\;& 0.0054 \text{ x cobalt (ppm)} &+\;& 2.95 \text{ x palladium (ppm)} \\
+\;& 12.47 \text{ x platinum (ppm)} &+\;& 6.95 \text{ x gold (ppm)}
\end{aligned}
$$

Table 2: NSR Factors for Prefeasibility and Current Study		
	Prefeasibility	Current
NSR Factor for Copper ($/%)	13.95	14.63
NSR Factor for Nickel ($/%)	29.23	37.44
NSR Factor for Cobalt ($/ppm)	0.0055	0.0054
NSR Factor for Palladium ($/ppm)	11.73	2.95
NSR Factor for Platinum ($/ppm)	10.44	12.47
NSR Factor for Gold ($/ppm)	5.17	6.95
Internal NSR Cutoff Grade ($US)	$4.31	$7.42

It can be seen that the relative value of nickel has increased significantly from the PFS. Moderate increases are also noted for copper, platinum, and gold. The relative value of the palladium has reduced significantly.

The NSR value represents the value of the ore after paying for SXEW, refining, and freight charges. The NSR value needs only to pay for mining, G&A, and processing costs that are common to every ore ton (crushing, grinding, flotation, pressure oxidation, and tailings, etc). The NSR factors shown on Table 2 are calculated from the Table 1 parameters as follows:

Copper:	($0.80)(0.937)(0.976)(20)(Cu%)	14.63 x Cu%
Nickel:	($2.80)(0.69)(0.969(20)(Ni%)	37.44 x Ni%
Cobalt:	($7.00)(0.42)(0.920)(20)(Co ppm)/10000	0.0054 x Co ppm
Palladium	($150 - $15)(0.796)(0.94)(Pd ppm)/34.285	2.95 x Pd ppm
Platinum:	($600 - $15)(0.769)(0.95)(Pt ppm)/34.285	12.47 x Pt ppm
Gold:	($350 - $15)(0.757)(0.94)(Au ppm)/34.285	6.95 x Au ppm

It can be seen that the metal recoveries, prices, and refining costs are accounted for in the NSR calculation.

Prefeasibility Study Economic Model With Current Prices

The metal prices proposed for this updated study were incorporated into the detailed cash flow model of the PFS. The prices used are as shown on Table 1 with $4.00 for nickel and $10.00 for cobalt.

Table 3 shows the financial results for the before-tax case.

Table 3: Prefeasibility Study Case
Financial Results for Before-Tax Cashflow Analysis

Parameter	PFS Prices	Current Prices
Net Present Value at 5% Discount Rate	$566.6 million	$156.7 million
Net Present Value at 10% Discount Rate	$171.1 million	($85.9 million)
Internal Rate of Return (IRR)	14.09%	7.77%
Payback Period (Undiscounted) From the Beginning of Commercial Production	5.4 years	9.8 years

Table 4 shows the financial results for the after-tax case.

Table 4: Preliminary Feasibility Study Case
Financial Results for After-Tax Cashflow Analysis

Parameter	PFS Prices	Current Prices
Net Present Value at 5% Discount Rate	$411.2 million	$83.5 million
Net Present Value at 10% Discount Rate	$79.6 million	($126.6million)
Internal Rate of Return (IRR)	12.00%	6.56%
Payback Period (Undiscounted) From the Beginning of Commercial Production	6.2 years	11.1 Years

It can be seen that the changes in metal prices have a significant negative impact on the PFS case.

Block Model Update

The block model for the PFS was developed by manually selecting drillhole composites inside the ore zone based on a $4.00 NSR cutoff grade. These composites were then used to select the ore zone blocks using an indicator kriging approach. The model was optimized to be accurate at about a $4.00 NSR cutoff grade.

Table 1 shows that with the revised economics the internal NSR cutoff grade is about $7.42 per ore ton (processing plus G&A). It is likely that the PFS model will be slightly over-smoothed (slightly high on ore tonnage and slightly low on metal grades) at the cutoff grades of current interest.

For this study, the block model was updated based on a $6.00 NSR cutoff grade. Drillhole composites were re-examined and those inside a $6.00 NSR ore zone were selected. A revised ore zone boundary was developed and grades of the various metals re-estimated based on the same methods used for the PFS. Resource classifications were also re-assigned using the same methods as the PFS model.

The section of this memo titled "Changes in Reserves – Preliminary Feasibility Study Case to Current" documents the change in reserves attributed to this revised model.

Floating Cone Evaluation

Table 5 summarizes the results of floating cone runs on the NorthMet deposit at various metal prices and other conditions.

Cases 1 through 5 are floating cones at various metal prices without time value of money discounting and with an hangingwall slope angle of 50 degrees. Mechanically, the various metal prices were handled by applying a recovery factor to the block NSR value, i.e. 100% of NSR is the base case prices, 80% of NSR is 80% of base case prices, etc. Only measured and indicated resources were allowed to contribute to economics to develop floating cone geometries. However, inferred resource within the developed geometries is included on the Table x tabulations. The inferred resource generally amounts to slightly over 10% of the total resource. It can be seen that ore tonnes range from 194.5 million tons to 55.8 million tons for these cases with the largest break occurring between Cases 4 and 5. Total tons range from 760 million to 145 million. The base case cone for the PFS contained 498.3 million ore tons within a geometry with 1.8 billion total tons. It is evident that the revised economics significantly reduce the size of the project.

Cases 6 and 7 include time value of money discounting of 1% and ½% per bench. In both cases the results fall in between the results for Cases 2 and 3. Case 8 examines a reduced slope angle on the hangingwall to account for more road on that wall than originally contemplated. It does not have a large impact on results.

In general, as effective metal prices are decreased in Cases 1 through 5, the cone targets more profitable material. It is important to note that metal grades do not change significantly in these cases. Higher profitability comes from reduction in strip ratio. The implication is the general lack of significant higher grade ore zones in the NorthMet deposit resource model. This could be a reflection of the true geologic character of the deposit, or alternatively it could be partially due to insufficient density of drilling data and over-smearing of the available data.

Another aspect of the NorthMet deposit that is not evident from Table 5, but is evident from examining measured, indicated, and inferred resources by category is that the grade of measured resources is less than the grade of indicated resources and the grade of indicated resources is less than the grade of indicated resources. This implies that grade increases with depth, which is not the desirable case for a mining project. For example, for the Case 1 cone the copper grade of measured, indicated, and inferred resource is 0.360%, 0.383%, and 0.398% respectively. This is also evident for nickel, palladium, platinum, and gold; only cobalt reverses this trend and exhibits decreasing grade at less confident resource classes.

Table 5

Table x
Floating Cone Resources at Various Metal Prices (Based on Percent Recovery of Available NSR Value)
Measured and Indicated Resource Only Used to Develop Cone Geometry
Tabulation Includes Inferred Material in the Geometry
Resources Tabulated at $US 7.42 NSR Cutoff Grade

Case	% of NSR	Discount Rate	HW Slope Angle	Ore Ktons	NSR ($US)	Copper (%)	Nickel (%)	Cobalt (ppm)	Palladium (ppm)	Platinum (ppm)	Gold (ppm)	Cu Eq (%)	Total Ktons	Strip Ratio
1	100%	none	50	194,500	12.16	0.370	0.097	68.14	0.372	0.105	0.052	0.901	759,857	2.91
2	95%	none	50	186,019	12.25	0.374	0.097	68.07	0.374	0.105	0.053	0.908	720,358	2.87
3	90%	none	50	141,030	12.37	0.378	0.098	68.51	0.374	0.107	0.054	0.915	497,612	2.53
4	85%	none	50	119,361	12.47	0.382	0.098	68.12	0.379	0.108	0.055	0.926	403,264	2.38
5	80%	none	50	55,808	12.40	0.375	0.099	69.00	0.379	0.108	0.053	0.914	144,763	1.59
6	100%	1%/ben	50	159,873	12.18	0.371	0.097	68.64	0.370	0.104	0.053	0.898	576,835	2.61
7	100%	0.5%/ben	50	181,405	12.17	0.371	0.097	68.52	0.370	0.104	0.052	0.900	690,709	2.81
8	100%	0.5%/ben	42	164,166	12.20	0.372	0.097	68.42	0.371	0.105	0.053	0.901	639,643	2.90

Mine Phase Designs

Five mining phases were designed. Table 6 summarizes the tonnage and grade results for each phase at the internal NSR cutoff grade ($7.42/t). The floating cones indicated that the most profitable material was in the south of the orebody; the first three mining phases are located in the south. The final two mining phases are in the north. The final geometry includes a north and a south final pit that are not connected. Note that starting of mining in the south is different than the PFS case, which started in the north. This change is due to the revised economics and change in relative importance of the various metals.

The final pit contains 176,199 ktons of measured, indicated and inferred ore using a $7.42 NSR/t cutoff grade and 720,199 ktons of total material. In terms of ore tonnage it approximates floating cone Cases 2 and 7. It is also close to Case 2 in terms of total tons. The final pit strip ratio is a bit higher than the cones. The 50 degree hangingwall slope angle used in the cones was steeper than could be achieved during pit design due to haulage roads.

Table 7 shows the phase tonnages at higher NSR cutoff grades. Increasing the NSR cutoff grade from $7.42/t to $12.00/t reduces the contained measured, indicated and inferred ore from 176.2 million tonnes to 83.2 million tonnes. Raising the NSR cutoff to $15.00/t drops the contained ore tonnage to 25.6 million tonnes.

Table 8 shows the measured and indicated only ore tonnage within the mining phases at various NSR cutoff grades. Removing the inferred ore grade material has the largest impact on phases 1-South and 3-South.

The net value of each mining phase was calculated to rank the phases and determine the best mining sequence for mine production schedules. The net value was calculated at the internal NSR cutoff grade of $7.42/t. The floating cone input costs of $0.60/t mining and

$7.42/t for processing and property G&A were used to calculate the costs. Table 9 shows the results on a net value and a value per ton of ore (at internal cutoff grade) calculation. The net value per ton of ore shows that the mining sequence should be south pit and then north pit.

Figure 1 shows the final geometry of the South pit (combination of south phases 1, 2, and 3. Figure 2 shows the final North Pit (north phases 1 and 2). Figure 3 shows the relationship of the 5 mining phases on the 1500 bench.

Table 6
Mining Phase Resources
Includes Measured, Indicated, and Inferred Resources
Tabulated at $US 7.42 NSR Cutoff Grade

Phase	Name	Ore Ktons	NSR ($US)	Copper (%)	Nickel (%)	Cobalt (ppm)	Palladium (ppm)	Platinum (ppm)	Gold (ppm)	Cu Eq (%)	Total Ktons	Strip Ratio
1	ph1sthtr4	23,283	13.50	0.407	0.091	58.59	0.447	0.162	0.070	1.065	109,070	3.68
2	ph2sthtr1	20,911	11.20	0.346	0.096	73.25	0.287	0.081	0.042	0.783	47,937	1.29
3	ph3sthtr2	62,883	12.66	0.398	0.096	66.91	0.372	0.111	0.057	0.941	277,004	3.41
4	ph1nthtr1	26,684	11.71	0.350	0.103	71.55	0.337	0.084	0.047	0.845	110,208	3.13
5	ph2nthtr1	42,438	11.48	0.342	0.098	70.88	0.366	0.086	0.043	0.842	175,980	3.15
TOTAL		176,199	12.17	0.372	0.097	68.22	0.365	0.104	0.052	0.900	720,199	3.09

Table 7

PolyMet Mining - NorthMet Project, May 2003 Update
Summary of Mining Phases by NSR Cutoff Values

MEASURED, INDICATED & INFERRED

Phase	+= $15.00 NSR					+= $14.00 NSR					+= $12.00 NSR				
	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio
1 South	11,486	16.65	0.515	1.351	13.46	16,708	16.00	0.495	1.287	8.94	23,635	15.10	0.466	1.203	6.03
2 South	648	15.69	0.542	1.103	72.98	1,543	14.95	0.500	1.057	30.07	6,615	13.26	0.422	0.947	6.25
3 South	9,967	16.86	0.529	1.349	21.07	14,169	16.16	0.509	1.270	14.53	24,980	14.76	0.469	1.124	7.81
1 North	1,283	15.77	0.491	1.190	84.90	2,921	15.03	0.463	1.120	36.73	12,028	13.40	0.405	0.989	8.16
2 North	2,180	16.48	0.508	1.275	79.72	4,462	15.42	0.475	1.187	38.44	15,921	13.58	0.411	1.013	10.05
Total Pit	25,564	16.65	0.519	1.329	27.17	39,803	15.88	0.496	1.249	17.09	83,179	14.31	0.444	1.092	7.66

Phase	+= $10.00 NSR					+= $7.42 NSR (Internal C/O)					Total Phase Ktonnes
	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	
1 South	30,824	14.12	0.430	1.117	4.39	35,151	13.52	0.412	1.061	3.73	166,095
2 South	15,243	11.97	0.373	0.843	2.14	20,911	11.20	0.346	0.783	1.29	47,937
3 South	40,709	13.30	0.423	0.989	4.40	51,015	12.44	0.393	0.915	3.31	219,976
1 North	20,994	12.40	0.372	0.905	4.25	26,684	11.71	0.350	0.845	3.13	110,208
2 North	31,375	12.30	0.369	0.905	4.61	42,438	11.48	0.342	0.842	3.15	175,980
Total Pit	139,145	12.97	0.399	0.970	4.18	176,199	12.17	0.372	0.900	3.09	720,196

Table 8

PolyMet Mining - NorthMet Project, May 2003 Update
Summary of Mining Phases by NSR Cutoff Values

MEASURED AND INDICATED ONLY

Phase	+= $15.00 NSR					+= $14.00 NSR					+= $12.00 NSR				
	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio
1 South	6,071	16.52	0.519	1.315	26.36	10,517	15.70	0.491	1.245	14.79	15,547	14.81	0.461	1.161	9.68
2 South	648	15.69	0.542	1.103	72.98	1,522	14.96	0.502	1.054	30.50	6,389	13.26	0.424	0.943	6.50
3 South	8,458	16.82	0.535	1.342	25.01	12,149	16.12	0.513	1.264	17.11	21,682	14.70	0.470	1.115	9.15
1 North	1,283	15.77	0.491	1.190	84.90	2,921	15.03	0.463	1.120	36.73	11,988	13.40	0.405	0.989	8.19
2 North	2,018	16.43	0.507	1.280	86.21	4,281	15.37	0.474	1.187	40.11	15,046	13.58	0.411	1.016	10.70
Total Pit	18,478	16.57	0.524	1.307	37.98	31,390	15.72	0.495	1.224	21.94	70,652	14.13	0.440	1.067	9.19

Phase	+= $10.00 NSR					+= $7.42 NSR (Internal C/O)					Total Phase Ktonnes
	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	ktonnes	NSR	Cu, %	CuEq, %	w/o Ratio	
1 South	20,560	13.87	0.425	1.080	7.08	23,415	13.30	0.408	1.028	6.09	166,095
2 South	14,765	11.97	0.374	0.841	2.25	20,434	11.18	0.345	0.779	1.35	47,937
3 South	35,503	13.25	0.422	0.979	5.20	44,277	12.42	0.392	0.909	3.97	219,976
1 North	20,906	12.41	0.372	0.905	4.27	26,532	11.72	0.350	0.846	3.15	110,208
2 North	29,634	12.30	0.368	0.906	4.94	39,229	11.54	0.344	0.847	3.49	175,980
Total Pit	121,368	12.82	0.396	0.949	4.93	153,887	12.04	0.369	0.883	3.68	720,196

Table 9

Net Value of Mining Phases

Mining Phase	Bottom Bench	ORE (=+ $7.42 NSR)				Waste	Total	Phase Net Value	Phase, Net Value per ton of Ore
		Ore ktons	NSR, $	Cu, %	CuEq, %	ktons	ktons	$ x 1000	$
PH 1 South	880	35,151	$13.52	0.412	1.061	130,944	166,095	$114,765	$3.26
PH 2 South	1200	30,911	$11.20	0.346	0.783	27,026	47,937	$50,281	$2.40
PH 3 South	700	51,015	$12.44	0.393	0.915	168,962	219,976	$124,517	$2.43
PH 1 North	1040	26,684	$11.71	0.350	0.845	83,524	110,208	$48,350	$1.81
PH 2 North	840	42,438	$11.48	0.342	0.842	133,542	175,980	$66,710	$1.57

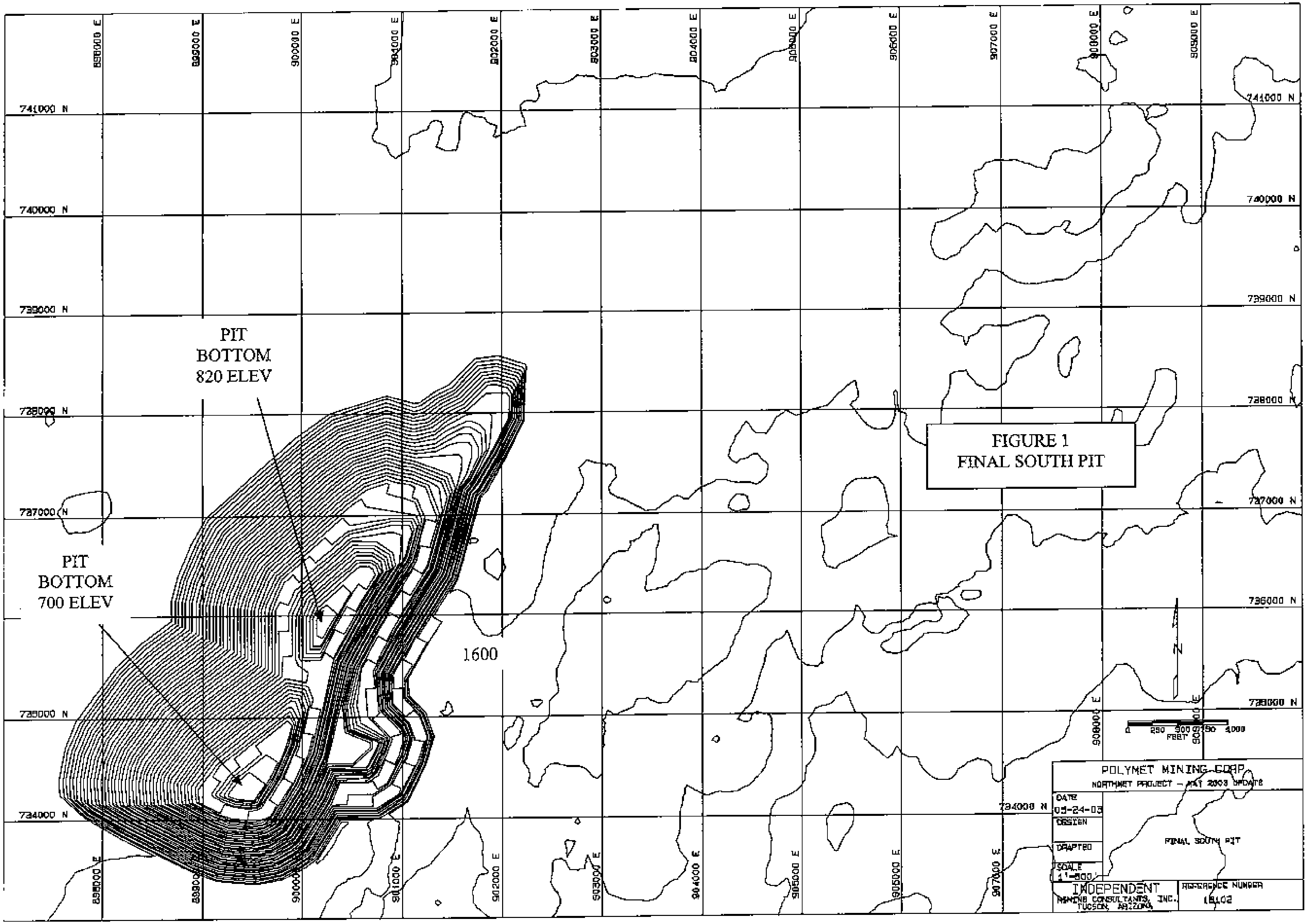


FIGURE 1
FINAL SOUTH PIT
PIT
BOTTOM
820 ELEV
PIT
BOTTOM
700 ELEV
1600
N
FEET
POLYMET MINING CORP.
NORTHMET PROJECT – MAY 2003 UPDATE
DATE
05-24-03
DESIGN
DRAFTED
SCALE
1"=800'
FINAL SOUTH PIT
INDEPENDENT
MINING CONSULTANTS, INC.
TUCSON, ARIZONA
REFERENCE NUMBER
18102

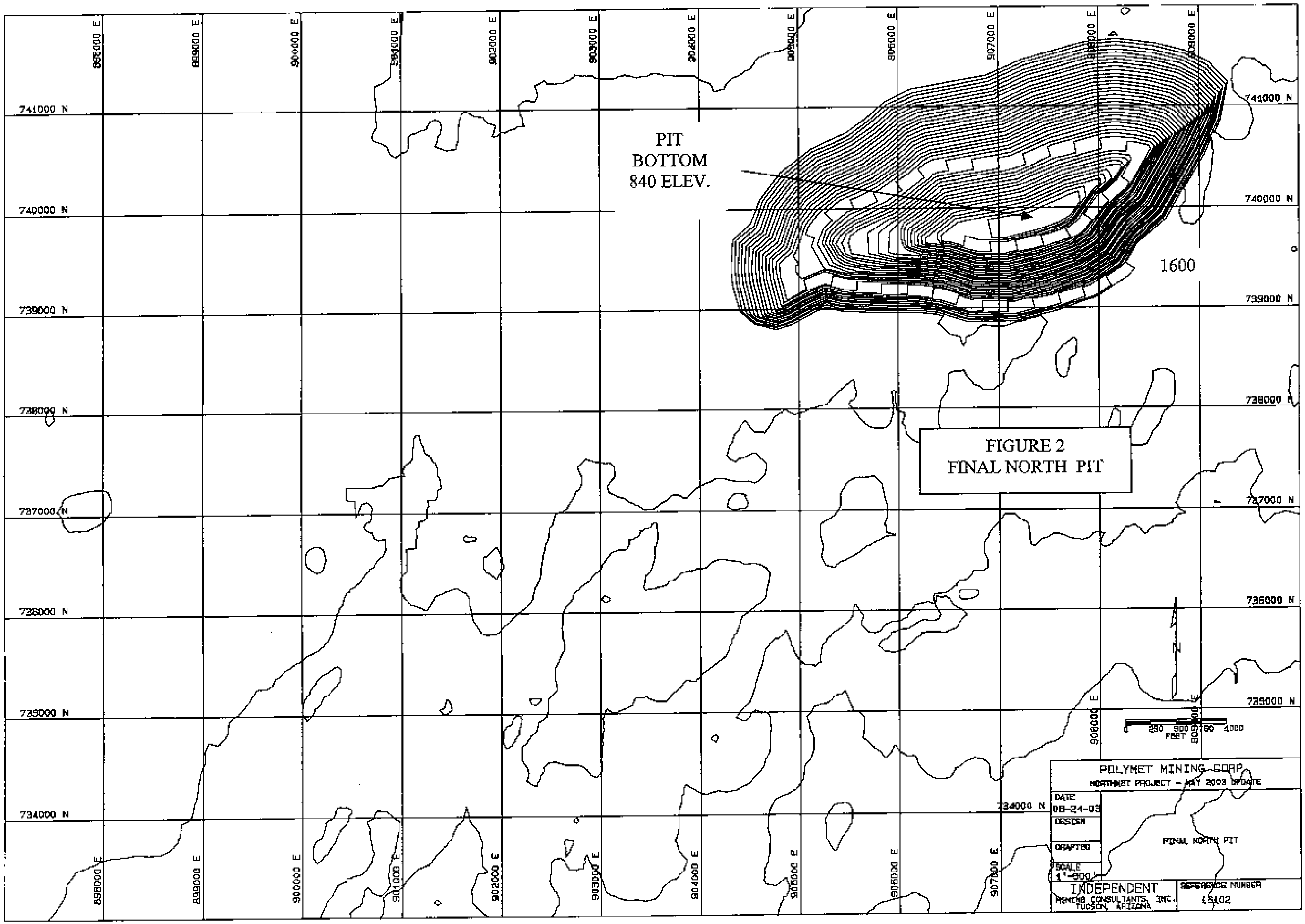
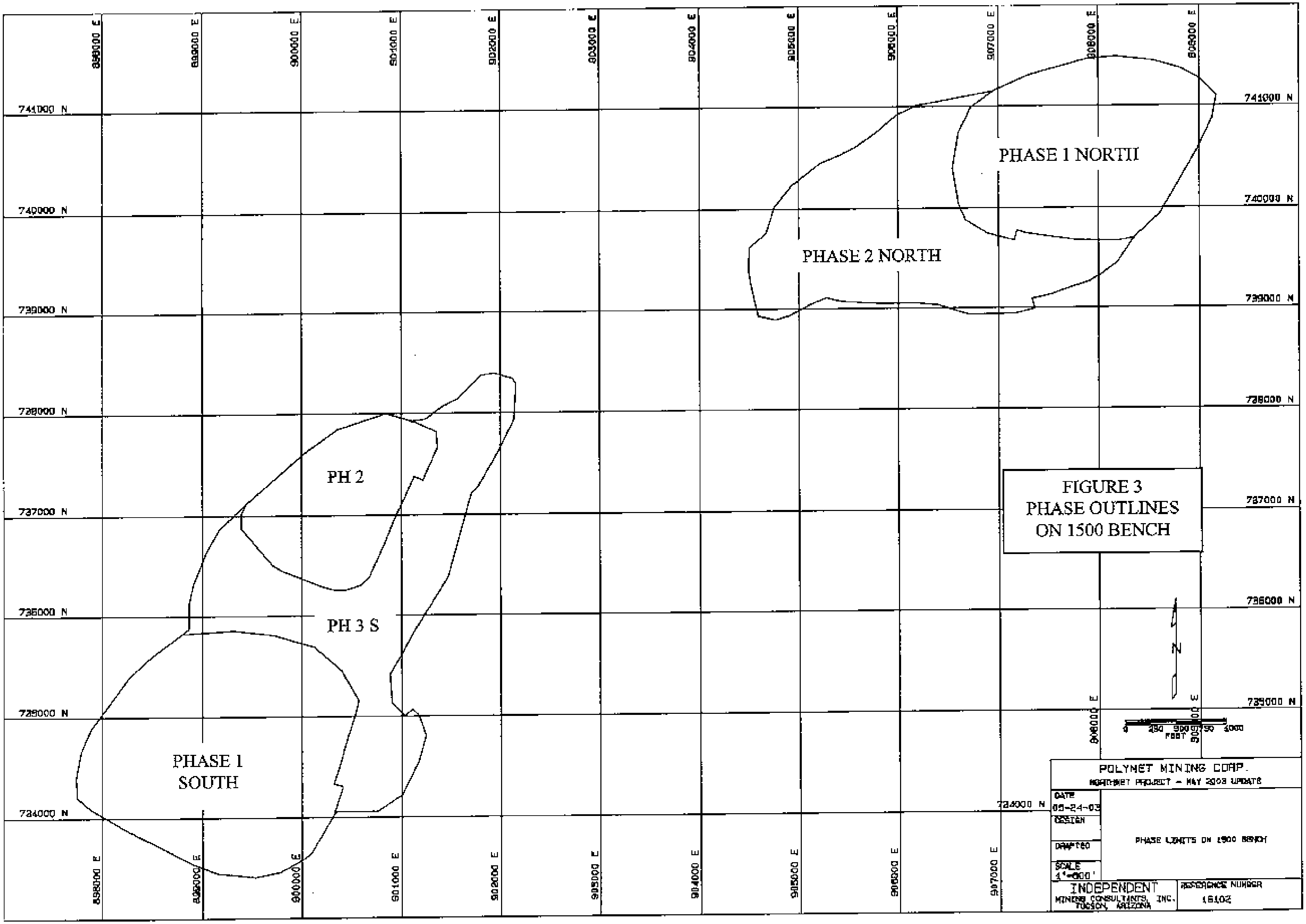


FIGURE 2
FINAL NORTH PIT


PHASE 1 NORTH
PHASE 2 NORTH
PH 2
PH 3 S
PHASE 1 SOUTH
FIGURE 3
PHASE OUTLINES
ON 1500 BENCH
741000 N
740000 N
739000 N
738000 N
737000 N
736000 N
735000 N
734000 N
898000 E
899000 E
900000 E
901000 E
902000 E
903000 E
904000 E
905000 E
906000 E
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N
FEET
POLYMET MINING CORP.
NORTHMET PROJECT - MAY 2003 UPDATE
DATE
05-24-03
DESIGN
DRAFTED
SCALE
PHASE LIMITS ON 1500 BENCH
INDEPENDENT
MINING CONSULTANTS, INC.
TUCSON, ARIZONA
REFERENCE NUMBER
16102

Mine Production Schedules

Preliminary mine production schedules were developed using the tonnage tabulations of the five mining phases for ore production rates of 15,000 tons per day (tpd) and 25,000 tpd. It is assumed that the plant will operate 365 days per year, thus the annual ore rate is 5,475,000 tons per year (tpy) for the 15,000 tpd case and 9,125,000 tpy for the 25,000 tpd schedules. The year 1 ore rate is at 85% of the nominal throughput rate and includes any ore mined during pre-production.

The mining sequence is phases 1, 2 and 3 in the south, then phases 1 and 2 in the north pit. Phases 1 and 2 in the south are independent phases and either one of them could be mined ahead of the other. Schedules were tried for both alternatives and starting with Phase 1 give a much higher net value during the earlier years at both production rates. Starting with Phase 1 requires a higher pre-production tonnage but this is more than offset by the higher head grades that are achieved.

The preliminary schedules developed for the two mill throughput rates have not been optimized and are intended to give an initial impression of the response to different cutoff grade sequences. Five cutoff grade schedules were run for each mill rate and the present value of the schedule at the end of years 5, 10 and end of mining was tabulated. This net value includes an allowance for the mine fleet capital (assuming new equipment) using a cost of $1.05 per ton of mining capacity. A discount rate of 8% was used to calculate the present value of the future revenues.

The NSR cutoff sequence used for the five production schedules summarized in Tables 10, 11 and 12 are:

Schedule 1: All years at internal cutoff grade of $7.42

Schedule 2: Pre-production through Year 2 at $10.00, Years 3 to 7 at $9.00, Years 8 through 10 at $8.00, and all years after Year 10 at $7.42

Schedule 3: Pre-production through Year 5 at $10.00, Years 6 to 8 at $9.00, Years 9 and 10 at $8.00, and all years after Year 10 at $7.42

Schedule 4: Pre-production through Year 5 at $9.00, Years 6 through 10 at $8.00, and all years after Year 10 at $7.42

Schedule 5: Pre-production through Year 10 at $8.00, and all years after Year 10 at $7.42

Higher cutoffs than $10.00 NSR were not evaluated because of the rapid decline of ore tonnage as the cutoff is increased, as seen on Table 7. For the sum of the South and North pits, the ore tonnage decreases by 37 million tons when the cutoff is raised from $7.42 to $10.00; this is a 21% decrease. When the cutoff is raised to $12.00, an additional 56 million tons is lost, or 40% of the ore tonnage at the $10.00 cutoff. The corresponding increase in NSR value per ton of ore is $0.80 (7%) when the cutoff is raised from $7.42 to $10.00, and an increase of $1.34 (10%) for the cutoff change from $10.00 to $12.00. The tonnage decrease is faster than the increase in net value as the cutoff is raised.

Table 10 is a summary of the preliminary schedules at 15,000 tpd ore and shows that there is some increase in the net value of the project with a modest increase in the cutoff grade in the early years. A smaller Phase 1 south was developed for the 15,000 tpd ore schedules to see if a smaller pre-production tonnage would improve the economics. Schedules with this sequence of phase designs are shown on Table 11. The smaller pre-production does improve the Year 5 NPV, but by Year 10 it and the schedules shown on Table 10 are similar. The smaller Phase 1 south was not used for the 25,000 tpd schedules because mining would occur too quickly through the benches in the phase.

The 25,000 tpd schedules are shown in Table 12 and show that a less aggressive cutoff grade strategy might be better at the higher throughput rate. The higher rate moves faster through the relative higher grade ore in Phase 1 South, thus bringing lower grade ore forward in time at a faster rate as the cutoff grade is raised. In all cutoff grade cases tested to date, the net values are similar for the preliminary nature of the input data. A 25,000 tpd rate was run with the smaller Phase 1 South and the NPV at Year 5 was about half of that shown on Table 12 for the sequence of cutoff grade trials. This is because of reduced amount of higher grade ore in the smaller phase 1.

Table 13 shows a 25,000 tpd ore schedule that has been refined from the preliminary schedules on Table 11. The total mining rate has been smoothed, but at this time is does not match the assignment of integer loading units per mining area. Additional refinements can be made to this schedule.

Table 10

Summary of Preliminary Production Schedules at 15,000 TPD Ore Rate

Large Phase 1 South (as shown on Table 7)

Schedule	Total Years	Total Ore ktons	Approximate Peak Annual Mining Rate (kt per year)	Net Present Value ($ x 1000) at End of (1)			Total Future Value (2) ($ x 1000)
				Year 5	Year 10	Mining	
1	32.3	176,200	PP = 30,200; Annually 24,000	12,849	40,494	98,622	404,619
2	31.8	173,016	PP = 30,200; 26,000 for years 1 &2, then 24,000 annually for years 3 through7, then 23,200 for balance	15,883	44,046	102,781	400,920
3	31.2	169,870	PP = 30,200; 27,000 for years 1&2, then 26,000 annually for years 3 through 12, then 23,300 for balance	20,570	44,873	103,127	395,487
4	32.0	174,301	PP = 30,200; 25,000 for years 1&2, then 24,400 for years 3 through 7, then 23,200 for balance	16,901	44,225	102,496	403,089
5	32.2	175,473	PP = 30,200; 25,000 for years 1&2, then 24,400 for years 3 through7, then 23,100 for balance	13,410	42,097	100,154	404,378

1) After allowance for initial mining capital at $1.05 per ton of capacity; 8% discount rate.
2) Sum of future net values after deduction of operating costs only.
(schedule6_ppp.d)

Table 11

Summary of Preliminary Production Schedules at 15,000 TPD Ore Rate

Smaller Phase 1 South

Schedule	Total Years	Total Ore ktons	Approximate Peak Annual Mining Rate (kt per year)	Net Present Value ($ x 1000) at End of (1)			Total Future Value (2) ($ x 1000)
				Year 5	Year 10	Mining	
1	32.3	176,200	PP = 24,000; 23,400 annual rate	22,516	37,641	100,656	404,619
2	31.6	172,002	PP = 24,000; 23,900 for years 1 and 2; 24,700 for years 3 through 11; 23,200 for balance	23,875	41,885	105,731	399,943
3	30.8	167,994	PP = 24,000; 27,000 for years 1 through 11; 23,100 for balance	19,434	38,059	102,742	392,479
4	31.4	171,154	PP = 24,000; 25,400 for years 1 through 10; 23,200 for balance	21,395	40,720	104,165	399,765
5	32.1	175,275	PP = 24,000; 23,700 for years 1 through 11; 23,200 for balance	22,656	38,883	102,031	404,327

1) After allowance for initial mining capital at $1.05 per ton of capacity; 8% discount rate.
2) Sum of future net values after deduction of operating costs only.
(schedule8_ppp.d)

Table 12

Summary of Preliminary Production Schedules at 25,000 TPD Ore Rate

Large Phase 1 South (as shown on Table 7)

Schedule	Total Years	Total Ore ktons	Approximate Peak Annual Mining Rate (kt per year)	Net Present Value ($ x 1000) at End of (1)			Total Future Value (2) ($ x 1000)
				Year 5	Year 10	Mining	
1	19.4	176,200	PP = 30,200; 34,500 in year 1; 38,500 annually	41,126	81,718	149,212	404,618
2	18.7	169,175	PP = 30,200; 38,000 in year 1; 41,900 in years 2 through 7; 38,700 for balance	39,324	87,082	148,660	396,126
3	17.9	162,311	PP = 30,200; 41,000 in year 1; 45,500 in years 2 through 7; 39,100 for balance	33,632	87,217	144,062	382,733
4	19.1	172,695	PP = 30,200; 35,500 in year 1; 39,600 in years 2 through 8; 38,500 for balance	43,978	88,323	153,390	401,609
5	19.3	175,103	PP = 30,200; 34,700 in year 1; 39,500 in years 2 through 4; 38,500 for balance	41,243	84,014	151,435	404,287

1) After allowance for initial mining capital at $1.05 per ton of capacity; 8% discount rate.
2) Sum of future net values after deduction of operating costs only.
(schedule7_ppp.d)

Table 13

Mine Production Schedule at 25,000 TPD Ore Rate

	ORE					WASTE	TOTAL
Year	Cutoff	ktons	NSR,$US	Cu, %	CuEq, %	ktons	Ktons
PP	9.00	2,093	13.94	0.401	1.132	25,907	28,000
1	9.00	5,663	12.92	0.384	1.001	31,161	36,824
2	9.00	9,125	12.86	0.391	0.985	29,875	39,000
3	9.00	9,125	12.94	0.396	1.000	29,875	39,000
4	9.00	9,125	12.63	0.387	0.967	29,875	39,000
5	8.00	9,125	11.75	0.356	0.869	29,875	39,000
6	8.00	9,125	12.49	0.382	0.922	29,875	39,000
7	8.00	9,125	11.87	0.370	0.824	29,875	39,000
8	8.00	9,125	11.90	0.373	0.585	29,875	39,000
9	8.00	9,125	12.30	0.395	0.882	29,875	39,000
10	8.00	9,125	12.18	0.394	0.877	29,875	39,000
11	8.00	9,125	12.83	0.413	0.939	29,875	39,000
12	8.00	9,125	12.83	0.396	0.956	29,875	39,000
13	8.00	9,125	13.09	0.392	1.003	29,875	39,000
14	8.00	9,125	11.98	0.354	0.885	29,875	39,000
15	7.42	9,125	11.52	0.339	0.843	29,875	39,000
16	7.42	9,125	11.45	0.338	0.835	29,875	39,000
17	7.42	9,125	11.13	0.327	0.783	27,798	36,923
18	7.42	9,125	11.24	0.338	0.814	10,478	19,603
19	7.42	9,125	12.58	0.389	0.970	3835	12,960
20	4.42	724	13.37	0.417	1.057	163	887
Total		172,730	12.25	0.375	0.907	547,467	720,197

Changes in Reserves – Preliminary Feasibility Study Case to Current

The purpose of this section is to document the changes in the stated potential minable resources from the Preliminary Feasibility Study published in April 2001 versus the current potential minable resource and to show the sources of the changes. Table 13 shows the resource change due to several different items.

Item 1 shows the potential minable resource at a $4.31 NSR cutoff grade as published in the PFS document. It shows 486.8 million ore tons in a total pit of 1.9 billion tons.

Item 2 shows the impact of excluding inferred resources as per the rules written in Canadian National Instrument 43-101 that became law about the time the PFS was completed. It can be seen that this amounted to 82.3 million tons of ore and the material was at higher average grades than the measured and indicated resources for all metals except cobalt.

Item 3 shows results due to a model developed in March 2001 with 13 additional holes. This model was documented in appendices to the original PFS, but was not the base case model used for that study. It can be seen that the impact was small as 4.7 million tons of low grade ore were added.

Item 4 shows the impact of the revised metal prices, recoveries, and process costs introduced during this May 2003 update. Note that the NSR cutoff grade increased from $4.31 to $7.42 with the revised economics. This resulted in the reduction of 99.7 million ore tons that were at quite low metal grades. Note that compared to Case 3 the metal grades increased significantly, but the NSR value did not increase. There were actually two components in Item 4. The first was the change to prices and recoveries. This caused a large change in NSR values but did not have much impact on ore tons. The second was the change to the process cost which caused the change to NSR cutoff grade. Almost all of the ore decrease is due to this second factor. The "N.A.'s" on the table mean that the calculation is nonsensical due to changes in base parameters between cases.

Item 5 shows the impact of the May 2003 revision to the model, due to designing ore zones at the higher cutoff grades, as discussed previously. This resulted in a 52.9 million ton decrease in ore tons, but an increase in grade since the ore lost was at marginal values.

Note that Items 1 through 5 were all tabulated inside the PFS final pit design. Note also that the strip ratio increased from 2.95 to 6.49 with the various changes. Item 6 shows the results of a re-design of the final pit to be more appropriate for the current economic conditions. It can be sent that the pit size was decreased by 1.2 billion total tons and that 102.7 million ore tons were lost in the change. The strip ratio is back down to 3.68.

Item 7 shows the effect of adding back inferred material in the pit design. This adds 22.3 million ore tons. The final ore tons and grade shown, as well as total tons, are the same as on Table 6. The strip ratio is similar to the original Item 1 results.

Table 13: NorthMet Project - Change in Potential Mineable Resources From Feasibility Study to May 2003 by Cause														
Item	Description	NSR Cutoff	Ore Ktonnes	NSR ($US)	Cu Eq (%)	Copper (%)	Nickel (%)	Cobalt (%)	Palladium (ppm)	Platinum (ppm)	Gold (ppm)	Total Ktonnes	Strip Ratio
1	Prefeasibility Study Mineable Resource	$4.31	486,832	11.43	0.819	0.301	0.083	66.20	0.287	0.084	0.042	1,921,266	2.95
2	Due to Exclusion of Inferred Resource:												
	Change	None	404,488	11.22	0.804	0.297	0.082	67.09	0.278	0.080	0.040	0	
	Mineable Resource w/o Inferred	$4.31	404,488	11.22	0.804	0.297	0.082	67.09	0.278	0.080	0.040	1,921,266	3.75
3	Due to 13 New Holes (March 2001 Model):												
	Change	None	4,716	6.01	0.457	0.123	0.082	73.16	0.191	0.080	0.040	0	
	March 2001 Model Mineable Resource	$4.31	409,204	11.16	0.800	0.295	0.082	67.16	0.277	0.080	0.040	1,921,266	3.70
4	Due to May 2003 Economics:												
	Change	$3.11	-99,697	N.A.	N.A.	0.174	0.057	62.16	0.137	0.046	0.021	0	
	Mineable With May 2003 Economics	$7.42	309,507	11.04	0.755	0.334	0.090	68.77	0.322	0.091	0.046	1,921,266	5.21
5	Due to May 2003 Model:												
	Change	None	-52,906	N.A.	0.115	0.169	0.056	59.99	0.157	0.047	0.027	0	
	Mineable Resource - May 2003 Model	$7.42	256,601	12.06	0.887	0.366	0.097	70.58	0.356	0.100	0.050	1,921,266	6.49
6	Due to Revised Final Pit Design:												
	Change	None	-102,713	12.09	0.893	0.367	0.097	72.03	0.357	0.101	0.050	-1,201,067	
	Measured, Indicated in Revised Pit	$7.42	153,888	12.04	0.883	0.369	0.097	69.61	0.355	0.099	0.05	720,199	3.68
7	Add Back Inferred Resource:												
	Change	None	22,311	13.07	1.017	0.393	0.097	58.63	0.434	0.138	0.066	0	
	Revised Mineable Resource	$7.42	176,199	12.17	0.900	0.372	0.097	68.22	0.365	0.104	0.052	720,199	3.09

APPENDIX II

PENGUIN AUTOMATED SYSTEMS INC.

UPDATE REPORT ON CAPITAL AND OPERATING COSTS FOR PROCESS PLANT AND INFRASTRUCTURE, USING THE CLIFF'S-ERIE PLANT

PolyMet Mining Corporation

NorthMet Project
Processing Facilities Scoping Study

Penguin Automated Systems Inc.
April, 2004

CERTIFICATE - Richard C. Alexander, P.Eng.

As a co-author of this Scoping Study summarizing the Capital and Operating Costs for the Process and Ancillary Facilities for the NorthMet Project located in Hoyt Lakes, Minnesota, USA, I, Richard C. Alexander do hereby certify that:

1. I am employed by, and carried out this assignment for, Penguin Automated Systems Inc., Suite 2310, Bay Wellington Tower, BCE Place, 181 Bay Street, Toronto, Ontario M5J 2Y2, tel. (950) 827-8175, fax (950) 825-0814, e-mail rick.alexander@penguinasi.com;

2. I hold the following academic qualifications:

   B.Sc. (Mechanical Engineering) The University of Alberta 1985

3. I am a registered Professional Engineer in the Province of British Columbia;

4. I have worked in engineering, construction management and project management in the minerals industry for 19 years;

5. I am familiar with NI 43-101 and, by reason of education, experience and professional registration, I fulfill the requirements of a Qualified Person as defined in NI 43-101;

6. I visited the properties during the period April 5 to April 8, 2004;

7. I have had no prior involvement with the mineral properties in question;

8. I am not aware of any material fact, or change in reported information, in connection with the subject properties, not reported or considered by me, the omission of which makes this report misleading;

9. I am independent of the parties involved in the transaction for which this report is required, other than providing consulting services;

10. I consent to the filing of the report with any Canadian stock exchange or securities regulatory authority, and any publication by them of the report.

Dated this 20 April, 2004

PROFESSIONAL
PROVINCE OF
R.C. ALEXANDER
BRITISH COLUMBIA
ENGINEER

Richard C. Alexander, P.Eng.
Project Manager
Penguin ASI

PolyMet Mining Corporation

NorthMet Project
Processing Facilities Scoping Study

Table of Contents

1.0 Introduction

1.0 Introduction

1.1 Background and Scope of Work

PolyMet Mining Corporation (PolyMet) intends to develop the NorthMet deposit located in the Mesabi Iron Range in Northeastern Minnesota. The project is located approximately 70 miles north of Duluth. The NorthMet Project is a polymetallic magmatic sulfide deposit containing platinum, palladium, gold, copper, nickel, cobalt, and silver. The deposit is hosted near the base of the Duluth Mafic Complex and is one of the largest undeveloped non-ferrous metal project in the U.S.

In 2001, (AMEC) (formerly AGRA Simons Inc.) completed a pre-feasibility level study for the NorthMet project. In 2003, a new management team review of the pre-feasibility work concluded that a technically simpler, lower tonnage project would be more appropriate to advance the project to feasibility level. As part of the strategy of the new management team, Polymet has secured an option to purchase and utilize the processing facilities available at the Cliffs Erie site in Hoyt Lakes, Minnesota. These assets were formerly owned by LTV Steel Mining Company, which permanently closed its iron ore mining and palletizing operations in January 2001. The Cliffs Erie site historically processed 100,000 st/day of iron ore through crushing, grinding and flotation. The Cliffs Erie plant acquisition therefore provides the “front end” of the proposed Polymet plant for treatment of NorthMet ore as well as land, buildings (for concentrate processing and metal recovery). Rail access and tailings dam facilities. As part of this revised approach, Polymet intend to utilize part of the existing processing facilities at the Cliffs Erie site in Hoyt Lakes, Minnesota. These assets were formerly owned by LTV Steel Mining Company, which permanently closed its iron ore mining and pelletizing operations in January 2001.

Penguin Automated System Inc. (Penguin ASI) was contracted in January 2004 to prepare a scoping level study for the NorthMet process plant facilities based on the revised concept as a prelude to proceeding to a feasibility study.

The Scope of Work was defined in the proposal issued January 21st 2004 and is summarized as follows:

- Develop scoping level capital and operating cost estimates for a stand alone concentrator capable of treating 9,125,000 tonnes per annum and utilizing parts of the existing Cliffs Erie processing facilities.

- Prepare preliminary flowsheets, material balances, process design criteria, equipment sizing and process plant layouts to support the development of the capital and operating costs.

This study is based on the AMEC pre-feasibility report, testwork reports from SGS Lakefield, metallurgical data supplied by Polymet and site visits and discussions with key personnel at the Cliffs Erie site.

1.2 Basis of Design

The basis of design was to develop capital and operating costs to a scoping level estimate of +/- 30 %.

The capital cost estimates are based on flowsheets and layouts. Process equipment costs are based on preliminary budget quotes or factored from the previous study.

Operating cost estimates are based upon the estimated manpower requirements and reagent and consumable quantities developed jointly between Polymet and Penguin ASI and updated to reflect current cost data. Power costs are based on data gathered from site.

All currency amounts are stated in first quarter 2004 US dollars. All units of measurement are in metric units unless otherwise noted.

2.0 Summary

2.0 Summary

2.1 Introduction

The NorthMet Project is a large disseminated polymetallic deposit located North of Duluth Minnesota. It is proposed that the project be developed to exploit the mineral resources to produce the following three primary products:

- copper cathode,
- a nickel/cobalt hydroxide and
- a concentrate containing platinum group metals (PGM's).

The project will utilize crushing, grinding and flotation processes followed by a standard autoclave circuit based on the patented PlatSol process. The copper metal will be recovered utilizing a conventional SX/EW circuit.

The nickel/cobalt and PGM concentrates will be refined offsite. The process will also produce significant quantities of gypsum and carbon dioxide gas as potentially saleable by-products. This is something that will be examined more completely during feasibility.

The average daily milling rate will be 25,000 tonnes per day based on a 91% overall plant availability equivalent to 9,125,000 tonnes per annum. Grades, recoveries and metal production are summarised in Table 2.1.

Table 2.1 NorthMet Production

	Cu	Ni	Co	Au	Pt	Pd
Head grade	0.4%	0.11%	0.0088%	0.06g/t	0.11g/t	0.38g/t
Recovery to concentrate	93.7%	69.0%	42.0%	75.7%	76.9%	79.6%
Concentrate grade	14.6%	2.94%	0.14%	1.63g/t	3.32g/t	11.82g/t
Pressure Leach Extraction	99.6%	98.9%	96.0%	96.0%	96.0%	96.0%
Recovery from Leach Solution	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
Overall Recovery	92.4%	67.6%	39.9%	72.0%	73.1%	75.7%
Metal Production tonnes per year	33,723	6,755	319	0.36	0.74	2.63

2.2 Project Location and Access

The NorthMet deposit is located in northeastern Minnesota, St. Louis County, 100 miles north of Duluth and 4 miles south of Babbitt (see Figures 2.1 and 2.2). The famous large-scale open-pit Mesabi Range iron mining operations are within two miles of the project. The Polymet process plant will be constructed on the site of the existing Cliffs Erie iron ore facilities located some 5 miles away by railroad from the deposit. The assets were formerly owned by LTV Steel Mining Company, which permanently closed its iron ore mining and pelletizing operations in January 2001. Founded as Erie Mining Company, LTV Steel Mining Company was one of the first taconite production facilities in Minnesota and in the iron mining industry. The construction of the Hoyt Lakes mine, plant, loading dock and the power plant facilities at Taconite Harbor was completed in 1957 at a cost of $300 million. Polymet has already acquired ownership of certain land, crushing and concentrating facilities, as well as shops, warehouses and other assets at the Cliffs Erie location and also has access to already established roads, tailings disposal facilities, water, electricity, offices and rail service. Rail lines connect to ports on nearby Lake Superior, all of USA and Canada.

Figure 2.1 NorthMet Deposit Location

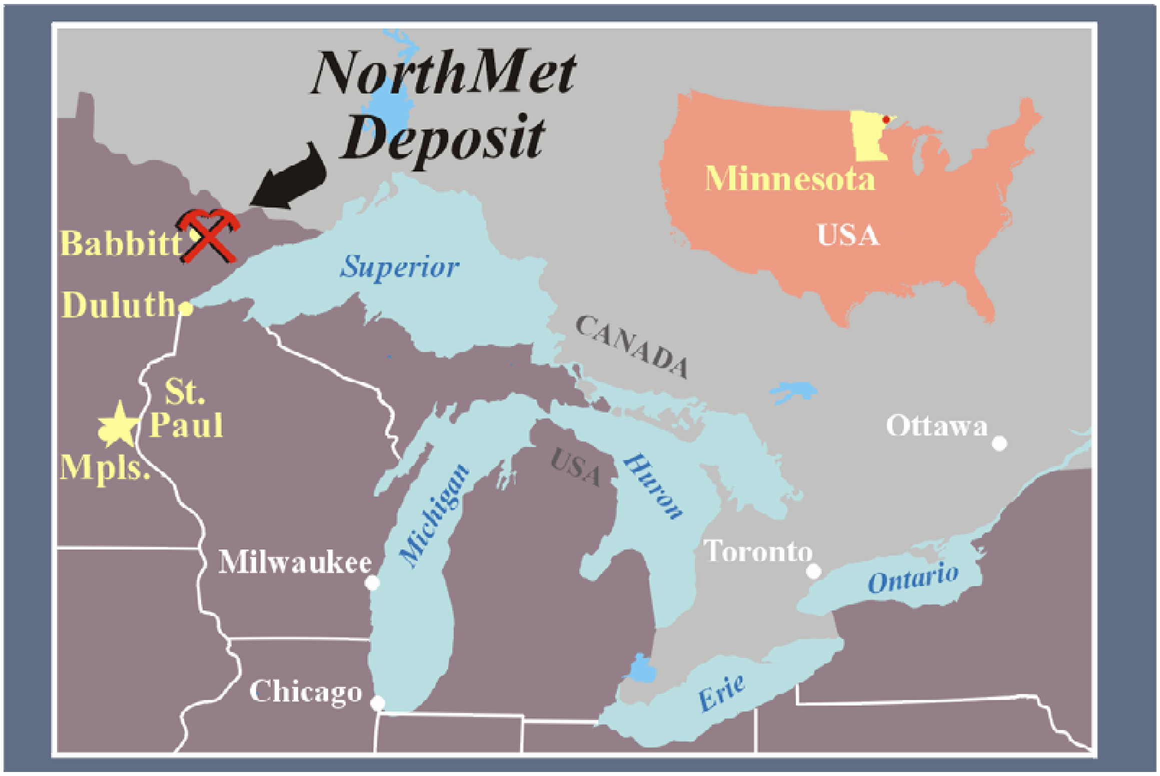
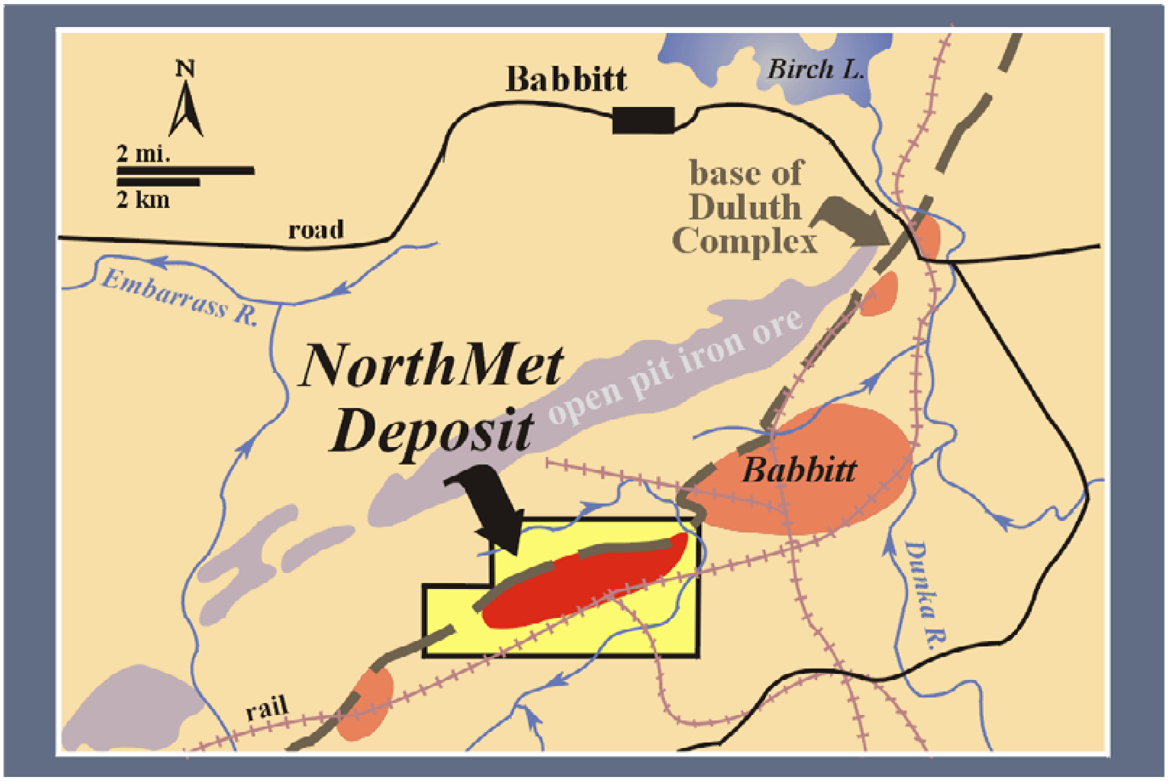


Figure 2.2 NorthMet Deposit Location



Accommodations and full services are located nearby in both Hoyt Lakes and Babbitt. Experienced general construction and operations labour can be obtained from the local area population.

2.3 Process Plant

The NorthMet Project will utilize parts of the existing processing facilities at the Cliffs Erie site for crushing and grinding of the ore. A new flotation plant will be installed in the existing concentrator building with new facilities and equipment installed for the downstream hydrometallurgical processes. The existing infrastructure and plant services will be utilized for the project.

2.4 Capital Cost

A scoping level capital cost estimate for the process facilities was prepared. The capital cost of the processing facilities was estimated to be $199,426,621. This estimate is summarized in the following table 2.4.1.

Table 2.4.1 NorthMet Project Initial Capital Cost

Item	Cost ($000)
Crushing	3,082
Grinding	4,282
Flotation & Regrind	17,546
Pressure Leaching	31,052
Solid / Liquid Separation	6,667
PGM Recovery	5,082
Neutralization	8,867
Solvent Extraction	6,439
Electrowinning	18,749
Fe & Hydroxide Precipitation	6,003
Infrastructure & Auxiliary Services	12,587
Tailings	4,549
Mining	5,760
Subtotal Direct Costs	130,665
EPCM	19,600
Construction Indirects	2,872
Capital Spares	4,323
First Fills	4,000
Vendor Representatives	1,319
Freight	2,499
Start Up and Commissioning	910
Contingency	33,238
Total Project Cost	$ 199,426

The capital cost estimate includes the estimated direct cost for equipment, material and labour and cost estimates for the project indirect costs including EPCM, start up, construction indirects, first fill, spares and contingency.

2.5 Operating cost

The annual operating costs for the processing facilities were estimated to be $60.2 million including a 5% contingency or $6.59 per ton milled. The processing operating cost estimate is summarized in the following table 2.5.1.

Table 2.5.1 Operating Cost Summary

Description	Total Cost US$	US$/tonne
Consumables	22,142,258	2.43
Labour	10,977,823	1.20
Power	16,746,886	1.84
Plant Operating Supplies	400,000	0.04
Maintenance Supplies	1,915,896	0.21
Environmental Monitoring	300,000	0.03
G&A	4,856,600	0.53
Sub total	**57,339,463**	**6.28**
Contingency 5 %	2,866,973	0.31
Total	**60,206,436**	**6.59**

3.0 Process Plant

3.0 Process Plant

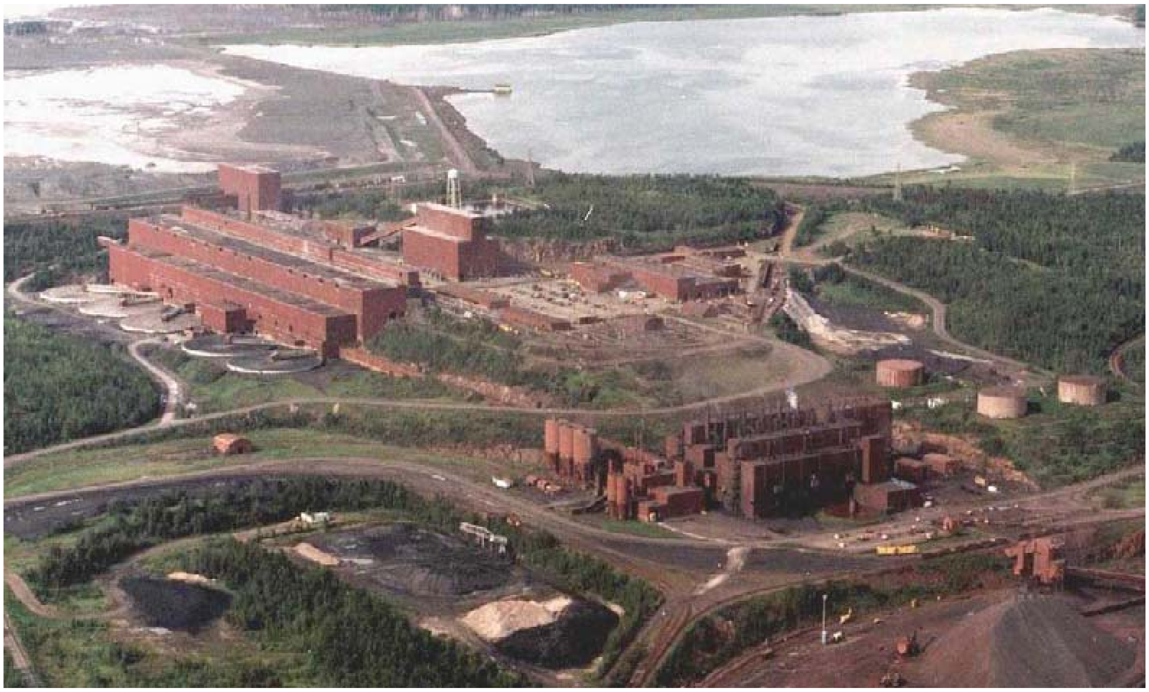
3.1 Existing Facilities at Cliffs Erie

The polymet process will incorporate standard crushing, grinding and flotation to produce a concentrate for hydromettalurgical processing to produce copper cathodes, nickel cobalt hydroxide and a PGM concentrate.

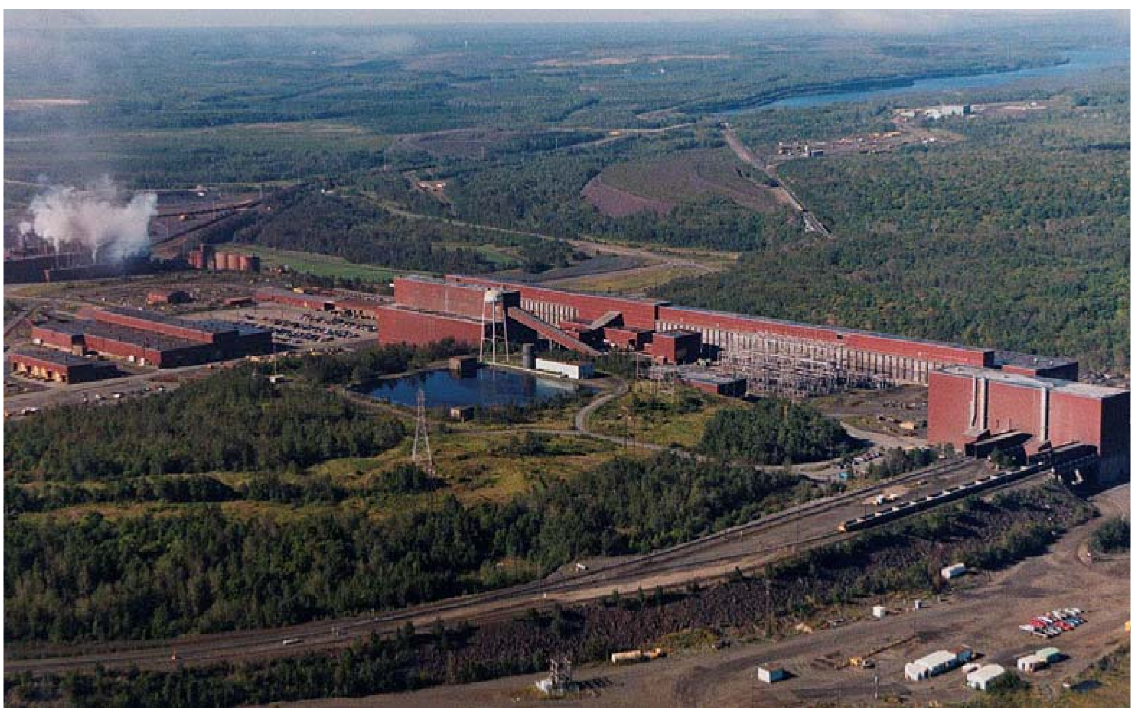
The NorthMet project process facility will be located within the existing Cliffs Erie plantsite making use of the following:

- one circuit of the rail dump pocket and the 60” gyrosphere crusher;
- the withdrawal feeder and the transfer conveyors to the coarse ore bins;
- 2-7’ standard cone crushers and associated feeders;
- 4-7’ short head cone crushers and associated feeders and screens;
- belt conveyors and tripper to the fine ore bins;
- 8 sets of rod/ball mill circuits;
- three regrind mills (two for concentrate regrind and one for limestone);
- ancillary facilities and offices;
- infrastructure including power supply and distribution;
- tailing storage and reclaim water facility.

Photograph 3.1.1 Overall Facilities at Cliffs Erie



Photograph 3.1.2 Concentrator Building



In early January 2004, the facilities were visually inspected by Equipment Specialist Dave Phelps (FFE Minerals) and Mickey Trader (Penguin ASI) and found to be in good standing. The plant is generously designed with good maintenance and service crane access to all major equipment.

It was noted that the previous operators kept excellent records of all equipment maintenance and spare parts.

3.2 Metallurgical Testwork and Design

Polymet conducted benchscale and pilot plant work at SGS Lakefield in preparation for the AMEC feasibility study. This work was reviewed and evaluated by T.O'Kane of Polymet and was reported separately at the same time as the AMEC study. The metallurgical testwork results, recommendations and flowsheet design as provided by Mr O'Kane were incorporated into the AMEC process facility design and equipment list without audit by AMEC. In compiling this scoping study, Penguin ASI has relied on process design criteria data in the AMEC report and in the hydrometallurgical mass balance provided by Polymet and has not audited or confirmed this data except for the following:

- Penguin ASI reviewed the filtration data from the pilot plant work and used the appropriate filtration rates for sizing the leach residue and gypsum filters
- Penguin ASI reviewed the calculation accuracy and completeness of the hydrometallurgical mass balance but did not conduct a metallurgical audit

In the next phase of the project a full review of all testwork completed to date will be required. Based upon the limited review that has been completed, Penguin ASI recommends the following additional testwork:

- Grinding testwork to confirm work indices of the ore and concentrate, and
- Filtration testwork on PGM concentrates to determine filtration rates.

There may be other areas that require additional or confirmatory work. This can only be assessed after a full review of all testwork completed to date.

Penguin ASI developed an overall mass balance for the NorthMet process based on the hydrometallurgical mass balance provided by Polymet, which set the feed headgrades and recoveries for copper, nickel, cobalt and PGM's at and a throughput of 9,125,000 tonnes per annum.

The development of the flowsheet and equipment sizing for the crushing, grinding and flotation process facilities was based on flowrates derived from this mass balance, plus process design criteria developed from the AMEC study and information by SGS Lakefield who were responsible for the pilot plant flotation trials. The flowsheet for the hydrometallugical facilities – pressure oxidation, solid-liquid separation, PGM recovery, copper SX/EW and nickel/cobalt hydroxide recovery – was derived primarily from the AMEC study with equipment resized accordingly for the new plant throughput, plus input from T.O'Kane of Polymet for the autoclave circuit. Testwork data from SGS Lakefield was reviewed for sizing of thickeners and filters.

Work indices used for crushing and grinding circuit calculations are estimates provided by SGS Lakefield based on limited grinding testwork. These numbers will require confirmation in the next phase.

3.3 Process Design Criteria

The detailed process design criteria is presented in Appendix 1 and the key criteria is summarized in Table 3.1.1.

Table 3.1.1 Process Design Criteria Summary

Parameter	Design Criteria
Annual mill throughput	9,125,000 tonnes
Average daily mill throughput	25,000 tpd dry
Plant Availability	91.34%
Operating Hours per day	24
Hourly Throughput	1140 tph dry
Concentrate produced	703 tpd dry
Rod mill work index	14 kWh/t
Ball mill work index	17 kWh/t
Regrind work index	7.5 kWh/t
Feed size to flotation	200 micron
Feed size to pressure leach	15 micron
Pressure leach residence time	2 hours
Autoclave operating temperature	225 C
Autoclave operating pressure	475 psig
H_2SO_4 concentration	50-60 g/l
Cl concentration	10 g/l
Cu SX plant	2 extraction; 1 wash; 2 strip
Organic / Acid ratio	1.5:1
PLS Cu	18.4 g/l
Raffinate Cu	0.99 g/l
SX Cu recovery	94.62%
E/W current density	260 amp/m^2
Cathodes per cell	54
Total cells required	125

3.4 Process Description

The overall process flow is described in the block flow diagram presented overleaf. Process flowsheets, general arrangements and site plan are provided in Appendix 2.

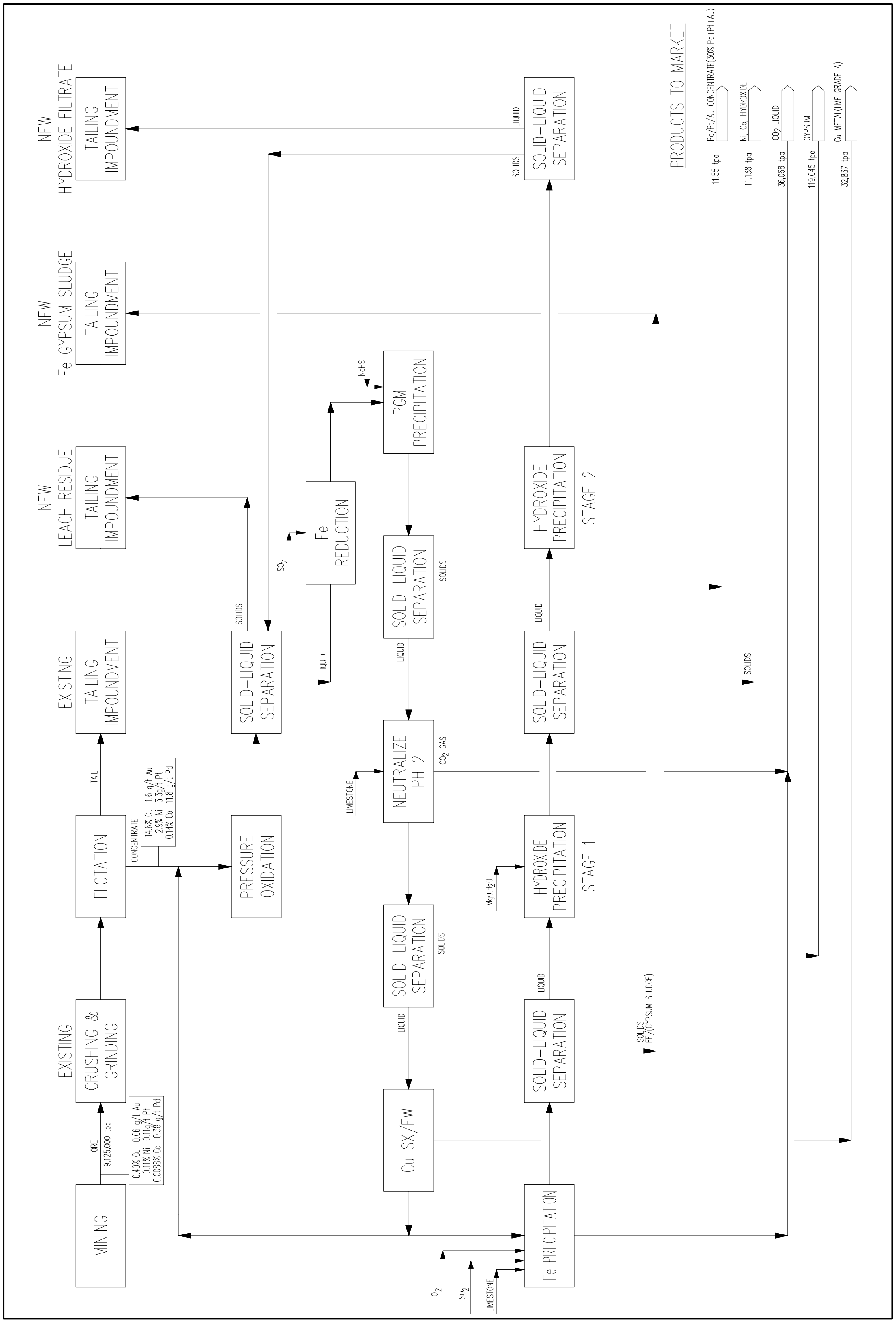
3.4.1 Crushing

Run of mine ore will be delivered by rail to the Cliffs Erie process plant and dumped into the primary crusher surge pocket. From the surge pocket, the ore will flow to a single existing 60” by 89” gyratory crusher set to produce a nominal coarse ore product with a P_{80} sizing of 6 inches. The existing secondary gyratory crushers will be removed and a surge pocket will be constructed allowing the crushed ore to discharge onto an existing apron feeder. The apron feeder will in turn discharge onto the exiting coarse ore surge bin feed conveyor. Ore from the coarse ore surge bin will discharge via the existing vibrating feeders onto existing belt feeders feeding two existing 7’ standard cone crushers. Each 7’ cone will discharge onto two existing vibrating feeders, each feeding an existing 6’ x 10’ vibrating screen. Screen oversize discharges into one of four existing 7’ shorthead cone crushers. The minus ¼” discharge from the tertiary shorthead crushers will combine with the screen undersize onto the existing feed conveyor to the existing fine ore bin.

3.4.2 Grinding

Ore from the fine ore bin will discharge via existing vibrating and belt feeders to the existing rod and ball mill circuits. For the design throughput of 25,000 tpd, 8 of the existing 12 circuits will be utilized. Each rod mill will operate in open circuit, with the rod mill discharge feeding a ball mall in closed circuit with new hydrocylones. The grinding circuit will produce a flotation feed of 30% solids at a P_{80} sizing of 200 micron.

Figure 3.1 Block Flowsheet



3.4.3 Flotation and Regrind

Cyclone overflow from the grinding circuits combine to feed a conditioning tank with a 5-minute retention time. The conditioner will feed a single bank of 4-160m^3 rougher tank cells providing a total residence time of approximately 8 minutes. Rougher discharge will feed 2 parallel banks of 5-160m^3 tank cells providing a residence time of 20 minutes.

Rougher concentrate combines with re-cleaner tail to feed the first cleaner flotation circuit. The cleaner flotation circuit will consist of a single bank of four 20m^3 conventional cells providing 16 minute retention time. Scavenger concentrate, mixed with cleaner tail, will be reground in an existing regrind ball mill to a target P_{80} of 30 micron prior to recirculation back to the conditioning tank. Cleaner concentrate will be fed to a single re-cleaner column cell, providing 16-minute retention time, for final concentrate cleaning. Cleaner concentrate will report to the concentrate regrind mill where the concentrate will be reground to the target P_{80} sizing of 15 micron, prior to pressure oxidation. A second existing regrind mill (using ceramic balls as grinding media to reduce iron contamination) will be used for this purpose.

Reground concentrate thickened to 50% solids and stored in a concentrate storage tank, which provides 12 hours of surge capacity between the flotation circuit and downstream hydrometallurgical processing.

Flotation tailings will be pumped to the existing Cliffs Erie tailings impoundment.

The flotation circuit reagents (MIBC, PAX, Flex 31, and WW1 752) are based on the AMEC study and was developed for effective base metal recoveries with associated high PGM recovery.

Flotation circuit metallurgical accounting will be accomplished using the sample data from an on-stream analyzer, and automated shift sample collection that will be obtained from sample multiplexers on the on-stream analyzer system.

3.4.4 Pressure Leaching

Pressure Leaching is based on standard Autoclave technology and utilizes the patented PlatSol process. Concentrate will be blended in the autoclave feed tank with sodim chloride prior to pumping into the autoclave at 50% solids. Recycled copper SX/EW raffinate will be pumped into the autoclave to maintain temperature control.

The two autoclaves will provide the required 2-hour residence time for the feed slurry. Each autoclave will have 6 compartments, and will be designed to operate at 225°C and approximately 475 psig. These pressures and temperatures are standard for autoclave dsign in the refractory gold ore/concentrate oxidation process. The NorthMet autoclave design will comprise a mild steel pressure vessel with a polymer-thermoplastic membrane corrosion barrier and two layers of acid resistant brick for thermal and abrasion resistance. This design follows the the reported design of the Phelps Dodge copper concentrate autoclave at Bagdad, Arizona. The Phelps Dodge autoclave has been designed for temperatures up to 235C and pressures of up to 4000 kPa.

Autoclave utilities and ancillary equipment include a packaged steam boiler for start-up heating, agitator seal water systems, compressed air, water treatment units, and oxygen blowout vessels. Oxygen supplied, at 98% purity, to the pressure oxidation circuit will be delivered via an "over the fence" type contract.

The slurry is cooled to below 63° C via a single stage let down and slurry coolers prior to downstream metal extraction processes.

3.4.5 Leach Residue

Prior to metal recovery, the leach residue will be separated from the pregnant leach solution (PLS) to provide a high recovery of solute via filtration and washing of the leach residue. To accomplish this, the circuit will include a primary thickener followed by a pressure plate filter unit. A wash ratio of 4:1 will be used to maintain high solute recoveries. Autoclave residue filter cake will be re-pulped and fed to a scavenger flotation circuit to recover residual PGM’s. The PGM concentrate will be re-circulated back to the feed end of the autoclave and the flotation tailing will be pumped to a new hydromet tailings impoundment constructed inside the existing tailings impoundment.

3.4.6 PGM Recovery

PLS will be mixed with $S0_2$ to ensure total reduction of oxidize iron species in solution (Fe (III) is reduced by Fe (II) in solution by SO_2). The SO_2 will be produced by a packaged sulphur burner system. After ferric iron reduction, the solution will be processed through a two-stage pipe reactor system, with the addition of NaHS, to precipitate the platinum and precious metals. After filtration, the PGM precipitate will be releached in a sulfuric acid solution in a batch autoclave to leach any co-precipitated base metals (Cu, Ni, Co) and sulfur/sulfides to produce a high grade PGM precipitate for toll refining. Batch autoclave leach solution will be recirculated back to the PLS surge tank before precious metal recovery to ensure full recovery of valuable metals.

3.4.7 Neutralization

The PLS filtrate from the PGM precipitation system will require neutralization to pH 2 prior to copper solvent extraction. Filtered PLS will be pumped from the neutralization surge tank to the solution neutralization cascade that consists of three tanks with a total retention of 180 minutes. Limestone is added to maintain a pH of 2 and prepare the solution for copper solvent extraction.

The slurry exiting the precipitation tanks will be pumped to a thickener. Thickener underflow is filtered using an automatic plate and frame pressure filter package. The filter cake solids (saleable grade gypsum) will be discharged to a conveyor and stockpiled prior to re-sale.

3.4.8 Copper Solvent Extraction and Electrowinning

Copper PLS from the neutralization circuit will be stored in the copper SX feed tank providing 4 hours of surge capacity. PLS will be filtered to avoid crud formation in the SX circuit. The filtration will use multi-media pressure filters and the backwash will be returned to the gypsum thickener. Copper will be extracted from the PLS into an organic solution containing 30% by volume of Cognis LIX-984.

The extraction circuit consists of three mixer settlers, in which the aqueous feed and the barren organic flow counter-current to one another. Raffinate leaving the final extractor will report to the copper raffinate tank, from which solution will either be recirculated back to pressure oxidation for use as cooling liquid, or sent forward to bleed treatment.

Copper loaded organic is pumped from the first stage extractor to the loaded organic tank where entrained aqueous solution will have the chance to settle out. Solution recovered in this way will be collected in a sump at the bottom of the tank and is periodically returned to the extraction circuit.

Loaded organic will be contacted, in a two-stage copper strip circuit, with lean electrolyte recycled from copper EW. The stripped organic will pass through to extraction, while the rich electrolyte will be pumped through organic recovery columns, and anthracite based multi-media filters to coalesce any residual organic, before discharging into the electrolyte recirculation tank.

The copper EW circuit reflects ISA stainless steel cathode tankhouse technology. Rich electrolyte will be trim heated to approximately 120°F before entering the tankhouse EW cells, using an indirect hot water heating system. A 125-cell tankhouse will provide the capacity required to harvest 33,000 tonnes per year of cathode copper.

Cathodes from the EW cells will be harvested on a daily basis, after a 7-day growth cycle. The copper sheets will be mechanically stripped from the stainless steel blanks using a standard fully automatic cathode washing and stripping machine. The stripping machine will also provide mechanical stacking, strapping, and weighing of the cathode bundles in preparation for shipping to market.

3.4.9 Nickel-Cobalt Hydroxide

Iron and aluminum must be removed from copper SX raffinate bleed solution before the extraction of nickel and cobalt.

In the first of three precipitation cascades, iron will be removed as goethite. In order for goethite to be formed, the bleed stream will be pre-heated to 170° F by direct steam injection into a tank with 45 minutes retention time. Direct injection will be used to negate the problem of gypsum scaling on the solution side of a shell and tube heat exchanger.

Hot solution overflows the pre-heat tank and will enter the first of five tanks in the iron precipitation cascade. Limestone will be added to the first tank to neutralize free acid in the copper raffinate, and will result in gypsum precipitation. Air is sparged into tanks l, 2 and 5 to facilitate ferrous oxidation, allowing ferric precipitation as goethite. In the third and fourth tanks ferrous oxidation will be enhanced using a mixture of oxygen and sulfur dioxide. More limestone will be added to neutralize the acid generated by the goethite precipitation and maintain a discharge pH of 3.5. At this pH a significant percentage of the aluminum hydrolyses and precipitates while loss of the valuable metals (Ni, Co, Zn) is minimized.

Overflow from the fifth tank will be pumped to a thickener where the solids settle to a density of 40 wt%. A significant portion of the thickened underflow will be returned to the precipitation cascade, where the solids act as seeds to facilitate the growth of larger particles, which in turn improves settling and filtration characteristics. The balance of the thickener underflow will be filtered through a plate-type pressure filter. After washing to recover entrained nickel and cobalt, the cake will discharge into a tank where it is slurried with reclaim water and pumped to a new tailings impoundment on the existing tailings dam

Overflow from the iron thickener will be neutralized with magnesium oxide in two stirred tanks to precipitate a combined nickel/cobalt hydroxide. Slurry will discharge from the second tank into a thickener. Thickener underflow is filtered in a plate-type pressure filter. The filter cake will be collected and steam dried prior to bagging for dispatch to an off site nickel/cobalt refinery.

Thickener overflow will be treated with lime in two stirred tanks to precipitate any remaining valuable metal content. Slurry will discharge from the second tank to a thickener. Thickener underflow will be recycled back to the leach residue thickener. Thickener overflow will be pumped to a new tailings impoundment on the existing tailings dam.

The valuable metals (Ni, Co) will be redissolved under the strong acid conditions prevailing in the leach residue thickener.

3.4.10 Tailings

The existing tailings facility at Cliffs Erie will be used to contain tailings products from the NorthMet process plant. Flotation plant tailings will form the bulk of the tailings products and will be discharged to the existing dam using the existing pumping and piping arrangement.

There will be three new hydromet tailings produced:

- leach residue flotation tailings,
- iron/aluminum gypsum sludge
- solution from the hydroxide precipitation circuit.

Each of these tailings will be contained in separate lined ponds constructed on the existing tailings dam. Each pond will have an initial capacity of 3 years storage.

3.4.11 Reagents

Included on the equipment list are the proposed reagent systems to support the process plant operations. Reagent systems included are:

- Limestone: Rail receipt and off-load, conveying, crushing and grinding, slurry storage and distribution loop. (An existing mill will be used for grinding.)
- MIBC: Bulk liquid storage and distribution.
- PAX: Mixing, storage and distribution.
- Flex 31: Bulk liquid storage and distribution.
- WW 1752: Bulk liquid storage and distribution.
- Flocculent: Mixing, storage and distribution
- Sulfuric Acid: Bulk liquid storage and distribution.
- NaHS: Bulk liquid storage and distribution.
- NaCl: Mixing, storage and distribution.
- MgO: Mixing, storage and distribution.
- CaO: Mixing, storage and distribution
- Sulphur: Bulk storage, burner, distribution and SO_2 scrubbing

3.4.12 Infrastructure and Ancillary Services

Reclaim water, utilities and services, compressed air supply, power supply and distribution, offices, warehousing and laboratories will all be provided for by existing facilities at the Cliffs Erie plant site. New assay laboratory equipment will be purchased for the NorthMet project.

3.5 Equipment List

A mechanical equipment list was developed and is presented in Appendix 3.0.

4.0 Operating Cost

4.0 Operating Costs

4.1 Summary

The operating cost estimate for the study is based on the following six major cost centers:

- Reagents and consumables
- Manpower
- Electrical power
- Plant operating supplies
- Maintenance supplies
- General and administration (G&A)

The development of the project mine operating costs is beyond the scope of this study and have not included.

A contingency of 5% has been applied and all costs are estimated in first quarter 2004 US dollars.

Average operating expenditures for the process plant facilities are estimated to be $60.2 million dollars per year or $6.59 per tonne milled based on an annual plant throughput of 9,125,000 tonnes. A breakdown of the costs is summarized in Table 4.1 and details are provided in Appendix 4.

Table 4.1 Operating Cost Estimates

Description	Total Cost US$	US$/tonne
Consumables	22,142,258	2.43
Labour	10,977,823	1.20
Power	16,746,886	1.84
Plant Operating Supplies	400,000	0.04
Maintenance Supplies	1,915,896	0.21
Environmental Monitoring	300,000	0.03
G&A	4,856,600	0.53
Sub total	**57,339,463**	**6.28**
Contingency 5 %	2,866,973	0.31
Total	**60,206,436**	**6.59**

4.2 Basis of Estimate

4.2.1 Consumable Unit costs

All costs are expressed in terms of US$ and metric tonnes and are based largely on unit rates FOB mine site provided by Polymet and reviewed by Penguin. In some cases, Penguin has sourced unit rates directly from vendors. For some items, unit rates from the AMEC study have been used. In all cases, the unit cost source is listed in the detailed operating cost breakdown in Appendix 4.

4.2.2 Consumable Consumption Rates

Crusher, mill liners and grinding media

Estimated liner and steel media consumption rates are based on Penguins in-house experience. Consumption of ceramic grinding media used in the final concentrate regrind mill is based on vendor experience.

Reagents and chemicals

Unit consumption rates for flotation reagents have been taken from the AMEC study. Unit rates for the hydrometallurgical plant consumables are based on the Polymet mass balance.

4.2.3 Manpower

The total workforce for the process plant facilities is estimated to be 170 supervisory, operating and maintenance personnel. The staffing plan by component is in Table 4.2.

Table 4.2 Staffing Plan

STAFF	No.	MAINTENANCE	No.	OPERATIONS	No.
Mill Superintendant	1	Maintenance Superintendent	1	General Foreman Operations	1
Chief Metallurgist	1	General Foreman Maintenance	1	Operations Shift Foreman	8
Metallurgist	4	Maintenance Planner	2	Mill Clerk	2
		Maintenance Clerk	2	Crusher Operator	4
MILL WAREHOUSE	**No.**	Millwright/ Mechanic	12	Grinding Operator	8
Warehouse Supervisor	1	Millwright Apprentice	6	Flotation/ Regrind/ Tails Operator	8
Warehouseman	4	Welder	4	Operator	4
Warehouse Clerk	1	Machinist	3	POX Operator	4
		Chief Electrician	1	PGM Operator	8
LABORATORY	**No.**	Electrician	3	Neutralization Operator	4
Chief Chemist	1	Instrumentation Tech	5	Cu SX/TF Operator	3
Chief Assayer	1			Cu EX Operator	6
Assayer	6			Cu Cathode Stripping Operator	3
Sample Prep	6			Hydroxide Operator	6
Lab Clerk	1			Limestone Plant Operator	4
				Reagents Operator	8
				Labourer	14
				Railhead Operator	4
				Janitor	1

The process plant facility labor plan utilizes two different shift schedules:

Type I Day shift only. One shift per day, eight hours per shift, five days per week, for a total of 2,080 hours per year per employee.

Type II Shift work - 24-hour operations coverage. Three shifts per day, eight hours per shift, shift rotation for a total of 2,080 hours per year per employee.

All supervisory, technical, and warehouse personnel are on a Type I schedule, as well as most maintenance personnel except for service mechanics who are on a Type II rotation.

It is assumed that non-union labour will be employed at the NorthMet plant. Wages and salaries are based on the current ranges in the region for similar operations levels. Employees on a Type II shift rotation are paid overtime. For overtime, employees are paid at 1.5 times the base hourly rate plus any applicable shift differential. An allowance of 20% has been included in the labor operating costs for Type II employees for overtime.

Fringe benefits are estimated at 30% of the base annual cost for salaried and wage personnel, in accordance with fringe benefit costs experience by local mines.
These include allowances for the following:

- Payroll taxes
- 401 k contributions
- Group medical and life insurance
- Accidental death and dismemberment insurance and long term disability insurance
- Medical stop loss
- Worker's compensation premiums of 5%.

Fringe benefits are included in the labour cost calculation

4.2.4 Electrical Power

The load list developed for the AMEC study was factored accordingly to reflect the current process plant design and the total load estimate required for the process plant will be 48 MW. The local utility provider, Minnesota Power, will supply power at a unit power rate of $0.033 per kWh for the first 25 MW and $0.036 thereafter.

4.2.5 Supplies

Operating and maintenance supplies are estimated on the basis of industry averages. The maintenance supplies allowance is approximately 3% of the mechanical equipment capital cost for the process plant. Operating supplies allow for general plant supplies and plant mobile equipment operations and maintenance. The operating supply annual cost for plant assay supplies and general mill supplies is estimated at $200,000. The annual expenditure for operating and maintaining the mill mobile equipment fleet is estimated at $200,000.

4.2.6 Freight

Operating consumables are to be purchased FOB at the mine site. A freight estimate of $30 per ton has been assumed for purchases of grinding media and liner steel, as well as general allowances for reagents, chemicals and other consumables.

4.2.7 Inflation

The operating cost estimates include no allowance for inflation

4.2.8 Taxes

As per the AMEC study, the only consumable subject to Minnesota State sales tax is crushing and grinding media (liners and balls). A sales tax of 6.5% has been included in the costs for these items.

5.0 Capital Cost

5.0 Capital Costs

5.1 Summary

The preproduction capital cost estimate for the design, procurement and construction of the NorthMet Project facilities was developed based upon the process and ancillary facilities previously defined.

The initial capital for the processing facilities and infrastructure was estimated to be $199.4 million. Table 5.1-1 summarizes the preproduction capital costs for development of the project including direct and indirect costs associated with the construction of the facilities. Sustaining capital costs are not included. The capital cost estimate was largely based on factored estimates and is considered accurate to within +/- 30% at the summary level. All costs are in 1st quarter, 2004 U.S. dollars. The detailed cost estimate is included in Appendix 5.

Table 5.1-1: Capital Costs Breakdown

Item	Cost ($000)
Crushing	3,082
Grinding	4,282
Flotation & Regrind	17,546
Pressure Leaching	31,052
Solid / Liquid Separation	6,667
PGM Recovery	5,082
Neutralization	8,867
Solvent Extraction	6,439
Electrowinning	18,749
Fe & Hydroxide Precipitation	6,003
Infrastructure & Auxiliary Services	12,587
Tailings	4,549
Mining	5,760
Subtotal Direct Costs	130,665
EPCM	19,600
Construction Indirects	2,872
Capital Spares	4,323
First Fills	4,000
Vendor Representatives	1,319
Freight	2,499
Start Up and Commissioning	910
Contingency	33,238
Total Project Cost	$ 199,427

5.2 Basis of Estimate

The Capital Cost Estimate for the NorthMet Project was completed for the design previously specified in this report. The estimate assumes a conventional EPCM project delivery methodology. The capital cost estimate includes the estimated direct cost for equipment, material and labour. In addition, cost estimates were developed for the project indirect costs including EPCM, start up, construction indirects, first fill, spares and contingency. The estimate was developed based on a site visit and inspection of existing equipment and facilities, and the following main sources of information:

- Process Design Criteria.
- Process Flow Sheets.
- Facility General Arrangement Drawings.
- Electrical and Mechanical Equipment List.
- Budget Quotations from Equipment Suppliers.
- Current Labour and Material Costs.
- The AMEC Simons Mining & Metals 2001 Prefeasibility Report.

5.2.1 Direct Costs

The Direct Costs include the estimated costs of the equipment, material and labour required to construct the facility.

Equipment

All process equipment is considered purchased new for the project with the exception of the crushing, screening and grinding equipment, which will be reused from the existing plant. The equipment costs were based upon budget quotations where ever possible. Equipment pricing that was not based upon budget quotations were based on current data from other projects or factored from the AMEC Simons Prefeasibility Study.

The SX and EW plant equipment was factored from the AMEC study based on the revised equipment sizing for this study using commonly applied size factors. The AMEC SX and EW plant estimates include all piping, civil, structural, mechanical, piping, electrical and instrumentation requirements.

The equipment being reused for the crushing and grinding circuits will be utilized in place. An allowance for the material and labour requirements to re-start the existing crushing and grinding equipment and facilities has been included in the estimate. The allowance includes the supply and installation of new materials to cover the replacement of wear items such as liners, idlers, conveyor bets and drive components for the existing equipment as well as repairs and upgrades recommended by the previous operations personnel. The allowances were developed based on an inspection of the equipment and facility condition conducted during a visit to the facility in April 2004. The site visit included a detailed estimate review with the former plant operations personnel on a site where repair/refurbishment material costs and labour manhours were confirmed. There is a significant opportunity for cost savings by utilizing spare parts available from the previous operation. This inventory of spare parts available will require an investigation during the feasibility study.

It has been assumed that no mobile equipment is available on site. The estimate includes the purchase of new equipment for the plant operations and maintenance.

Materials

The material cost estimates were based either on quantity take-offs for areas that could be derived from the drawings or upon factored quantities from similar projects where drawing information was not available.

Concrete quantities are derived from layouts, historical factors or factored from the AMEC study adapted to the requirements of this study. Quantities are estimated as in-place, unit prices include formwork, reinforcing steel, imbedded metals, concrete supply, transport, placing, finishing, curing and the suppliers' quality control testing. Costs for independent quality control and testing are included in the indirects.

Platework quantities were estimated from the equipment list and flowsheets and historical experience from similar projects. Structural steel quantities are factored based on square footage obtained from general arrangement drawings. The unit prices include supply, detailing, fabrication, painting and delivery.

Cost for process piping, electrical, lighting and instrumentation distribution within the facilities is factored from similar installations or the AMEC study.

Buildings

The crushing, grinding and flotation circuits will utilize portions of the existing buildings. The existing warehouse will be utilized for the solid/liquid separation, PGM recovery, neutralization, solvent extraction, electrowinning and Fe & hydroxide precipitation. The pressure leaching circuit will be constructed in a new pre-engineered insulated metal building adjacent to the existing warehouse. Where existing facilities are utilized an allowance has been made for repairs and modifications, including replacement of doors/windows, repairs to the building envelope and new openings for HVAC piping and electrical. An architectural allowance has been provided for the warehouse for installation of offices, compressor rooms and electrical rooms.

The estimate assumes the reuse of the existing administration building, truckshop, mine administration and operations office and laboratory. An allowance has been provided in the estimate for minor repairs, painting and furnishings for these existing buildings.

Labour

The labour component of the cost estimate was estimated using installation man-hours, based on historical data applied to a blended ‘all in’ labour rate. The blended construction hourly labour rate was estimated at $68/hour from current rates for crew configurations for this type of industrial construction. The labour rate component includes for the base pay and the payroll burden, including payroll taxes and workman's compensation. The hourly rate also includes supervision, small tools and consumables, contractor's site and home office overhead and profit. The labour rate is based on a 40 hour work week including an allowance for casual overtime; no allowance has been made for scheduled overtime. The workforce will be housed locally and no construction camp has been provided for in the estimate.

5.2.2 Indirect Costs

Indirect costs for the project were calculated for EPCM, project start up, contractor's indirects, and contingency. The indirect costs were developed from industry standard percentages and are considered reasonable for a project of this scope.

EPCM

Engineering, Procurement and Construction Management (EPCM) costs were estimated based on currently accepted percentages for these services applied to the total direct costs. The EPCM costs include allowances for subconsultant costs including geotechnical, survey and site quality control for soils and concrete testing.

Contractor's Indirects

Contractor's indirect costs for overhead are included in the calculated blended labour rate. An equipment allowance was calculated at $6.00 per construction man-hour.

Startup and Vendors Representatives

Startup costs including commissioning were calculated as an allowance and include retaining contractor forces during the commissioning phase to assist with start up. An allowance has been included for vendor assistance during commissioning for pre-operational testing of equipment and operations and maintenance training.

Freight, Spare Parts

Indirect costs for freight, spare parts and initial fills were included in the project indirects. Freight costs were estimated as 3% of the direct cost for the equipment and materials. Spare parts were estimated at 5% of the process equipment. There is a significant opportunity for cost savings if spare parts are available from the previous operation for use by the project. This inventory of spare parts available is to be further investigated during the feasibility study.

Contingency

A blended contingency of 20% was applied to the Project Direct and Indirect Costs. The contingency is to cover items not adequately defined based upon the current level of engineering. This allowance is included to cover these unknowns but is not intended to cover changes in the project scope.

Appendix 1- Process Design Criteria

PENGUIN**ASI**			**DESIGN CRITERIA**			**April-04**
NorthMet Project						**Rev. C**
Hoyt Lakes, Minnesota						

			Unit	**Design**	**Source**	**Note**
Key	Source					
1	Polymet					
2	Assumption					
3	Calculation					
4	AMEC pre-feasibility report					
5	Lakefield					
6	Vendor					
Ore Characteristics						
Ore Specific Gravity				3.0	1	
Moisture Content			%	6.4	1	
Bond Work Index		Ball	kWh/mt	17	5	
		Rod	kWh/mt	14	5	
Production						
Average daily thru'put		dry	mt/d	25,000	1	
Operating days			days per year	365	2	
Ore Treated	per annum	dry	mt/y	9,125,000	1	
Availability			%	91.34	3	
Daily Thu'put	@ 91.34% avail	dry	mt/d	27,370	3	
Daily Thu'put	@ 91.34% avail	wet	mt/d	29,242	3	
Primary Crushing						
Crusher						
Type		Existing		Gyratory		
Size			inches	60" x 89"		
Number				one	3	
Open side setting			inches	6"		
Motor			HP	900		
Apron Feeder						
Type		Existing				
Size			mm	1500 x 4800		
Number				one	3	
Motor			HP	115		
Secondary Crushing						
Type		Existing		Cone		
Size				7' standard		
Number				two	3	
Closed side setting				3"		
Motor			HP	350		
Tertiary Crushing						
Type		Existing		Cone		
Size				7' shorthead		
Number				four	3	
Closed side setting				3/4"		
Motor			HP	350		

PENGUIN**ASI**			**DESIGN CRITERIA**			**April-04**
NorthMet Project						**Rev. C**
Hoyt Lakes, Minnesota						
			Unit	**Design**	**Source**	**Note**
Primary Milling						
Feed size				3/4"		
Type		Existing		Rod		
Size			feet	10' x 14'		
Number				8	3	
Motor			HP	800		
Grind size		p80	micron	1000		
Rod size				3"		
Secondary Milling						
Mills						
Type		Existing		Ball		
Size			feet	10' x 14'		
Number				8		
Motor			HP	1250		
Grind Size		p80	micron	1000		
Ball Size			inch	3"		
Cyclones		New				
Size			mm	840	3	
Number		per mill		1op/1sb	3	
Circulating load			%	250	2	
Flotation						
Reagents						
Flex 31	collector		g/t	18.2	4	
PAX	collector		g/t	45.5	4	
MIBC	frother		g/t	40.9	4	
WW1752			g/t	90.9	4	
Rougher conditioning						
Residence Time			mins	5	4	
Tank size			m	7.5D x 8.0	3	
Roughers						
Residence Time			mins	8	4	
Cell Volume required			m^3	640	3	
Cell size			m^3	160	2	
Number of cells				4	3	
Cell type				Tank	4	
Rougher conc prod.		Average	% mill feed	~7.0	4	
Scavengers						
Residence Time			mins	20	4	
Cell Volume required			m^3	1,600	3	
Cell size			m^3	160	2	
Number of cells				10	3	
Cell type				Tank	4	
Scavenger conc prod.		Average	% mill feed	~3.2	4	

		Unit	Design	Source	Note
Cleaners					
Residence Time		mins	20	4	
Cell Volume required		m^3	168	3	
Cell size		m^3	21	2	
Number of cells			8	3	
Cell type			Conventional	2	
Cleaner conc prod.	Average	% mill feed	~7.0	4	
Re-cleaner					
Residence Time		mins	16	4	
Cell Volume required		m^3	118	3	
Cell size		m	3.7 D x 12.2	3	
Number of cells			1	3	
Cell type			Column	2	
Cleaner conc prod.	Average	% mill feed	2.57	1	
Regrind mill - Scavenger conc/cleaner tail					
Work Index			7.5	5	
Type	Existing		Regrind ball		
Size			12'2" x 24'		
Motor		HP	1500		
Ball size			1" steel		
Feed size	f80	micron	81	5	
Regrind size	p80	micron	31	5	
Regrind mill - Feed to Pressure Oxidation					
Work Index			7.5	5	
Type	Existing		Regrind ball		
Size			12'2" x 24'		
Motor		HP	1500		
Ball size			1" ceramic	4	
Feed size	f80	micron	81	5	
Regrind size	p80	micron	15	4,5	
Concentrate production		t/d	703	3	
Thickener unit area		m2/tpd	0.2	4	
Thickener diameter		m	13.4	3	
Concentrate storage					
Residence Time		hrs	12	4	
Tank size		m	8.0D x 9.0	3	

PENGUIN**ASI**			**DESIGN CRITERIA**			**April-04**
NorthMet Project						**Rev. C**
Hoyt Lakes, Minnesota						

			Unit	**Design**	**Source**	**Note**
Pressure Oxidation						
Autoclave feed tank						
Residence Time			hrs	1	4	
Tank size			m	3.0D x 3.5	3	
Autoclaves						
Slurry	solids		%	11.5	1	
Number required				2	1	
Flowrate	per autoclave		m^3/hr	96	1	
Availability			%	90	1	
Flowrate	per autoclave		m^3/hr	107	1	
Residence time total			hr	2	1	
Capacity	per autoclave		%	75	1	
Factor	per autoclave			1.15	1	
Volume required	per autoclave		m^3	327	3	
Size	per autoclave	ID	m	4.1	1	
		length	m	24.6	1	
Volume installed	per autoclave		m^3	325	1	
Compartments	per autoclave			5	1	
Agitators	per autoclave			6	1	
Power per agitator			kW	90	1	
Operating conditions						
Temperature			^oC	225	1	
Pressure			psi O_2	100	1	
Pressure			psig	~ 475	1	
Pulp density			g/l	1050	1	
H_2SO_4			g/l	50-60	1	
Chloride			g/l	10	1	
Cu			g/l	~ 20	1	
Ni			g/l	~ 20	1	
Slurry Cooling						
Flash tanks						
Solution loss to steam			%	19	1	
Leach Residue Liquid-Solid Separation						
Thickener						
Feedrate			t/d	612	3	
Thickener unit area			m2/tpd	0.4	4	
Thickener diameter			m	17.7	3	

	Unit	Design	Source	Note
Filter				
Feedrate	tph dry	25.9	3	
Cake density		1.4	5	
capacity	m3/hr	18.50	3	
cycle time	mins	14.94	5	
cycles per hour		4.02	3	
Volume	litres	4607	3	
scale up factor		1.25	2	
Volume required	litres	5758	3	
Filter type		Pressure		
Model		VPA 2050	6	
volume	l/chamber	205	5,6	
chambers req		28.09	3	
chambers installed		30		
Leach Residue Flotation				
Roughers				
Residence Time	mins	20	4	
Cell Volume	m^3	15	3	
Cell size	m^3	3	3	
Number of cells		5	3	
Cell type		conventional	2	
Cleaners				
Residence Time	mins	10	4	
Cell Volume	m^3	0.24	3	
Cell size	m^3	0.08	3	
Number of cells		3	3	
Cell type		conventional	2	
PGM Recovery				
Reactors				
Reactor type		pipe	4	
number		2	4	
residence time	secs	30	4	
size		315mm x 55m	3	
Clarifier				
number		2	4	
diameter	m	5	4	scaled
angle	degree	60	4	
sidewall ht	m	2.0	4	

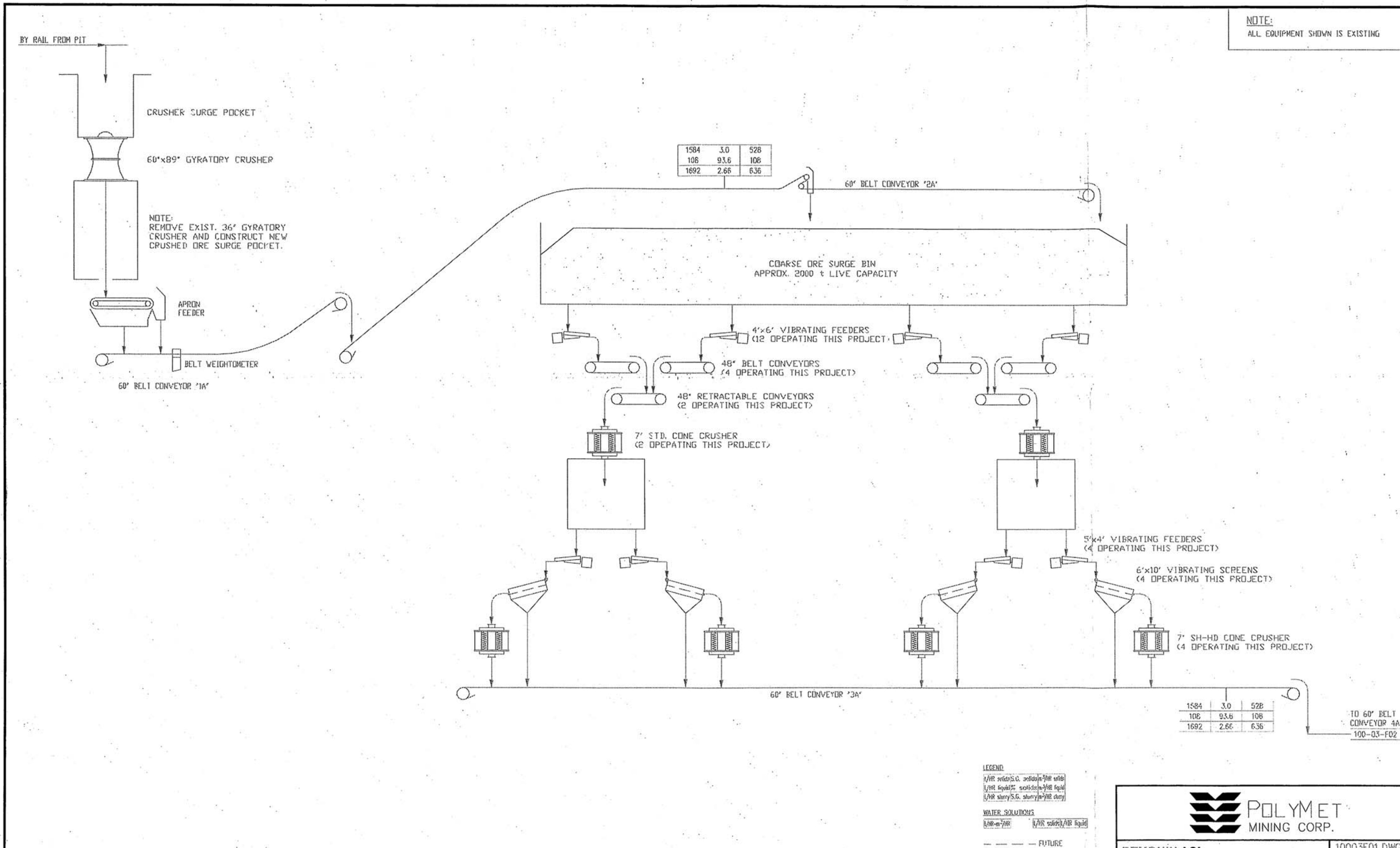
	Unit	Design	Source	Note
Neutralisation				
pH required		2	4	
Retention time	hr	3	4	
Feedrate	t/d	612	3	
Thickener unit area	m2/tpd	1.45	5	
Thickener diameter	m	33.6	3	
Gypsum Filter				
Feedrate	tph dry	14.9	3	
Cake density		0.704	5	
capacity	m3/hr	21.16	3	
cycle time	mins	12.28	5	
cycles per hour		4.89	3	
Volume	litres	4332	3	
scale up factor		1.25	2	
Volume	litres	5415	3	
Filter type		Pressure	5,6	
Model		VPA 2050	6	
Volume	l/chamber	205	6	
chambers req		26.41	3	
chambers installed		30		
Copper Solvent Extraction				
Mixer tank				
Residence time	mins	3	2	Typical
Size	m	3.5 D x 4.0	3	
PLS surge tank				
Residence time	hrs	4	4	
Size	m	3.5 D x 4.0	3	
PLS flow	m3/hr	225	3	
scale factor		1.2	2	
PLS flow	m3/hr	270	3	
No of SX trains		1	2	Lakefield p/p
Extraction stages		3	2	2ex, 1w, 2 s
Wash stages		0	2	
Strip stages		2	2	
O/A ratio		1.5	2	
Total flow	m3/hr	675	3	
Settling Rate	m3/hr/m2	4.4	2	
Organic depth	mm	300	2	
Av aqueous depth	mm	450	2	
Settler area	m2	153	3	
Av sol velocity	cm/sec	3	2	
Settler width	m	**8.3**	3	
Settler length	m	18.4	3	
Add for weirs	m	1	2	
Add for distr. fence	m	2.5	2	
Total length	m	**21.9**	3	

Appendix 2- Drawings

POLYMET MINING CORPORATION
NORTHMET PROJECT
SCOPING STUDY
DRAWING LIST

DRAWING NO.	DESCRIPTION
METALLURGY	
100-03-F00	SIMPLIFIED FLOWDIAGRAM
100-03-F01	CRUSHING AND SCREENING-FLOWSHEET # 1
100-03-F02	GRINDING CIRCUIT-FLOWSHEEET # 2
100-03-F03	FLOTATION AND REGRIND-FLOWSHEET # 3
100-03-F04	PRESSURE LEACHING-FLOWSHEET # 4
100-03-F05	SOLID/LIQUID SEPARATION-FLOWSHEET # 5
100-03-F06	PRECIOUS METAL RECOVERY-FLOWSHEET # 6
100-03-F07	Cu SOLVENT EXTRACTION-EXTRACTION CIRCUIT-FLOWSHEET # 7
100-03-F08	Cu SOLVENT EXTRACTION-STRIPPING CIRCUIT-FLOWSHEET # 8
100-03-F09	COPPER ORGANIC SYSTEM-FLOWSHEET # 9
100-03-F10	Cu ELECTROLYTE CLEANING AND RECIRCULATION-FLOWSHEET # 10
100-03-F11	Cu ELECTROWINNING AND CATHODE HANDLING-FLOWSHEET # 11
100-03-F12	Fe & HYDROXIDE PRECIPITATION-FLOWSHEET # 12
100-03-F13	LIMESTONE HANDLING-FLOWSHEET # 13
GENERAL LAYOUT	
100-10-001	OVERALL PLANT SITE-PLAN
100-10-002	CONCENTRATOR-GA-PLAN
100-10-F03	CONCENTRATOR-GA-SECTION
100-10-F04	REGRIND MILLS-GA-PLAN
100-10-F05	HYDROMET PLANT-GA-PLAN
100-10-F06	FLOTATION CIRCUIT-GA-PLAN AND SECTIONS
100-10-F07	PRESSURE LEACHING-GA-PLAN AND SECTION
100-10-F08	SETTLING TANKS-GA-PLAN AND SECTION
100-10-F09	Cu ELECTROWINNING CIRCUIT-GA-PLAN AND SECTIONS
100-10-F10	RECOVERY & PRECIPITATION-GA-PLAN AND SECTIONS

20/04/2004



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	16FEB04	MT

REVISIONS

DWG. NO. | REFERENCE DRAWINGS

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGNED:	PASI	JAN04
DRAWN:	MT	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

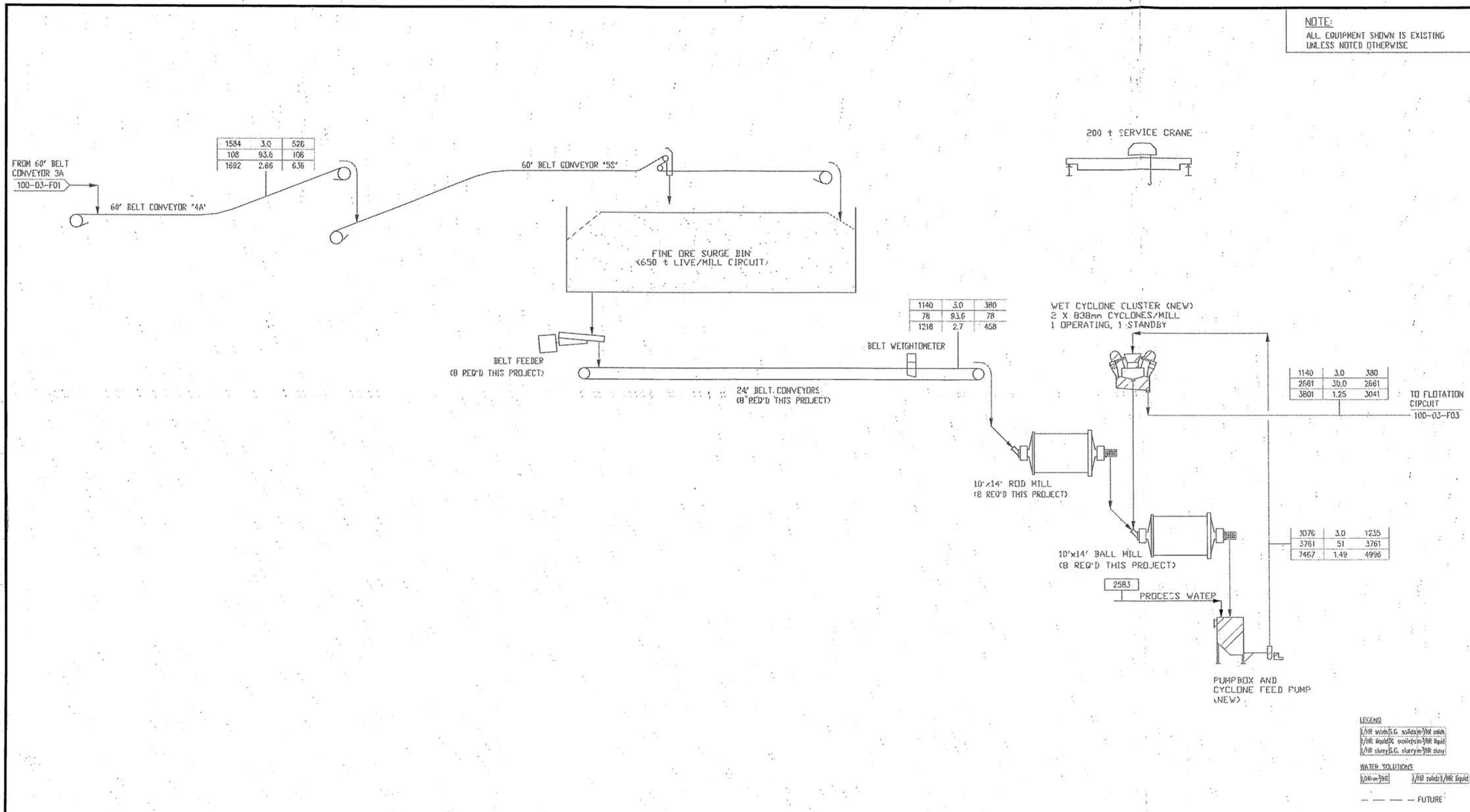
THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS
CRUSHING AND SCREENING
FLOWSHEET # 1

10003F01.DWG	
EQUIP/UNIT/LOOP No.	
EQUIP/UNIT/LOOP No.	
PROJECT No.	DIVISION No.
200401	10
DRAWING NUMBER	REV
100-03-F01	B

22X34.DWG MT 20AUG03



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

DWG. NO.	REFERENCE DRAWINGS

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	18FEB04	MT

REVISIONS

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGNED:	PASI	JAN04
DRAWN:	MT	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS
GRINDING CIRCUIT
FLOWSHEET # 2

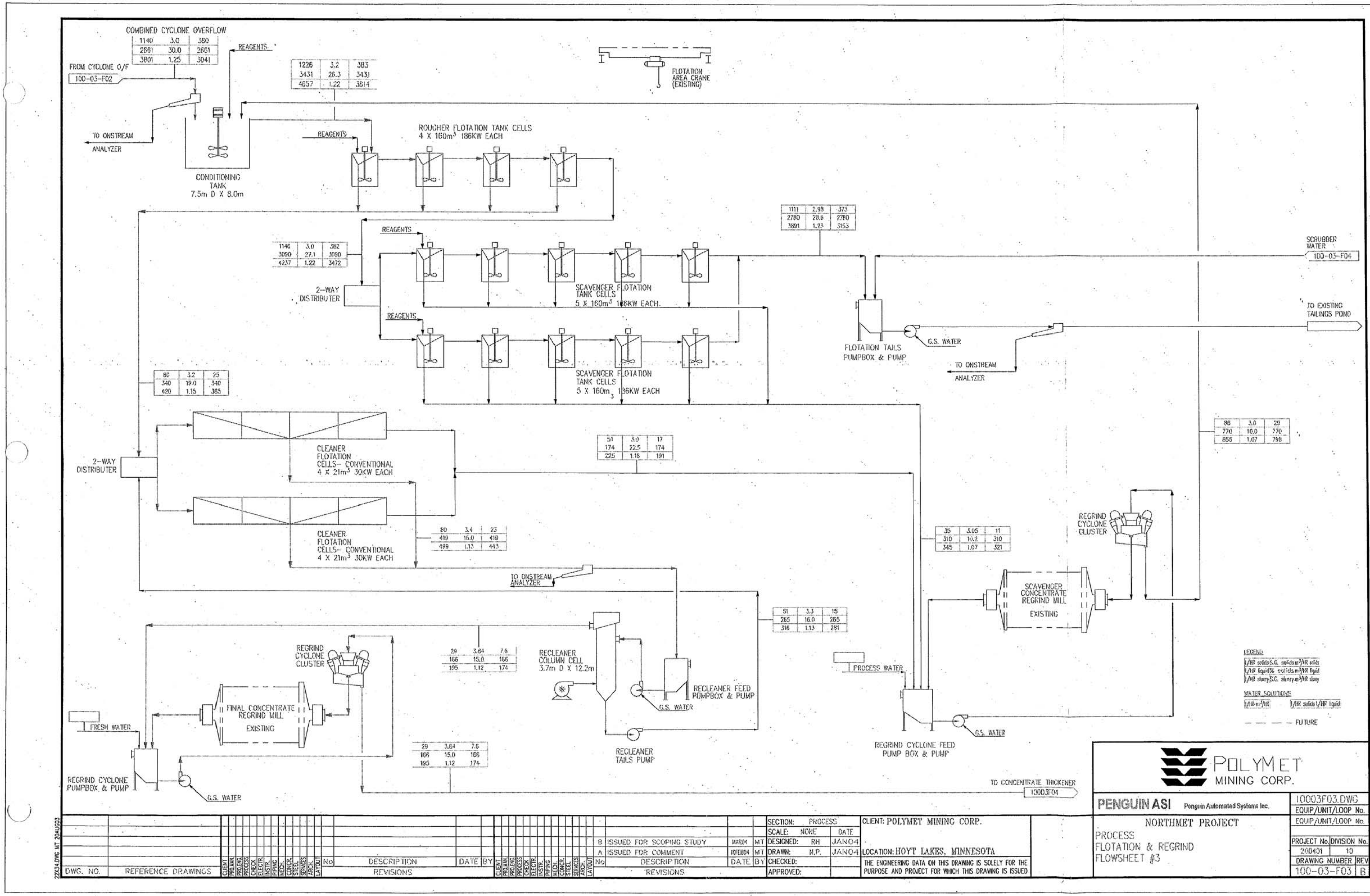
10003F02.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

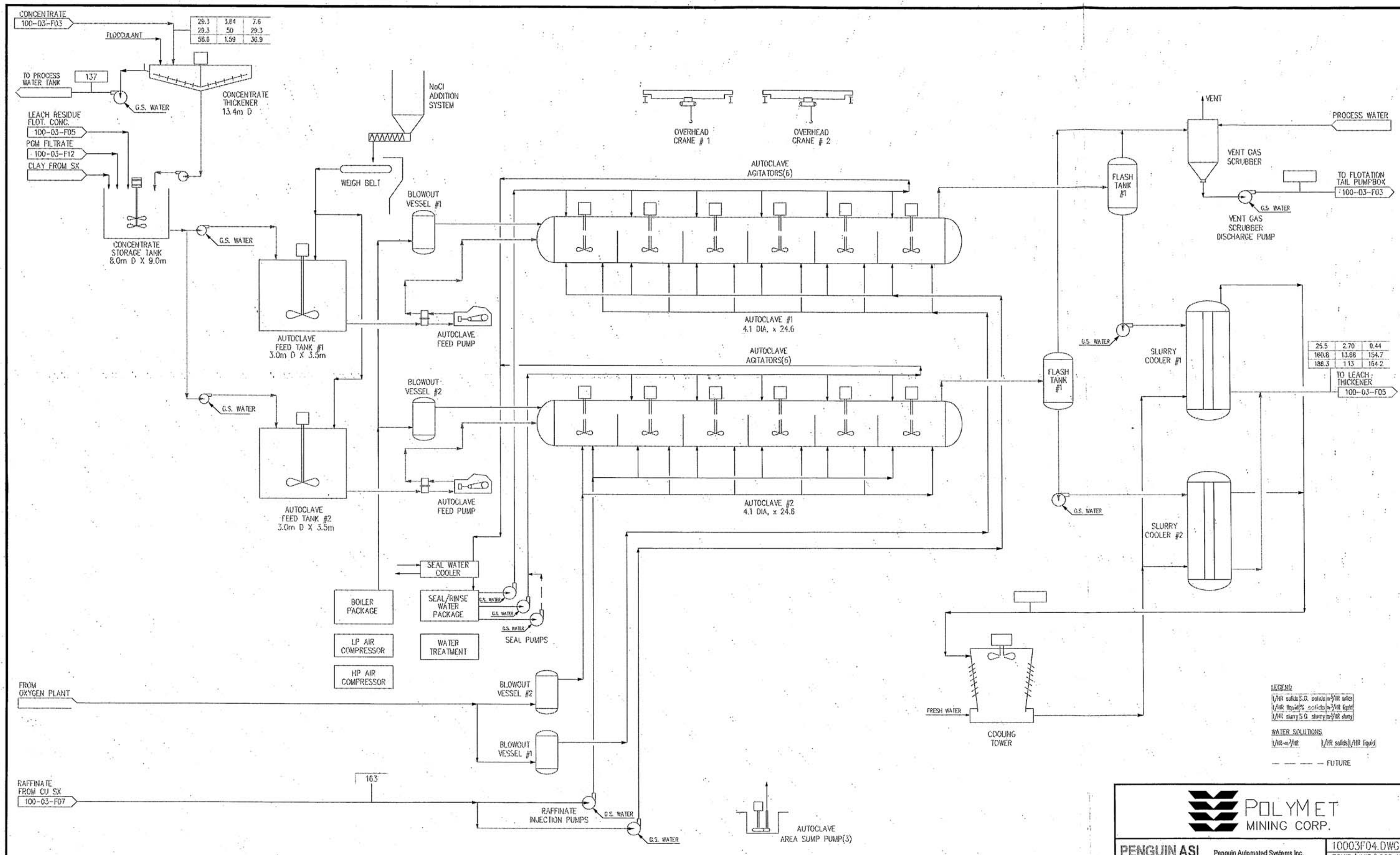
PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F02	B

HH:MM

22234.DWG MT 20AUG03


COMBINED CYCLONE OVERFLOW
1140 | 3.0 | 380
2661 | 30.0 | 2661
3801 | 1.25 | 3041
FROM CYCLONE O/F
100-03-F02
REAGENTS
TO ONSTREAM ANALYZER
CONDITIONING TANK
7.5m D X 8.0m
1226 | 3.2 | 383
3431 | 26.3 | 3431
4657 | 1.22 | 3814
REAGENTS
ROUGHER FLOTATION TANK CELLS
4 X 160m³ 186KW EACH
FLOTATION AREA CRANE (EXISTING)
1111 | 2.98 | 373
2780 | 28.6 | 2780
3891 | 1.23 | 3153
1146 | 3.0 | 382
3090 | 27.1 | 3090
4237 | 1.22 | 3472
REAGENTS
2-WAY DISTRIBUTER
SCAVENGER FLOTATION TANK CELLS
5 X 160m³ 186KW EACH
REAGENTS
SCAVENGER FLOTATION TANK CELLS
5 X 160m³ 186KW EACH
SCRUBBER WATER
100-03-F04
TO EXISTING TAILINGS POND
FLOTATION TAILS PUMPBOX & PUMP
G.S. WATER
TO ONSTREAM ANALYZER
80 | 3.2 | 25
340 | 19.0 | 340
420 | 1.15 | 365
2-WAY DISTRIBUTER
CLEANER FLOTATION CELLS- CONVENTIONAL
4 X 21m³ 30KW EACH
51 | 3.0 | 17
174 | 22.5 | 174
225 | 1.18 | 191
86 | 3.0 | 29
770 | 10.0 | 770
855 | 1.07 | 799
CLEANER FLOTATION CELLS- CONVENTIONAL
4 X 21m³ 30KW EACH
80 | 3.4 | 23
419 | 16.0 | 419
499 | 1.13 | 443
35 | 3.05 | 11
310 | 10.2 | 310
345 | 1.07 | 321
REGRIND CYCLONE CLUSTER
SCAVENGER CONCENTRATE REGRIND MILL
EXISTING
TO ONSTREAM ANALYZER
51 | 3.3 | 15
265 | 16.0 | 265
316 | 1.13 | 281
REGRIND CYCLONE CLUSTER
29 | 3.84 | 7.6
166 | 15.0 | 166
195 | 1.12 | 174
RECLEANER COLUMN CELL
3.7m D X 12.2m
RECLEANER FEED PUMPBOX & PUMP
G.S. WATER
PROCESS WATER
FINAL CONCENTRATE REGRIND MILL
EXISTING
FRESH WATER
29 | 3.84 | 7.6
166 | 15.0 | 166
195 | 1.12 | 174
RECLEANER TAILS PUMP
REGRIND CYCLONE FEED PUMP BOX & PUMP
G.S. WATER
REGRIND CYCLONE PUMPBOX & PUMP
G.S. WATER
TO CONCENTRATE THICKENER
10003F04
LEGEND:
t/HR solids | S.G. solids | m³/HR solids
t/HR liquid | % solids | m³/HR liquid
t/HR slurry | S.G. slurry | m³/HR slurry
WATER SOLUTIONS
t/HR | m³/HR
t/HR solids | t/HR liquid
FUTURE
POLYMET MINING CORP.
PENGUIN ASI Penguin Automated Systems Inc.
10003F03.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.
NORTHMET PROJECT
PROCESS
FLOTATION & REGRIND
FLOWSHEET #3
PROJECT No. | DIVISION No.
200401 | 10
DRAWING NUMBER | REV
100-03-F03 | B
SECTION: PROCESS
SCALE: NONE | DATE
DESIGNED: RH | JAN04
DRAWN: N.P. | JAN04
CHECKED:
APPROVED:
CLIENT: POLYMET MINING CORP.
LOCATION: HOYT LAKES, MINNESOTA
THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED
B | ISSUED FOR SCOPING STUDY | MAR04 | MT
A | ISSUED FOR COMMENT | 15FEB04 | MT
No | DESCRIPTION | DATE | BY
REVISIONS
DWG. NO. | REFERENCE DRAWINGS
CLIENT PROMAN PROJENG PROCESS CHECK ELECTR. INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT
22X34.DWG MT 20AUG03
10JAN04 10:00



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

B	ISSUED FOR SCOPING STUDY	MAR04	MT	
A	ISSUED FOR COMMENT	16FEB04	MT	
No	DESCRIPTION	DATE	BY	

REVISIONS

DWG. NO. | REFERENCE DRAWINGS

CLIENT PROJ.MAN. PROJ.ENG. PROCESS CHECK ELECTR. INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGNED:	RH	JAN04
DRAWN:	N.P.	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS
PRESSURE LEACHING
FLOWSHEET #4

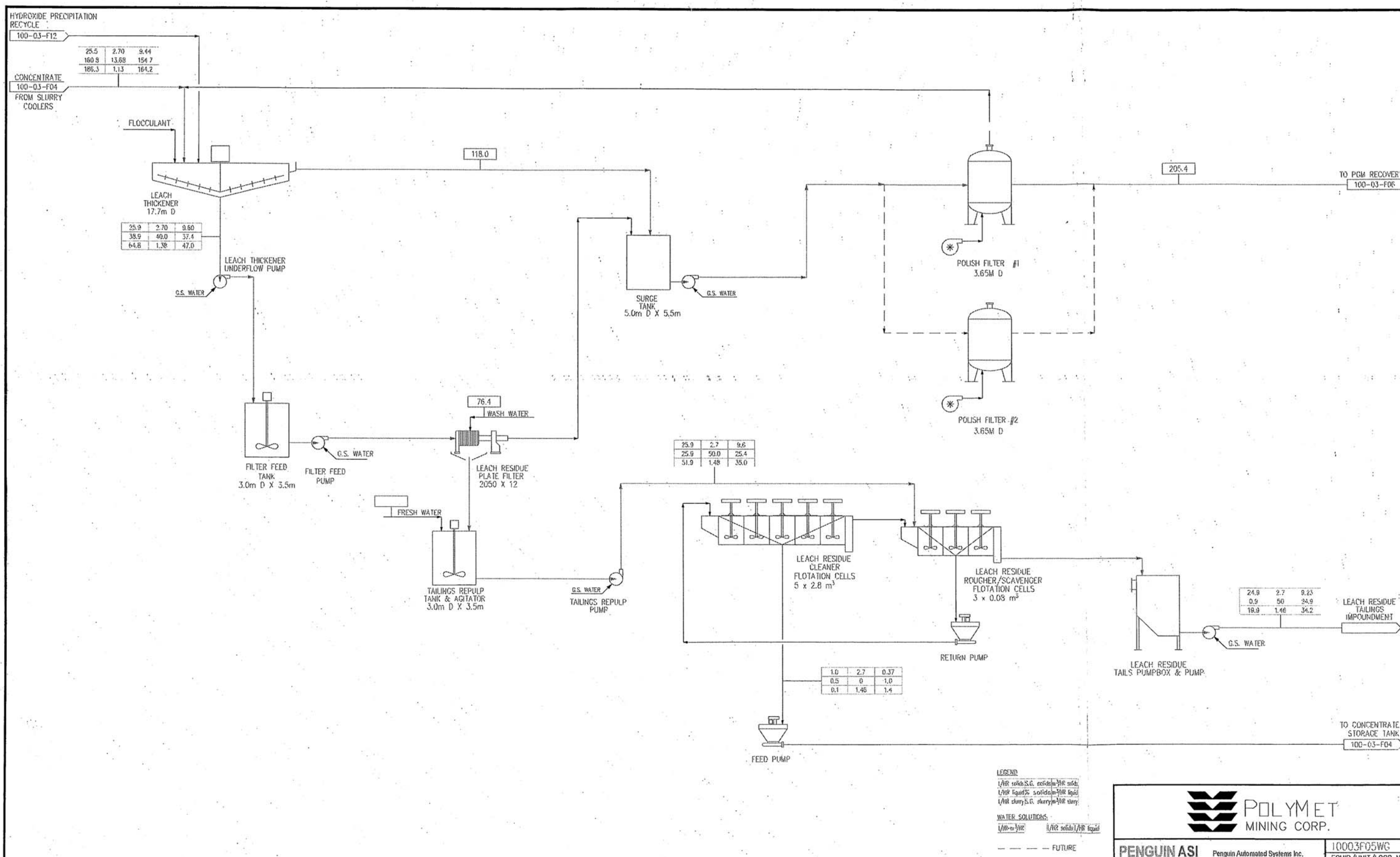
10003F04.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F04	B

22X34.DWG MT 20AUG03

10JAN04 10:00



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

10003F05WG	EQUIP/UNIT/LOOP No.
	EQUIP/UNIT/LOOP No.

DWG. NO.	REFERENCE DRAWINGS

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	16FEB04	MT

REVISIONS

CLIENT / PROJ.MAN. / PROCESS / CHECK / ELECTR. / INSTR. / PIPING / MECH. / CONCR. / STEEL / SERVICES / ARCH. / LAYOUT

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGNED:	R.H.	JAN04
DRAWN:	N.P.	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

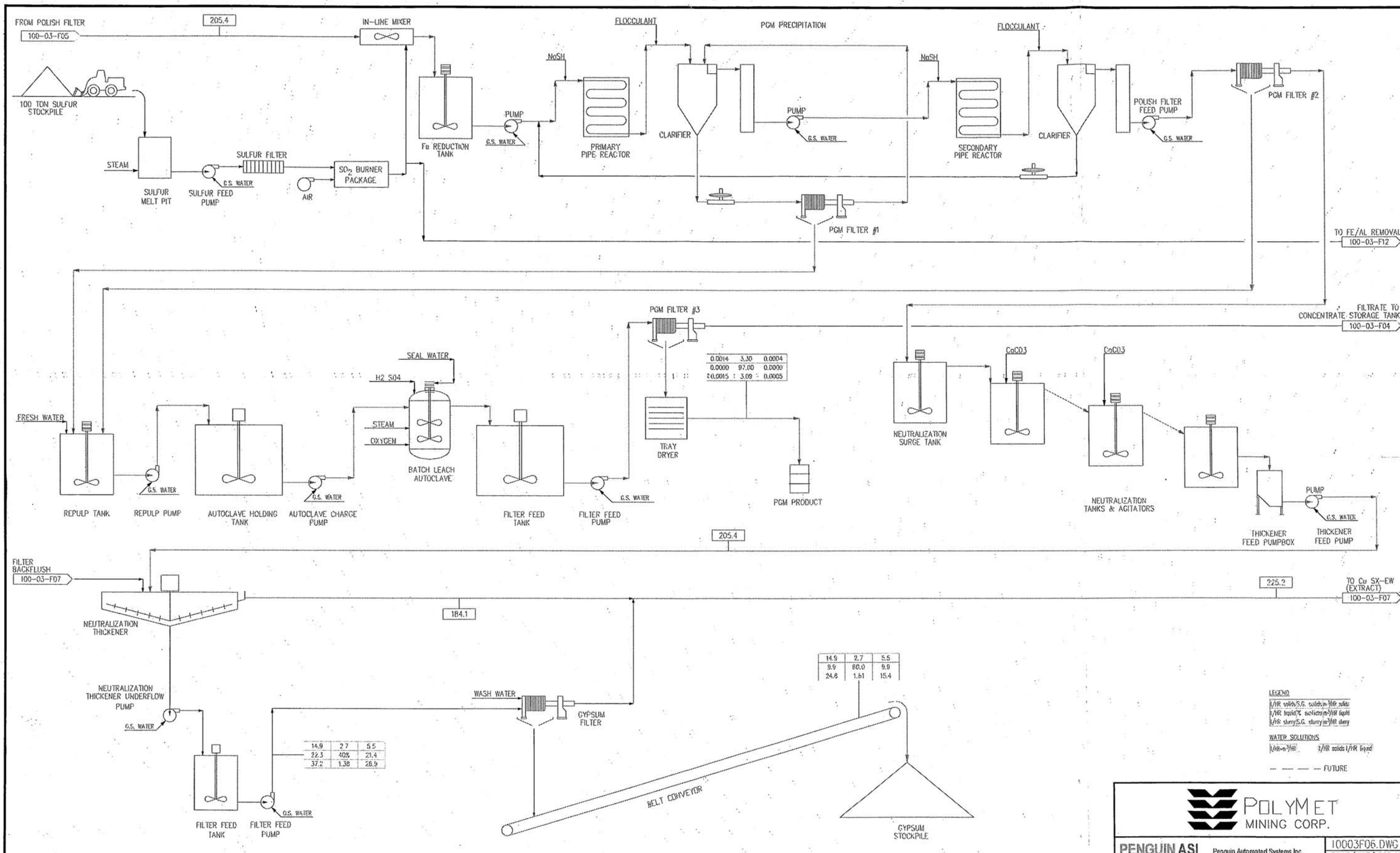
PROCESS
SOLID/LIQUID SEPARATION
FLOWSHEET #5

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F05	B

22X34.DWG MT 20AUG03

10JAN04 10:00



0.0014	3.30	0.0004
0.0000	97.00	0.0000
0.0015	3.09	0.0005

14.9	2.7	5.5
22.5	40%	21.4
37.2	1.38	26.9

14.9	2.7	5.5
9.9	60.0	9.9
24.8	1.61	15.4

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	10FEB04	MT

DWG. NO. | REFERENCE DRAWINGS | CLIENT | PROJ.MAN. | PROJ.ENG. | PROCESS | CHECK | ELECTR. | INSTR. | PIPING | MECH. | CONCR. | STEEL | SERVICES | ARCH. | LAYOUT

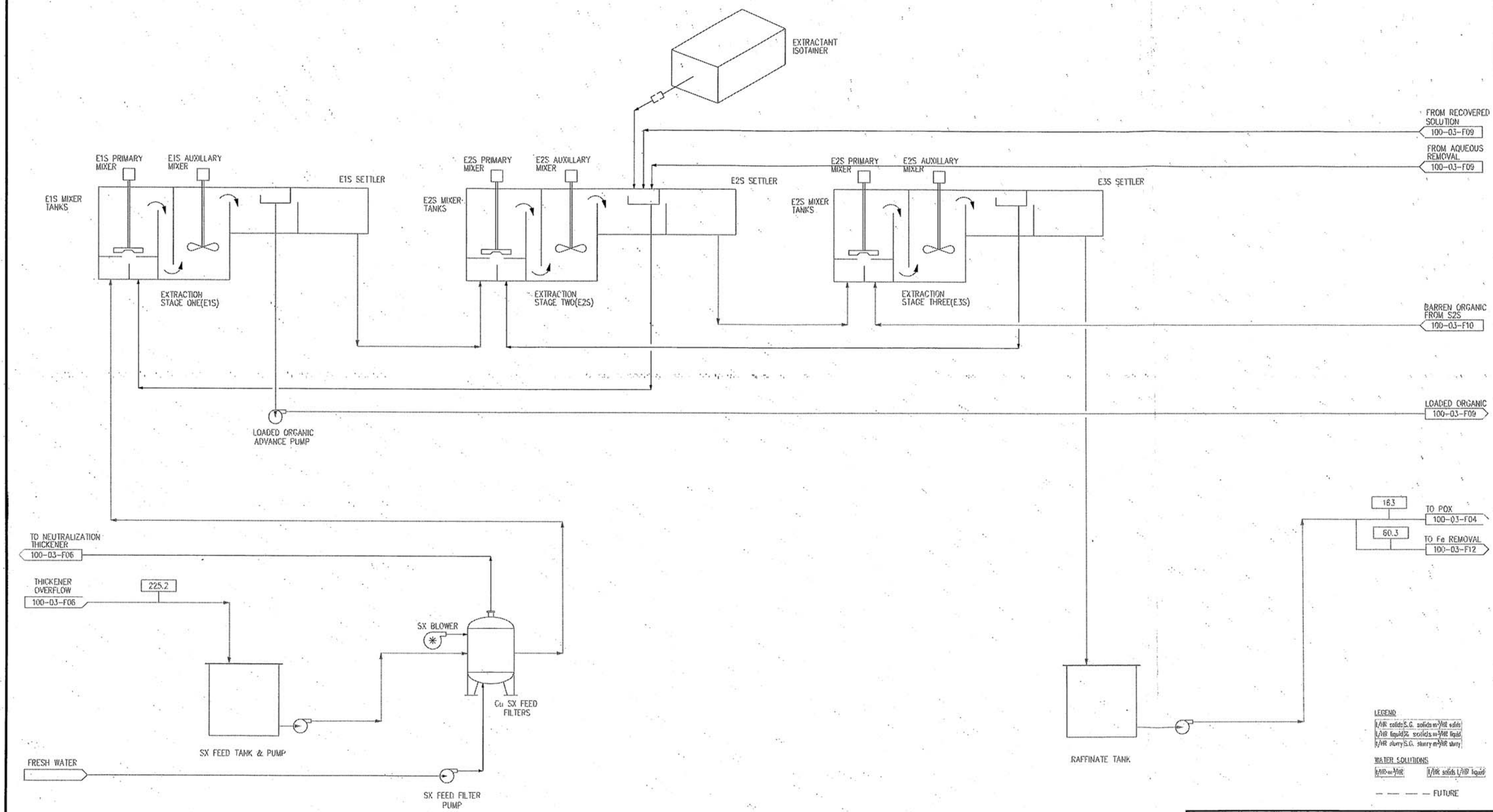
SECTION: PROCESS
SCALE: NONE | DATE
DESIGNED: RH | JAN04
DRAWN: N.P. | JAN04
CHECKED:
APPROVED:

CLIENT: POLYMET MINING CORP.
LOCATION: HOYT LAKES, MINNESOTA
THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT
PROCESS
PRECIOUS METAL RECOVERY
FLOWSHEET #6

10003F06.DWG
EQUIP/UNIT/LOOP No.
PROJECT No. 200401 | DIVISION No. 10
DRAWING NUMBER 100-03-F06 | REV B

22X34.DWG MT 20AUG03



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	16FEB04	MT
No	DESCRIPTION REVISIONS	DATE	BY

DWG. NO. | REFERENCE DRAWINGS | DESCRIPTION REVISIONS | DATE | BY

SECTION: PROCESS
SCALE: NONE — DATE
DESIGNED: R.H. JAN04
DRAWN: N.P. JAN04
CHECKED:
APPROVED:

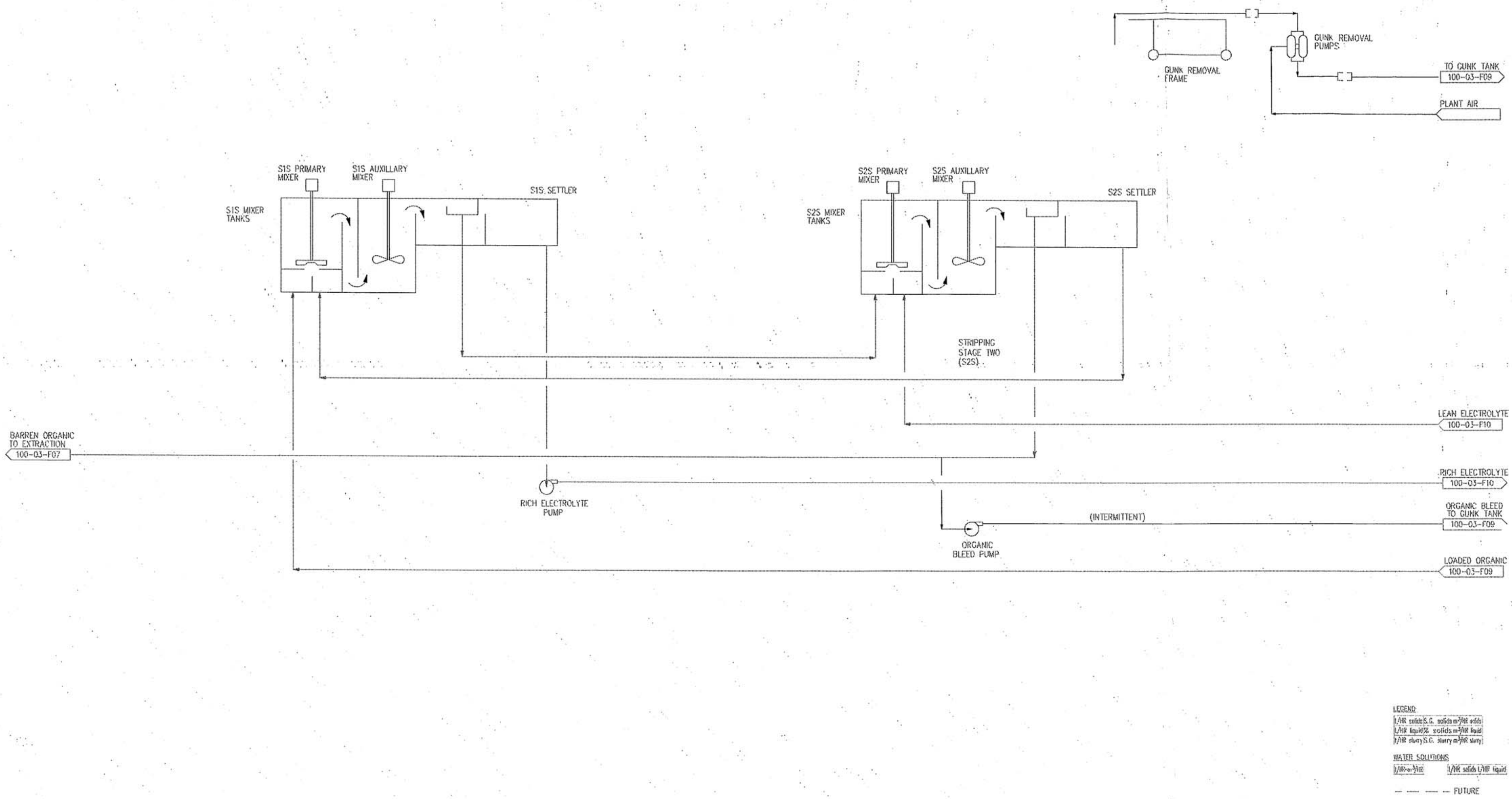
CLIENT: POLYMET MINING CORP.
LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT
PROCESS
COPPER SOLVENT EXTRACTION
EXTRACTION CIRCUIT
FLOWSHEET #7

10003F07.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.
PROJECT No. 200401 — DIVISION No. 10
DRAWING NUMBER 100-03-F07 — REV B

22X34.DWG MT 20AUG03
10JAN04 10:00



22X34.DWG MT 20AUG03

DWG. NO.	REFERENCE DRAWINGS	No	DESCRIPTION	DATE	BY
		B	ISSUED FOR SCOPING STUDY	MAR04	MT
		A	ISSUED FOR COMMENT	16FEB04	MT

CLIENT / PROJ.MAN. / PROJ.ENG. / PROCESS / CHECK / ELECTR. / INSTR. / PIPING / MECH. / CONCR. / STEEL / SERVICES / ARCH. / LAYOUT — REVISIONS

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGNED:	R.H.	JAN04
DRAWN:	N.P.	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

NORTHMET PROJECT

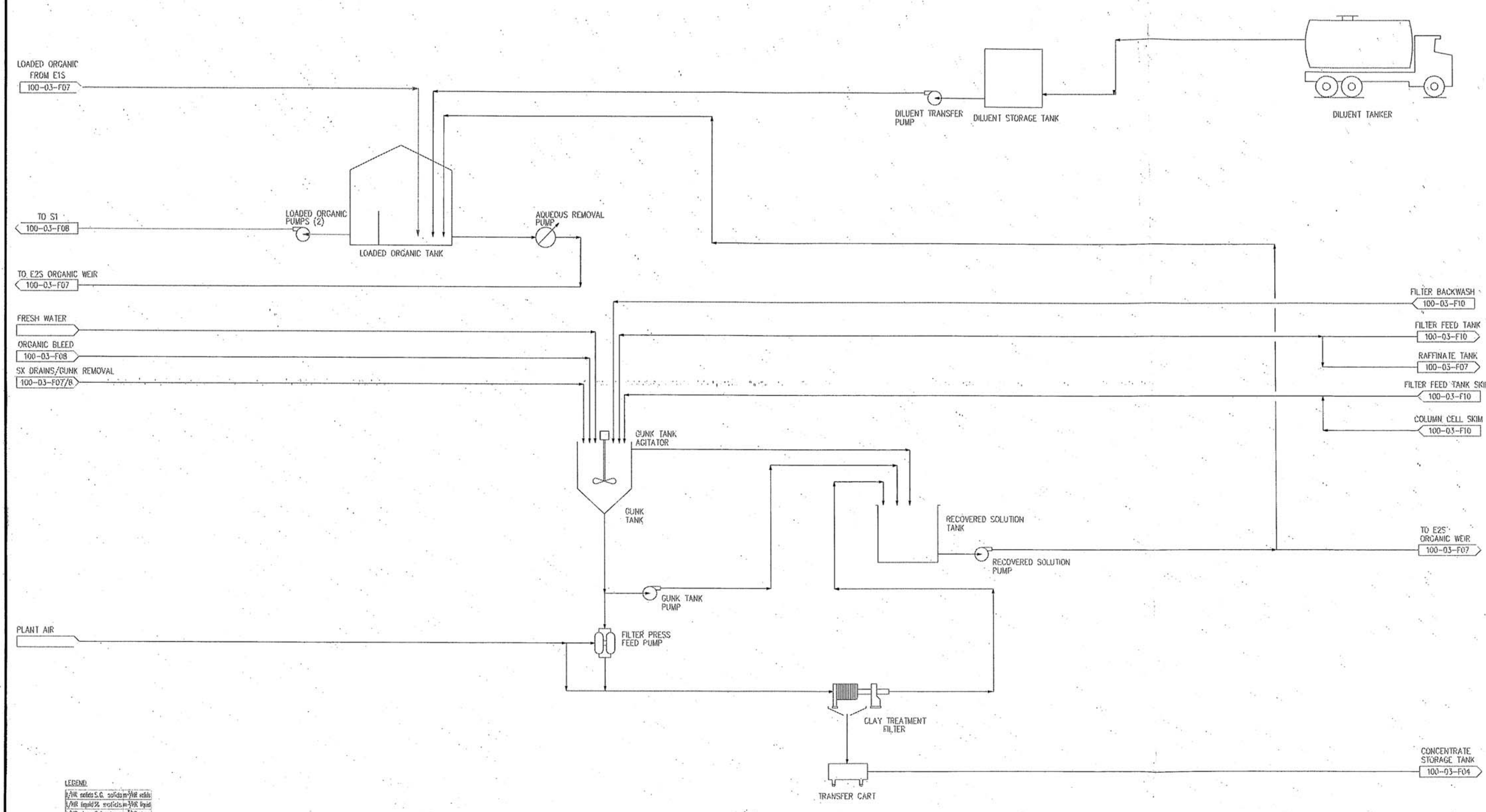
PROCESS
COPPER SOLVENT EXTRACTION
STRIPPING CIRCUIT
FLOWSHEET #8

10003F08.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F08	B

10JAN04 10:00



LEGEND

t/HR solids	S.G. solids	m^3/HR solids
t/HR liquid	% solids	m^3/HR liquid
t/HR slurry	S.G. slurry	m^3/HR slurry

WATER SOLUTIONS

t/HR=m^3/HR   t/HR solids | t/HR liquid

— — — — FUTURE

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	16FEB04	MT

REVISIONS

DWG. NO. | REFERENCE DRAWINGS

CLIENT | PRO.MAN. | PRO.ENG. | PROCESS | CHECK | ELECTR. | INSTR. | PIPING | MECH. | CONCR. | STEEL | SERVICES | ARCH. | LAYOUT

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGNED:	R.H.	JAN04
DRAWN:	N.P.	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

NORTHMET PROJECT

PROCESS
COPPER ORGANIC SYSTEM
FLOWSHEET #9

10003F09.DWG

EQUIP/UNIT/LOOP No.

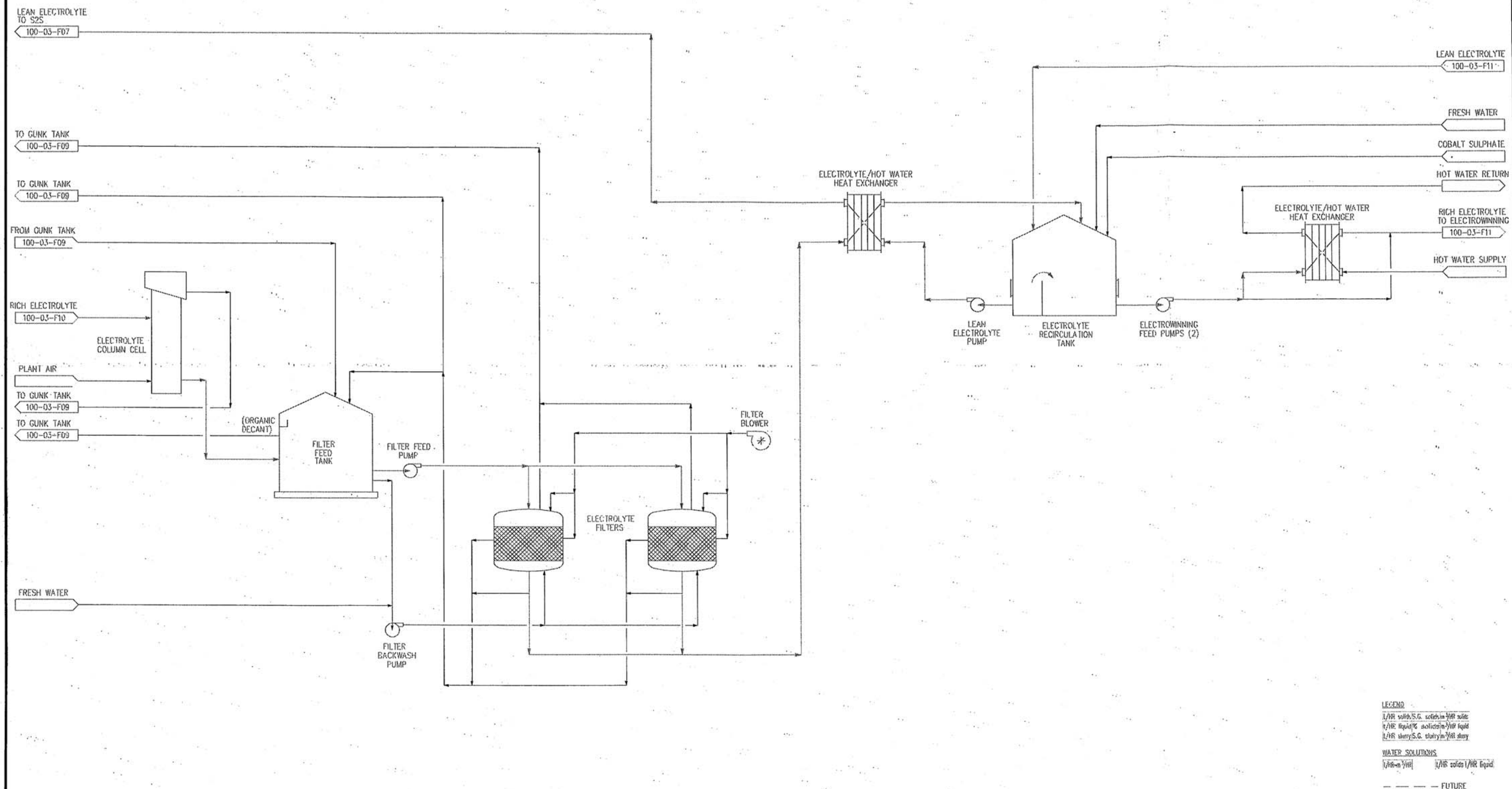
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F09	B

10JAN04 10:00

22X34.DWG MT 20AUG03



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

10003F10.DWG

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	16FEB04	MT

REVISIONS

DWG. NO. | REFERENCE DRAWINGS

SECTION: PROCESS
SCALE: NONE

		DATE
DESIGNED:	R.H.	JAN04
DRAWN:	N.P.	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT
PROCESS
COPPER ELECTROLYTE CLEANING AND RECIRCULATION
FLOWSHEET #10

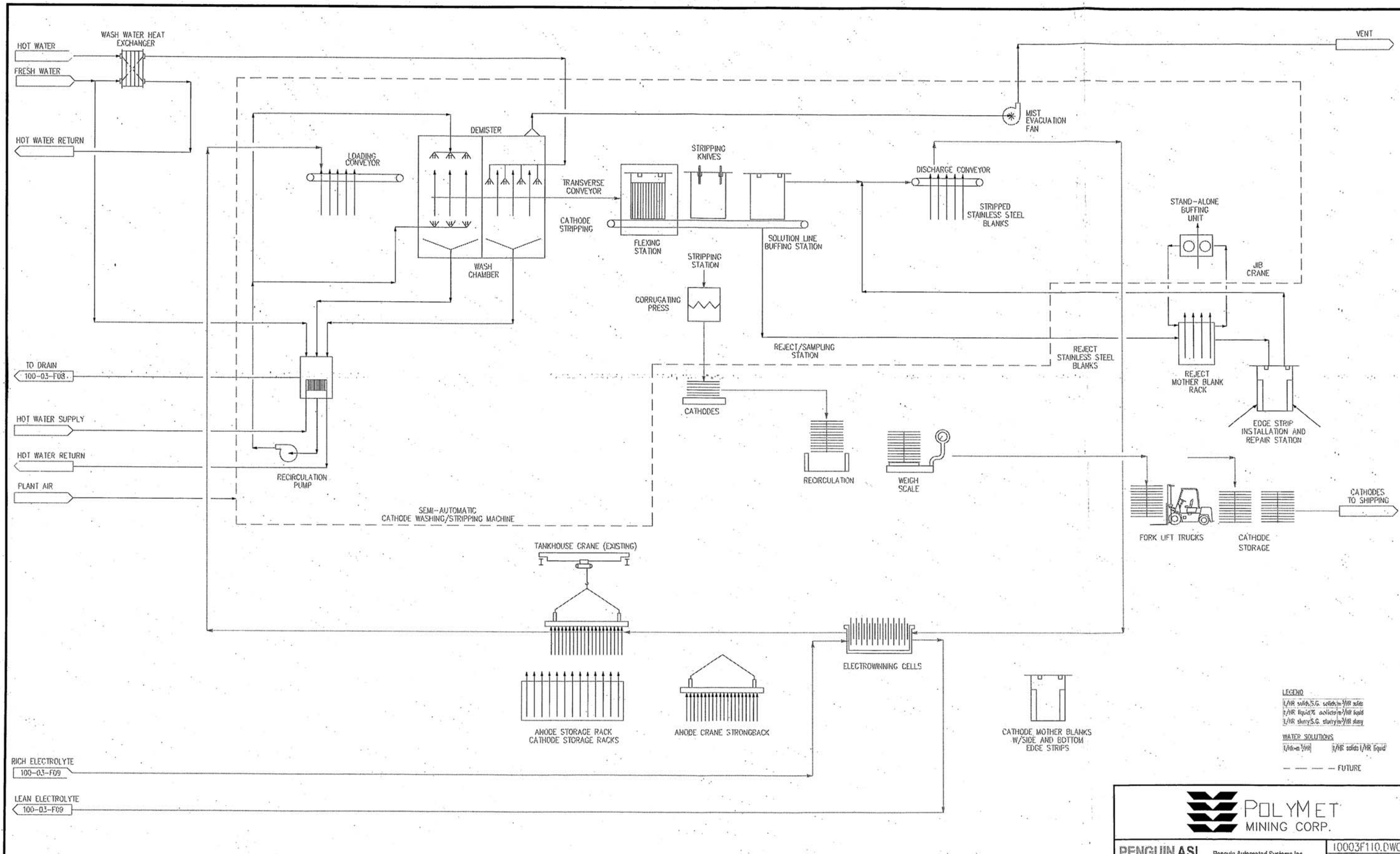
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F10	B

10JAN04 10:00

22234.DWG MT 20AUG03



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

B	ISSUED FOR SCOPING STUDY	MAR04	MT	DESIGNED: R.H.	JAN04
A	ISSUED FOR COMMENT	16FEB04	MT	DRAWN: N.P.	JAN04
No	DESCRIPTION	DATE	BY	CHECKED:	
	REVISIONS			APPROVED:	

DWG. NO. | REFERENCE DRAWINGS

SECTION: PROCESS
SCALE: NONE | DATE

CLIENT: POLYMET MINING CORP.
LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS
COPPER ELECTROWINNING
AND CATHODE HANDLING
FLOWSHEET #11

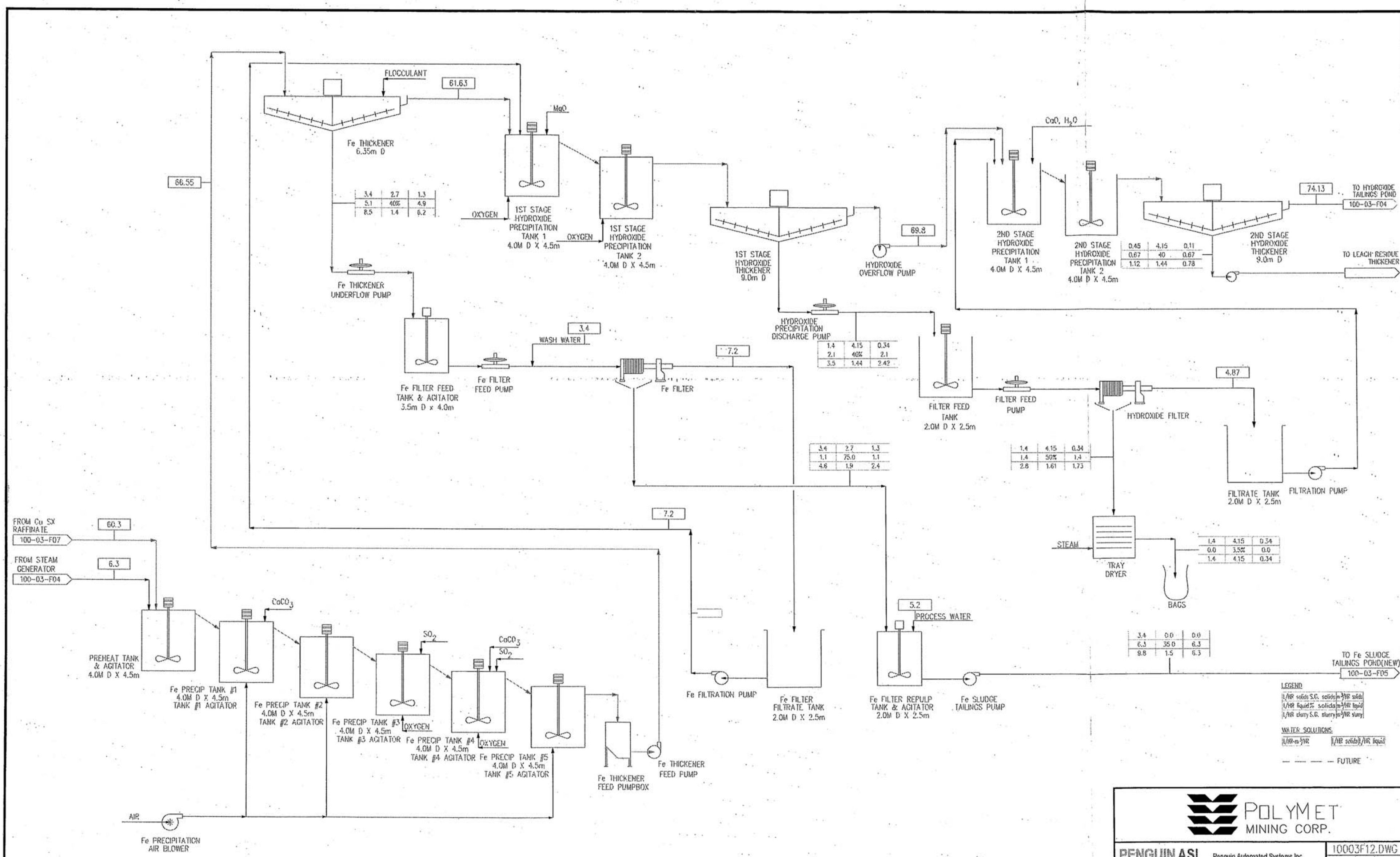
10003F110.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F11	B

22X34.DWG MT 20AUG03

10JAN04 10:00



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR COMMENT	16FEB04	MT
No	DESCRIPTION	DATE	BY
	REVISIONS		

DWG. NO. | REFERENCE DRAWINGS

No | DESCRIPTION | DATE | BY — REVISIONS

CLIENT PROJMAN PROCESS CHECK ELECTR INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT

SECTION: PROCESS
SCALE: NONE — DATE
DESIGNED: RH — JAN04
DRAWN: N.P. — JAN04
CHECKED:
APPROVED:

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS
FE & HYDROXIDE PRECIPITATION
FLOWSHEET #12

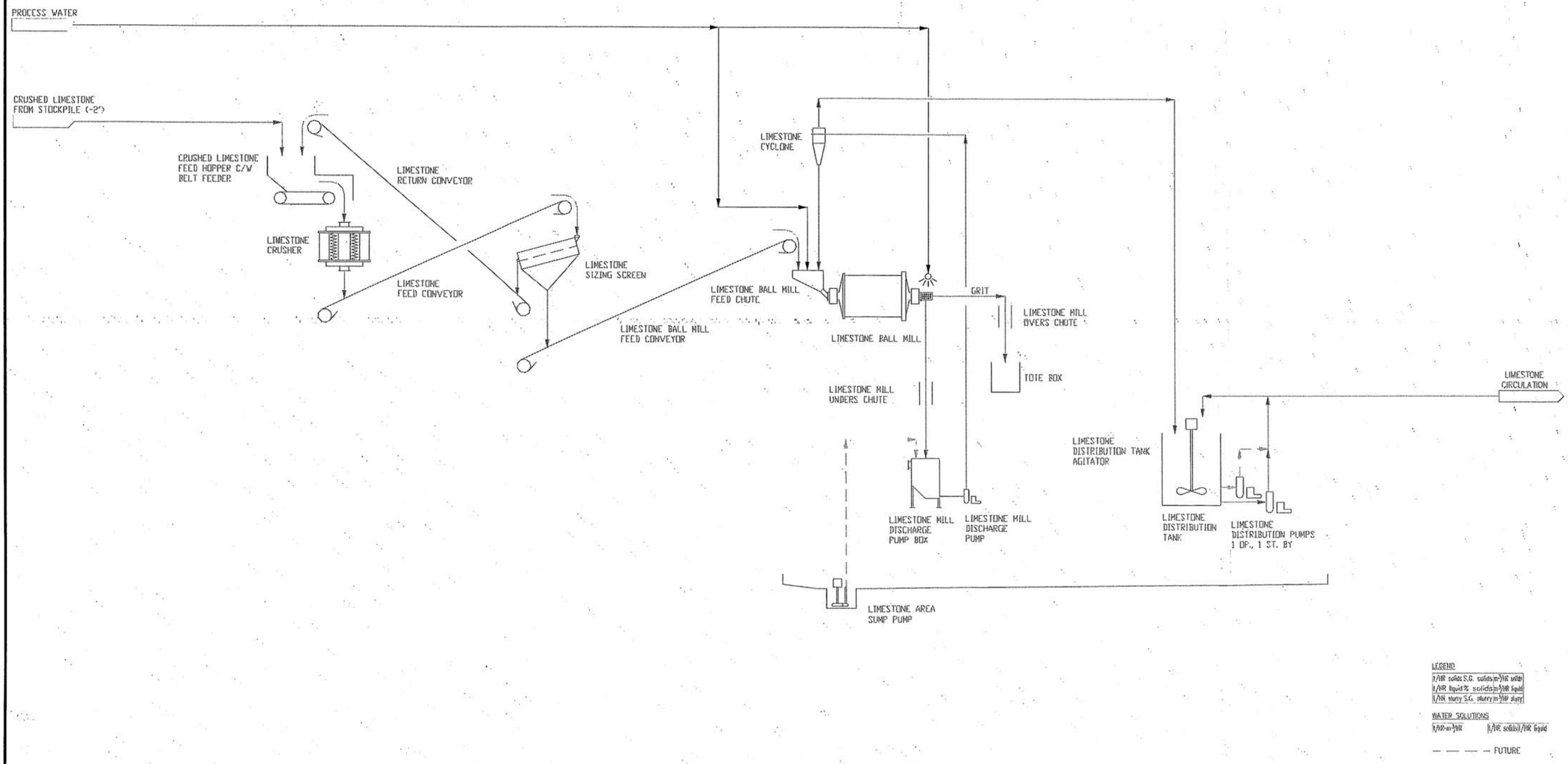
10003F12.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F12	B

22434.DWG MT 20AUG03

10JAN04 10:00



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

DWG. NO.	REFERENCE DRAWINGS

No	DESCRIPTION	DATE	BY
A	ISSUED FOR SCOPING STUDY	MAR04	MT

SECTION: PROCESS
SCALE: NONE
DESIGNED: R.H. MAR04
DRAWN: M.T. MAR04
CHECKED:
APPROVED:

CLIENT: POLYMET MINING CORP.
LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT
PROCESS
LIMESTONE HANDLING
FLOWSHEET # 13

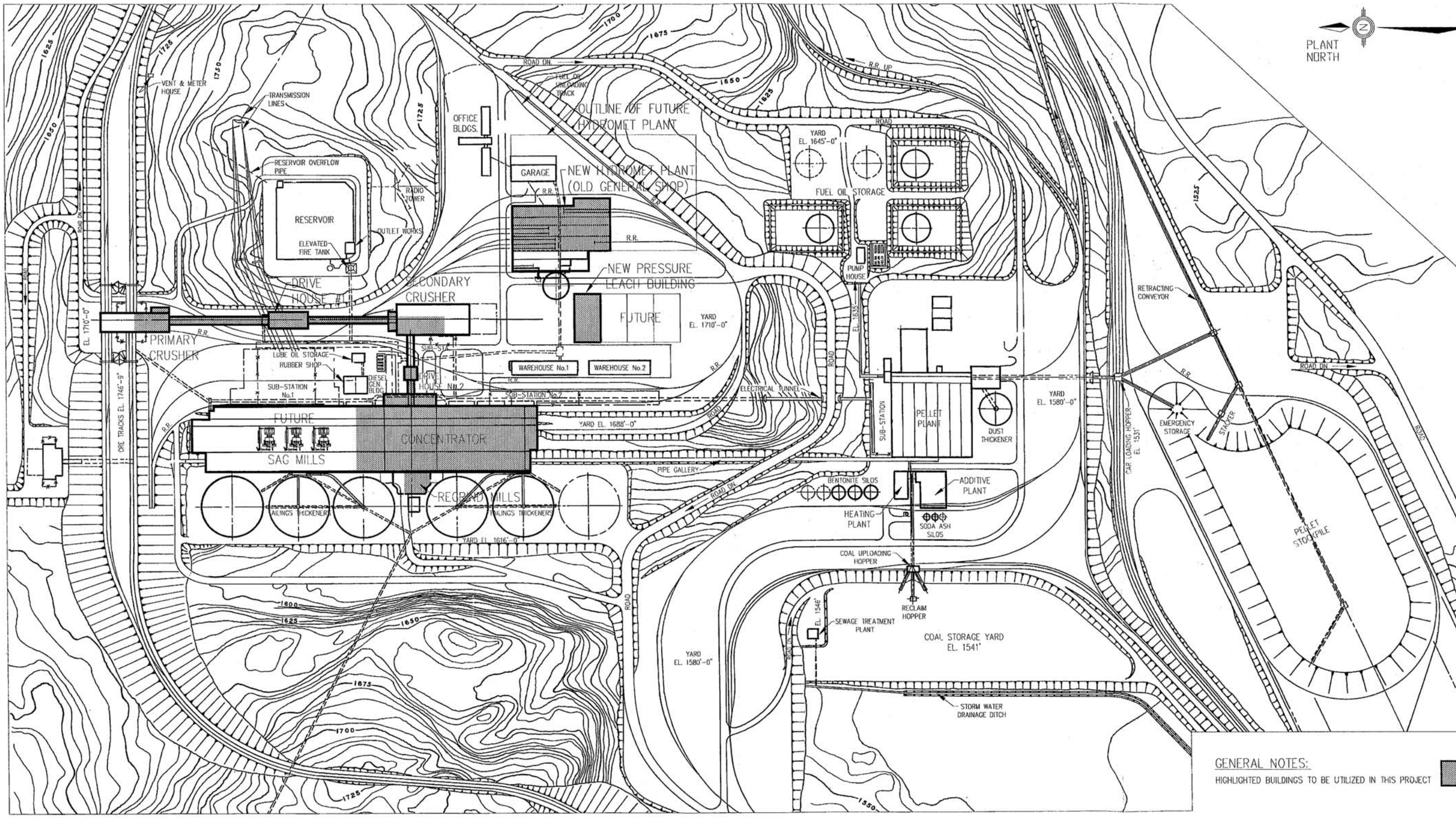
10003F13.DWG
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-03-F13	A

22/03/04 HH:MM

22X34.DWG MT 20AUG03



GENERAL NOTES:

HIGHLIGHTED BUILDINGS TO BE UTILIZED IN THIS PROJECT

PROCESS PLANT SITE PLAN

SCALE: APPRXIMATELY 1" = 200'-0"

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

B	ISSUED FOR SCOPING STUDY	APR04	PAZ	SECTION: LAYOUT	
A	ISSUED FOR COMMENT	18FEB04	MT	SCALE: NONE	DATE
No	DESCRIPTION	DATE	BY	DESIGNED: PMM	JAN04
	REVISIONS			DRAWN: SNPCAD	JAN04
				CHECKED:	
				APPROVED:	

PICTURE 011	TJ-200	No	DESCRIPTION	DATE	BY
DWG. NO.	REFERENCE DRAWINGS		REVISIONS		

CLIENT PROJ.MAN. PROJ.ENG. PROCESS CHECK ELECTR. INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

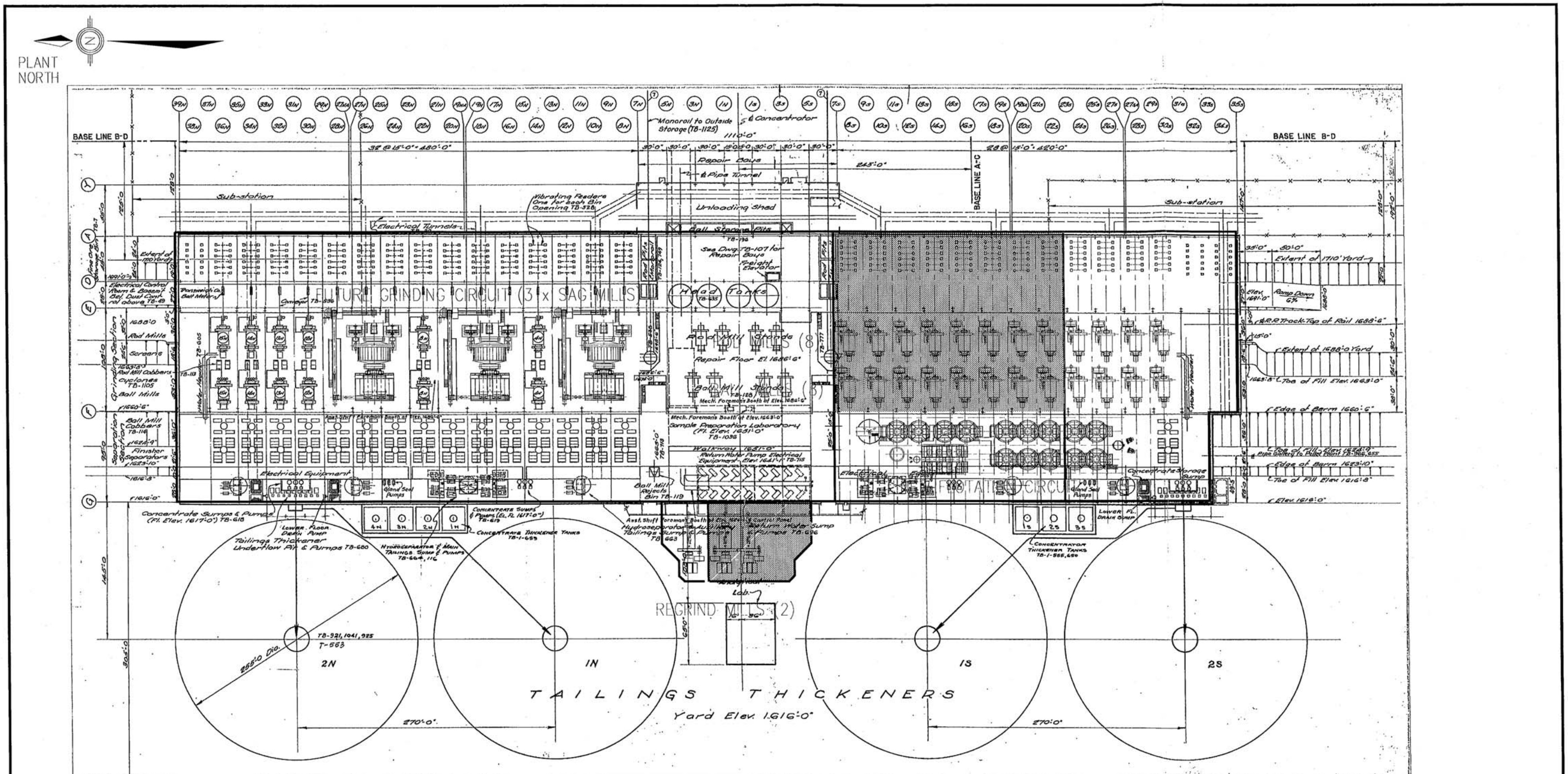
NORTHMET PROJECT

PROCESS PLANT
GENERAL ARRANGEMENT
SITE
PLAN

10010F01.DWG	
EQUIP/UNIT/LOOP No.	
EQUIP/UNIT/LOOP No.	
PROJECT No.	DIVISION No.
200401	10
DRAWING NUMBER	REV
100-10-F01	B

22X34.DWG MT 20AUG03

10JAN04 10:00



GENERAL NOTES:

HIGHLIGHTED BUILDINGS TO BE UTILIZED IN THIS PROJECT

CONCENTRATOR PLAN

SCALE: APPROXIMATELY 1"= 50'-0"

POLYMET MINING CORP

PENGUIN ASI Penguin Automated Systems Inc.

PICTURE 008	TB-102
DWG. NO.	REFERENCE DRAWINGS

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	APR04	PAZ
A	ISSUED FOR COMMENT	18FEB04	MT
	REVISIONS		

CLIENT PROMAN PROJENG PROCESS CHECK ELECTR. INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT

SECTION:	LAYOUT	
SCALE:	NONE	DATE
DESIGNED:	PMM	JAN04
DRAWN:	SNPCAD	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS PLANT
CONCENTRATOR
GENERAL ARRANGEMENT
PLAN

10010F02.DWG

EQUIP/UNIT/LOOP No.

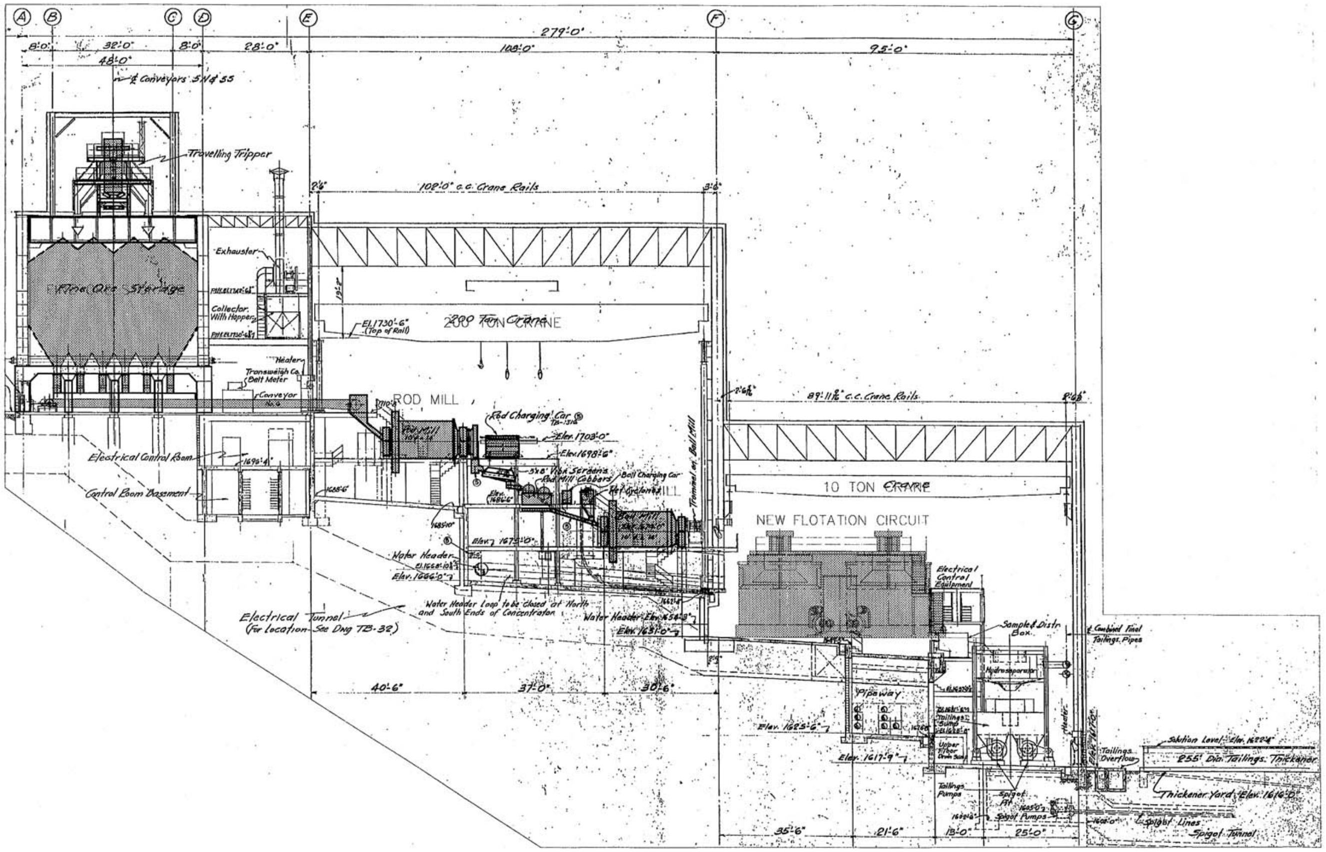
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-10-F02	B

22X34.DWG MT 20AUG03

10JAN04 10:00



CROSS SECTION THROUGH CONCENTRATOR

LOOKING SOUTH

SCALE: APPROXIMATELY 1/16"=1'-0"

GENERAL NOTES:

HIGHLIGHTED BUILDINGS TO BE UTILIZED IN THIS PROJECT

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

PICTURE 007	TB-103		
DWG. NO.	REFERENCE DRAWINGS		

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	APR04	PAZ
A	ISSUED FOR COMMENT.	18FEB04	MT
	REVISIONS		

SECTION: LAYOUT
SCALE: NONE — DATE
DESIGNED: PMM JAN04
DRAWN: SNPCAD JAN04
CHECKED:
APPROVED:

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

PROCESS PLANT
CONCENTRATOR ARRANGEMENT
SECTION

10010F03.DWG

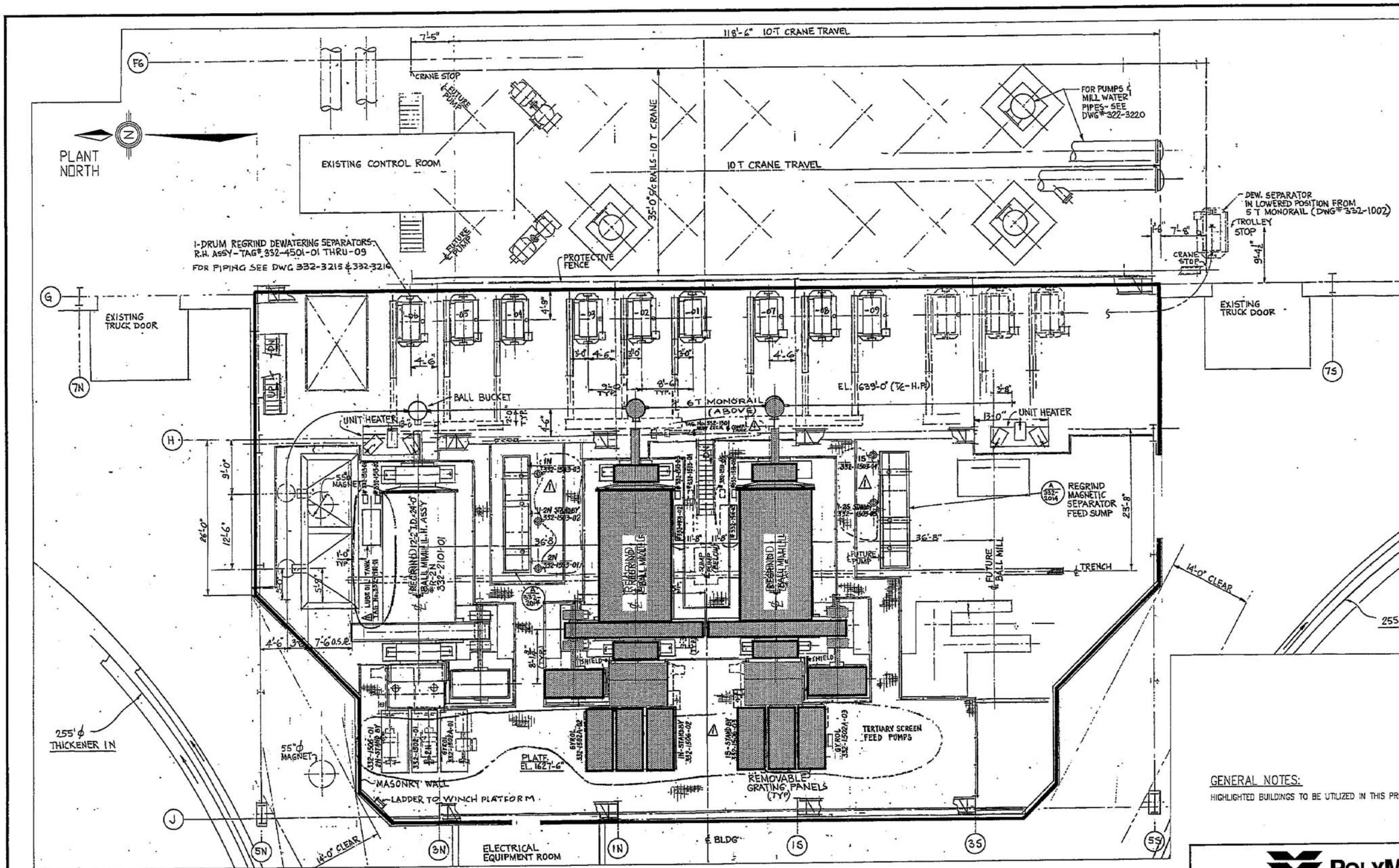
EQUIP/UNIT/LOOP No.

EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-10-F03	B

22X34.DWG MT 20AUG03



REGRIND MILLS–PLAN

SCALE: APPROXIMATELY 1/8"=1'-0"

GENERAL NOTES:

HIGHLIGHTED BUILDINGS TO BE UTILIZED IN THIS PROJECT

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

DWG. NO.	REFERENCE DRAWINGS
PICTURE 006	332-1003

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	APR04	PAZ
A	ISSUED FOR COMMENT	18FEB04	M.T.

REVISIONS

SECTION:	LAYOUT	
SCALE:	NONE	DATE
DESIGNED:	PMM	JAN04
DRAWN:	SNPCAD	JAN04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

NORTHMET PROJECT

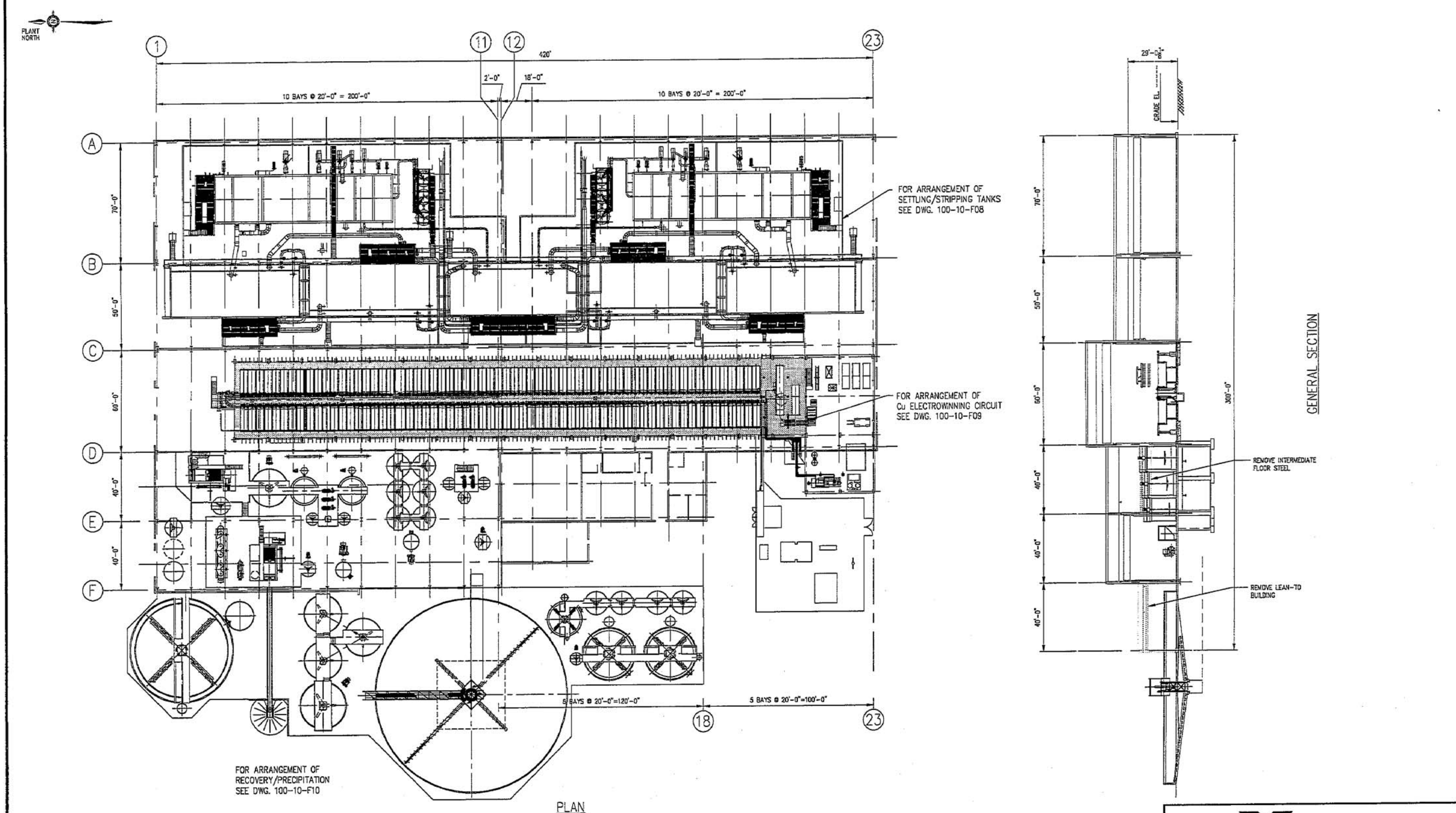
PROCESS PLANT
REGRIND MILLS
GENERAL ARRANGEMENT
PLAN

10010F04.DWG

PROJECT No.	DIVISION No.	
200401	10	
DRAWING NUMBER		REV
100-10-F04		B

22X34.DWG MT 20AUG03

10JAN04 10:00



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

NORTHMET PROJECT

PROCESS
HYDROMET PLANT
GENERAL ARRANGEMENT
PLAN

10010F05.DWG	
EQUIP/UNIT/LOOP No.	
EQUIP/UNIT/LOOP No.	
PROJECT No. 200401	DIVISION No. 10
DRAWING NUMBER 100-10-F05	REV A

10MAR04 10:00

SECTION: LAYOUT	
SCALE: 3/64"=1'-0"	DATE
DESIGNED: MT	MAR04
DRAWN: MT	MAR04
CHECKED:	
APPROVED:	

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

No	DESCRIPTION	DATE	BY
A	ISSUED FOR SCOPING STUDY	MAR04	MT

REVISIONS

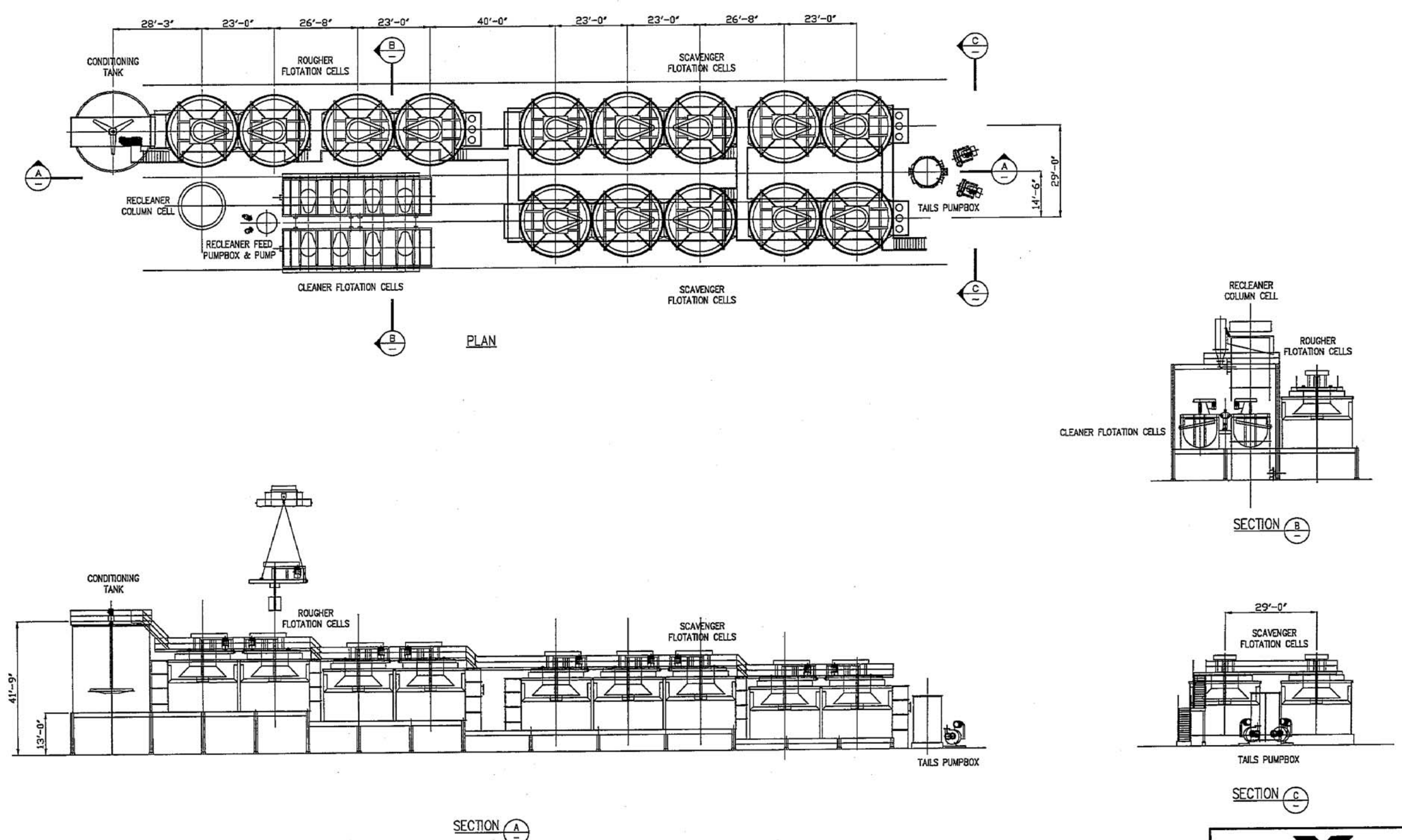
No	DESCRIPTION	DATE	BY

REVISIONS

CLIENT, PROMAN, PROENG, PROCESS, CHECK, ELECTR, INSTR, PIPING, MECH, CONCR, STEEL, SERVICES, ARCH, LAYOUT

DWG. NO.	REFERENCE DRAWINGS

22X34.DWG MT 20AUG03



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

NORTHMET PROJECT

PROCESS
FLOTATION CIRCUIT
GENERAL ARRANGEMENT
PLAN AND SECTIONS

10010F06.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-10-F06	A

29/2/04

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

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SECTION:	LAYOUT	
SCALE: 1/16"=1'-0"		DATE
DESIGNED:	MT	FEB04
DRAWN:	MT	FEB04
CHECKED:		
APPROVED:		

No	DESCRIPTION	DATE	BY
A	ISSUED FOR SCOPING STUDY	MAR04	MT

REVISIONS

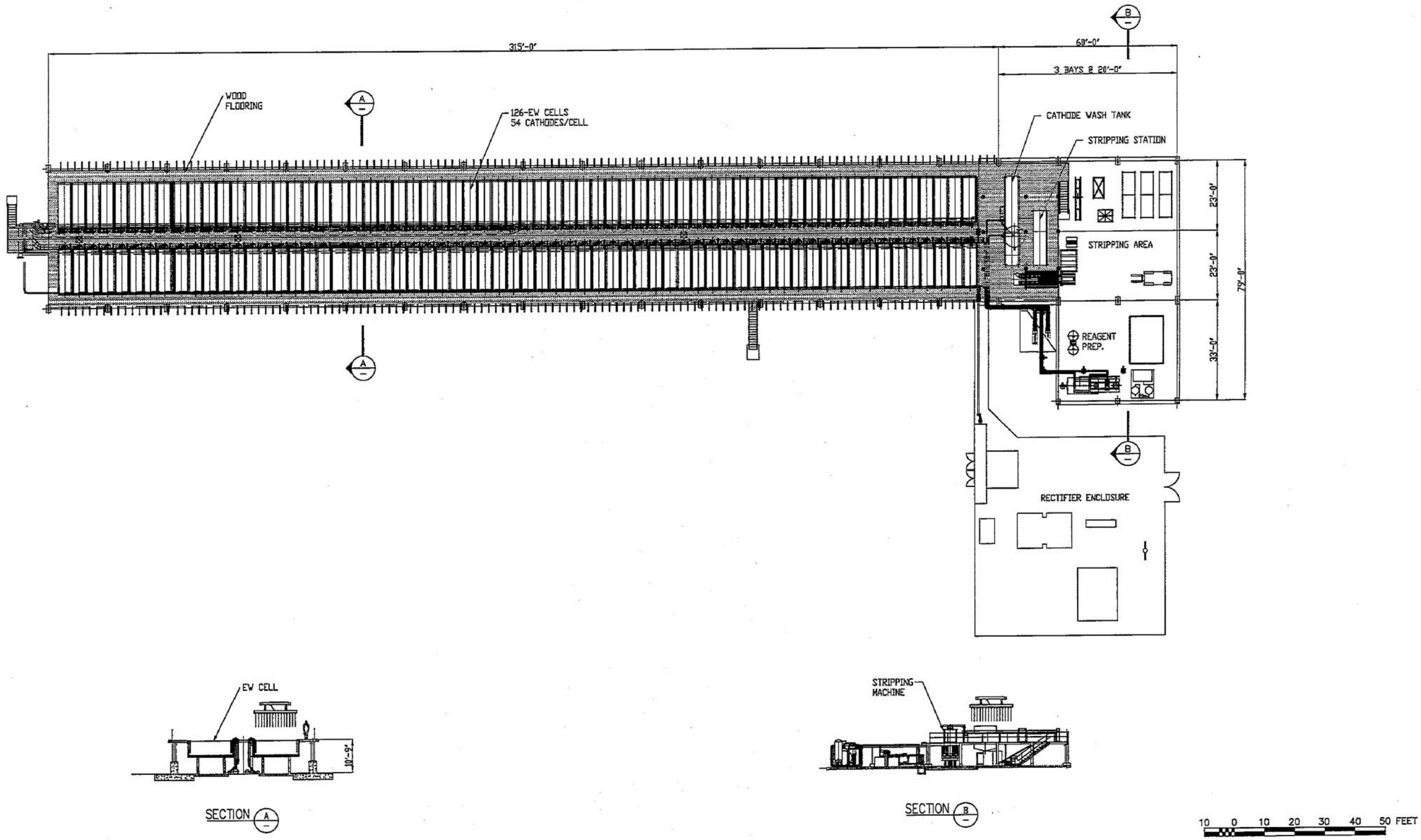
No	DESCRIPTION	DATE	BY

REVISIONS

CLIENT PROJ.MAN. PROJ.ENG. PROCESS CHECK ELECTR. INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT

DWG. NO.	REFERENCE DRAWINGS

22X34.DWG MT 20AUG03



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

NORTHMET PROJECT

PROCESS
COPPER-ELECTROWINNING CIRCUIT
GENERAL ARRANGEMENT
PLAN AND SECTIONS

10010F09.DWG	
EQUIP/UNIT/LOOP No.	
EQUIP/UNIT/LOOP No.	
PROJECT No. 200401	DIVISION No. 10
DRAWING NUMBER 100-10-F09	REV B

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR REVIEW	23/2/04	MT
	REVISIONS		

SECTION: LAYOUT		
SCALE: 1/16"=1'-0"		DATE
DESIGNED:	MT	FEB04
DRAWN:	MT	FEB04
CHECKED:	N.N.N.	DDMONYY
APPROVED:	N.N.N.	DDMONYY

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

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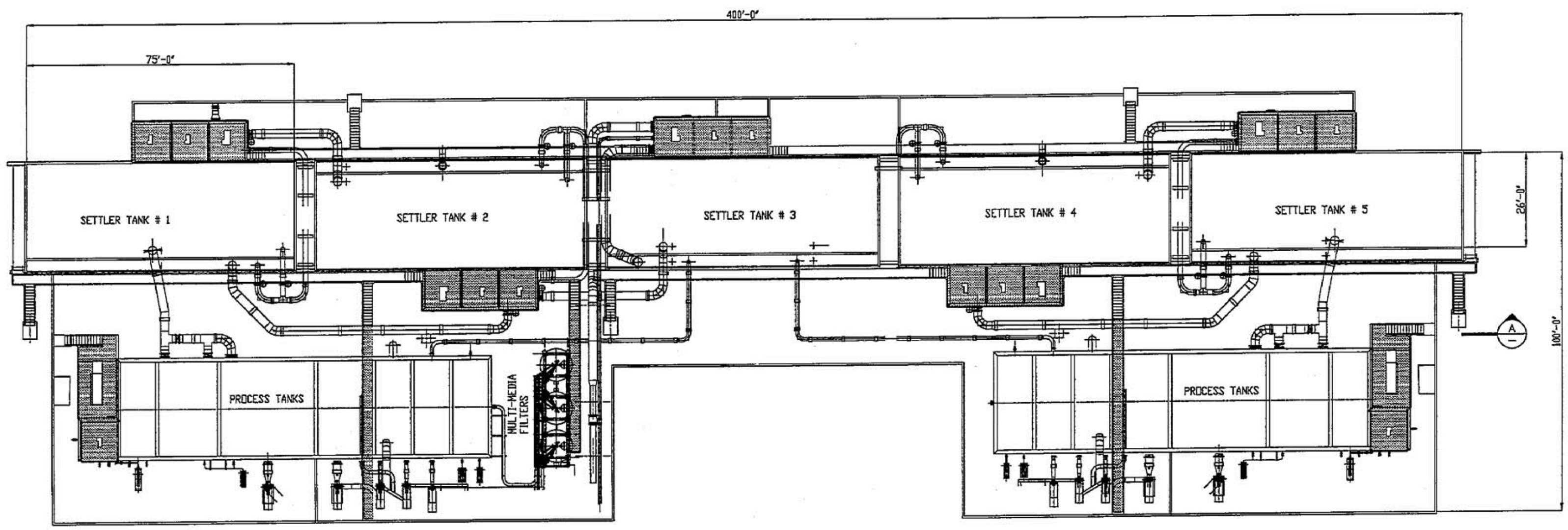
DWG. NO.	REFERENCE DRAWINGS

CLIENT / PROJMAN / PROCENG / PROCESS / CHECK / ELECTR / INSTR. / PIPING / MECH. / CONCR. / STEEL / SERVICES / ARCH. / LAYOUT

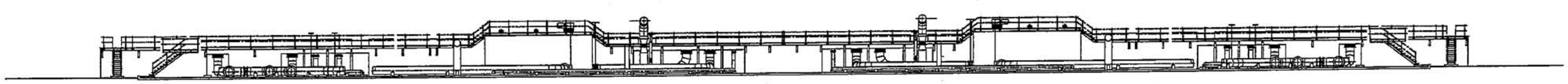
No | DESCRIPTION | DATE | BY — REVISIONS

22234.DWG MT 20AUG03

DDMONYY 19/2/04



PLAN



SECTION A

DWG. NO.	REFERENCE DRAWINGS

No	DESCRIPTION	DATE	BY
A	ISSUED FOR SCOPING STUDY	MAR04	MT
No	DESCRIPTION REVISIONS	DATE	BY

CLIENT / PROJ.MAN. / PROJ.ENG. / PROCESS / CHECK / ELECTR. / INSTR. / PIPING / MECH. / CONCR. / STEEL / SERVICES / ARCH. / LAYOUT

SECTION:	LAYOUT	
SCALE: 1/16"=1'-0"		DATE
DESIGNED:	MT	FEB04
DRAWN:	MT	FEB04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

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POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

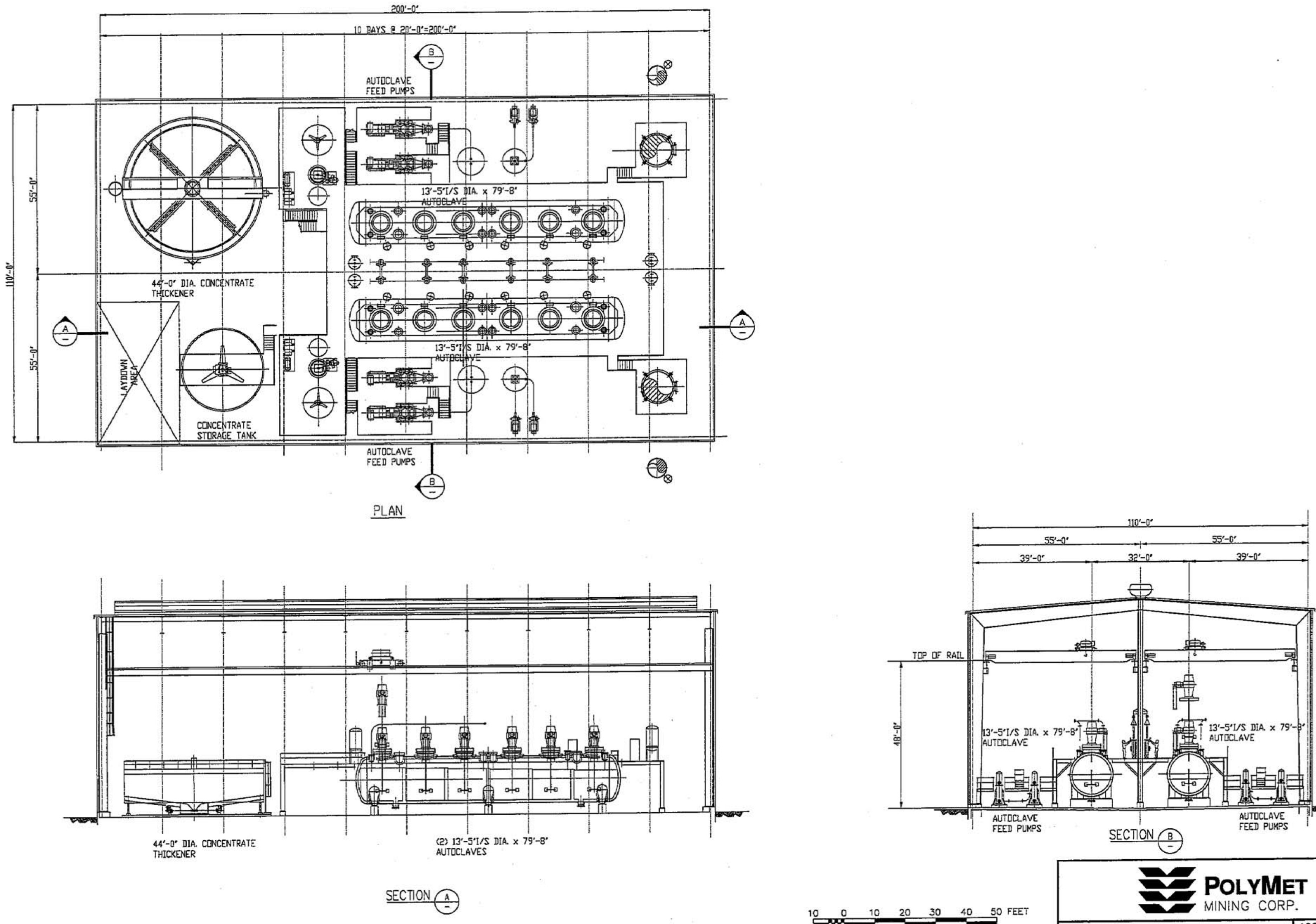
NORTHMET PROJECT

PROCESS
SETTLING TANKS
GENERAL ARRANGEMENT
PLAN AND SECTIONS

10010F08.DWG	
EQUIP/UNIT/LOOP No.	
EQUIP/UNIT/LOOP No.	
PROJECT No.	DIVISION No.
200401	10
DRAWING NUMBER	REV
100-10-F08	A

22X34.DWG MT 20AUG03

19/2/04 IHHMM



POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

10010F07.DWG	
EQUIP/UNIT/LOOP No.	
EQUIP/UNIT/LOOP No.	
PROJECT No.	DIVISION No.
200401	10
DRAWING NUMBER	REV
100-10-F07	B

NORTHMET PROJECT

PROCESS
PRESSURE LEACHING
GENERAL ARRANGEMENT
PLAN AND SECTIONS

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

SECTION:	LAYOUT	
SCALE: 1/16"=1'-0"		DATE
DESIGNED:	MT	FEB04
DRAWN:	MT	FEB04
CHECKED:		
APPROVED:		

No	DESCRIPTION	DATE	BY
B	ISSUED FOR SCOPING STUDY	MAR04	MT
A	ISSUED FOR REVIEW	23/2/04	MT

REVISIONS

DWG. NO.	REFERENCE DRAWINGS

CLIENT PROJMAN PROJENG PROCESS CHECK ELECTR INSTR. PIPING MECH. CONCR. STEEL SERVICES ARCH. LAYOUT

22X34.DWG MT 20AUG03

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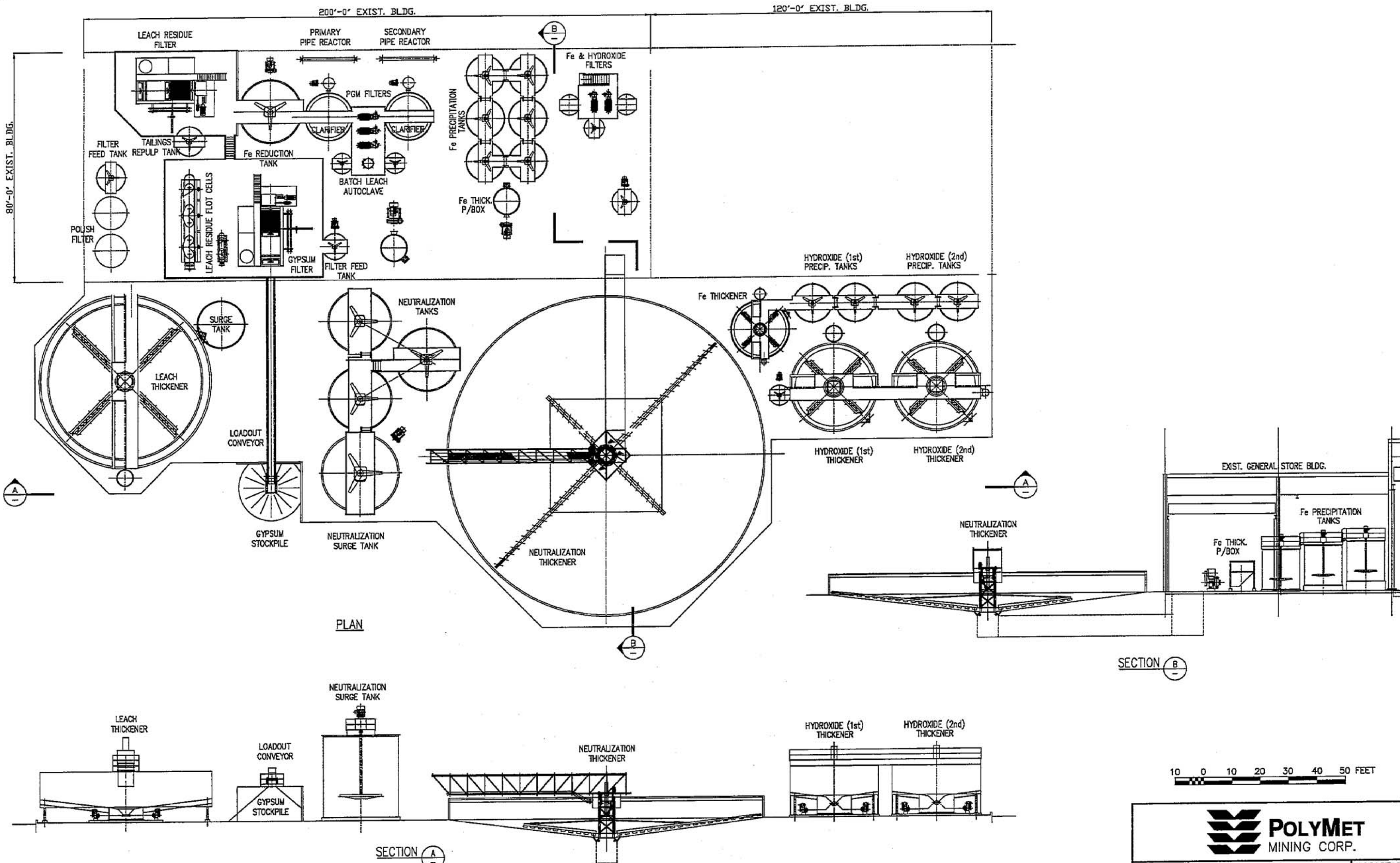

DWG. NO.	REFERENCE DRAWINGS

No	DESCRIPTION	DATE	BY
	REVISIONS		

No	DESCRIPTION	DATE	BY
A	ISSUED FOR SCOPING STUDY	MAR04	MT
	REVISIONS		

SECTION:	LAYOUT	
SCALE: 1/16"=1'-0"		DATE
DESIGNED:	MT	MAR04
DRAWN:	MT	MAR04
CHECKED:		
APPROVED:		

CLIENT: POLYMET MINING CORP.

LOCATION: HOYT LAKES, MINNESOTA

THE ENGINEERING DATA ON THIS DRAWING IS SOLELY FOR THE PURPOSE AND PROJECT FOR WHICH THIS DRAWING IS ISSUED

POLYMET MINING CORP.

PENGUIN ASI Penguin Automated Systems Inc.

NORTHMET PROJECT

PROCESS
RECOVERY AND PRECIPITATION
GENERAL ARRANGEMENT
PLAN AND SECTIONS

10010F10.DWG
EQUIP/UNIT/LOOP No.
EQUIP/UNIT/LOOP No.

PROJECT No.	DIVISION No.
200401	10

DRAWING NUMBER	REV
100-10-F10	A

18/03/04 HHMM

22X34.DWG MT 20AUG03

Appendix 3- Equipment List

PENGUIN**ASI**		MECHANICAL EQUIPMENT LIST						April-04
NorthMet Project								
Hoyt Lakes, Minnesota								
Equip. #	**Qty.**	**Description**	**Size**	**Material Specification**	**HP Each**	**HP Total**	**Remarks**	**New / Existing**
CRUSHING AND SCREENING								
	1	PRIMARY CRUSHER SURGE POCKET						EXISTING
	1	PRIMARY CRUSHER	60 x 89 GYRATORY		900	900		EXISTING
	1	CRUSHED ORE SURGE POCKET						NEW
	1	APRON FEEDER	1500 x 4800		115	115		EXISTING
	1	CONVEYOR 1A	60"		900	900		EXISTING
	1	CONVEYOR 2A	60"		900	900		EXISTING
	1	CONVEYOR 2A-TRIPPER	60"		15	15		EXISTING
	1	COARSE ORE SURGE BIN	2000 T					EXISTING
	12	COARSE ORE RECLAIM FEEDERS	4' x 6' VIBRATING		4	48		EXISTING
	4	COARSE ORE RECLAIM CONVEYORS	48"		5	20		EXISTING
	2	RETRACTABLE CONVEYORS	48"		5	10		EXISTING
	2	SECONDARY CRUSHER (PRIME)	7' STD. CONE		350	700		EXISTING
	2	SECONDARY CRUSHER SURGE BIN						EXISTING
	4	CRUSHER RECLAIM FEEDER	4' x 5' VIBRATING		4	16		EXISTING
	4	SIZING SCREENS	6' x 10' VIBRATING		15	60		EXISTING
	4	TERTIARY CRUSHER	7' SH. HD. CONE		350	1400		EXISTING
	1	CONVEYOR 3A	60"		75	75		EXISTING
	1	CONVEYOR 4A	60"		750	750		EXISTING
	1	CONVEYOR 5S	60"		450	450		EXISTING
	1	CONVEYOR 5S-TRIPPER	60"		15	15		EXISTING
		SUMP PUMPS						EXISTING
GRINDING CIRCUIT								
	1	FINE ORE SURGE BIN	650 T LIVE CAPACITY					EXISTING
	8	FINE ORE RECLAIM BELT FEEDERS			3	24		EXISTING
	8	FINE ORE RECLAIM CONVEYORS	24'		3	24		EXISTING
	8	ROD MILL	10' x 14'		800	6400		EXISTING
	8	BALL MILL	10' x 14'		1250	10000		EXISTING
	8	CYCLOPAC 1 OP 1 STDBY	2 x 33" dia					NEW
	8	CYCLONE FEED PUMPBOX						NEW
	8	CYCLONE FEED PUMPS						NEW
	1	OVERHEAD CRANE	200 T		100	100		EXISTING
		SUMP PUMPS						EXISTING
FLOTATION & REGRIND								
	1	CONDITIONING TANK	7.5 m dia x 8 m					NEW
	1	CONDITIONING TANK AGITATOR						NEW
	4	ROUGHER CELLS	160 m3		260	1040	Tank cell	NEW
	10	SCAVENGER CELLS WITH DISTRIBUTER	160 m3		260	2600	Tank cell	NEW
	8	CLEANER CELLS WITH DISTRIBUTER	21 m3		45	360	Conventional cell	NEW
	1	FLOTATION TAILS PUMPBOX				0		NEW
	1	FLOTATION TAILS PUMPS				0		NEW
	1	RECLEANER FEED PUMPBOX						NEW
	1	RECLEANER FEED PUMPS						NEW
	1	RE CLEANER COLUMN CELLS	3.7m x 12.2 m				Column	NEW
	1	RECLEANER TAILS PUMP						NEW
	1	RECLEANER BLOWER						NEW
		FLOTATION BLOWERS						NEW
	3	SAMPLERS						NEW
	1	ANALYSER						NEW
	1	FLOTATION AREA OVERHEAD CRANE						EXISTING
	1	SCAVENGER REGRIND CYCLONE FEED PUMPBOX						NEW
	1	SCAVENGER REGRIND CYCLONE FEED PUMPS						NEW
	1	SCAVENGER REGRIND CYCLOPAC						NEW
	1	SCAVENGER REGRIND MILL	12'-2" x 24'		1500	1500		EXISTING
	1	FINAL CONC. REGRIND CYCLONE FEED PUMPBOX						NEW
	1	FINAL CONC. REGRIND CYCLONE FEED PUMPS						NEW
	1	FINAL CONC. REGRIND CYCLOPAC						NEW
	1	FINAL CONC REGRIND MILL	12'-2" x 24'		1500	1500		EXISTING
	2	SUMP PUMPS						NEW

PENGUIN**ASI** **MECHANICAL EQUIPMENT LIST** **April-04**
NorthMet Project
Hoyt Lakes, Minnesota

Equip. #	Qty.	Description	Size	Material Specification	HP Each	HP Total	Remarks	New / Existing
PRESSURE LEACHING								
	1	CONCENTRATE THICKENER	13.4 m dia.					NEW
	1	THICKENER O/F PUMP						NEW
	1	THICKENER U/F PUMP						NEW
	1	CONCENTRATE STORAGE TANK	8 m dia. X 9 m					NEW
	1	CONCENTRATE STORAGE TANK AGITATOR						NEW
	2	CONCENTRATE FEED PUMPS						NEW
	2	AUTOCLAVE FEED TANK	3 m dia. X 3.5 m					NEW
	2	AOTOCLAVE FEED PUMPS						NEW
	2	AUTOCLAVES	4.1m x 24.6m					NEW
	2	FLASH TANKS						NEW
	2	SLURRY COOLER FEED PUMPS						NEW
	2	SLURRY COOLERS						NEW
	1	COOLING TOWER						NEW
	1	VENT GAS SCRUBBER						NEW
	1	VENT GAS SCRUBBER DISHARGE PUMP						NEW
	2	RAFFINATE INJECTION PUMPS						NEW
	1	BOILER PACKAGE						NEW
	2	BOILER BLOWOUT VESSELS						NEW
	1	HP AIR COMPRESSOR						NEW
	1	LP AIR COMPRESSOR						NEW
	1	SEAL WATER COOLER						NEW
	1	SEAL/RINSE WATER PACKAGE						NEW
	2	OXYGEN BLOWOUT VESSEL						NEW
	3	SEAL WATER PUMPS						NEW
	1	WATER TREATMENT PACKAGE						NEW
	3	SUMP PUMPS						NEW
	1	NaCL STORAGE SYLO						NEW
	1	NaCL FEED SCREW						NEW
	1	NaCL WEIGH BELT						NEW
	2	AUTOCLAVE AREA OVERHEAD CRANE						NEW
SOLID LIQUID SEPARATION								
	1	LEACH THICKENER	17.7 m dia.					NEW
	1	LEACH THICKENER O/F PUMP						NEW
	1	LEACH THICKENER U/F PUMP						NEW
	1	FILTER FEED TANK	3 m dia. X 3.5 m					NEW
	1	FILTER FEED TANK AGITATOR						NEW
	1	FILTER FEED PUMP						NEW
	1	LEACH RESIDUE FILTER	2050 x 12 Plates				Plate & Frame	NEW
	1	TAILINGS REPULP TANK	3 m dia. X 3.5 m					NEW
	1	TAILINGS REPULP TANK AGITATOR						NEW
	1	TAILINGS REPULP PUMP						NEW
	1	THICKENER O/F SURGE TANK	5 m dia. X 5.5 m					NEW
	2	POLISH FILTER	3.5 m dia.					NEW
	2	POLISH FILTER BLOWER						NEW
	5	ROUGHER/SCAVENGER FLOTATION CELL	2.8m3					NEW
	3	CLEANER FLOTATION CELLS	0.08m3					NEW
	1	ROUGHER/SCAV FLOT CELLS RETURN PUMP						NEW
	1	CONCENTRATE STORAGE TANK FEED PUMP						NEW
	1	LEACH RESIDUE TAILINGS PUMPBOX						NEW
	2	LEACH RESIDUE TAILINGS PUMP						NEW
	2	SUMP PUMPS						NEW

PENGUINASI | MECHANICAL EQUIPMENT LIST | April-04

NorthMet Project
Hoyt Lakes, Minnesota

Equip. #	Qty.	Description	Size	Material Specification	HP Each	HP Total	Remarks	New / Existing
PGM RECOVERY								
	1	SULPHUR MELT PIT						NEW
	1	SULPHUR FEED PUMP						NEW
	1	SULPHUR FILTER						NEW
	1	SULPHUR BURNER PACKAGE						NEW
	1	SULPHUR BURNER BLOWER						NEW
	1	IN LINE MIXER						NEW
	1	Fe REDUCTION TANK	6.5 m dia x 7 m					NEW
	1	Fe REDUCTION TANK AGITATOR						NEW
	2	PIPE REACTOR FEED PUMP						NEW
	2	PIPE REACTOR	315mm D x 55m					NEW
	2	CLARIFIER						NEW
	3	PGM FILTER						NEW
	2	CLARIFIER O/F STANDPIPE						NEW
	1	POLISH FILTER FEED PUMP						NEW
	2	CLARIFIER U/F DIAPHRAM PUMP						NEW
	1	REPULP TANK	1m dia x 1.2m					NEW
	1	REPULP PUMP						NEW
	1	AUTOCLAVE HOLDING TANK	2m dia x 2.5m					NEW
	1	AUTOCLAVE CHARGE PUMP						NEW
	1	BATCH LEACH AUTOCLAVE	1m dia x 1.5m					NEW
	1	FILTER FEED TANK	2m dia x 2.5m					NEW
	1	FILTER FEED TANK AGITATOR						NEW
	1	FILTER FEED PUMP						NEW
	1	TRAY DRYER						NEW
	1	SUMP PUMP						
	1	PGM PRODUCT BIN						NEW
NEUTRALIZATION								
	1	NEUTRALLIZATION SURGE TANK	8m dia x 8.5m					NEW
	1	NEUTRALIZATION SURGE TANK AGITATOR						NEW
	1	NEUTRALIZATION FEED PUMP						NEW
	3	NEUTRALISATION TANKS	6.5m dia x 7m					NEW
	3	NEUTRALIZATION TANK AGITATORS						NEW
	1	THICKENER FEED PUMPBOX						NEW
	3	THICKENER FEED PUMP						NEW
	1	NEUTRALISATION THICKENER	33.6m dia					NEW
	2	NEUTRALISATION THICKENER O/F PUMP						NEW
	2	NEUTRALISATION THICKENER U/F PUMP						NEW
	1	FILTER FEED TANK	2.5m dia x 3m					NEW
	1	FILTER FEED PUMP						NEW
	1	GYPSUM FILTER	2050mm x 8 chamber					NEW
	1	GYPSUM STOCKPILE CONVEYOR						NEW
	2	SUMP PUMPS						NEW

PENGUIN**ASI**		MECHANICAL EQUIPMENT LIST						April-04
NorthMet Project								
Hoyt Lakes, Minnesota								
Equip. #	**Qty.**	**Description**	**Size**	**Material Specification**	**HP Each**	**HP Total**	**Remarks**	**New / Existing**
SOLVENT EXTRACTION AND STRIPPING								
	1	SX FEED TANK						NEW
	1	SX FEED PUMP						NEW
	1	SX FEED FILTER WATER PUMP						NEW
	1	Cu SX FEED FILTERS						NEW
	1	SX BLOWER						NEW
	5	MIXER TANKS						NEW
	10	MIXER TANK AGITATORS						NEW
	1	LOADED ORGANIC ADVANCE PUMP						NEW
	1	RICH ELECTROLYTE PUMP						NEW
	1	ORGANIC BLEED PUMP						NEW
	1	LOADED ORGAINIC TANK						NEW
	2	LOADED ORGANIC PUMP						NEW
	1	AQUEOUS REMOVAL PUMP						NEW
	1	RAFFINATE TANK						NEW
	1	RAFFINATE FEED PUMP						NEW
	1	EXTRACTANT ISOTAINER PACKAGE						NEW
	1	GUNK REMOVAL FRAME						NEW
	1	GUNK REMOVAL PUMP						NEW
	1	GUNK TANK						NEW
	1	GUNK TANK AGITATOR						NEW
	1	GUNK TANK PUMP						NEW
	1	RECOVERED SOLUTION TANK						NEW
	1	CLAY FILTER PRESS FEED PUMP						NEW
	1	CLAY TREATMENT FILTER PRESS						NEW
	1	RECOVERED SOLUTION PUMP						NEW
	1	DILUENT STORAGE TANK						NEW
	1	DILUENT TRANSFER PUMP						NEW
ELECTROLYTE CLEANING								
	1	ELECTROLYTE COLUMN CELL						NEW
	1	FILTER FEED TANK						NEW
	1	FILTER FEED PUMP						NEW
	1	FILTER BACKWASH PUMP						NEW
	2	ELECTROLYTE FILTERS						NEW
	1	ELECTROLYTE FILTER BLOWER						NEW
	2	ELECTROLYTE HEAT EXCHANGER						NEW
	1	ELECTROLYTE RECIRCULATION TANK						NEW
	1	LEAN ELECTROLYTE PUMP						NEW
	2	ELECTROWINNING FEED PUMPS						NEW
	1	SUMP PUMP						NEW
ELCTROWINNING								
	1	WASH WATER HEAT EXCHANGER						NEW
	1	LOADING CONVEYOR						NEW
	1	DEMISTER						NEW
	1	DEMISTER EVACUATION FAN						NEW
	1	DEMISTER WASH CHAMBER						NEW
	1	DEMISTER RECIRCULATION PUMPS						NEW
	1	FLEXING STATION						NEW
	1	STRIPPING STATION						NEW
	1	BUFFING STATION						NEW
	1	CORRUGATING PRESS						NEW
	1	DISCHARGE CONVEYOR						NEW
	1	WEIGH SCALE						NEW
	1	STAND ALONE BUFFING UNIT						NEW
	1	REJECT MOTHERBLANK RACK						NEW
	1	EDGE STRIP INSTALLATION AND REPAIR STATION						NEW
	1	ANODE STORAGE RACKS						NEW
	1	CATHODE STORAGE RACKS						NEW
	130	ELECTROWINNING CELLS	54 CATHODES					NEW
	1	ELECTROWINNING AREA O/H CRANE						NEW
	1	TANKHOUSE CRANES						NEW
	2	SUMP PUMPS						NEW
		CATHODE MOTHER BLANKS						NEW

PENGUIN**ASI**		MECHANICAL EQUIPMENT LIST						April-04
NorthMet Project								
Hoyt Lakes, Minnesota								
Equip. #	**Qty.**	**Description**	**Size**	**Material Specification**	**HP Each**	**HP Total**	**Remarks**	**New / Existing**
Fe & HYDROXIDE PRECIPITATION								
	1	Fe THICKENER	6.35 M DIA.					NEW
	1	Fe THICKENER U/F PUMP						NEW
	1	Fe FILTER FEED TANK	3.5 x 4					NEW
	1	Fe FILTER FEED TANK AGITATOR						NEW
	1	Fe FILTER FEED PUMP						NEW
	1	Fe FILTER						NEW
	1	Fe FILTER FILTRATE TANK	2m x 2.5					NEW
	1	Fe FILTRATION PUMP						NEW
	1	Fe FILTER REPULP TANK	2m x 2.5					NEW
	1	Fe FILTER REPULP TANK AGITATOR						NEW
	1	Fe SLUDGE TAILINGS PUMP						NEW
	2	1st STAGE HYDROXIDE PRECIPITATION T	4 x 4.5					NEW
	2	1st STAGE HYDROXIDE PRECIP TANK AGITATOR						NEW
	1	HYDROXIDE THICKENER	9m					NEW
	1	HYDROXIDE O/F PUMP						NEW
	2	2nd STAGE HYDROXIDE PRECIPITATION T	4 x 4.5					NEW
	2	2nd STAGE HYDROXIDE PRECIP TANK AGITATOR						NEW
	1	TAILINGS THICKENER	9m					NEW
	1	TAILINGS THICKENER U/F PUMP						NEW
	1	HYDROXIDE PRECIPITATION U/F PUMP						NEW
	1	FILTER FEED TANK	2 x 2.5					NEW
	1	FILTER FEED TANK AGITATOR						NEW
	1	FILTER FEED PUMP						NEW
	1	HYDROXIDE FILTER						NEW
	1	FILTRATE TANK						NEW
	1	FILTRATION PUMP						NEW
	1	TRAY DRYER						NEW
	6	Fe PRECIPITATE TANKS	4m x 4.5					NEW
	6	Fe PRECIPITATE TANKS AGITATORS						NEW
	1	Fe THICKENER FEED PUMPBOX						NEW
	1	Fe THICKENER FEED PUMP						NEW
	1	Fe PRECIPITATION BLOWER						NEW

Appendix 4- Operating Costs

PENGUINASI

NorthMet Project

Hoyt Lakes, Minnesota

PLANT REAGENTS AND CONSUMABLES COST

April-04

Rev. A

Tonnes ore milled per annum **9,125,000**

AREA	SUPPLY	Unit/tonne Source	UNIT	UNITS/TONNE MILLED	UNITS PER ANNUM	UNIT COST	Unit price Source	TOTAL COST	ESCALATION FACTOR	TOTAL COST 2004	COST PER TONNE ORE
Crush/Grind	Primary Crusher Liners	AMEC	kg	0.0073	66,364	$2.82	AMEC	$186,880	1.0	$186,880	0.020
	Secondary Crusher Liners	Penguin	kg	0.0045	41,477	$4.46	AMEC	$185,146	1.0	$185,146	0.020
	Tertiary Crusher Liners	Penguin	kg	0.0045	41,477	$4.46	Penguin	$185,146	1.0	$185,146	0.020
	Rod Mill Liners	Penguin	kg	0.0386	352,557	$4.80	AMEC	$1,691,638	1.0	$1,691,638	0.185
	Ball Mill Liners	Penguin	kg	0.0291	265,455	$4.80	Penguin	$1,273,704	1.0	$1,273,704	0.140
	Regrind Mill Liners	Penguin	kg	0.0082	74,659	$3.54	AMEC	$263,950	1.0	$263,950	0.029
	Rods	Penguin	kg	0.4545	4,147,727	$0.44	Penguin	$1,825,000	1.0	$1,825,000	0.200
	Ball Mill Balls (2" & 3")	AMEC	kg	0.3636	3,318,182	$0.44	AMEC	$1,460,000	1.0	$1,460,000	0.160
	Regrind Mill Balls (1") steel	AMEC	kg	0.2273	2,073,864	$0.61	AMEC	$1,254,688	1.0	$1,254,688	0.138
	Regrind Mill Balls (1") ceramic	Penguin	kg	0.1136	1,036,932	$1.80	Penguin	$1,866,477	1.0	$1,866,477	0.205
	6.5% Tax on liners and media	calc						$662,521	1.0	$662,521	0.073
	Conveyor Belting (allowance)	Penguin						$400,000	1.0	$400,000	0.044
Flotation	Flex 31	AMEC	kg	0.0182	165,909	$2.75	AMEC	$456,250	1.0	$456,250	0.050
	PAX	AMEC	kg	0.0455	414,773	$1.54	AMEC	$638,750	1.0	$638,750	0.070
	MIBC	AMEC	kg	0.0409	373,295	$1.43	AMEC	$533,813	1.0	$533,813	0.059
	WW1752	AMEC	kg	0.0909	829,545	$2.20	AMEC	$1,825,000	1.0	$1,825,000	0.200
	Flocculant (Percol 155)	Polymet	kg	0.0004	3,733	$3.85	Polymet	$14,372	1.0	$14,372	0.002
POX	NaCl	Mass Balance	kg	0.4776	4,358,338	$0.04	Polymet	$153,414	1.0	$153,414	0.017
	Water Treatment (allowance)						Polymet	$41,500	1.0	$41,500	0.005
	Oxygen (over the fence)	Mass Balance	mt	0.016	148,107	$19.72	AMEC	$2,920,670	1.0	$2,920,670	0.320
S/L Separation	Flocculent (Percol 355)	AMEC	kg	0.0005	4,148	$3.85	Polymet	$15,969	1.0	$15,969	0.002
	Filter Aid (allowance)							$100,000	1.0	$100,000	0.011
	Limestone (to leach residue tails)	Mass Balance	mt	0.006	56,285	$10.00	Polymet	$562,852	1.0	$562,852	0.062
PGM Recovery	Sulfur for SO2	Mass Balance	kg	0.1240	1,131,160	$0.06	Polymet	$64,702	1.0	$64,702	0.007
	NaHS	Mass Balance	kg	0.0474	432,502	$0.64	Polymet	$278,791	1.0	$278,791	0.031
	Flocculant	AMEC	kg	0.0002	1,659	$3.85	Polymet	$6,388	1.0	$6,388	0.001
	Filter Aid (allowance)						Polymet	$46,500	1.0	$46,500	0.005
	$H_2SO_,$ (allowance)						Polymet	$18,600	1.0	$18,600	0.002
	Oxygen (incl in POX)										
Neutralization	Limestone	Mass Balance	mt	0.009	82,854	$10.00	Polymet	$828,542	1.0	$828,542	0.091
	Flocculant	AMEC	kg	0.0005	4,563	$3.85	Polymet	$17,566	1.0	$17,566	0.002
	Filter Aid (allowance)						Polymet	$93,000	1.0	$93,000	0.010

PENGUINASI

PLANT REAGENTS AND CONSUMABLES COST

April-04

NorthMet Project

Rev. A

Hoyt Lakes, Minnesota

Tonnes ore milled per annum **9,125,000**

AREA	SUPPLY	Unit/tonne Source	UNIT	UNITS/TONNE MILLED	UNITS PER ANNUM	UNIT COST	Unit price Source	TOTAL COST	ESCALATION FACTOR	TOTAL COST 2004	COST PER TONNE ORE
Cu SX/EW	Extractant (M5640)	AMEC	litres	0.0061	55,267	$9.12	Polymet	$503,992	1.0	$503,992	0.055
	Diluent (SX 11)	AMEC	litres	0.0140	127,805	$0.71	Polymet	$91,159	1.0	$91,159	0.010
	H_2SO	AMEC	mt	0.0011	10,038	$60.00	Penguin	$602,250	1.0	$602,250	0.066
	Cobalt Sulphate	AMEC	kg	0.0006	5,392	$5.50	Polymet	$29,656	1.0	$29,656	0.003
	Clay (allowance)						Polymet	$30,000	1.0	$30,000	0.003
	Cathodes (10yrlife)	Calc	plate		675	$250.00	Polymet	$30,000	1.0	$30,000	0.003
	Anodes (7 yr life)	Calc	plate		965	$165.00	Polymet	$30,000	1.0	$30,000	0.003
	Cathode Bundling Supplies						Polymet	$30,000	1.0	$30,000	0.003
	FC1100 (allowance)						Polymet	$40,000	1.0	$40,000	0.004
	Guar (allowance)						Polymet	$20,000	1.0	$20,000	0.002
Fe Precipitation	Limestone	Mass Balance	mt	0.002	19,286	$10.00	Polymet	$192,863	1.0	$192,863	0.021
	Sulfur for SO2	Mass Balance	kg	0.0335	305,296	$0.06	Polymet	$17,463	1.0	$17,463	0.002
	Flocculant	AMEC	kg	0.0002	1,659	$3.85	Polymet	$6,388	1.0	$6,388	0.001
	Filter Aid (allowance)						Polymet	$58,000	1.0	$58,000	0.006
	Oxygen (ind in POX)										
Hydroxide ppt'n	MgO	Mass Balance	kg	0.5868	5,354,716	$0.10	Polymet	$535,472	1.0	$535,472	0.059
	CaO	Mass Balance	kg	0.0914	833,693	$0.06	Polymet	$53,190	1.0	$53,190	0.006
	Hydroxide Bundling Supplies						Polymet	$8,400	1.0	$8,400	0.001
	Flocculent	AMEC	kg	0.0002	1,659	$3.85	Polymet	$6,388	1.0	$6,388	0.001
TOTAL										22,142,258	$2.43

Appendix 5- Capital Costs

PENGUINASI
NorthMet Project
Hoyt Lakes, Minnesota

CAPITAL COST ESTIMATE
SUMMARY

April-04
Rev. C

Item	Item Description	Total Mhrs	Labor	Material	Subcontract Costs	Total Costs
	SUMMARY - OVERALL					
100	CRUSHING	15,842	$ 1,075,130	$ 2,007,038	$ -	$ 3,082,168
210	GRINDING	15,640	$ 1,049,723	$ 3,174,011	$ 58,501	$ 4,282,235
220	FLOTATION & REGRIND	65,827	$ 4,476,264	$ 13,004,243	$ 65,900	$ 17,546,408
300	PRESSURE LEACHING	118,638	$ 8,067,369	$ 22,981,576	$ 3,000	$ 31,051,945
410	SOLID / LIQUID SEPARATION	26,903	$ 1,830,793	$ 4,822,330	$ 13,381	$ 6,666,504
420	PGM RECOVERY	19,927	$ 1,356,385	$ 3,712,286	$ 13,381	$ 5,082,053
510	NEUTRALIZATION	38,661	$ 2,633,222	$ 6,220,210	$ 13,381	$ 8,866,813
520	SOLVENT EXTRACTION	35,242.9	$ 2,397,018	$ 4,011,187	$ 30,767	$ 6,438,971
530	ELECTROWINNING	55,855	$ 3,800,408	$ 14,930,476	$ 18,678	$ 18,749,562
540	Fe & HYDROXIDE PRECIPITATION	30,868	$ 2,100,460	$ 3,889,689	$ 13,381	$ 6,003,530
600	INFRASTRUCTURE & AUXILIARY SERVICES	46,404	$ 3,168,312	$ 8,912,206	$ 506,193	$ 12,586,710
700	TAILINGS	2,740	$ 186,320	$ 385,000	$ 3,977,524	$ 4,548,844
800	MINING	6,185	$ 439,810	$ 411,700	$ 4,908,239	$ 5,759,749
	TOTAL DIRECT COSTS	478,732	$ 32,581,212	$ 88,461,953	$ 9,622,327	$ 130,665,492

PENGUINASI
NorthMet Project
Hoyt Lakes, Minnesota

CAPITAL COST ESTIMATE
SUMMARY

April-04
Rev. C

Item	Item Description	Total Mhrs	Basis	Labor	Material	Subcontract Costs	Total Costs
	SUMMARY - OVERALL						
920	EPCM	15%	On Direct Costs			$ 19,599,824	$ 19,599,824
930	CONSTRUCTION INDIRECTS	$6	On Manhours for Construction Equipment *Site Costs and Contractor O/H and Profit included in labour rate*			$ 2,872,394	$ 2,872,394
941	CAPITAL SPARES	5%	On Process Materials Excluding Crushing			$ 4,322,746	$ 4,322,746
942	FIRST FILLS	LS	3 Months Consumables			$ 4,000,000	$ 4,000,000
950	VENDOR REPRESENTATIVES	LS				$ 1,319,508	$ 1,319,508
960	FREIGHT	3%	On Materials			$ 2,498,427	$ 2,498,427
970	START UP AND COMMISSIONING	LS				$ 910,460	$ 910,460
	CONTINGENCY	20%	On Direct and Indirect Costs *Excluding Owners Costs*				$ 33,237,770
	PROJECT TOTAL						$ 199,426,621

CRUSHING AND SCREENING

Area 100		Item Description CRUSHING AND SCREENING		Qty	Unit	Unit Mhrs	Total Mhrs	MH Rate	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	Existing equipment refurbishment costs include an allowance for labour and an allowance for materials based on 10% of new equipment cost for liners, idlers etc.												
110	**PRIMARY CRUSHING**												
		REMOVE EXISTING 36" GYRATORY *Removed at no cost for salvage*		1	EA	-	-	$ 68	$ -	$ -	$ -		$ -
		CRUSHER SURGE POCKET DEMOLITION		1	LS	500	500	$ 68	$ 34,000	$ -	$ -		$ 34,000
		CRUSHER SURGE POCKET MODIFICATIONS		20	TN	30	600	$ 68	$ 40,800	$ 3,000	$ 60,000		$ 100,800
	EXISTING	PRIMARY CRUSHER *Discharge Skirt Repairs and New Lube Unit*	60 x 89 GYR, 900 HP	1	EA	300	300	$ 68	$ 20,400	$ 250,000	$ 250,000		$ 270,400
	EXISTING	APRON FEEDER	1500 x 4800, 115HP	1	EA	299	299	$ 68	$ 20,323	$ 29,887	$ 29,887		$ 50,210
	EXISTING	CONVEYOR 1A *Change Troughing Idler Sets at Feed End*	60", 900 HP	1	EA	250	250	$ 68	$ 17,000	$ 25,000	$ 25,000		$ 42,000
	EXISTING	BELT WEIGHSCALE		1	EA	12	12	$ 68	$ 816	$ 2,000	$ 2,000		$ 2,816
	EXISTING	CONVEYOR 2A *Change Troughing Idlers at Feed End*	60", 900 HP	1	EA	250	250	$ 68	$ 17,000	$ 25,000	$ 25,000		$ 42,000
	EXISTING	CONVEYOR 2A-TRIPPER *Modify Tripper Drive*	60", 15 HP	1	EA	700	700	$ 68	$ 47,600	70,000	$ 70,000		$ 117,600
	EXISTING	CONV. 2A TRIPPER SUPPORT REPAIR		20	TN	60	1,224	$ 69	$ 84,456	$ 3,000	$ 61,200		$ 145,656
	NEW	RE & RE PRIMARY CRUSHER CHUTEWORK LINERS		15	TN	30	450	$ 68	$ 30,600	$ 3,500	$ 52,500		$ 83,100
	EXISTING	PRIMARY CRUSHER PIPING *20% of new for inspection/repair*		1	LS	158	158	$ 68	$ 10,744	$ 15,800	$ 15,800		$ 26,544
	EXISTING	PRIMARY CRUSHER ELECTRICAL/LIGHTING *10% of new for repair*		1	LS	274	274	$ 68	$ 18,627	$ 27,393	$ 27,393		$ 46,020
	EXISTING	PRIMARY CRUSHER INSTRUMENTATION *20% of new for repair*		1	LS	40	40	$ 68	$ 2,720	$ 10,400	$ 10,400		$ 13,120
	EXISTING	PRIMARY CRUSHER HVAC/SERVICES *Allowance*		1	LS	80	80	$ 68	$ 5,440	$ 5,000	$ 5,000		$ 10,440
	EXISTING	PRIMARY CRUSHER FIRE PROTECTION *Allowance*		1	LS	80	80	$ 68	$ 5,440	$ 5,000	$ 5,000		$ 10,440
	EXISTING	PRIMARY CRUSHER BUILDING *Allowance for Repairs/Modifications*		1	LS	250	250	$ 68	$ 17,000	$ 25,000	$ 25,000		$ 42,000
120	**SECONDARY AND TERTIARY CRUSHING AND SCREENING**												
	EXISTING	RE & RE COARSE ORE SURGE BIN LINERS *Liners in Stock*	2000 T BIN	24	TN	100	2,400	$ 68	$ 163,200	$ 350	$ 8,400		$ 171,600
	EXISTING	COARSE ORE RECLAIM FEEDERS	4' x 6' VIB, 4 HP	12	EA	177	2,119	$ 68	$ 144,109	$ 14,717	$ 176,604		$ 320,713
	EXISTING	COARSE ORE RECLAIM CONVEYORS *Recently Replaced*	48", 5 HP	4	EA	39	156	$ 68	$ 10,608	$ 325	$ 1,300		$ 11,908
	EXISTING	RETRACTABLE CONVEYORS	48", 5 HP	2	EA	39	78	$ 68	$ 5,304	$ 3,250	$ 6,500		$ 11,804
	EXISTING	SECONDARY CRUSHER *Replace Lube Unit*	7' STD. CONE, 350 HP	2	EA	150	300	$ 68	$ 20,400	$ 150,000	$ 300,000		$ 320,400
	EXISTING	CRUSHER RECLAIM FEEDER	4' x 5' VIB, 4 HP	4	EA	175	700	$ 68	$ 47,600	$ 14,717	$ 58,868		$ 106,468
	EXISTING	SIZING SCREENS *Spare Parts in Stock*	6' x 10' VIB, 15 HP	4	EA	50	200	$ 68	$ 13,600	$ 17,000	$ 68,000		$ 81,600
	EXISTING	TERTIARY CRUSHER *Replace Lube Unit*	7' CONE, 350 HP	4	EA	150	600	$ 68	$ 40,800	$ 100,000	$ 400,000		$ 440,800
	EXISTING	RELACE BOTTOM SECTION OF DISCHARGE CHUTES		10	TN	30	300	$ 68	$ 20,400	$ 3,000	$ 30,000		$ 50,400
	EXISTING	CONVEYOR 3A *Change Troughing Idlers at Feed End*	60", 75 HP	1	EA	250	250	$ 68	$ 17,000	$ 25,000	$ 25,000		$ 42,000
	EXISTING	CONVEYOR 4A *Change Troughing Idlers at Feed End*	60", 750 HP	1	EA	250	250	$ 68	$ 17,000	$ 25,000	$ 25,000		$ 42,000
	EXISTING	CONVEYOR 5S *Change Troughing Idlers at Feed End*	60", 450 HP	1	EA	250	250	$ 68	$ 17,000	$ 25,000	$ 25,000		$ 42,000
	EXISTING	CONVEYOR 5S-TRIPPER	60", 15 HP	1	EA	200	200	$ 68	$ 13,600	$ 20,000	$ 20,000		$ 33,600
	EXISTING	SUMP PUMPS		2	EA	100	200	$ 68	$ 13,600	$ 1,500	$ 3,000		$ 16,600
	NEW	RE & RE SEC AND TER CHUTEWORK LINERS		4	TN	50	200	$ 68	$ 13,600	$ 3,500	$ 14,000		$ 27,600
	NEW	REPLACE DUST COLLECTION COLLECTOR DUCTING *Material on Site*		1	sum	400	400	$ 60	$ 23,856	$ 4,000	$ 4,000		$ 27,856

PENGUIN**ASI** — **CRUSHING AND SCREENING** — **April-04**

NorthMet Project — **Rev. C**

Hoyt Lakes, Minnesota

Area 100		Item Description CRUSHING AND SCREENING	Qty	Unit	Unit Mhrs	Total Mhrs	MH Rate	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	EXISTING	SECONDARY CRUSHER PIPING	1	LS	316	**316**	$ 68	**$ 21,488**	$ 31,600	**$ 31,600**		**$ 53,088**
	EXISTING	SECONDARY CRUSHER ELEC/LIGHTING	1	LS	548	**548**	$ 68	**$ 37,254**	$ 54,786	**$ 54,786**		**$ 92,040**
	EXISTING	SECONDARY CRUSHER INSTRUMENTATION	1	LS	208	**208**	$ 68	**$ 14,144**	$ 20,800	**$ 20,800**		**$ 34,944**
	EXISTING	SECONDARY CRUSHER HVAC	1	LS	100	**100**	$ 68	**$ 6,800**	$ 10,000	**$ 10,000**		**$ 16,800**
	EXISTING	SECONDARY CRUSHER FIRE PROTECTION	1	LS	100	**100**	$ 68	**$ 6,800**	$ 10,000	**$ 10,000**		**$ 16,800**
	EXISTING	SECONDARY CRUSHER BUILDING *Allowance for Repairs/Modifications*	1	LS	500	**500**	$ 68	**$ 34,000**	$ 50,000	**$ 50,000**		**$ 84,000**
110		**SUB TOTAL CRUSHING AND SCREENING**				**15,842**		**$ 1,075,130**		**$ 2,007,038**		**$ 3,082,168**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

200 - GRINDING

April-04
Rev. C

Area 210		Item Description GRINDING		Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	Existing equipment refurbishment costs include an allowance for labour and an allowance for materials based on 10% of new equipment cost for liners, idlers etc.											
		EQUIPMENT AND STEEL DEMOLITION *Removed at no cost for salvage*		1	LS	-	**-**	**$ -**	$ -	**$ -**	**$ -**	**$ -**
		GRINDING CIRCUIT DEMOLITION		1	LS	500	**500**	**$ 34,000**	$ 3,500	**$ 3,500**	**$ 2,000**	**$ 39,500**
		BACKFILL		1	LS	200	**200**	**$ 13,600**	$ 2,000	**$ 2,000**	**$ 1,500**	**$ 17,100**
		NEW CONCRETE FOOTINGS AND PIERS		1	LS	400	**400**	**$ 27,200**	$ 300	**$ 300**	**$ -**	**$ 27,500**
		NEW STRUCTURAL STEEL AND PLATFORMS		8	TN	30	**240**	**$ 16,320**	$ 3,200	**$ 25,600**	**$ -**	**$ 41,920**
		FINE ORE SURGE BIN BULKHEADS *Not Required*		0	TN	30	**-**	**$ -**	$ 3,200	**$ -**	**$ -**	**$ -**
	EXISTING	RE & RE FINE ORE SURGE BIN LINERS	650 T LIVE CAPACITY	16	TN	25	**400**	**$ 27,200**	$ 3,500	**$ 56,000**	**$ -**	**$ 83,200**
	EXISTING	FINE ORE RECLAIM CONVEYORS	24', 3 HP	8	ea	147	**1,176**	**$ 79,968**	$ 14,717	**$ 117,736**	**$ -**	**$ 197,704**
	EXISTING	ROD MILL	10' x 14', 800 HP	8	ea	300	**2,400**	**$ 163,200**	$ 100,000	**$ 800,000**	**$ -**	**$ 963,200**
	EXISTING	BALL MILL	10' x 14', 1250 HP	8	ea	300	**2,400**	**$ 163,200**	$ 100,000	**$ 800,000**	**$ -**	**$ 963,200**
	NEW	CYCLOPAC 1 OP 1 STDBY	2 x 33" dia	8	ea	100	**800**	**$ 54,400**	$ 40,000	**$ 320,000**	**$ -**	**$ 374,400**
	NEW	CYCLONE FEED PUMPBOX		8	ea	80	**640**	**$ 43,520**	$ 10,000	**$ 80,000**	**$ -**	**$ 123,520**
	NEW	CYCLONE FEED PUMPS		8	ea	100	**800**	**$ 54,400**	$ 50,000	**$ 400,000**	**$ -**	**$ 454,400**
	EXISTING	REPLACE 42" PROCESS WATER HEADER		1	EA	210	**210**	**$ -**	$ 21,000	**$ 21,000**	**$ 1**	**$ 21,001**
	EXISTING	OVERHEAD CRANE		1	ea	40	**40**	**$ 2,720**	$ 25,000	**$ 25,000**	**$ 5,000**	**$ 32,720**
	EXISTING	SUMP PUMPS	6"	2	ea	100	**200**	**$ 13,600**	$ 750	**$ 1,500**	**$ -**	**$ 15,100**
		RE & RE GRINDING CHUTEWORK / LINERS		20	TN	30	**600**	**$ 40,800**	$ 3,500	**$ 70,000**	**$ -**	**$ 110,800**
		GRINDING PIPING		1	LS	1,695	**1,695**	**$ 115,260**	$ 169,500	**$ 169,500**	**$ -**	**$ 284,760**
		GRINDING ELECTRICAL/LIGHTING		1	LS	1,271	**1,271**	**$ 86,445**	$ 127,125	**$ 127,125**	**$ -**	**$ 213,570**
		GRINDING INSTRUMENTATION		1	LS	848	**848**	**$ 57,630**	$ 84,750	**$ 84,750**	**$ -**	**$ 142,380**
		GRINDING HVAC/SERVICES *Allowance*		1	LS	160	**160**	**$ 10,880**	$ 10,000	**$ 10,000**	**$ -**	**$ 20,880**
		GRINDING FIRE PROTECTION *Allowance*		1	LS	160	**160**	**$ 10,880**	$ 10,000	**$ 10,000**	**$ -**	**$ 20,880**
		GRINDING BUILDING *Allowance for Repairs/Modifications*		1	LS	500	**500**	**$ 34,500**	$ 50,000	**$ 50,000**	**$ -**	**$ 84,500**
		SEPARATION WALL ALLOWANCE		1	LS						**$ 50,000**	**$ 50,000**
210		**SUB TOTAL GRINDING**					**15,640**	**$ 1,049,723**		**$ 3,174,011**	**$ 58,501**	**$ 4,282,235**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

FLOTATION AND REGRIND

April-04
Rev. C

Area 220		**Item Description FLOTATION & REGRIND**		**Qty**	**Unit**	**Unit Mhrs**	**Total Mhrs**	**Labor**	**Unit Matl**	**Material**	**Subcontract Specl Costs**	**Total Costs**
		EQUIPMENT AND STEEL DEMOLITION *Removed at no cost for salvage*		1	LS	0	**0**	**$ -**	$ -	**$ -**	**$ -**	**$ -**
		GRINDING CIRCUIT DEMOLITION		1,100	CY	1	**1100**	**$ 74,800**	$ -	**$ -**	**$ 8,800**	**$ 83,600**
		BACKFILL		700	CY	0.1	**70**	**$ 4,760**	$ 8	**$ 5,600**	**$ 2,100**	**$ 12,460**
		NEW CONCRETE FOOTINGS/PIERS/SLABS		400	CY	8	**3200**	**$ 217,600**	$ 300	**$ 120,000**		**$ 337,600**
		STRUCTURAL STEEL AND PLATFORMS		70	TN	22	**1540**	**$ 104,720**	$ 2,800	**$ 196,000**		**$ 300,720**
		GENERAL BUILDING MODIFICATIONS		1	LS	500	**500**	**$ 34,000**	$ 50,000	**$ 50,000**		**$ 84,000**
	EXISTING	FLOTATION AREA CRANE	25T/5T 20/5 HP	1	EA	40	**40**	**$ 2,720**	$ 8,000	**$ 8,000**	**$ 5,000**	**$ 15,720**
	NEW	CONDITIONING TANK	7.5 m dia x 8 m	31,700	LB	0.03	**951**	**$ 64,668**	$ 1	**$ 31,700**		**$ 96,368**
	NEW	CONDITIONING TANK AGITATOR		1	EA	100	**100**	**$ 6,800**	$ 48,000	**$ 48,000**		**$ 54,800**
	NEW	ROUGHER CELLS *Quoted*	160 m3 TANK CELL	4	EA	60	**240**	**$ 16,320**	$ 307,500	**$ 1,230,000**		**$ 1,246,320**
	NEW	SCAVENGER CELLS *Quoted*	160 m3 TANK CELL	10	EA	60	**600**	**$ 40,800**	$ 338,250	**$ 3,382,500**		**$ 3,423,300**
	NEW	CLEANER CELLS WITH DISTRIBUTOR *Quoted*	21 m3 CONV. CELL	8	EA	120	**960**	**$ 65,280**	$ 99,000	**$ 792,000**		**$ 857,280**
	NEW	FLOTATION TAILS PUMPBOX		1	EA	250	**250**	**$ 17,000**	$ 15,000	**$ 15,000**		**$ 32,000**
	NEW	FLOTATION TAILS PUMPS		2	EA	400	**800**	**$ 54,400**	$ 200,000	**$ 400,000**		**$ 454,400**
	NEW	RECLEANER FEED PUMPBOX		1	EA	40	**40**	**$ 2,720**	$ 10,000	**$ 10,000**		**$ 12,720**
	NEW	RECLEANER FEED PUMPS		2	EA	60	**120**	**$ 8,160**	$ 30,000	**$ 60,000**		**$ 68,160**
	NEW	RE CLEANER COLUMN CELLS	3.7mx12.2 m COL CELL	1	EA	120	**120**	**$ 8,160**	$ 99,000	**$ 99,000**		**$ 107,160**
	NEW	RECLEANER TAILS PUMP		2	EA	60	**120**	**$ 8,160**	$ 30,000	**$ 60,000**		**$ 68,160**
	NEW	RECLEANER BLOWER		1	EA	60	**60**	**$ 4,080**	$ 15,000	**$ 15,000**		**$ 19,080**
	NEW	FLOTATION BLOWERS		2	EA	61	**122**	**$ 8,296**	$ 15,001	**$ 30,002**		**$ 38,298**
	NEW	SAMPLERS		3	EA	50	**150**	**$ 10,200**	$ 10,000	**$ 30,000**		**$ 40,200**
	NEW	ANALYSER		1	EA	900	**900**	**$ 61,200**	$ 500,000	**$ 500,000**		**$ 561,200**
	NEW	SUMP PUMPS		4	EA	60	**240**	**$ 16,320**	$ 15,000	**$ 60,000**		**$ 76,320**
	NEW	SCAVENGER REGRIND CYCLONE FEED PUMPBOX		1	EA	100	**100**	**$ 6,800**	$ 10,000	**$ 10,000**		**$ 16,800**
	NEW	SCAVENGER REGRIND CYCLONE FEED PUMPS		2	EA	125	**250**	**$ 17,000**	$ 50,000	**$ 100,000**		**$ 117,000**
	NEW	SCAVENGER REGRIND CYCLOPAC		1	EA	80	**80**	**$ 5,440**	$ 50,000	**$ 50,000**		**$ 55,440**
	EXISTING	SCAVENGER REGRIND MILL	12'-2" x 24', 1500 HP	1	EA	250	**250**	**$ 17,000**	$ 150,000	**$ 150,000**		**$ 167,000**
	NEW	FINAL CONC. REGRIND CYCLONE FEED PUMPBOX		1	EA	100	**100**	**$ 6,800**	$ 10,000	**$ 10,000**		**$ 16,800**
	NEW	FINAL CONC. REGRIND CYCLONE FEED PUMPS		2	EA	60	**120**	**$ 8,160**	$ 50,000	**$ 100,000**		**$ 108,160**
	NEW	FINAL CONC. REGRIND CYCLOPAC		1	EA	80	**80**	**$ 5,440**	$ 50,000	**$ 50,000**		**$ 55,440**
	EXISTING	FINAL CONC REGRIND MILL	12'-2" x 24', 1500 HP	1	EA	250	**250**	**$ 17,000**	$ 150,000	**$ 150,000**		**$ 167,000**
		FLOTATION PIPING		1	LS	14,766	**14,766**	**$ 1,004,115**	$ 1,476,640	**$ 1,476,640**		**$ 2,480,756**
		OUTSIDE LINES *To Pressure Leaching and Reagent Supply*		1	LS	18,478	**18,478**	**$ 1,256,504**	$ 1,847,801	**$ 1,847,801**		**$ 3,104,305**
		FLOTATION ELECTRICAL		1	LS	11,087	**11,087**	**$ 753,903**	$ 1,108,680	**$ 1,108,680**		**$ 1,862,583**
		FLOTATION INSTRUMENTATION		1	LS	7,383	**7,383**	**$ 502,058**	$ 738,320	**$ 738,320**		**$ 1,240,378**
		FLOTATION HVAC		1	LS	80	**80**	**$ 5,440**	$ 10,000	**$ 10,000**		**$ 15,440**
		FLOTATION FIRE PROTECTION		1	LS	80	**80**	**$ 5,440**	$ 10,000	**$ 10,000**		**$ 15,440**
		FLOTATION BUILDING *Allowance for Repairs / Modifications*		1	LS	500	**500**	**$ 34,000**	$ 50,000	**$ 50,000**		**$ 84,000**
		SEPARATION WALL ALLOWANCE		1	LS						**$ 50,000**	**$ 50,000**
220		**SUB TOTAL FLOTATION & REGRIND**					**65,827**	**$ 4,476,264**		**$ 13,004,243**	**$ 65,900**	**$ 17,546,408**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

PRESSURE LEACHING

April-04
Rev. C

Area 300		Item Description PRESSURE LEACHING		Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		SITE PREPARATION AND CIVIL		1	LS	500	**500**	**$ 34,000**	$ 10,000	**$ 10,000**	**$ 3,000**	**$ 47,000**
		PRE ENGINEERED BUILDING *Including Concrete and Architectural*		24,000	SF	0.70	**16,800**	**$ 1,142,400**	$ 70	**$ 1,680,000**		**$ 2,822,400**
		BUILDING HVAC		24,000	SF	0.05	**1,200**	**$ 81,600**	$ 8	**$ 192,000**		**$ 273,600**
		BUILDING FIRE PROTECTION		24,000	SF	0.02	**480**	**$ 32,640**	$ 4	**$ 96,000**		**$ 128,640**
		BUILDING ELECTRICAL *lighting/convenience electrical*		24,000	SF	0.05	**1,200**	**$ 81,600**	$ 6	**$ 144,000**		**$ 225,600**
		CONCRETE EQUIP FOUNDATIONS AND PIERS		350	YD	6	**2,100**	**$ 142,800**	$ 300	**$ 105,000**		**$ 247,800**
		EQUIPMENT SUPPORT STRUCTURAL STEEL		35	TN	30	**1,050**	**$ 71,400**	$ 3,200	**$ 112,000**		**$ 183,400**
		AUTOCLAVE AREA OVERHEAD CRANE	5t/1t	2	EA	240	**480**	**$ 32,640**	$ 80,000	**$ 160,000**		**$ 192,640**
	NEW	CONCENTRATE THICKENER *Budget Quotation*	44 ft. dia	1	EA	1,500	**1,500**	**$ 102,000**	$ 301,125	**$ 301,125**		**$ 403,125**
	NEW	THICKENER O/F PUMP		2	EA	40	**80**	**$ 5,440**	$ 15,000	**$ 30,000**		**$ 35,440**
	NEW	THICKENER U/F PUMP		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	CONCENTRATE STORAGE TANK	26 ft dia. X 29 ft	45,000	LBS	0.03	**1,350**	**$ 91,800**	$ 1	**$ 45,000**		**$ 136,800**
	NEW	CONCENTRATE STORAGE TANK AGITATOR	29.52	1	EA	100	**100**	**$ 6,800**	$ 50,000	**$ 50,000**		**$ 56,800**
	NEW	CONCENTRATE FEED PUMPS		2	EA	40	**80**	**$ 5,440**	$ 12,000	**$ 24,000**		**$ 29,440**
	NEW	AUTOCLAVE FEED TANK	3 m dia. X 3.5 m	8,000	LBS	0.03	**240**	**$ 16,320**	$ 1	**$ 8,000**		**$ 24,320**
	NEW	AUTOCLAVE FEED TANK AGITATOR		2	EA	40	**80**	**$ 5,440**	$ 10,000	**$ 20,000**		**$ 25,440**
	NEW	AUTOCLAVE FEED PUMPS		2	EA	80	**160**	**$ 10,880**	$ 75,000	**$ 150,000**		**$ 160,880**
	NEW	NaCL ADDITION SYSTEM		1	EA	400	**400**	**$ 27,200**	$ 150,000	**$ 150,000**		**$ 177,200**
	NEW	AUTOCLAVES *Adjusted to 65% of AMEC study*	4.1m x 24.6m	2	EA	4,000	**8,000**	**$ 544,000**	$ 3,475,046	**$ 6,950,092**		**$ 7,494,092**
	NEW	AUTOCLAVE AGITATORS		12	EA	150	**1,800**	**$ 122,400**	$ 200,000	**$ 2,400,000**		**$ 2,522,400**
	NEW	FLASH TANKS *Adjusted to 65% of AMEC study*		2	EA	1,000	**2,000**	**$ 136,000**	$ 656,398	**$ 1,312,795**		**$ 1,448,795**
	NEW	SLURRY COOLER FEED PUMPS		2	EA	60	**120**	**$ 8,160**	$ 35,000	**$ 70,000**		**$ 78,160**
	NEW	SLURRY COOLERS		2	EA	80	**160**	**$ 10,880**	$ 50,000	**$ 100,000**		**$ 110,880**
	NEW	COOLING TOWER		1	EA	1,200	**1,200**	**$ 81,600**	$ 200,000	**$ 200,000**		**$ 281,600**
	NEW	VENT GAS SCRUBBER		1	EA	60	**60**	**$ 4,080**	$ 260,000	**$ 260,000**		**$ 264,080**
	NEW	VENT GAS SCRUBBER DISCHARGE PUMP		2	EA	40	**80**	**$ 5,440**	$ 5,000	**$ 10,000**		**$ 15,440**
	NEW	RAFFINATE INJECTION PUMPS		2	EA	80	**160**	**$ 10,880**	$ 75,000	**$ 150,000**		**$ 160,880**
	NEW	BOILER PACKAGE *Adjusted to 65% of AMEC study*		1	EA	4,000	**4,000**	**$ 272,000**	$ 617,786	**$ 617,786**		**$ 889,786**
	NEW	BOILER BLOWOUT VESSELS		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	HP AIR COMPRESSOR		1	EA	40	**40**	**$ 2,720**	$ 60,000	**$ 60,000**		**$ 62,720**
	NEW	LP AIR COMPRESSOR		1	EA	40	**40**	**$ 2,720**	$ 40,000	**$ 40,000**		**$ 42,720**
	NEW	SEAL WATER COOLER		1	EA	80	**80**	**$ 5,440**	$ 50,000	**$ 50,000**		**$ 55,440**
	NEW	SEAL/RINSE WATER TREATMENT PACKAGE		1	EA	100	**100**	**$ 6,800**	$ 50,000	**$ 50,000**		**$ 56,800**
	NEW	OXYGEN BLOWOUT VESSEL		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	SEAL WATER PUMPS		3	EA	40	**120**	**$ 8,160**	$ 8,000	**$ 24,000**		**$ 32,160**
	NEW	WATER TREATMENT PACKAGE		1	EA	200	**200**	**$ 13,600**	$ 100,000	**$ 100,000**		**$ 113,600**
	NEW	SUMP PUMPS		3	EA	60	**180**	**$ 12,240**	$ 12,000	**$ 36,000**		**$ 48,240**
		PRESSURE LEACHING PIPING *Adjusted to 65% of AMEC study*		1	LS	33,808	**33,808**	**$ 2,298,967**	$ 3,380,833	**$ 3,380,833**		**$ 5,679,800**
		OUTSIDE LINES TO SOLID LIQUID SEPARATION *Allowance*		1	LS	16,904	**16,904**	**$ 1,149,483**	$ 1,690,417	**$ 1,690,417**		**$ 2,839,900**
		PRESSURE LEACHING ELECTRICAL/LIGHTING *Adjusted to 65% AMEC*		1	LS	12,680	**12,680**	**$ 862,244**	$ 1,268,006	**$ 1,268,006**		**$ 2,130,249**
		PRESSURE LEACHING INSTRUMENTATION *Adjusted to 65% AMEC*		1	LS	8,865	**8,865**	**$ 602,835**	$ 886,523	**$ 886,523**		**$ 1,489,358**
300		**SUB TOTAL PRESSURE LEACHING**					**118,638**	**$ 8,067,369**		**$ 22,981,576**	**$ 3,000**	**31,051,945**

PENGUINASI
NorthMet Project
Hoyt Lakes, Minnesota

SOLID / LIQUID SEPARATION

April-04
Rev. C

Area 410		Item Description SOLID / LIQUID SEPARATION		Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		SITE PREPARATION		1	LS	500	**500**	**$ 34,000**	$ 5,000	**$ 5,000**	**3,000**	**$ 42,000**
		DEMOLITION		1,185	YD	1	**1,185**	**$ 80,593**	$ -	**$ -**	**$ 9,481**	**$ 90,074**
		BACKFILL		1,200	CY	0.08	**96**	**$ 6,528**	$ 5	**$ 6,000**	**$ 900**	**$ 13,428**
		CONCRETE EQUIP FOUNDATIONS AND PIERS		120	YD	6	**720**	**$ 48,960**	$ 300	**$ 36,000**		**$ 84,960**
		TANK FARM CONCRETE		180	YD	7	**1,260**	**$ 86,940**	$ 301	**$ 54,180**		**$ 141,120**
		PLATFORMS		1,000	SF	0.15	**150**	**$ 10,350**	$ 12	**$ 12,000**		**$ 22,350**
		EQUIPMENT SUPPORT STRUCTURAL STEEL		20	TN	30	**600**	**$ 40,800**	$ 3,200	**$ 64,000**		**$ 104,800**
		BUILDING MODIFICATIONS		1	LS	500	**500**	**$ 34,000**	$ 100,000	**$ 100,000**		**$ 134,000**
		BUILDING ARCHITECTURAL *Allowance*		1,200	SF	1	**1,200**	**$ 81,600**	$ 75	**$ 90,000**		**$ 171,600**
		BUILDING HVAC		4,000	SF	0.05	**200**	**$ 13,600**	$ 8	**$ 32,000**		**$ 45,600**
		BUILDING FIRE PROTECTION		4,000	SF	0.02	**80**	**$ 5,440**	$ 5	**$ 20,000**		**$ 25,440**
		BUILDING ELECTRICAL *Lighting/Convenience Electrical*		4,000	SF	0.05	**200**	**$ 13,600**	$ 6	**$ 24,000**		**$ 37,600**
		CRANE		1	EA	400	**400**	**$ 27,200**	$ 50,000	**$ 50,000**		**$ 77,200**
	NEW	LEACH THICKENER *Budget Quotation*	17.7 m dia.	1	EA	3000	**3,000**	**$ 204,000**	$ 380,000	**$ 380,000**		**$ 584,000**
	NEW	LEACH THICKENER O/F PUMP		2	EA	60	**120**	**$ 8,160**	$ 15,000	**$ 30,000**		**$ 38,160**
	NEW	LEACH THICKENER U/F PUMP		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	FILTER FEED TANK	3 m dia. X 3.5 m	1	EA	200	**200**	**$ 13,600**	$ 30,000	**$ 30,000**		**$ 43,600**
	NEW	FILTER FEED TANK AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 6,000	**$ 6,000**		**$ 8,720**
	NEW	FILTER FEED PUMP		2	EA	30	**60**	**$ 4,080**	$ 8,000	**$ 16,000**		**$ 20,080**
	NEW	LEACH RESIDUE FILTER - Budget Quote		1	EA	500	**500**	**$ 34,000**	$ 1,690,000	**$ 1,690,000**		**$ 1,724,000**
	NEW	TAILINGS REPULP TANK	3 m dia. X 3.5 m	1	EA	200	**200**	**$ 13,600**	$ 30,000	**$ 30,000**		**$ 43,600**
	NEW	TAILINGS REPULP TANK AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 6,000	**$ 6,000**		**$ 8,720**
	NEW	TAILINGS REPULP PUMP		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	THICKENER O/F SURGE TANK	5 m dia. X 5.5 m	1	EA	600	**600**	**$ 40,800**	$ 100,000	**$ 100,000**		**$ 140,800**
	NEW	POLISH FILTER FEED PUMP		2	EA	40	**80**	**$ 5,440**	$ 6,000	**$ 12,000**		**$ 17,440**
	NEW	POLISH FILTER	3.5 m dia.	2	EA	120	**240**	**$ 16,320**	$ 175,000	**$ 350,000**		**$ 366,320**
	NEW	POLISH FILTER BLOWER		1	EA	60	**60**	**$ 4,080**	$ 15,000	**$ 15,000**		**$ 19,080**
	NEW	ROUGHER/SCAVENGER CELLS *Budget Quote*	2.8m3	5	EA	30	**150**	**$ 10,200**	$ 18,000	**$ 90,000**		**$ 100,200**
	NEW	CLEANER FLOTATION CELLS *Budget Quote*	0.08m3	3	EA	40	**120**	**$ 8,160**	$ 8,333	**$ 25,000**		**$ 33,160**
	NEW	ROUGHER/SCAV FLOT CELLS RETURN PUMP		1	EA	40	**40**	**$ 2,720**	$ 6,000	**$ 6,000**		**$ 8,720**
	NEW	CONCENTRATE STORAGE TANK FEED PUMP		1	EA	40	**40**	**$ 2,720**	$ 5,000	**$ 5,000**		**$ 7,720**
	NEW	LEACH RESIDUE TAILINGS PUMPBOX		1	EA	80	**80**	**$ 5,440**	$ 20,000	**$ 20,000**		**$ 25,440**
	NEW	LEACH RESIDUE TAILINGS PUMP		2	EA	80	**160**	**$ 10,880**	$ 45,000	**$ 90,000**		**$ 100,880**
	NEW	SUMP PUMPS		2	EA	40	**80**	**$ 5,440**	$ 6,000	**$ 12,000**		**$ 17,440**
		SOLID / LIQUID SEPARATION PIPING		1	LS	5,890	**5,890**	**$ 400,520**	$ 589,000	**$ 589,000**		**$ 989,520**
		SOLID LIQUID SEPARATION ELECTRICAL		1	LS	4,418	**4,418**	**$ 300,390**	$ 441,750	**$ 441,750**		**$ 742,140**
		SOLID LIQUID INSTRUMENTATION		1	LS	3,534	**3,534**	**$ 240,312**	$ 353,400	**$ 353,400**		**$ 593,712**
410		**SUB TOTAL SOLID / LIQUID SEPARATION**					**26,903**	**$ 1,830,793**		**$ 4,822,330**	**$ 13,381**	**$ 6,666,504**

PENGUINASI
NorthMet Project
Hoyt Lakes, Minnesota

PGM RECOVERY

April-04
Rev. C

Area 420		Item Description PGM RECOVERY		Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		SITE PREPARATION		1	LS	500	**500**	**$ 34,000**	$ 5,000	**$ 5,000**	**3,000**	**$ 42,000**
		DEMOLITION		1,185	YD	1	**1,185**	**$ 80,593**	$ -	**$ -**	**$ 9,481**	**$ 90,074**
		BACKFILL		1,200	CY	0.08	**96**	**$ 6,528**	$ 5	**$ 6,000**	**$ 900**	**$ 13,428**
		CONCRETE EQUIP FOUNDATIONS AND PIERS		120	YD	6	**720**	**$ 48,960**	$ 300	**$ 36,000**		**$ 84,960**
		TANK FARM CONCRETE		180	YD	7	**1,260**	**$ 86,940**	$ 301	**$ 54,180**		**$ 141,120**
		PLATFORMS		500	SF	0.15	**75**	**$ 5,175**	$ 12	**$ 6,000**		**$ 11,175**
		EQUIPMENT SUPPORT STRUCTURAL STEEL		20	TN	30	**600**	**$ 40,800**	$ 3,200	**$ 64,000**		**$ 104,800**
		BUILDING MODIFICATIONS		1	LS	500	**500**	**$ 34,000**	$ 100,000	**$ 100,000**		**$ 134,000**
		BUILDING ARCHITECTURAL *Allowance*		1,200	SF	1	**1,200**	**$ 81,600**	$ 75	**$ 90,000**		**$ 171,600**
		BUILDING HVAC		4,000	SF	0.05	**200**	**$ 13,600**	$ 8	**$ 32,000**		**$ 45,600**
		BUILDING FIRE PROTECTION		4,000	SF	0.02	**80**	**$ 5,440**	$ 5	**$ 20,000**		**$ 25,440**
		BUILDING ELECTRICAL *lghting/Convenience Electrical*		4,000	SF	0.05	**200**	**$ 13,600**	$ 6	**$ 24,000**		**$ 37,600**
		CRANE		1	EA	400	**400**	**$ 27,200**	$ 50,000	**$ 50,000**		**$ 77,200**
	NEW	PLANT AIR COMPRESSOR		1	EA	60	**60**	**$ 4,080**	$ 40,000	**$ 40,000**		**$ 44,080**
	NEW	INSTRUMENT AIR COMPRESSOR		1	EA	60	**60**	**$ 4,080**	$ 40,000	**$ 40,000**		**$ 44,080**
	NEW	SULPHUR BURNER PACKAGE		1	EA	800	**800**	**$ 54,400**	$ 200,000	**$ 200,000**		**$ 254,400**
	NEW	SULPHUR BURNER BLOWER		1			**-**	**$ -**		**$ -**		**$ -**
	NEW	IN LINE MIXER		1	EA	40	**40**	**$ 2,720**	$ 10,000	**$ 10,000**		**$ 12,720**
	NEW	Fe REDUCTION TANK	6.5 m dia x 7 m	1	EA	800	**800**	**$ 54,400**	$ 120,000	**$ 120,000**		**$ 174,400**
	NEW	Fe REDUCTION TANK AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 13,000	**$ 13,000**		**$ 15,720**
	NEW	PIPE REACTOR FEED PUMP		2	EA	40	**80**	**$ 5,440**	$ 17,000	**$ 34,000**		**$ 39,440**
	NEW	PIPE REACTOR	315mm D x 55m	2	EA	120	**240**	**$ 16,320**	$ 10,000	**$ 20,000**		**$ 36,320**
	NEW	CLARIFIER		2	EA	120	**240**	**$ 16,320**	$ 80,000	**$ 160,000**		**$ 176,320**
	NEW	PGM FILTER		2	EA	500	**1,000**	**$ 68,000**	$ 690,002	**$ 1,380,005**		**$ 1,448,005**
	NEW	CLARIFIER O/F STANDPIPE		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	POLISH FILTER FEED PUMP		2	EA	80	**160**	**$ 10,880**	$ 30,000	**$ 60,000**		**$ 70,880**
	NEW	CLARIFIER U/F DIAPHRAM PUMP		4	EA	40	**160**	**$ 10,880**	$ 8,000	**$ 32,000**		**$ 42,880**
	NEW	REPULP TANK	1m dia x 1.2m	1	EA	20	**20**	**$ 1,360**	$ 2,000	**$ 2,000**		**$ 3,360**
	NEW	REPULP TANK AGITATOR		1	EA	20	**20**	**$ 1,360**	$ 4,000	**$ 4,000**		**$ 5,360**
	NEW	REPULP PUMP		2	EA	30	**60**	**$ 4,080**	$ 4,000	**$ 8,000**		**$ 12,080**
	NEW	AUTOCLAVE HOLDING TANK	2m dia x 2.5m	1	EA	40	**40**	**$ 2,720**	$ 6,500	**$ 6,500**		**$ 9,220**
	NEW	AUTOCLAVE HOLDING TANK AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 5,000	**$ 5,000**		**$ 7,720**
	NEW	AUTOCLAVE CHARGE PUMP		2	EA	40	**80**	**$ 5,440**	$ 5,000	**$ 10,000**		**$ 15,440**
	NEW	BATCH LEACH AUTOCLAVE	1m dia x 1.5m	1	EA	80	**80**	**$ 5,440**	$ 60,000	**$ 60,000**		**$ 65,440**
	NEW	BATCH LEACH AUTOCLAVE AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 25,000	**$ 25,000**		**$ 27,720**
	NEW	FILTER FEED TANK	2m dia x 2.5m	1	EA	40	**40**	**$ 2,720**	$ 6,500	**$ 6,500**		**$ 9,220**
	NEW	FILTER FEED TANK AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 5,000	**$ 5,000**		**$ 7,720**
	NEW	FILTER FEED PUMP		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	PGM FILTER		1	EA	50	**50**	**$ 3,400**	$ 50,000	**$ 50,000**		**$ 53,400**
	NEW	TRAY DRYER		1	EA	80	**80**	**$ 5,440**	$ 50,000	**$ 50,000**		**$ 55,440**
	NEW	PGM PRODUCT BIN		1	EA	10	**10**	**$ 680**	$ 5,000	**$ 5,000**		**$ 5,680**
		PGM RECOVERY PIPING		1	LS	4756	**4,756**	**$ 323,409**	$ 475,600.97	**$ 475,601**		**$ 799,010**
		PRESSURE LEACHING ELECTRICAL/LIGHTING		1	LS	2253	**2,253**	**$ 153,204**	$ 225,300.36	**$ 225,300**		**$ 378,505**
		PRESSURE LEACHING INSTRUMENTATION		1	LS	1462	**1,462**	**$ 99,416**	$ 146,200.24	**$ 146,200**		**$ 245,616**
420		**SUB TOTAL PGM RECOVERY**					**19,927**	**$ 1,356,385**		**$ 3,712,286**	**$ 13,381**	**$ 5,082,053**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

NEUTRALIZATION

April-04
Rev. C

Area 510		Item Description NEUTRALIZATION		Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		SITE PREPARATION		1	LS	500	**500**	**$ 34,000**	$ 5,000	**$ 5,000**	**3,000**	**$ 42,000**
		DEMOLITION		1,185	YD	1	**1,185**	**$ 80,593**	$ -	**$ -**	**$ 9,481**	**$ 90,074**
		BACKFILL		1,200	CY	0.08	**96**	**$ 6,528**	$ 5	**$ 6,000**	**$ 900**	**$ 13,428**
		CONCRETE EQUIP FOUNDATIONS AND PIERS		120	YD	6	**720**	**$ 48,960**	$ 300	**$ 36,000**		**$ 84,960**
		TANK FARM CONCRETE		560	YD	7	**3,920**	**$ 270,480**	$ 301	**$ 168,560**		**$ 439,040**
		PLATFORMS		2,500	SF	0.15	**375**	**$ 25,875**	$ 12	**$ 30,000**		**$ 55,875**
		EQUIPMENT SUPPORT STRUCTURAL STEEL		35	TN	30	**1,050**	**$ 71,400**	$ 3,200	**$ 112,000**		**$ 183,400**
		BUILDING MODIFICATIONS		1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
		BUILDING ARCHITECTURAL *Allowance*		1,200	SF	1	**1,200**	**$ 81,600**	$ 75	**$ 90,000**		**$ 171,600**
		BUILDING HVAC		4,000	SF	0.05	**200**	**$ 13,600**	$ 8	**$ 32,000**		**$ 45,600**
		BUILDING FIRE PROTECTION		4,000	SF	0.02	**80**	**$ 5,440**	$ 5	**$ 20,000**		**$ 25,440**
		BUILDING ELECTRICAL *lghting/Convenience Electrical*		4,000	SF	0.05	**200**	**$ 13,600**	$ 6	**$ 24,000**		**$ 37,600**
		CRANE		1	EA	400	**400**	**$ 27,200**	$ 50,000	**$ 50,000**		**$ 77,200**
		THICKENER PLATEWORK		135	T	22	**2,970**	**$ 201,960**	$ 2,800	**$ 378,000**		**$ 579,960**
		THICKENER CLADDING		700	SF	0.08	**56**	**$ 3,808**	$ 4	**$ 2,800**		**$ 6,608**
	NEW	NEUTRALIZATION SURGE TANK	8m dia x 8.5m	1	EA	1,000	**1,000**	**$ 68,000**	$ 150,000	**$ 150,000**		**$ 218,000**
	NEW	NEUTRALIZATION SURGE TANK AGITATOR		1	EA	60	**60**	**$ 4,080**	$ 20,000	**$ 20,000**		**$ 24,080**
	NEW	NEUTRALIZATION FEED PUMP		1	EA	40	**40**	**$ 2,720**	$ 15,000	**$ 15,000**		**$ 17,720**
	NEW	NEUTRALIZATION TANKS	6.5m dia x 7m	3	EA	900	**2,700**	**$ 183,600**	$ 135,000	**$ 405,000**		**$ 588,600**
	NEW	NEUTRALIZATION TANK AGITATORS		3	EA	40	**120**	**$ 8,160**	$ 12,000	**$ 36,000**		**$ 44,160**
	NEW	THICKENER FEED PUMPBOX		1	EA	100	**100**	**$ 6,800**	$ 15,000	**$ 15,000**		**$ 21,800**
	NEW	THICKENER FEED PUMP		2	EA	50	**100**	**$ 6,800**	$ 30,000	**$ 60,000**		**$ 66,800**
	NEW	NEUTRALIZATION THICKENER *Bdget Qote*	33.6m dia	1	EA	4,000	**4,000**	**$ 272,000**	$ 990,000	**$ 990,000**		**$ 1,262,000**
	NEW	NEUTRALIZATION THICKENER O/F PUMP	0.7872	2	EA	40	**80**	**$ 5,440**	$ 30,000	**$ 60,000**		**$ 65,440**
	NEW	NEUTRALIZATION THICKENER U/F PUMP		2	EA	40	**80**	**$ 5,440**	$ 8,000	**$ 16,000**		**$ 21,440**
	NEW	FILTER FEED TANK	2.5m dia x 3m	1	EA	80	**80**	**$ 5,440**	$ 24,000	**$ 24,000**		**$ 29,440**
	NEW	FILTER FEED TANK AGITATOR		1	EA	40	**40**	**$ 2,720**	$ 6,000	**$ 6,000**		**$ 8,720**
	NEW	FILTER FEED PUMP		1	EA	40	**40**	**$ 2,720**	$ 28,000	**$ 28,000**		**$ 30,720**
	NEW	GYPSUM FILTER	2050mm x 30 chamber	1	EA	180	**180**	**$ 12,240**	$ 1,690,000	**$ 1,690,000**		**$ 1,702,240**
	NEW	GYPSUM STOCKPILE CONVEYOR		1	EA	100	**100**	**$ 6,800**	$ 50,000	**$ 50,000**		**$ 56,800**
	NEW	SUMP PUMPS		1	EA	60	**60**	**$ 4,080**	$ 8,000	**$ 8,000**		**$ 12,080**
		NEUTRALIZATION PIPING		1	LS	7,146	**7,146**	**$ 485,928**	$ 714,600	**$ 714,600**		**$ 1,200,528**
		NEUTRALIZATION ELECTRICAL/LIGHTING		1	LS	5,360	**5,360**	**$ 364,446**	$ 535,950	**$ 535,950**		**$ 900,396**
		NEUTRALIZATION INSTRUMENTATION		1	LS	3,423	**3,423**	**$ 232,764**	$ 342,300	**$ 342,300**		**$ 575,064**
510		**SUB TOTAL NEUTRALIZATION**					**38,661**	**$ 2,633,222**		**$ 6,220,210**	**$ 13,381**	**$ 8,866,813**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

SOLVENT EXTRACTION AND STRIPPING

April-04
Rev. C

Area 520		Item Description SOLVENT EXTRACTION AND STRIPPING	Qty	Unit	Unit Mhrs	Total Mhrs	MH Rate	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		DEMOLITION	3,733	YD	1	**3,733**	$ 68	**$ 253,867**	$ -	**$ -**	**$ 29,867**	**$ 283,733**
		BACKFILL	1,867	CY	0	**149**	$ 68	**$ 10,155**	$ 5	**$ 9,333**	**$ 900**	**$ 20,388**
		BUILDING MODIFICATIONS	1	LS	1,000	**1,000**	$ 68	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
		CONCRETE AND STEEL PROTECTION *Allowance*	50,400	SF	0.01	**504**	$ 69	**$ 34,776**	$ 1	**$ 35,280**		**$ 70,056**
		ARCHITECTURAL *Allowance*	1	LS	2,000	**2,000**	$ 68	**$ 136,000**	$ 200,000	**$ 200,000**		**$ 336,000**
		BUILDING HVAC	50,400	SF	0.10	**5,040**	$ 68	**$ 342,720**	$ 16	**$ 806,400**		**$ 1,149,120**
		BUILDING FIRE PROTECTION	50,400	SF	0.02	**1,008**	$ 68	**$ 68,544**	$ 10	**$ 504,000**		**$ 572,544**
		BUILDING ELECTRICAL *lighting/convenience electrical*	50,400	SF	0.05	**2,520**	$ 68	**$ 171,360**	$ 6	**$ 302,400**		**$ 473,760**
	NEW	CRANE	2	EA	400	**800**	$ 68	**$ 54,400**	$ 50,000	**$ 100,000**		**$ 154,400**
	NEW	**SOLVENT EXTRACTION PACKAGE INCLUDING:**	1	EA	18,488	**18,488**	$ 68	**$ 1,257,197**	$ 1,953,773	**$ 1,953,773**		**$ 3,210,970**
		Adjusted to 70% of AMEC Study										
	NEW	SX FEED TANK	1	EA								
	NEW	SX FEED PUMP	2	EA								
	NEW	SX FEED FILTER WATER PUMP	1	EA								
	NEW	Cu SX FEED FILTERS	1	EA								
	NEW	SX BLOWER	1	EA								
	NEW	MIXER TANKS	5	EA								
	NEW	MIXER TANK AGITATORS	10	EA								
	NEW	LOADED ORGANIC ADVANCE PUMP	1	EA								
	NEW	RICH ELECTROLYTE PUMP	1	EA								
	NEW	ORGANIC BLEED PUMP	1	EA								
	NEW	RAFFINAATE TANK	1	EA								
	NEW	RAFINATE FEED PUMP	1	EA								
	NEW	EXTRACTANT ISOTAINER PACKAGE	1	EA								
	NEW	GUNK REMOVAL FRAME	1	EA								
	NEW	GUNK REMOVAL PUMP	1	EA								
	NEW	GUNK TANK	1	EA								
	NEW	GUNK TANK AGITATOR	1	EA								
	NEW	GUNK TANK PUMP	1	EA								
	NEW	RECOVERED SOLUTION TANK	1	EA								
	NEW	CLAY FILTER PRESS FEED PUMP	1	EA								
	NEW	CLAY TREATMENT FILTER PRESS	1	EA								
	NEW	RECOVERED SOLUTION PUMP	1	EA								
	NEW	LOADED ORGANIC TANK AND PUMPS	1	EA								
	NEW	AQUEOUS REMOVAL PUMP	1	EA								
	NEW	DILUENT STORAGE TANK	1	EA								
	NEW	DILUENT TRANSFER PUMP	1	EA								
	NEW	ELECTROLYTE COLUMN CELL	1	EA								
	NEW	FILTER FEED TANK AND PUMP	1	EA								
	NEW	FILTER BACKWASH PUMP	1	EA								
	NEW	ELECTROLYTE FILTERS	2	EA								
	NEW	ELECTROLYTE FILTER BLOWER	1	EA								
	NEW	ELECTROLYTE HEAT EXCHANGER	2	EA								
	NEW	ELECTROLYTE RECIRCULATION TANK	1	EA								
	NEW	LEAN ELECTROLYTE PUMP	1	EA								
	NEW	ELECTROWINNING FEED PUMPS	2	EA								
520		**SUB TOTAL SOLVENT EXTRACTION**				**35,243**		**$ 2,397,018**		**$ 4,011,187**	**$ 30,767**	**$ 6,438,971**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

SOLVENT EXTRACTION AND STRIPPING

March-04
Rev. B

Area 520		Item Description SOLVENT EXTRACTION AND STRIPPING	Qty	Unit	Unit Mhrs	Total Mhrs	MH Rate	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	NEW	ELECTROLYTE HEAT EXCHANGER	2	EA								
	NEW	ELECTROLYTE RECIRCULATION TANK	1	EA								
	NEW	LEAN ELECTROLYTE PUMP	1	EA								
	NEW	ELECTROWINNING FEED PUMPS	2	EA								
	NEW	HEAT EXCHANGERS	2	EA								
520		**SUB TOTAL SOLVENT EXTRACTION**				**35,243**		**$ 2,397,018**		**$ 4,011,187**	**$ 30,767**	**$ 6,438,071**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

ELECTROWINNING

April-04
Rev. C

Area 530		Item Description ELECTROWINNING	Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		DEMOLITION	2,963	YD	1	**2,963**	**$ 201,481**	$ -	**$ -**	**$ 17,778**	**$ 219,259**
		BACKFILL	1,481	CY	0	**119**	**$ 8,059**	$ 5	**$ 7,407**	**$ 900**	**$ 16,367**
		CONCRETE AND STEEL PROTECTION	29,872	SF	0.01	**299**	**$ 20,612**	$ 1	**$ 20,910**		**$ 41,522**
		BUILDING MODIFICATIONS	1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
		ARCHITECTURAL	2,000	SF	1	**2,000**	**$ 138,000**	$ 150	**$ 300,000**		**$ 438,000**
	NEW	ELECTROWINNING PACKAGE *Adjusted to 70% of AMEC study*	1		49,474	**49,474**	**$ 3,364,256**	$ 14,502,159	**$ 14,502,159**		**$ 17,866,415**
	NEW	WASH WATER HEAT EXCHANGER	1								
	NEW	LOADING CONVEYOR	1								
	NEW	DEMISTER	1								
	NEW	DEMISTER EVACUATION FAN	1								
	NEW	DEMISTER WASH CHAMBER	1								
	NEW	DEMISTER RECIRCULATION PUMPS	1								
	NEW	FLEXING STATION	1								
	NEW	STRIPPING STATION	1								
	NEW	BUFFING STATION	1								
	NEW	CORRUGATING PRESS	1								
	NEW	DISCHARGE CONVEYOR	1								
	NEW	WEIGH SCALE	1								
	NEW	STAND ALONE BUFFING UNIT	1								
	NEW	REJECT MOTHERBLANK RACK	1								
	NEW	EDGE STRIP INSTALLATION AND REPAIR STATION	1								
	NEW	ANODE STORAGE RACKS	1								
	NEW	CATHODE STORAGE RACKS	1								
	NEW	ELECTROWINNING CELLS	1								
	NEW	TANKHOUSE CRANES	1								
	NEW	CATHODE MOTHER BLANKS	1								
530		**SUB TOTAL ELECTROWINNING**				**55,855**	**$ 3,800,408**		**$ 14,930,476**	**$ 18,678**	**$ 18,749,562**

PENGUIN**ASI**
NorthMet Project
Hoyt Lakes, Minnesota

Fe & HYDROXIDE PRECIPITATION

April-04
Rev. C

Area 540		Item Description Fe & HYDROXIDE PRECIPITATION	Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
		SITE PREPARATION	1	LS	500	**500**	**$ 34,000**	$ 5,000	**$ 5,000**	**3,000**	**$ 42,000**
		DEMOLITION	1,185	YD	1	**1,185**	**$ 80,593**	$ -	**$ -**	**$ 9,481**	**$ 90,074**
		BACKFILL	1,200	CY	0.08	**96**	**$ 6,528**	$ 5	**$ 6,000**	**$ 900**	**$ 13,428**
		CONCRETE EQUIP FOUNDATIONS AND PIERS	120	YD	6	**720**	**$ 48,960**	$ 300	**$ 36,000**		**$ 84,960**
		TANK FARM CONCRETE	180	YD	7	**1,260**	**$ 86,940**	$ 301	**$ 54,180**		**$ 141,120**
		PLATFORMS	1,000	SF	0.15	**150**	**$ 10,350**	$ 12	**$ 12,000**		**$ 22,350**
		EQUIPMENT SUPPORT STRUCTURAL STEEL	20	TN	30	**600**	**$ 40,800**	$ 3,200	**$ 64,000**		**$ 104,800**
		BUILDING MODIFICATIONS	1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
		BUILDING ARCHITECTURAL *Allowance*	1,200	SF	1	**1,200**	**$ 81,600**	$ 75	**$ 90,000**		**$ 171,600**
		BUILDING HVAC	4,000	SF	0.05	**200**	**$ 13,600**	$ 8	**$ 32,000**		**$ 45,600**
		BUILDING FIRE PROTECTION	4,000	SF	0.02	**80**	**$ 5,440**	$ 5	**$ 20,000**		**$ 25,440**
		BUILDING ELECTRICAL *Lighting/Convenience Electrical*	4,000	SF	0.05	**200**	**$ 13,600**	$ 6	**$ 24,000**		**$ 37,600**
		CRANE	1	EA	400	**400**	**$ 27,200**	$ 50,000	**$ 50,000**		**$ 77,200**
	NEW	Fe THICKENER	1	EA	1200	**1200**	**$ 81,600**	335000	**$ 335,000**		**$ 416,600**
	NEW	Fe THICKENER U/F PUMP	2	EA	30	**60**	**$ 4,080**	8000	**$ 16,000**		**$ 20,080**
	NEW	Fe FILTER FEED TANK	13,900	LBS	0.03	**417**	**$ 28,356**	$ 2	**$ 27,800**		**$ 56,156**
	NEW	Fe FILTER FEED TANK AGITATOR	1	EA	40	**40**	**$ 2,720**	$ 6,000	**$ 6,000**		**$ 8,720**
	NEW	Fe FILTER FEED PUMP	3	EA	40	**120**	**$ 8,160**	$ 3,000	**$ 9,000**		**$ 17,160**
	NEW	Fe FILTER	1	EA	120	**120**	**$ 8,160**	$ 850,000	**$ 850,000**		**$ 858,160**
	NEW	Fe FILTER FILTRATE TANK	12,800	LBS	0.03	**384**	**$ 26,112**	$ 2	**$ 25,600**		**$ 51,712**
	NEW	Fe FILTRATION PUMP	2	EA	30	**60**	**$ 4,080**	$ 5,000	**$ 10,000**		**$ 14,080**
	NEW	Fe FILTER REPULP TANK	7,010	LBS	0.03	**210.3**	**$ 14,300**	$ 2	**$ 14,020**		**$ 28,320**
	NEW	Fe FILTER REPULP TANK AGITATOR	1	EA	40	**40**	**$ 2,720**	$ 7,000	**$ 7,000**		**$ 9,720**
	NEW	Fe SLUDGE TAILINGS PUMP	2	EA	30	**60**	**$ 4,080**	$ 5,000	**$ 10,000**		**$ 14,080**
	NEW	1st STAGE HYDROXIDE PRECIPITATION TANK	38,300	LBS	0.03	**1149**	**$ 78,132**	$ 2	**$ 76,600**		**$ 154,732**
	NEW	1st STAGE HYDROXIDE PRECIP TANK AGITATOR	2	EA	80	**160**	**$ 10,880**	$ 19,000	**$ 38,000**		**$ 48,880**
	NEW	HYDROXIDE THICKENER	1	EA	900	**900**	**$ 61,200**	$ 90,000	**$ 90,000**		**$ 151,200**
	NEW	HYDROXIDE O/F PUMP	2	EA	40	**80**	**$ 5,440**	$ 14,000	**$ 28,000**		**$ 33,440**
	NEW	2nd STAGE HYDROXIDE PRECIPITATION TANK	38,300	LBS	0.03	**1149**	**$ 78,132**	$ 2	**$ 76,600**		**$ 154,732**
	NEW	2nd STAGE HYDROXIDE PRECIP TANK AGITATOR	1	EA	80	**80**	**$ 5,440**	$ 19,000	**$ 19,000**		**$ 24,440**
	NEW	TAILINGS THICKENER	1	EA	900	**900**	**$ 61,200**	$ 90,000	**$ 90,000**		**$ 151,200**
	NEW	TAILINGS THICKENER U/F PUMP	2	EA	30	**60**	**$ 4,080**	$ 8,000	**$ 16,000**		**$ 20,080**
	NEW	HYDROXIDE PRECIPITATION U/F PUMP	2	EA	30	**60**	**$ 4,080**	$ 8,000	**$ 16,000**		**$ 20,080**
	NEW	FILTER FEED TANK	13,900	LBS	0.03	**417**	**$ 28,356**	$ 2	**$ 27,800**		**$ 56,156**
	NEW	FILTER FEED TANK AGITATOR	1	EA	40	**40**	**$ 2,720**	$ 8,000	**$ 8,000**		**$ 10,720**
	NEW	FILTER FEED PUMP	3	EA	40	**120**	**$ 8,160**	$ 3,000	**$ 9,000**		**$ 17,160**
	NEW	HYDROXIDE FILTER	1	EA	80	**80**	**$ 5,440**	$ 50,000	**$ 50,000**		**$ 55,440**
	NEW	FILTRATE TANK	1	EA	120	**120**	**$ 8,160**	$ 12,000	**$ 12,000**		**$ 20,160**
	NEW	FILTRATION PUMP	2	EA	40	**80**	**$ 5,440**	$ 15,000	**$ 30,000**		**$ 35,440**
	NEW	HYDROXIDE FILTER TOTE BIN	1	EA	10	**10**	**$ 680**	$ 1,500	**$ 1,500**		**$ 2,180**
	NEW	TRAY DRYER	1	EA	10	**10**	**$ 680**	$ 2,500	**$ 2,500**		**$ 3,180**
	NEW	Fe PRECIPITATE TANKS	132,000	LBS	0.03	**3960**	**$ 269,280**	$ 2	**$ 264,000**		**$ 533,280**
	NEW	Fe PRECIPITATE TANKS AGITATORS	6	EA	75	**450**	**$ 30,600**	$ 19,000	**$ 114,000**		**$ 144,600**
	NEW	Fe THICKENER FEED PUMPBOX	1	EA	40	**40**	**$ 2,720**	$ 8,000	**$ 8,000**		**$ 10,720**
	NEW	Fe THICKENER FEED PUMP	2	EA	40	**80**	**$ 5,440**	$ 15,000	**$ 30,000**		**$ 35,440**
	NEW	Fe PRECIPITATION BLOWER	1	EA	80	**80**	**$ 5,440**	$ 25,000	**$ 25,000**		**$ 30,440**

PENGUIN**ASI** **INFRASTRUCTURE** **April-04**

NorthMet Project **Rev. C**

Hoyt Lakes, Minnesota

Area 600		Item Description INFRASTRUCTURE	Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	COMMUNICATIONS *Allowance for site telecom to new facilities*		1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
	WATER SUPPLY AND DISTRIBUTION *Additional requirements for new facilities*		1	LS	1,926	**1,926**	**$ 131,002**	$ 192,649	**$ 192,649**		**$ 323,651**
	ELECTRICAL *New distribution to new facilities from existing substation*		1	LS	10,070	**10,070**	**$ 684,760**	$ 3,292,771	**$ 3,292,771**		**$ 3,977,530**
	FUEL STORAGE *Refurbishment and relocation of existing*		1	LS	100	**100**	**$ 6,800**	$ 3,750	**$ 3,750**		**$ 10,550**
	REAGENTS *New reagents for new facilities*										
		REAGENT MECHANICAL	1	LS	12,512	**12,512**	**$ 850,841**	$ 1,251,237	**$ 1,251,237**		**$ 2,102,079**
		REAGENT PIPING	1	LS	3,754	**3,754**	**$ 255,252**	$ 375,371	**$ 375,371**		**$ 630,624**
		REAGENT ELECTRICAL	1	LS	3,128	**3,128**	**$ 212,710**	$ 312,809	**$ 312,809**		**$ 525,520**
		REAGENT INSTRUMENTATION	1	LS	2,502	**2,502**	**$ 170,168**	$ 250,247	**$ 250,247**		**$ 420,416**
		MgO PACKAGE *Allowance*	1	LS	3,000	**3,000**	**$ 210,000**	$ 300,000	**$ 300,000**		**$ 510,000**
		RELOCATE BENTONITE STORAGE SILO *Including Concrete*	1	LS	2,000	**2,000**	**$ 142,000**	$ 180,000	**$ 180,000**		**$ 322,000**
	COMPRESSED AIR										
	EXISTING	RELOCATE EXISTING COMPRESSORS (Purchase FM Cliffs)	2	EA	400	**800**	**$ 55,200**	$ 100,000	**$ 200,000**		**$ 255,200**
		DEMOLITION	474	YD	1	**474**	**$ 32,237**	$ -	**$ -**	**$ 3,793**	**$ 36,030**
		BACKFILL	274	CY	0.08	**22**	**$ 1,491**	$ 5	**$ 1,370**	**$ 900**	**$ 3,761**
		CONCRETE EQUIP FOUNDATIONS AND PIERS	200	YD	6	**1,200**	**$ 81,600**	$ 300	**$ 60,000**		**$ 141,600**
		COMPRESSOR PIPING	1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
		COMPRESSOR ELECTRICAL	1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
		COMPRESSOR INSTRUMENTATION	1	LS	1,000	**1,000**	**$ 68,000**	$ 100,000	**$ 100,000**		**$ 168,000**
	LABORATORY										
	EXISTING	LABORATORY *Repairs/painting to existing facilities*	4,000	SF	0.08	**300**	**$ 20,400**	$ 6	**$ 22,000**		**$ 42,400**
	NEW	LABORATORY EQUIPMENT *Allowance for new equipment*	1	LS	125	**125**	**$ 8,500**	$ 500,000	**$ 500,000**		**$ 508,500**
	SEWAGE TREATMENT PLANT										
	NEW	SEWAGE TREATMENT PLANT	1	LS	0	**-**	**$ -**	$ -	**$ -**	**$ 500,000**	**$ 500,000**
	PLANT MOBILE EQUIPMENT INCLUDING:										
	NEW	INTEGRATED TOOL CARRIER	1	EA	40	**40**	**$ 2,720**	$ 200,000	**$ 200,000**		**$ 202,720**
	NEW	FORKLIFT	2	EA	20	**40**	**$ 2,720**	$ 50,000	**$ 100,000**		**$ 102,720**
	NEW	PICKUP TRUCKS	16	EA	10	**160**	**$ 10,880**	$ 30,000	**$ 480,000**		**$ 490,880**
	NEW	EMERGENCY VEHICLE	1	EA	40	**40**	**$ 2,720**	$ 50,000	**$ 50,000**		**$ 52,720**
	NEW	UTILITY TRUCK	1	EA	30	**30**	**$ 2,040**	$ 90,000	**$ 90,000**		**$ 92,040**
	NEW	FUEL TRUCK	1	EA	30	**30**	**$ 2,070**	$ 100,000	**$ 100,000**		**$ 102,070**
	NEW	FRONT END LOADER	1	EA	40	**40**	**$ 2,720**	$ 200,000	**$ 200,000**		**$ 202,720**
	NEW	BOBCAT	2	EA	10	**20**	**$ 1,360**	$ 20,000	**$ 40,000**		**$ 41,360**
	NEW	PALLET MOVER	1	EA	10	**10**	**$ 680**	$ 10,000	**$ 10,000**		**$ 10,680**
	NEW	35 T ALL TERRAIN CRANE	1	EA	80	**80**	**$ 5,440**	$ 300,000	**$ 300,000**	**$ 1,500**	**$ 306,940**
100		**SUB TOTAL INFRASTRUCTURE**				**46,404**	**$ 3,168,312**		**$ 8,912,206**	**$ 506,193**	**$ 12,586,710**

PENGUINASI
NorthMet Project
Hoyt Lakes, Minnesota

TAILINGS & RECLAIM

April-04
Rev. C

Area 700	Item Description TAILINGS & RECLAIM			Qty	Unit	Unit Mhrs	Total Mhrs	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	EXISTING	TAILINGS PUMPHOUSE & USED LINE	3000 M3/HR	3,000	FT	0.32	960	$ 65,280	$ 30	$ 90,000		$ 155,280
	EXISTING	FLOTATION RECLAIM BARGE REFURBISH		1	EA	180	180	$ 12,240	$ 70,000	$ 70,000		$ 82,240
	EXISTING	FLOTATION RECLAIM LINE REFURBISH		5,000	FT	0.02	120	$ 8,160	$ 6	$ 27,500		$ 35,660
	EXISTING	FLOTATION TAILINGS POND - EXISTING		0								
	NEW	Fe SLUDGE TAILINGS LINE	6 M3/HR	5,000	FT	0.05	250	$ 17,000	$ 3	$ 15,000		$ 32,000
	NOT REQUIRED	Fe SLUDGE TAILS RECLAIM WATER BARGE										
	NOT REQUIRED	Fe SLUDGE TAILINGS RECLAIM WATER LINE										
	NEW	Fe SLUDGE TAILINGS POND		23,908	SY						$ 239,076	$ 239,076
				(150' x 150')								
	NEW	LEACH RESIDUE TAILINGS LINE	34 M3/HR	4,500	FT	0.1	450	$ 30,600	$ 9	$ 40,500	$ 50,000	$ 121,100
	NOT REQUIRED	LEACH RESIDUE TAILINGS RECLAIM BARGE										
	NOT REQUIRED	LEACH RESIDUE TAILINGS RECLAIM LINE										
	NEW	LEACH RESIDUE TAILINGS POND		119,538	SY						$ 1,195,378	$ 1,195,378
				(350' x 350')								
	NEW	HYDROXIDE TAILINGS LINE	74 M3/HR	4,000	FT	0.15	600	$ 40,800	$ 18	$ 72,000	$ 44,444	$ 157,244
	NOT REQUIRED	HYDROXIDE TAILINGS RECLAIM BARGE										
	NOT REQUIRED	HYDROXIDE TAILINGS RECLAIM LINE										
	NEW	HYDROXIDE TAILINGS POND		239,076	SY						$ 2,390,756	$ 2,390,756
				(500' x 500')								
	EXISTING	DREDGE OUT EMERGENCY DUMP POND		1	LS	0	-	$ -	$ -	$ -	$ 57,870	$ 57,870
	EXISTING	REFURBISH DUMP POND BARGE		1	EA	180	180	$ 12,240	$ 70,000	$ 70,000		$ 82,240
700		**SUB TOTAL TAILINGS & RECLAIM**					2,740	$ 186,320		$ 385,000	$ 3,977,524	$ 4,548,844

PENGUIN**ASI** **MINING** **April-04**
NorthMet Project **Rev. C**
Hoyt Lakes, Minnesota

Area 700	Item Description MINING	Qty	Unit	Unit Mhrs	Total Mhrs	MH Rate	Labor	Unit Matl	Material	Subcontract Specl Costs	Total Costs
	MINING	1	LS	-	**5,375**		**$ 384,730**		**$ 299,000**		**$ 683,730**
	RAILSPUR	2	MI	-	**-**	0	**$ -**	$ -	**$ -**	**$ 2,266,667**	**$ 2,266,667**
	SUPERPOCKET	1	LS	-	**-**	0	**$ -**	$ -	**$ -**	**$ 2,641,572**	**$ 2,641,572**
	MINE BUILDINGS										
	EXISTING MINE SHOP *Repairs/painting to existing facilities*	19,000	SF	0.04	**760**	68	**$ 51,680**	$ 3	**$ 62,700**		**$ 114,380**
	NEW MINE SHOP FURNITURE *Allowance for new furniture/computers*	1	LS	50	**50**	68	**$ 3,400**	$ 50,000	**$ 50,000**		**$ 53,400**
700	**SUB TOTAL MINING**				**6,185**		**$ 439,810**		**$ 411,700**	**$ 4,908,239**	**$ 5,759,749**

Patrick Downey & Associates Ltd.
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CERTIFICATE OF AUTHOR

I, PATRICK G. DOWNEY, P.Eng do hereby certify that:

1. I am not employed by:
PolyMet Mining Corp

2. I graduated with an Honours Degree of Bachelor of Science in Engineering from Queen's University of Belfast, Ireland in 1982.

3. I am registered as a Professional Engineer (No. 18474) by the Association of Professional Engineers and Geoscientists of British Columbia.

4. I have worked as an Engineer for a total of 22 years since my graduation from university.

5. I have read the definition of a "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

6. I am responsible for the preparation of the technical report entitled "Independent Technical Report on the NorthMet Project" dated (the "Technical Report") relating to the NorthMet Project property. I visited the property on December 12 – 13, 2002.

7. I have had prior involvement with the property that is the subject of the Technical Report.

8. I am not aware of any material fact or material change with respect to the subject matter of the Technical Report that is not reflected in the Technical Report, the omission to disclose which makes the Technical Report misleading.

9. I am independent of the issuer applying all of the tests in section 1.5 of the National Instrument 43-101.

10. I have read the National Instrument 43-101 and the Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

11. I consent to the filing of the Technical Report with any stock exchange and other regulatory authority and any publication by them for regulatory purposes, including electronic publication in the public company files on their websites accessible by the public, of the Technical Report.

Dated this 22nd day of July 2004.

Patrick G. Downey, P.Eng

PROFESSIONAL
PROVINCE OF
P. G. DOWNEY
BRITISH COLUMBIA
ENGINEER

P. Eng # 18474