NI 43-101 Technical Report on the Bloom Lake Mine Re-Start Feasibility Study

This report was prepared for Quebec Iron Ore on behalf of Champion Iron Limited.

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Québec Iron Ore Inc.
Bloom Lake Mine

TECHNICAL REPORT 43-101
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Revision Status

Revision	Date	Description	Author		Approver	
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List of Abbreviations

Unit	Meaning
µm	Microns, Micrometer
’	Foot
”	Inch
$	dollar
$/L	Dollar per litre
$/t	Dollar per metric tonne
%	Per cent
°	degree
°C	Degrees Celsius/degrees Centigrade
3D	Three dimensional
A	Ampere
AG	Autogenous Grinding
AIS	Air-Insulated Switchgear
Al_2O_3	Aluminium Oxide
API	American Petroleum Institute
ARD	Acid Rock Drainage
ASL	Above Sea Level
ATV	All-Terrain Vehicles
Avg.	Average
BF	Blast Furnace
BIF	Banded Iron Formation
BOF	Basic Oxygen Furnace
BQ	Drill Core Size (3.65 cm diameter)
BTW	Drill Core Size (4.20 cm diameter)
BWI	Bond Ball Mill Work Index
CAD	Canadian Dollar
CAGR	Compounded Average Growth Rate
CaO	Calcium Oxide
CAPEX	Capital Expenditures
CCR	Central Control Room

Unit	Meaning
CDE	Canadian Development Expenses
CEAA	Canadian Environmental Assessment Act
CEET	Comminution Economic Evaluation Tool
CFR	Cost and Freight
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
cm	centimetre
DGPS	Differential Global Positioning System
dmt	Dry Metric Tonne
DR	Direct Reduction
DRI	Direct Reduced Iron
DSO	Direct Shipping Ore
DT	Davis Tube
DTM	Digital Terrain Model
DTWR	Davis Tube Weight Recovery
DWT	Deadweight tonnage
EAF	Electric Arc Furnace
EGL	Equivalent Grinding Length
EIA	Environmental Impact Assessment
EL	Elevation
EMP	Environmental Management Plan
EPCM	Engineering, Procurement and Average Construction Management
EQA	Environmental Quality Act
ER	Electrical Room
ESIA	Environmental and Social Impact Assessment
FAG	Fully Autogenous Grinding
FBLK	Field-Inserted Blank
FDUP	Field Duplicates
Fe	Iron
FOB	Free on Board
g	Gram
G&A	General and Administration
g/L	Gram per litre
g/t	Gram per Tonne

Unit	Meaning
g/cm^3	Gram per cubic centimetre
GDP	Gross Domestic Product
GESTIM	Public Register of Mining Rights in Quebec
GIS	Gas Insulated Switchgear
GPS	Global Positioning System
H	Head
h	Hour
h/y	Hour per Year
HBI	Hot Briquetted Iron
HDPE	High Density Polyethylene
HF	Hydrofluoric Acid
HLS	Heavy liquid separation
HM	Heavy mineral with specific gravity >2.85 sg
HPGR	High Pressure Grinding Rolls
HPi	high-pressure indices
HQ	Drill Core Size (6.4 cm Diameter)
HVAC	Heating Ventilation and Air Conditioning
I/O	Input / Output
IBA	Impact Benefit Agreement
ICP	Inductively Coupled Plasma
ID	Identification
IDW	Inverse Distance Method
IDW^2	Inverse Distance Squared
IDW^{10}	Inverse Distance to the 10th
IOS	IOS Services Géoscientifiques inc.
IP	Internet Protocol
IRR	Internal Rate of Return
JV	Joint Venture
JVA	Joint Venture Agreement
K_2O	Potassium Oxide
kg	Kilogram
kg/L	Kilogram per Litre
kg/t	Kilogram per Metric Tonne

Unit	Meaning
$kgDS/m^2$	Kilogram Dry Solid per square meter
km	Kilometre
km/h	Kilometre per Hour
kPa	Kilopascal
kt	Kilotonne
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
kWh/t	Kilowatt-hour per Metric Tonne
LAN	Local Area Network
LCR	Local Control Room
LHM	Light heavy minerals in the +2.85 to -4.05 sg range
LiDAR	Light Detection and Ranging
LIMS	Low Intensity Magnetic Separator
LM	Light mineral with specific gravity <2.85 sg
LoI	Letter of Intent
LOI	Loss on Ignition
LoM	Life of Mine
LV	Low Voltage
LTZ	Lithotectonic Zone
m	Metre
m/h	Metre per Hour
m^2	Square Metre
m^3	Cubic Metre
m^3/d	Cubic Metre per Day
m^3/h	Cubic Metre per Hour
m^3/y	Cubic Metre per Year
MagFe	Magnetic Iron
MBIOI	Metal Bulletin Iron Ore Index
MCC	Motor Control Centre
MDDELCC	Ministère du Développement Durable, de l'Environnement et de la Lutte aux Changements Climatiques
mg/l	Milligram per Litre

Unit	Meaning
MgO	Magnesium Oxide
min	minute
min/h	Minute per Hour
mm	Millimetre
Mm^3	Million Cubic Metres
MMER	Metal Mining Effluent Regulation
MN	Manganese
MOU	Memorandum of Understanding
mph	Miles per hour
MRB	MRB and Associates Inc.
MRC	Midland Research Center
MRNF	*Ministère des Ressources Naturelles et de la Faune*
Mt	Million Metric Tonnes
Mt/y	Millions of Metric Tonnes per year
MV	Medium Voltage
MVA	Mega Volt-Ampere
MVAR	Mega Volt-Ampere Reactive
MW	Megawatts
N	North
Na_2O	Sodium Oxide
NI	National Instrument
Nm^3/h	Normal Cubic Metre per Hour
No.	Number
NPV	Net Present Value
NQ	Drill Core Size (4.8 cm diameter)
NTS	National Topographic System
O/For OF	overflow
OPEX	Operating Expenditures
OS or OS	oversize
P	Phosphor
PCS	Programmable Control System
PD	Positive Displacement
PDCS	Power Distribution Control System

Unit	Meaning
PDS	Product Delivery System
PEA	Preliminary Economic Assessment
pH	Potential Hydrogen Protocol
PLC	Programmable Logic Controllers
ppm	Parts per Million
PPP	Purchasing Power Parity
PQ	Drill Core Size (8.5 cm diameter)
QA/QC	Quality Assurance/Quality Control
QC	Province of Quebec
QNS&LR	Quebec North Shore & Labrador Railway
QP	Qualified Person
Release curves	Mass yield versus mineral recovery, separation efficiency or grade for a specified element at a selected operating condition
ROM	Run of Mine
RQD	Rock Quality Index
S	South
S	Sulphur
SAG	Semi-Autogenous Grinding
SCADA	Supervisory Control and Data Acquisition
SE	South East
sec	Second
SEDAR	System for Electronic Document Analysis
SFe_H	Soluble Iron Head
SG or sg	Specific Gravity
SGS or SGS-Lakefield	SGS Lakefield Research Limited of Canada
SIA	Social Impact Assessment
Sighter test	Scoping, small test conducted to evaluate separation performance of a piece of equipment
SFPPN	SFP Pointe-Noire
SiO_2	Silica
SMC	SAG Mill Comminution
SPI	SAG Power Index
SPT	Static Pressure Test
SVC	Static VAR Compensation

Unit	Meaning
t/h	Metric Tonne per Hour
$t/h/m^2$	Metric Tonne per Hour per Square Metre
t/m^3	Metric Tonne per Cubic Metre
t/y	Metric Tonne per Year
TCP/IP	Transmission Control Protocol/Internet
TFe	Total Iron
TiO_2	Titanium Dioxide
TMF	Tailings Management Facility
ton	Short Ton
tonne	Metric Tonne
TSS	Total Suspended Solids
U/F	Underflow
ULC	Underwriters Laboratories of Canada
UPS	Uninterruptible Power Supply
U/S or US	undersize
USD	United States Dollar
UTM	Universal Transverse Mercator
VHM	Very heavy minerals with specific gravity >4.05 sg
W	West
WHIMS	Wet High Intensity Magnetic Separation
WR	Weight Recovery
WRA	Whole Rock Analysis Method
WSP	Water Supply Pond
wt	Weight
Wt % stage	Mass distribution for an individual stage of separation or processing
Wt % head	Mass distribution calculated from the feed to a defined multi-stage circuit
w/w	Ratio or proportion based on two masses
X	X Coordinate (E-W)
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence
y	Year
Y	Y coordinate (N-S)

Unit	Meaning
Z	Z coordinate (depth or elevation)
Zn	Zinc

Technical Report – QP Responsibility Matrix

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1 Executive Summary

1.1 Introduction

In December 2006, an environmental impact assessment of the Bloom Lake mine project was submitted to the agencies. Decree 137-2008 authorizing the project was adopted on February 20, 2008 by the provincial government. Consolidated Thompson Iron Mines Limited began the construction of the mining infrastructures in 2008 and commenced mining operations in 2010 with the phase 1 concentrator plant (referred to as phase 1 plant in the document). As part of an expansion plan to increase the mine production, the design and construction of a second concentrator plant (referred to as phase 2 plant in the document) was initiated to increase nominal capacity to about 15 million tonnes of concentrate per annum.

The mine was sold to Cliffs Natural Resources Inc. (Cliffs) in 2011, which continued the phase 2 construction project and conducted mining operations until they were suspended in December 2014. The site was employing about 600 people.

In January 2015, Cliffs sought creditor protection under Companies' Creditors Arrangement Act (CCAA), resulting in the mine being then put on a care and maintenance program, and placed into creditor protection.

In April of 2016, Champion Iron Limited (Champion), acquired the Bloom Lake assets through its subsidiary Quebec Iron Ore Inc. (QIO) and the Quinto Claims for a cash consideration of C$10.5 million ($9.75 M for Bloom Lake and $0.75 M for Quinto) and the assumption of liabilities. Quebec Iron Ore Inc. is 63.2% owned by Champion Iron Limited, with the remaining 36.8% equity interest owned by Ressources Quebec through its fund "Mines & Hydrocarbons", acting as a mandatory of the Government of Quebec. Under the asset purchase agreement, Quebec Iron Ore Inc. has become responsible for bonds securing obligations of Bloom Lake, totalling approximately C$1.1 million, plus the assumption of reclamation obligations in the amount of about C$41.7 million.

The monitor of the CCAA proceedings, maintained the site idled from December 2014 up to April 2016 when QIO became its owner. During the care and maintenance period, Cliffs improved some of the water management infrastructure, in order to meet legal and environmental obligations.

The mine has already been authorized for operation under the federal environmental authority including Fisheries and Oceans Canada (DFO), Transport Canada, Natural Resources Canada and Environment Canada. The project was subject to an environmental impact assessment and review process under Section 31 of the Provincial Environment Quality Act, which led to the first decree issued by the Quebec government in 2008 authorizing mining activities at the Bloom Lake site.

Operations in 2014 produced about 6 million tonnes on an annualised basis of iron fines at slightly over 66% Fe. QIO has identified the potential to improve production capacity and recovery at Bloom Lake to over 7 million tonnes per year at a similar grade, mainly through the implementation of a new mine plan as well as improved process recovery.

QIO also plans significant cost reductions at the Bloom Lake Mine by bringing the operational FOB costs per tonne down substantially from previous levels.

Given the amount of work that Cliffs has already committed to preparing the site for idling, the extended care and maintenance and planned upgrades to the facilities, the Bloom Lake Mine could become one of the lowest capital cost iron ore mines in the world due to the low acquisition price from CCAA and limited investment requirement for the restart.

The scope of this feasibility study was to identify areas for improvement or correction prior to the planned re-start of the Bloom Lake Mine. Feasibility study level engineering was performed on each of these areas to outline work to be performed. Associated capital and operating cost estimates were generated to allow for the Bloom Lake financial model to be developed.

1.2 Access, Local Resources and Infrastructure

The mine site lies approximately 13 km west of the town of Fermont (central geographical coordinates 52° 50' N and 67° 16' W). A 5-km access road has been constructed to connect the Bloom Lake mine with Highway 389. It is accessible by road from Baie-Comeau on the north shore of the Saint Lawrence River, as well as by road from the Wabush airport in Newfoundland & Labrador. The Wabush airport is located approximately 30 km from the Bloom Lake mine. The mine site is located approximately 950 km northeast of Montreal.

The rail access to port consists of three separate segments. The first segment is the rail spur on site, consisting of a 31.9-km long segment that is operational and connects to the Quebec North Shore and Labrador (QNS&L) railway at the Wabush Mines facilities in Wabush, Labrador. This first segment belongs to QIO. The second segment employs the QNS&L railway from Wabush to Arnaud Junction in Sept-Îles and from there, the third section is from Arnaud junction to Pointe-Noire (Sept-Îles), property of “Les Chemins de Fer Arnaud”, Sept-Îles, Quebec, where the concentrate will be unloaded, stockpiled, and loaded onto vessels. The third segment is owned by the Government of Quebec through the Société du Plan Nord, which acquired these assets from Cliffs’ CCAA.

The town of Fermont has a population of 2874 as per Statistics Canada, and is the residential town for employees working for ArcelorMittal’s Mont-Wright mine operations. The town has all of the necessary infrastructure to support the employees and families who live in this town. As part of the purchase of the Bloom Lake mine, QIO acquired the following accommodations, which are in the town of Fermont:

- 4 houses located on *rue des Mélèzes* (with 5 rooms each and built in 2012)
- 22 houses, fully furnished, located on *rue des Bâtisseurs* (12 with 8 rooms each, 6 with 7 rooms each and 4 with 5 rooms each and built in 2009)
- Two blocks (motels) of 99 rooms of lodging located on *rue du Fer* (built in 2013)

These accommodations are fully equipped with furniture, linen, and wiring for communications and entertainment and can host up to about 700 people on a fly-in-fly-out basis.

The electrical power supply currently installed is supplied by Hydro-Quebec from the Normand sub-station, located 12 km from the mine. The previous owner, Cliffs, was preparing for an expansion of the operations, which would have doubled the production capacity. As part of this preparation, the high voltage power lines were upgraded to be able to handle a further 30 MW. QIO owns a 315 kV station including two 80 MVA transformers. QIO’s current plans for a moderate increase in production capacity and further tailings pumping will use only a small fraction of this surplus electrical power availability (68 MW authorized by Hydro-Quebec).

A spare parts inventory representing a total of CAN $43.6 M, as estimated in October 2014 (before the mining operations shutdown), is currently available for the future operations. Moreover, all equipment including a mining fleet sufficient to support future operations and infrastructure dedicated to future expansion planned by the previous owner is still at the site, and is available for the current project.

1.3 Geology

The Bloom Lake iron deposit lies within the Fermont Iron Ore District (FIOD), a world-renowned iron-mining camp at the southern end of the Labrador Trough within the geological Grenville Province. The high-grade metamorphism of the Grenville Province is responsible for recrystallization of both iron oxides and silica in primary iron formation, producing coarse-grained sugary quartz, magnetite, specular hematite schists (meta-taconites) that are of improved quality for concentrating and processing.

The Bloom Lake deposit comprises gently plunging synforms on a main east-west axis separated by a gently north-to-northwest plunging antiform. In addition to these regional scale folds, there are several other folds of diverse orientation on the property which are the result of a minimum of two episodes of folding. Visible on the ground magnetic survey map and recognizable through gravels and muddy material in drill holes, a major discontinuity oriented north-north-east can be seen in the central portion of the west part.

Iron-formations are predominantly of the magnetite-hematite-quartz facies that form the major domains of mineralization. The hematite is of the specularite type and is non-magnetic. The hematite most often occurs in anastomosing to discontinuous stringers and bands less than 10 cm thick in a quartz or actinolite-quartz rock matrix.

Magnetite-rich iron formations are less important in volume in the western part than in the eastern half of the Bloom Lake deposit. Magnetite typically occurs in narrow millimetric veinlets associated with quartz-carbonate veining material. When associated with hematite-enriched mineralization, the magnetite occurs as blebs of porous grains, often granoblastic, that may extend up to several centimetres.

A fairly abrupt change in facies takes place along the strike east of a line passing northwest across Bloom Lake, east of which the grunerite-Ca-pyroxene-actinolite-magnetite-carbonate facies predominates.

The mineralization style in the Bloom Lake property is typical of the Lake Superior deposit type.

1.4 Mineral Resource Estimate

G Mining Services Inc. (“GMS”) was mandated to produce the mineral resource estimate for the Bloom Lake Project. The mineral resource estimate was prepared in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (“CIM”) Standards for Mineral Resource and Mineral Reserves (2014) as incorporated in National Instrument 43-101 – Standards of Disclosure for Mineral Projects (NI 43-101). The 2016 Bloom Lake Mineral Resource presented herein was prepared under the supervision and approved by Réjean Sirois, P. Eng., from GMS. Mr. Sirois is an independent “Qualified Person” as defined in NI 43-101.

In November 2014, Dassault Systemes, Geovia (“Geovia”) prepared a resource estimate for the Bloom Lake deposit for Cliffs Natural Resources and the results were published internally in the company. GMS reviewed and approved the geology and mineralization model, the geostatistical studies, the variography analysis, the interpolation assumptions and estimation procedure developed by Geovia in 2014.

Geovia® GEMS software was used to facilitate the resource estimation process including geological modelling review, geostatistical and variography analysis, and grade interpolation. The resource model was prepared in November 2016, using all of the drill holes available in the zone of interest as of that date.

Eight geological units were modelled on cross-sections which interpretations were transferred to plan sections through the use of traverses (or horizontal holes). The final geological model, including mineralized and non-mineralized units, was based on wireframes extruded every 14 m bench level. Because of the folded nature of the Bloom Lake deposit, the geological model was divided into multiple structural domains, each of which outlines a single mineralization continuity orientation.

The raw-assays were composited into regular 7.0 m run lengths within each mineralized unit. Grade variography analyses were completed on the 7.0 m composites, grouped by litho-structural domains. Large search ellipsoids and one pass run strategy were used to perform the ordinary kriging grade interpolation inside the block model. The dimensions of the blocks in the block model are (X)10 m by (Y)10 m by (Z)14 m. The interpolation was done strictly within the mineralization wireframes, using various search ellipsoid orientations, according to the structural domains defined in the deposit. The mineral resource estimate was classified into measured, indicated and inferred categories according to the CIM Definition Standards on Mineral Resources and Mineral Reserves.

Table 1-1 presents the Mineral Resource for the Bloom Lake Project as of November 15, 2016, estimated at a cut-off grade of 15% Fe, inside an optimized Whittle open pit shell based on a long-term iron price of USD $60/dmt concentrate. The Measured and Indicated Mineral Resource for the Bloom Lake Project is estimated at 911.6 Mt at an average grade of 29.7% Fe, and Inferred Mineral Resource at 80.4 Mt at an average grade of 25.6% Fe.

Table 1-1 – Mineral Resource Estimate for the Bloom Lake Project

Classification	**Tonnage (dry)**	**Fe**	**CaO**	**Sat**	**MgO**	**Al_2O_3**
	kt	**%**	**%**	**%**	**%**	**%**
Measured	439,700	31.0	0.6	3.0	0.7	0.3
Indicated	471,900	28.5	2.5	6.8	2.3	0.4
Total M&I	911,600	29.7	1.6	5.0	1.5	0.4
Inferred	80,400	25.6	1.9	7.9	1.7	0.3

Notes on Mineral Resources:

1. The mineral resources were estimated using the **Canadian Institute of Mining, Metallurgy and Petroleum** (CIM) Standards for Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10th, 2014.
2. The independent and qualified person for the 2016 Bloom Lake resource estimate, as defined by NI 43-101, is Réjean Sirois, P. Eng., from G Mining. The effective date of the estimate is November 15, 2016.
3. The mineral resources are estimated at a cut-off grade of 15% Fe.
4. The mineral resources are estimated using a long-term iron price of USD $60/dmt con and an exchange rate of 1.30 CAD/USD.
5. The mineral resources are reported within an optimized Whittle open pit shell.
6. The average strip ratio is 0.97:1 (w:o).
7. “Sat” stands for Satmagan or Saturation Magnetization Analyser, an instrument which measures magnetite in ores.
8. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. There is no certainty that all or any part of the Mineral Resource will be converted into Mineral Reserves.
9. The number of metric tons was rounded to the nearest hundred. Any discrepancies in the totals are due to rounding effects; rounding followed the recommendations in NI 43-101.

1.5 Mineral Reserves

The mineral reserve for the Bloom Lake Project is estimated at 411.7 Mt at an average grade of 30.0% Fe as summarized in Table 1-2. The mineral reserve estimate was prepared by G Mining Services Inc. (“GMS”). The resource block model was also generated by GMS.

Table 1-2 – Mineral Reserve Estimate

Classification	Diluted Ore Tonnage (dry)	Fe	CaO	SAT	MgO	Al_2O_3
	kt	%	%	%	%	%
Proven	264,160	30.73	0.48	2.98	0.56	0.32
Probable	147,554	28.71	2.84	6.68	2.72	0.40
Total P&P	**411,713**	**30.01**	**1.33**	**4.30**	**1.33**	**0.35**

Notes:

1. CIM definitions were followed for mineral reserves.
2. Mineral reserves based on September 28, 2016 LIDAR survey
3. Mineral reserves are estimated at a cut-off grade of 15% Fe.
4. Mineral reserves are estimated using a long-term iron price reference price (Platt’s 62%) of $50/dmt and an exchange rate of 1.30 CAD/USD. An Fe concentrate price adjustment of $4.00/dmt was added.
5. Bulk density of ore is variable but averages 3.63 t/m^3.
6. The average strip ratio is 0.48:1.
7. The mining dilution factor is 4.3%.
8. Numbers may not add due to rounding.

The mine design and mineral reserve estimate have been completed to a level appropriate for feasibility studies. The mineral reserve estimate stated herein is consistent with the CIM definitions and is suitable for public reporting. As such, the mineral reserves are based on measured and indicated (“M&I”) mineral resources, and do not include any inferred mineral resources. The inferred resources contained within the mine design are classified as waste. The mineral reserve includes a 4.3% mining dilution at an average grade of 10.34% Fe.

Open pit optimization was conducted to determine the optimal economic shape of the open pit to guide the pit design process. This task was undertaken using Whittle software, which is based on the Lerchs-Grossmann algorithm. The optimization parameters are presented in Table 1-3.

Table 1-3 – Optimization Parameters

Optimization Parameters		**Values**
Ore tonnage	Mtpy	20.00
Mining dilution	%	3%
Mining recovery	%	100%
Royalty	%	0%
Weight recovery	%	34.5%
Fe recovery	%	80.0%
Revenues		
Concentrate production	Mt con.	6.90
Concentrate iron grade	% Fe	66.0%
Concentrate moisture content	%	3.5%
Reference price (Platt's 62%)	US$/dmt con.	50.00
Fe concentrate price adj.	US$/dmt con.	4.00
Concentrate adjusted price CIF China (66%)	US$/dmt con.	54.00
Exchange rate	C$/US$	1.30
Concentrate adjusted price CIF China	C$/dmt con.	70.20
Land Logistics (Mine to Sept-Iles Port)	C$/dmt con.	16.58
Ocean freight (Sept-Iles to China)	C$/dmt con.	16.72
Total concentrate logistics costs	C$/dmt con.	33.30
Concentrate adjusted price FOB Bloom Lake	C$/dmt con.	36.90
Ore-Based Costs		
Processing cost	C$/dmt ore	3.41
Crushing cost	C$/dmt ore	0.56
Tailings and water mgmt. cost	C$/dmt ore	1.03
G&A costs	C$/dmt ore	2.15
Total ore based cost	C$/dmt ore	7.15
Mining Costs & Parameters		
Reference mining cost	C$/dmt mined	2.85
Incremental bench cost	US$/t/14m	0.029
Reference elevation	RL	704

A pit slope design study was carried out by Golder following a request from the previous owner of the project. The conclusions of this study have been used as an input to the pit optimization and design process.

1.6 Mining

The Bloom Lake Project was previously owned by Cliffs Natural Resources and was closed and placed on care in maintenance in January 2015. It was later acquired by QIO in April 2016. The restart of the operation is based on different operating assumptions which consist of an upgrade to the Phase I plant with a mineral reserve and mining scenario updated for the current iron ore market.

The operation consists of a conventional surface mining method using an owner mining approach with electric hydraulic shovels and mine trucks. All major mine equipment required for the restart of the project is present on site as this equipment was among the assets purchased by QIO from Cliffs. The study consists of resizing the open pit based on parameters outlined in this section and producing a life-of-mine (“LOM”) plan to feed a plant at a nominal rate of 20 Mtpa.

Drill and blast specifications are established to effectively single pass drill and blast a 14 m bench. For this bench height, a 311 mm blast holes size is proposed with a 6.25 m burden by 7.25 m spacing with 1.5 m of sub-drill in ore. The blast pattern in waste material varies slightly with the various rock types. These drill parameters, combined with a high energy bulk emulsion with a density of 1.2 kg/m^3, result in a powder factor of 0.40 kg/t. Blast holes are initiated with electronic detonators and primed with 450 g boosters. The bulk emulsion product is a gas-sensitized pumped emulsion blend specifically designed for use in wet blasting applications.

The majority of the loading in the pit will be done by two electric drive hydraulic face shovels equipped with a 23 m^3 bucket. The shovels are matched with a fleet of 218 t payload capacity mine trucks. The project already owns three Caterpillar 6060 electric drive hydraulic front shovels. The hydraulic shovels will be complemented by one production front-end wheel loader (“FEL”) with a 12 m^3 bucket. Two Komatsu WA1200-6 units are available on site.

Haulage will be performed with 218 tonne class mine trucks. The existing truck fleets consist of seven Caterpillar 793D and three Caterpillar 793F mechanical drive trucks, which is sufficient for the project excluding equipment replacement.

Mining of the Bloom Lake Project is planned in four phases with a starter phase and a final pushback in both the east and west pits. Waste rock will be disposed of in two distinct waste dumps. The original northern location used by the previous owner and a new location to the south. From year 5 onwards, in-pit dumping will occur whenever possible, once a phase gets fully depleted. The open pit generates 198.9 Mt of overburden and waste rock for a strip ratio of 0.48:1.

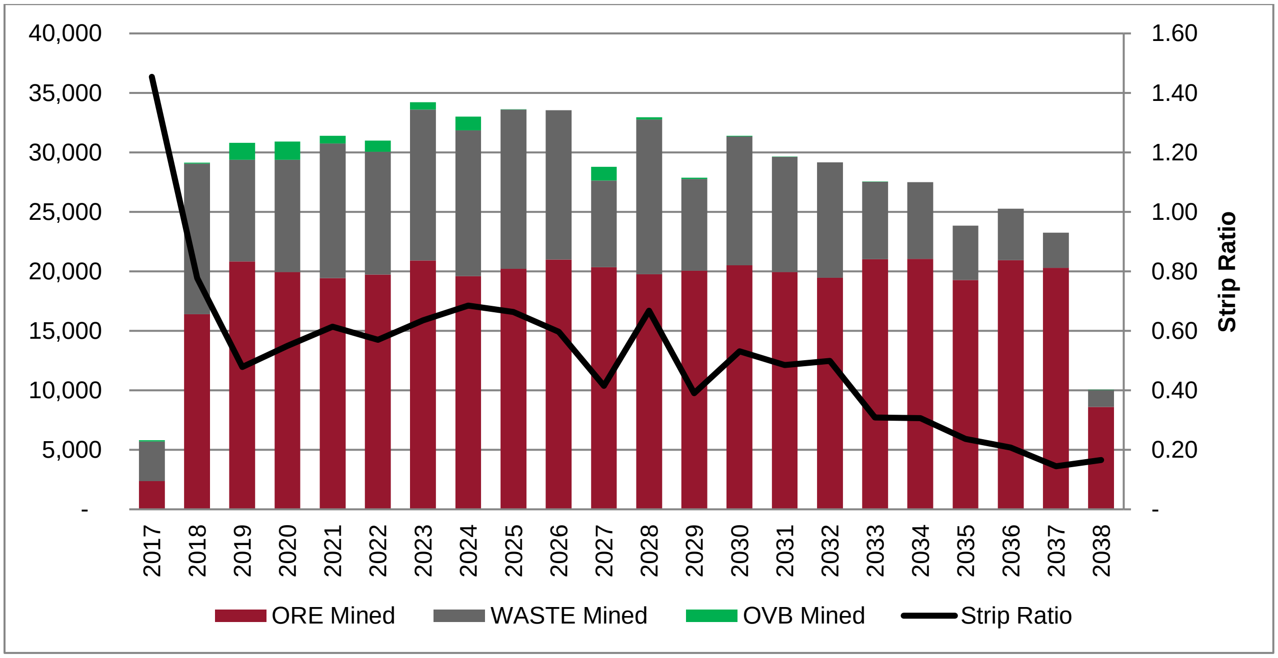


Figure 1-1 – Mine Production

1.7 Mineral Processing and Metallurgical Testing

The proposed Phase 1 upgrade flowsheet was developed to improve the overall iron recovery achieved by the existing Phase 1 concentrator. The specific goal was to improve the recovery of both the coarser (+425 microns) and fine (-106 microns) iron minerals, while having no adverse effect on the recovery of other size fractions.

The Phase 1 upgrade flowsheet development was initially based on historical Phase 1 data, pilot testing data undertaken during the Phase 1 operation, the proposed Phase 2 flowsheet design and Mineral Technologies design data and information on spiral and UCC performance in iron ore applications in the Labrador Trough area.

Mineral Technologies proposed two processing routes for the Phase 1 upgrade flowsheet:

1. A gravity-only primary case comprising rougher spirals, rougher middlings scavenging spirals, an up-current classifier (UCC) and a final UCC overflow scavenging spiral stage.
2. A bonus case serving to boost recovery of iron ore through the treatment of the gravity circuit tailings by a series of wet high intensity magnetic separators (WHIMS).

The proposed flowsheet, including the bonus case, is presented in Figure 1-2.

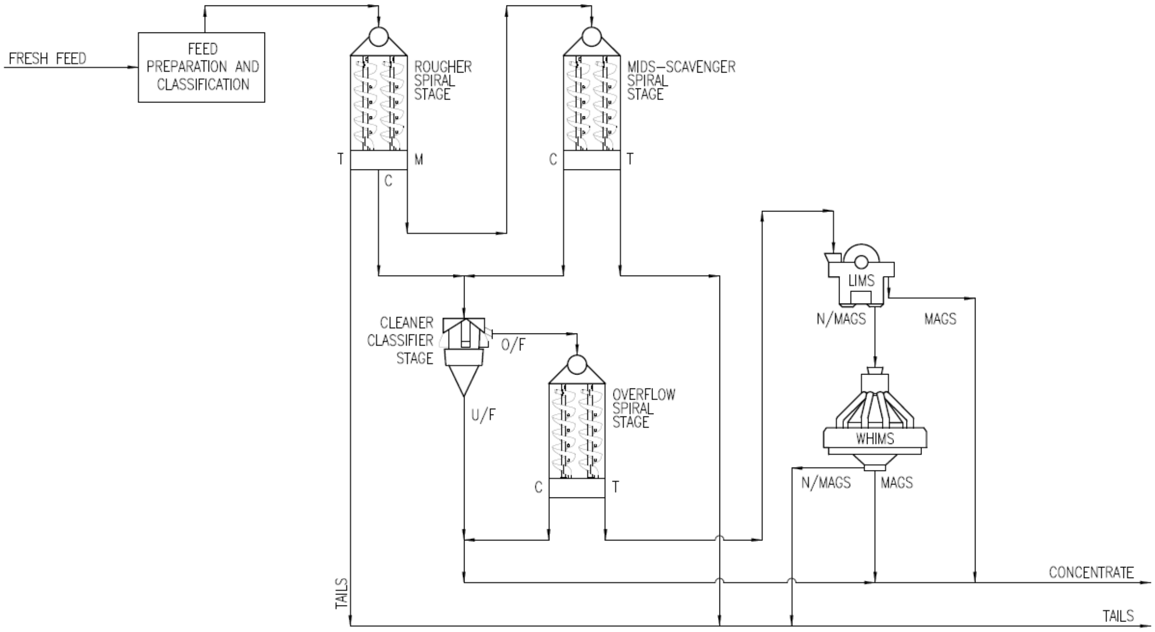


Figure 1-2 – Phase 1 Upgrade Conceptual Flow Diagram

This flowsheet is similar to that developed for the planned Phase 2 concentrator; however, it includes a Mids Scavenger spiral stage. This stage has been included in the flowsheet to enable:

- Improved iron recovery through the production of a lower grade gravity circuit tailings stream than would otherwise be produced by a Rougher spiral stage only

- Maximum utilisation of the Rougher spirals for treating virgin run-of-mine material (compared to recirculating the middlings back to the Rougher spiral feed).
- “Buffer” capacity that serves to recover minerals that would otherwise be lost to tailings in the event of an increase in feed grade to a Rougher spiral stage.

A metallurgical model was developed to estimate the mineral recovery levels in the flowsheet. To verify and confirm the performance estimated by the model, a comprehensive metallurgical testing program has been conducted using six bulk samples taken from the Bloom Lake deposit as well as an additional 500kg composite sample taken from drill core samples on hand at Bloom Lake to represent plant feed for the first 5 years of mine operation. The metallurgical testing of the gravity portion of the upgrade flowsheet comprised the following stages:

- Rougher stage spiral testing was conducted on each bulk sample separately, to produce a bulk Rougher concentrate
- The Rougher stage middlings products were combined and used as feed for the Mids Scavenger spiral stage testing.
- Both the Rougher and Mids Scavenger spiral concentrate products were blended as feed for the UCC testwork. The UCC underflow product represents the main source of gravity concentrate.
    - Fine iron from the UCC overflow was scavenged by retreating this stream over a spiral to simulate the overflow spiral stage. The concentrate from this overflow spiral stage combines with the UCC underflow, to make up the gravity concentrate stream.

Following on from the gravity circuit testwork, the tailings (reject) material from both the Overflow spiral and Mids Scavenger stages were tested separately for amenability to iron scavenging in a Wet High Intensity Magnetic Separator (WHIMS).

The tailings stream from the Overflow spirals was upgraded by rougher and cleaner stage WHIMS to an iron grade sufficient for inclusion as part of the overall plant concentrate production, whereas the iron grade achieved when scavenging the Mids spiral tailings was not sufficient for inclusion in the combined final concentrate.

The bulk sample processing iron recovery to the final product from both gravity and WHIMS stages of metallurgical testwork was 81.0% (refer to Table 1-4).

Table 1-4 – Metallurgical Test Program Concentrate Summary

		XRF assay									**Recovery**		
PRODUCT	**% Mass Head**	**Fe %**	**SiO_2 %**	**Al_2O_3 %**	**P %**	**S %**	**CaO %**	**TiO_2 %**	**Mn %**	**MgO %**	**Fe %**	**SiO_2 %**	**Al_2O_3 %**
UCC Underflow	33.1	67.2	3.19	0.23	0.01	0.01	0.06	0.12	0.08	0.06	69.8	2.0	10.2
O/F Spiral Concentrate	4.76	64.4	5.92	0.51	0.04	0.01	0.32	0.40	0.08	0.28	9.6	0.5	3.3
O/F Spiral Reject WHIMS Concentrate	1.00	48.1	29.3	0.40	0.02	0.01	0.34	0.26	0.09	0.31	1.5	0.6	0.5
Total	38.8	66.4	4.20	0.27	0.01	0.01	0.10	0.16	0.08	0.09	81.0	3.1	14.0

The recovery obtained during the testwork pertains to performance within the limits of stage-by-stage bulk sample processing in a laboratory environment. Plant operation incorporates fully integrated circuitry which allows greater control of the final product grade and plant recovery, hence, a higher level of recovery is expected.

The experimental data collected from the testwork program was used to update the metallurgical model, allowing it to be utilised for optimising and predicting plant circuit performance in terms of concentrate grade, production rate and recovery at various feed grades. Following the update of the metallurgical model, the 500kg drill core sample was processed and subsequently confirmed the results of the model.

The model predicts a theoretical maximum iron recovery from the flowsheet of 85.3% and an expected plant recovery of 83.3% from a continuous plant operation treating ore of similar characteristics to the sample tested at the expected life of mine feed grade of 30% iron.

1.8 Recovery Methods

Quebec Iron Ore (QIO) intends to use the crushing and storage facilities of the Phase II operation along with the mill and the rail load-out facilities from the Phase I operation to produce 7.4 Mtpa of concentrate, with a recovery of 83.3% from the ore mined from the main pit.

The phase I and phase II facilities currently exist; however, prior to the start-up planned for the end of 2017, refurbishments and improvements as described below will be made to improve the iron ore recovery, operational reliability, and fugitive dust control.

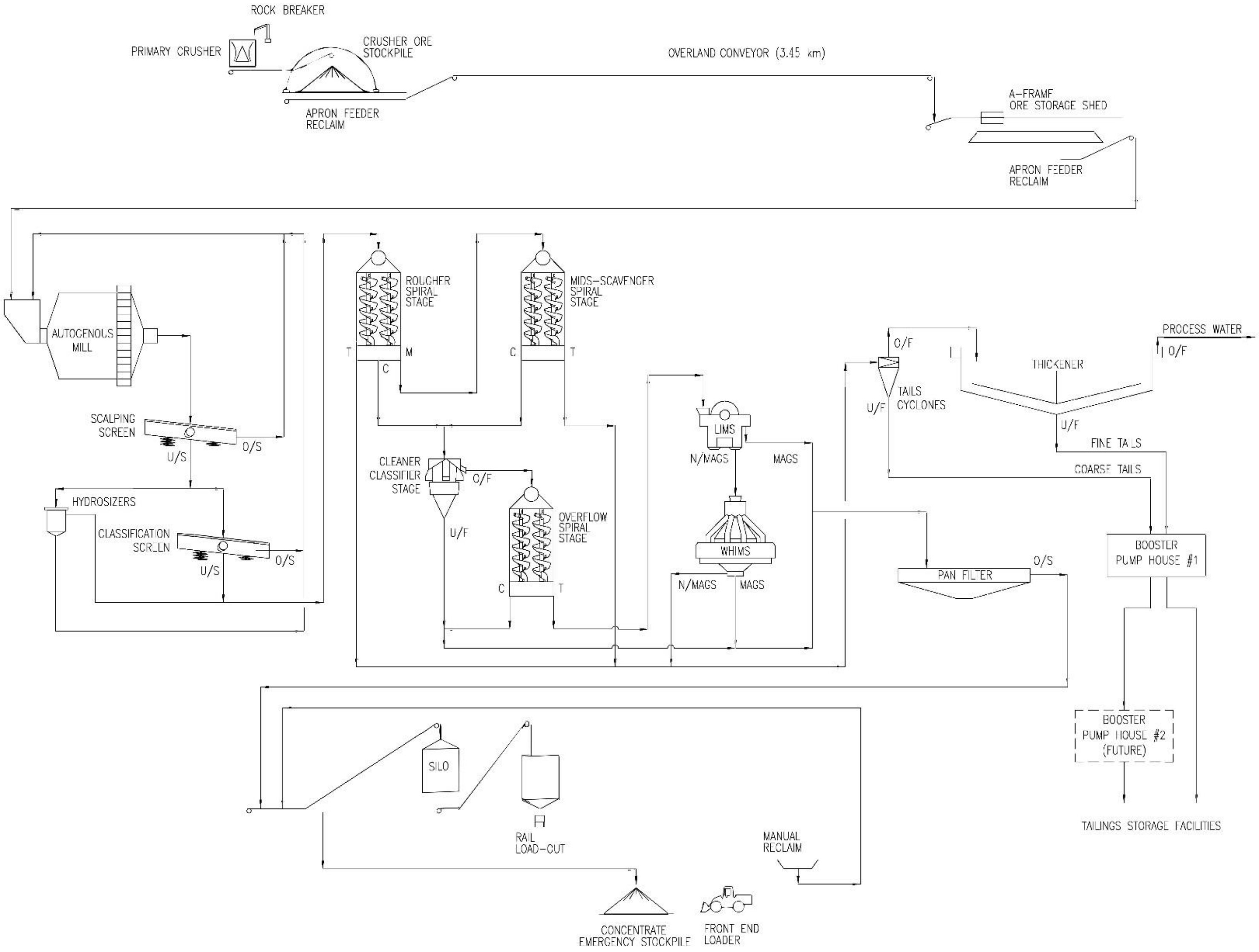
Table 1-5 following is the list of major equipment that will be used for QIO operations and from which operational phase it comes from:

Table 1-5 – List of Major Processing Facilities

Major Processing Facilities	Source Phase
Primary Crusher (near pit)	Phase II
Crushed ore stock pile (local to the crusher)	Phase II
Overland conveyor (3.46 km)	Phase II
A-Frame crushed ore stockpile shed	Phase II
Reclaim apron feeders (within the A-Frame)	Phase I
AG Mill	Phase I
Screens	Phase I
Spirals	Phase II & New
Hydrosizer	New
Magnetic separators	New
Pan filter & thickener	Phase I
Concentrate storage and rail load-out	Phase I

The following Figure **1-3** shows the block flow diagram of the plant process from the primary crusher to the rail load-out.

Figure 1-3 **Block Flow Diagram**



1.8.1 Existing Phase 1 Concentrator Circuit

The existing Phase 1 concentrator circuit is a traditional 3-stage spiral separator circuit with rougher, cleaner and re-cleaner spiral stages. The three stages of spiral separators are arranged vertically, allowing products from one stage to flow to the next via gravity. A basic flowsheet is shown in Figure 1-8.

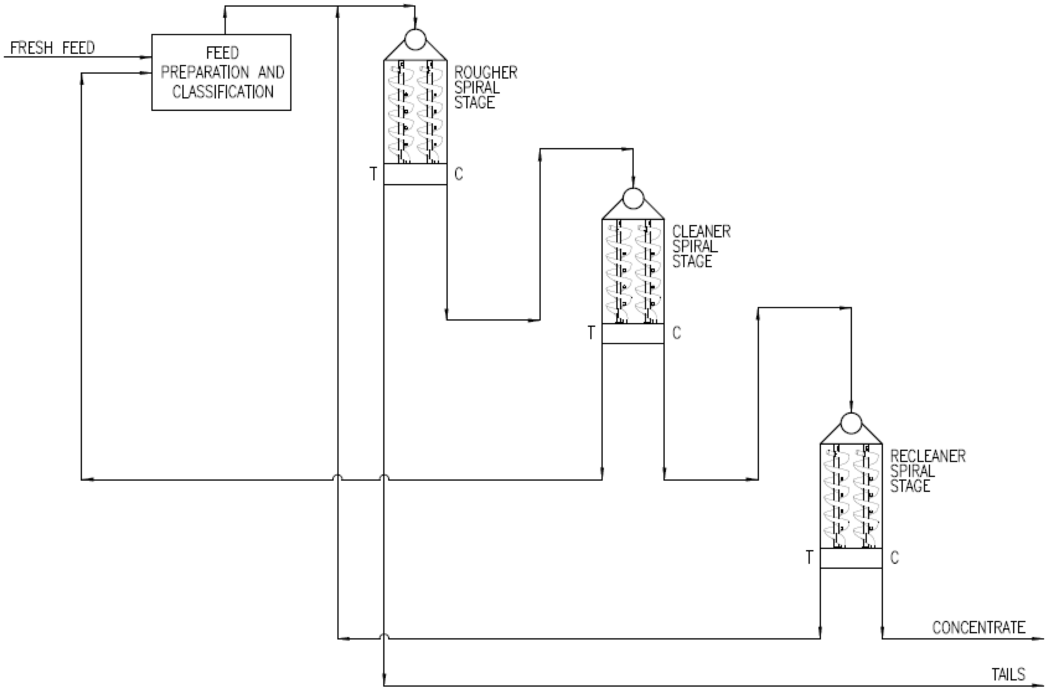


Figure 1-4 – Simplified Phase 1 Three-Stage Spiral Recovery Circuit Flowsheet

The long-term iron recovery of the Phase 1 concentrator prior to the shutdown averaged nominally 72%. Factors influencing this lower-than-expected performance include the selection of the spiral model used in the process, premature wear of the spirals, changing concentrate grade requirements and operational issues relating to inconsistent spiral feed densities and wash water supply. To enable direct comparison of the previous operational recoveries and those achieved through the testwork, the previous feed PSD was evaluated against the sample characterisation undertaken during the metallurgical testing (refer section 13.1.4). This confirmed a close match and shows that the sample preparation closely represented the operational feed preparation.

1.8.2 Planned Phase 2 Concentrator Circuit

For the planned Phase 2 concentrator, an alternative gravity concentration flowsheet was developed to provide significantly improved iron recoveries. The Phase 2 flowsheet is comprised of rougher spirals followed by a cleaning stage employing UCCs (up-current classifiers) producing final concentrate to the underflow. The UCC overflow stream is scavenged with a spiral separator stage to recover misplaced fine iron. This complementary use of these two methods of gravity separation maximises iron recovery across a broad range of particle sizes. A simplified diagram of the Phase 2 recovery circuit flowsheet is shown in Figure 1-8.

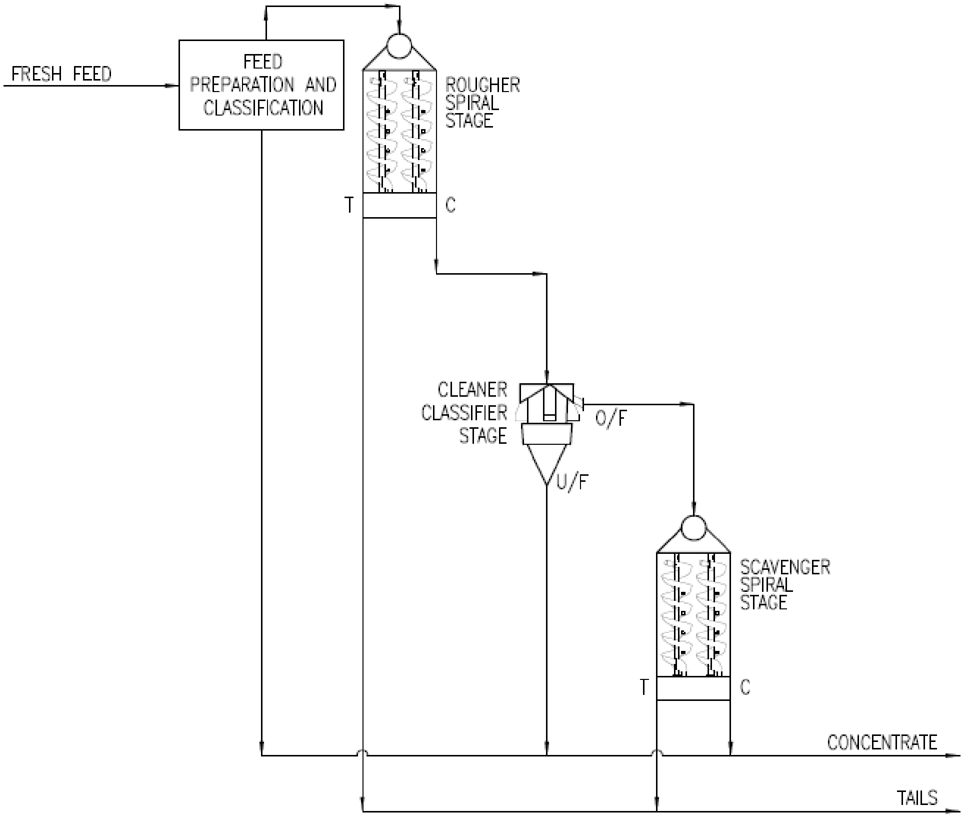


Figure 1-5 – Simplified Phase 2 Spiral and UCC Recovery Circuit Flowsheet

The seven-turn WW6+ spiral was selected for both the rougher and UCC overflow spiral stages in the Phase 2 flowsheet following in-plant testing against 3 other spiral models. The WW6 spiral separator has been used successfully for many years for iron ore processing; thousands of spiral starts are in operation around the world, with a high concentration of units in service in the Labrador Trough.

1.8.3 Upgraded Phase 1 Concentrator Circuit

The effort to develop an improved flowsheet for implementation in the Phase 1 concentrator upgrade was initially based on the review of available data, including historical Phase 1 performance, testing and pilot data from development of the Bloom Lake Phase 2 flowsheet and MT information regarding spiral performance on typical ores in the Labrador Trough.

Based on the results of the data review and process modelling (described in section 13), Mineral Technologies developed a proposed Phase 1 upgrade flowsheet (refer to Figure 1-6) to replace the existing Phase 1 iron recovery circuit. The key difference between the proposed upgrade flowsheet and the Phase 2 flowsheet is the inclusion of a mids scavenger spiral stage to treat the rougher middlings and an additional magnetic separation stage to recover fine iron from the gravity circuit tailings.

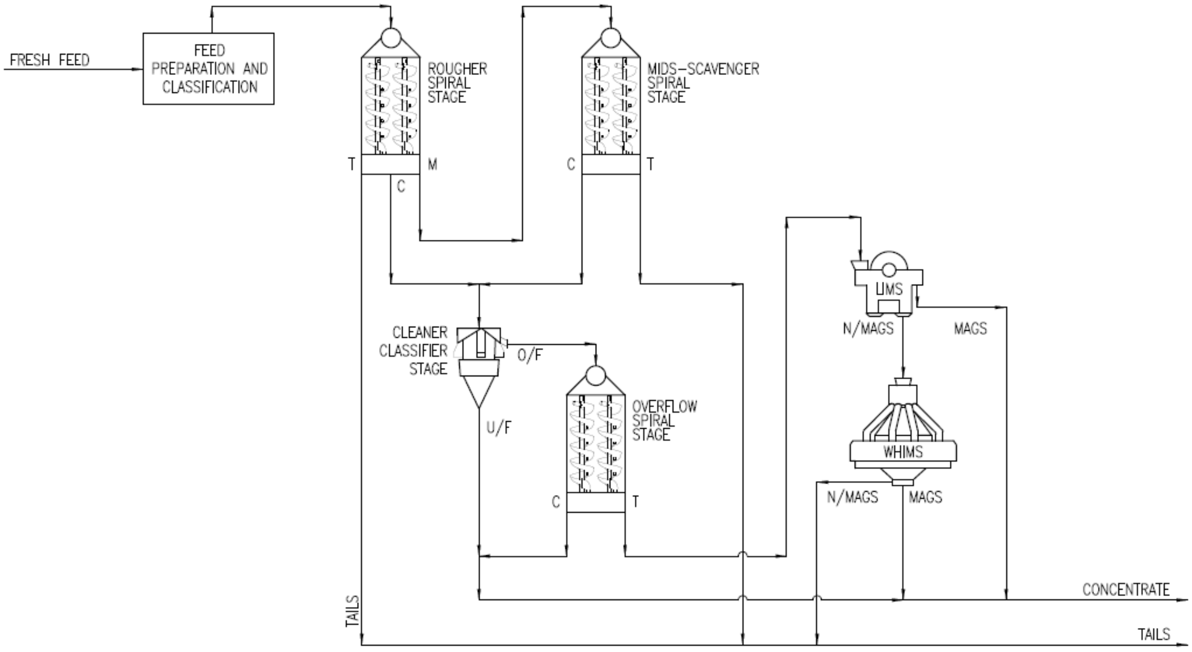


Figure 1-6 – Upgraded Phase 1 Recovery Circuit Flowsheet

1.8.4 Upgraded Phase 1 Concentrator Equipment and Performance

The upgraded Phase 1 recovery circuit flowsheet depicts the replacement of the existing three-stage spiral circuit with a new gravity circuit comprising:

- WW6+ spirals used in the Rougher duty for primary concentration of the feed, with the rougher stage concentrate proceeding directly to the cleaner UCC
- WW6+ spirals used in the Mids-Scavenger duty to scavenge iron minerals remaining in the Rougher spiral middlings
- MT’s SLIM UCC’s in a cleaner duty, closely coupled with WW6+ spirals treating the UCC overflow stream to scavenge fine iron and produce a combined concentrate stream. This unique configuration allows the two processing stages to be located on the one floor level, enabling its use in the existing Phase 1 concentrator building
- MT’s Low Intensity Magnetic Separators (LIMS) and Wet High Intensity Magnetic Separators (WHIMS) to scavenge fine iron from overflow spiral rejects and produce a supplementary concentrate for blending with the gravity concentrate stream

All new equipment for the upgraded Phase 1 recovery circuit will be housed in the existing Phase 1 concentrator building and, as such, will utilise existing services, infrastructure and ancillary processing equipment.

The performance of the proposed flowsheet has been confirmed by a comprehensive metallurgical testing program (described in section 13 of this document). Testing data was used to confirm separation models used for each stage of upgrading, and this in turn allowed the population of a detailed mass balance for the entire circuit.

Table 1.6 below shows the predicted iron recovery of the overall recovery circuit (gravity and magnetic circuits) at varying feed grades.

Table 1-6 – Modelled Performance of the Upgraded Phase 1 Circuit

	29% Feed Fe		**30% Feed Fe**		**31% Feed Fe**	
	Fe Recovery (%)	**Mass Recovery (%)**	**Fe Recovery (%)**	**Mass Recovery (%)**	**Fe Recovery (%)**	**Mass Recovery (%)**
Optimum Case	84.3%	37.3%	85.3%	39.0%	86.3%	40.8%
Expected Plant Performance	82.3%	36.6%	83.3%	38.2%	84.3%	39.9%

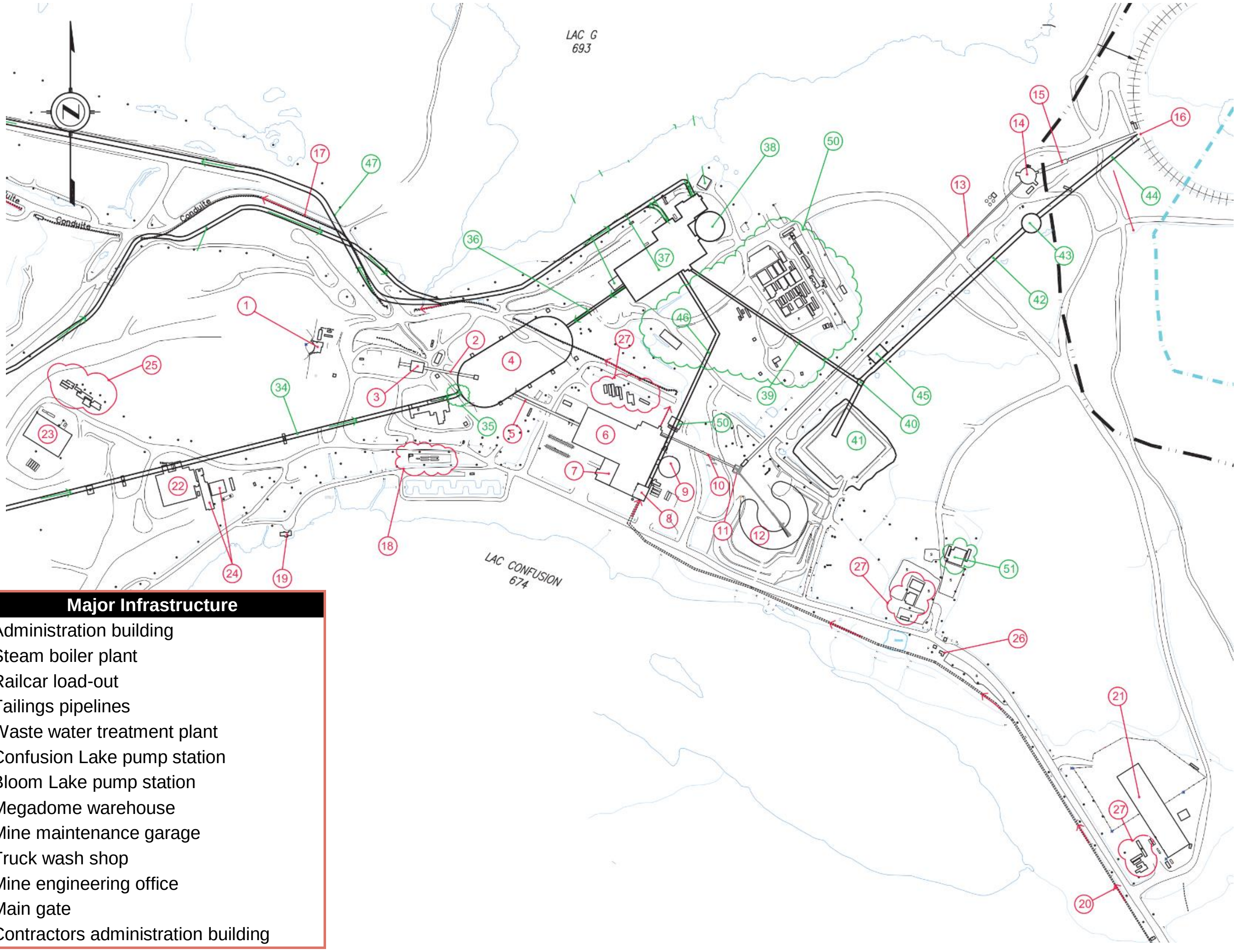
1.9 Mine Infrastructure

The entire mine infrastructure which was being used by Cliffs is available for the mining operations. It includes the following facilities:

- Mine maintenance shop (with 4 bays)
- Mine equipment secondary garage capable of servicing 320 t trucks (35 m x 50 m, with two bays)
- Mine equipment wash bay (38 m x 60 m)
- Fuel storage and distribution system
- Electrical infrastructure for the mine, including a 34.5 kV sub-station
- A cafeteria at Bloom West Mine (to minimize the lost time for truck driver breaks)
- Mobile shovel bucket repair shop
- Dispatch system, complete with trailers, offices and a cafeteria

1.10 Infrastructure Located at the Processing Plants

The entire infrastructure which was being used by Cliffs is available for the Quebec Iron Ore operations. The following Figure 1-7 shows the location of the major infrastructure located at the phase I and phase II plants.



Item	Major Infrastructure
7	Administration building
8	Steam boiler plant
16	Railcar load-out
17	Tailings pipelines
18	Waste water treatment plant
19	Confusion Lake pump station
20	Bloom Lake pump station
21	Megadome warehouse
22	Mine maintenance garage
23	Truck wash shop
24	Mine engineering office
26	Main gate
51	Contractors administration building

Figure 1-7 – Major Infrastructure Located at the Processing Plants

1.11 Port Infrastructure

The concentrate is unloaded from railcars at Pointe Noire, which is owned by SFP Pointe-Noire (SFPPN) which is controlled by the Government of Quebec and can be either loaded directly onto a vessel or stockpiled to be reclaimed and loaded at a later date. The former Cliffs / Bloom Lake concentrate stockpiling and shipping system is comprised of a rotary car dumper, dump hopper, stockpiling and reclaiming conveyors, a stacker-reclaimer, and ship loaders. Storage capacity is currently 670,000 t of concentrate in the stockpile yard.

A new multi-user dock, owned by the Port of Sept-Iles, was built at Pointe-Noire. The dock has a capacity of 50 Mtpa via two 10,000 t/h travelling ship loaders. The dock was designed to receive 400,000 DWT Chinamax vessels.

1.12 Tailings and Surface Water Management

Work on surface water management and the tailings storage facility (TSF) is required in order to operate the Bloom Lake site in accordance with regulations and operational standards.

The surface water management system is composed of a network of ditches, collection basins, pumping stations and retention ponds. The surface contact water is pumped to the tailings storage facility to be managed. The process water reserve and the legislative water storage capacity is located in the TSF. A water treatment plant is located next to the TSF where excess water can be treated and released. For the restart of mining operations, the existing water management system is mostly unchanged as it is functional. However, upgrades to some components are required to meet operational standards and governmental regulations. Among others, increase in pumping capacity and automation is considered.

In section 18, figure 18.2 presents the tailings management facility. The tailings management strategy is developed around tailings slurry pumping and hydraulic placement of an annual 12.36 Mt of tailings that are separated in two feeds: coarse (83%) and fine (17%). This separation optimizes the footprint and utilizes the existing infrastructure. Slurry pumping and hydraulic deposition is an economic way to transport and store large quantities of tailings. Fine tailings are stored in a basin developed with impervious dykes and filtering dykes, while coarse tailings are contained in a storage facility developed with filtering dykes to hold the tailings and with water-retaining dykes to hold the process water. Most construction work in the fine tailings basin is expected to be executed by contractors, while the coarse tailings management facility will be mostly built by the QIO personnel and equipment using an upstream construction method. In order to achieve the tailings management strategy, upgrades to the existing tailings slurry pumping system and the construction of a second booster pumping station are also required.

1.13 Environment

The mine has been authorized for operation under the federal environmental authorities and provincial governments. There is only one pending process with the federal government associated with the 2016 authorization for destruction of fish habitats. The compensatory plan is under preparation and the authorization from DFO to proceed with the compensation project should be issued in 2017. This process does not prevent QIO from operating the mine.

The new mine plan and the proposed tailings management strategy will require modifications to the existing authorizations from the MDDELCC.

Considering that the mine does exist, and that there is no expansion projected, no additional impacts are anticipated on plants and wildlife. Impacts to local lakes and water courses were identified in the initial environmental impact study. No additional serious harm to fish or fish habitat loss is anticipated in order to operate the mine, as no expansion is projected. The mine conducts routine monitoring of water, wastewater and air as part of its decrees and authorizations.

In regards to water quality, QIO must comply with the requirements from Directive 019, the MMER, as well as the depollution attestation. The depollution attestation should be effective in 2017. The attestation will comprise several conditions that were already included in previous certificates of authorization delivered to the mine. There are no new conditions expected within the attestation.

Potential nonpoint sources of dust include the tailings pond, the waste rock piles and the ore and concentrate stockpile areas. The mine has dust mitigation measures for fine particle emissions, such as dust collectors. The mine proceeds to watering of the roads to reduce dust emission. In the tailings impoundment as well as the waste rock stockpiles, areas that become inactive are gradually revegetated to avoid wind erosion and dust dispersion.

There are no known significant issues that are believed to materially impact the mine's ability to operate.

MERN approved a revised closure plan at a cost of CAD $41.7 million which was covering five years of mining operations for both Phase I and Phase II. The plan was approved for the previous owner starting in 2012. QIO must provide a financial guarantee covering this five years closure plan cost to the provincial government in accordance with Section 111 of the Regulation Respecting Mineral Substances other than Petroleum, Natural Gas and Brine (Chapter M-13.1, r. 2). In order to estimate a mine closure and restoration costs for the entire life of the new Bloom Lake mining project, WSP used a conservative approach in line with the concepts of the MERN's guide on mine closure and restoration (MRNF, 1997). The mine closure and restoration costs for the entire life of the new Bloom Lake mining project is estimated at CAD $76,435,740, assuming no salvage value for the equipment and that a third party will complete the closure and restoration work. This cost includes the direct and indirect costs of site restoration as well as post-operation and post-closure monitoring

1.14 Market Studies

Ausenco has engaged Metalytics to provide an iron ore market study covering the period to 2035 for use in the Bloom Lake Feasibility Study NI 43-101 Technical Report.

Metalytics has derived base case projections, based on an integrated range of assumptions relating to the steel and iron ore industries. Among these is the key premise that the global steel industry is in a post-boom era which will see continued slowing of steel consumption growth over the timeframe of this study. Metalytics' thesis is that the maturing and then decline of China's steel usage will not be fully offset by growing demand elsewhere, including in other emerging economies. Nevertheless, annual global finished steel usage will still rise from around 1.5 to 2.0 billion tonnes between 2016 and 2035.

Another important assumption is that constraints on building new plant and infrastructure globally will mean that China's massive installed production capacity will be required to contribute to meeting projected world steel demand, while its own requirements decline. This will lead to China's steel production plateauing in the 2020s.

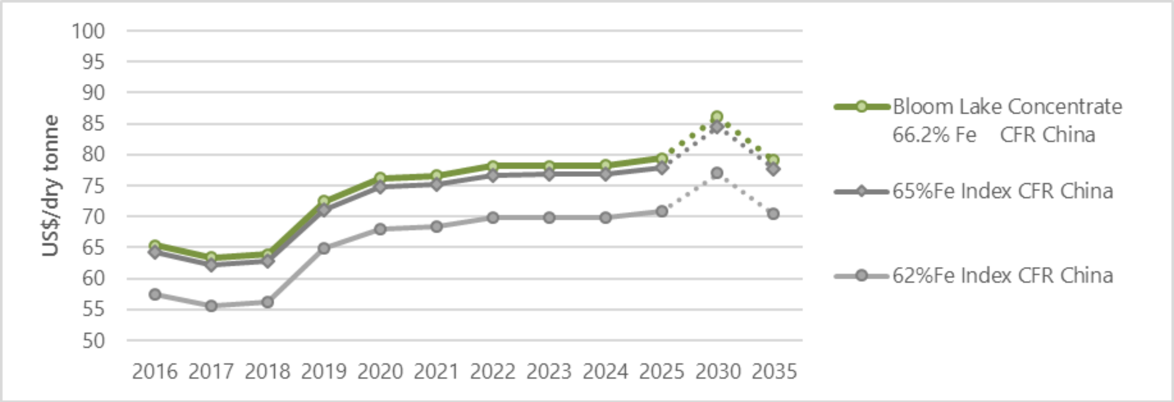
Iron ore consumption will grow more slowly than steel production because scrap generation and usage will increase. Thus, annual iron ore consumption is projected to rise by 475 Mt by 2035. While that may seem a modest target for supply to match over that timeframe, the challenges to iron ore project development can be expected to increase.

Global iron ore supply and trade projections suggest that while globally, supply will expand more slowly than demand, Australia will remain the predominant producer and exporter, with Brazil remaining the next largest. Further, seaborne trade will continue to dominate in the world market, with China remaining the largest importer as its domestic supply declines. The net result is that the current production surplus will be absorbed and the market will start to come into balance in 2018, after which the post-boom legacy of investment caution, mine depletion, and development constraints should keep the supply and demand broadly in equilibrium, albeit with periodic imbalances.

In this scenario, Bloom Lake concentrate would be positioned as a high-grade sinter feed, based on sample analysis made available to us. At 66.2% Fe, its iron content compares well with other high-grade products and against price index and trading platform specifications. Its other main chemical attributes are similar to long-established Labrador Trough products.

The primary reference for pricing internationally-traded iron ore is the price of 62% Fe fines delivered to China. Several publications compile an index of these prices, with Platts' IODEX being the most commonly cited. Based on the projections provided in this study, prices should range sideways over the next two years before lifting towards a higher equilibrium level in 2019 and beyond. Metalytics' price profile assumes there is mostly a lagged response by suppliers to improving prices until another period of investment emerges late in the next decade, which results in a price correction and rebalancing.

Real 2016 Terms derived from Base Case assumptions



Source: Metalytics December 2016 (Index price forecasts); Metalytics January 2017 (Bloom Lake 66.2% Fe Concentrate prices)

Figure 1-8 Price Projections

For Bloom Lake concentrate, a convenient and appropriate reference for price projections is a 65% Fe fines index, as this already incorporates assumptions about future premiums for high-grade products. While actual contract pricing terms may use a different methodology, Metalytics has derived Bloom Lake prices by a pro-rata escalation of 65% Fe prices to arrive at CFR (cost and freight) China prices. Forecast index and Bloom Lake concentrate price trajectories are shown in Figure 1-8 above.

The iron ore market is dominated by medium-grade products, mainly from Australia and Brazil. High-grade products play an important role in improving the chemistry of steel mill iron ore blends, improving blast furnace productivity and efficiency. The price premiums they command depends on pricing of other raw materials (especially coal), as well as on steel market fundamentals and other considerations including product supply/demand factors. Vale's Carajás S11D mine (due to start commercial production in 2017) will significantly increase the supply of high-grade material into the market over the next few years. This may have both positive and negative consequences for other high-grade iron producers – positive in that Vale will lead pricing, but negative in terms of market balances. However, Bloom Lake concentrate was successfully sold into global markets (mainly to China) prior to the plant shutdown in 2014, with sales exceeding six million tonnes in its last year.

1.15 Capital Cost Estimate

The following is the summary tables for the capital cost estimate (CAPEX).

Table 1-7 – Capital Cost Estimate Summary by Area (CAD)

WBS	Area	Cost
0000	General	$13,318,225
1000	Mine	$46,725,919
2000	Process	$64,851,532
3000	On-site Infrastructure	$0
4000	Off-site Infrastructure	$0
9000	Indirect Costs	$32,291,825
Total		$157,187,501

Table 1-8 – Capital Cost Estimate Summary by Discipline (CAD)

Type	Discipline	Cost
A	Site Work	$0
B	Earthworks	$14,345,950
C	Concrete	$0
E	Structural Steel	$0
F	Architectural and Unit Building	$0
G	Port/Marine	$0
H	Rail	$0
J	Mining	$41,898,100
K	Pipeline	$0
L	Mechanical Plate-work and Tanks	$0
M	Mechanical Equipment	$64,342,069
P	Piping	$0
Q	Electrical Equipment	$549,500
R	Conduit and Cable Tray	$164,437
S	Wire and Cable	$2,309,515
T	Instrumentation	$1,286,106
U	Construction Indirects	$6,182,126
V	Other Indirects	$0
W	EPCM	$7,834,291
X	Contingency	$8,106,485
Y	Owner Cost, including Risk	$10,168,924

Z	Open	$0
Total		$157,187,501

1.16 Operating Cost Estimate (OPEX)

A summary of the average operating cost over the life of mine is show in Table 1-9.

Table 1-9 – Summary of Average Production Period Operating Costs (CAD)

Description	Production Period Average		
	$/t Ore	$/t Dry Concentrate	% of Costs
Mining	3.95	10.45	24.35%
Crushing plant	0.37	0.98	2.29%
Process plant	2.81	7.44	17.32%
Concentrate shipping	6.37	16.88	39.32%
Water & tailings operations	0.83	2.20	5.13%
General and administration	1.88	4.98	11.59%
Total Cost	16.21	42.93	100.00%

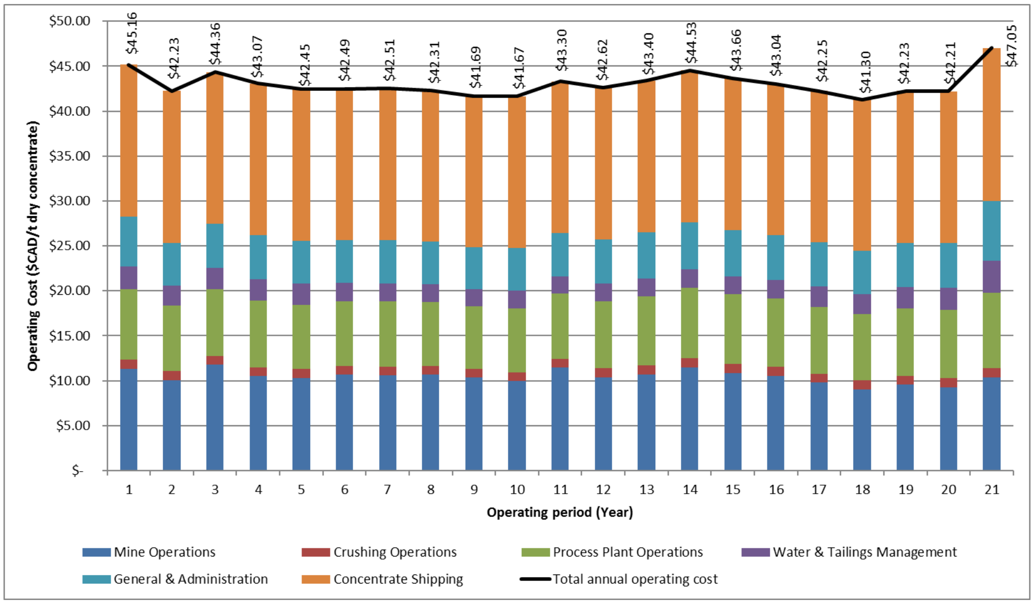


Figure 1-9: Operating Costs over the Project Life

1.17 Economic Analysis

The economic/financial assessment of the Bloom Lake project of Quebec Iron Ore Inc. is based on Q1-2017 price projections in U.S. currency and cost estimates in Canadian currency. A spot exchange rate of 0.7600 USD per CAD was assumed to convert particular components of the cost estimates into CAD and forward exchange rate estimates were used to convert USD market price projections into CAD. No provision was made for the effects of inflation. The evaluation was carried out on a 100%-equity basis. Current Canadian tax regulations were applied to assess the corporate taxes, while the recently adopted regulations in Quebec (originally proposed as Bill 55, December 2013) were applied to assess the mining taxes. The financial indicators under base case conditions are presented in Table 1-10.

Table 1-10 – Financial Model Indicators

Financial Results	Unit	Value
Pre-tax NPV @ 4%	M CAD	2,468.6
Pre-tax NPV @ 6%	M CAD	2,024.2
Pre-tax NPV @ 8%	M CAD	1,674.8
Pre-tax IRR	%	43.9
Pre-tax Payback Period	Years	2.5
After-tax NPV @ 4%	M CAD	1,491.1
After-tax NPV @ 6%	M CAD	1,207.2
After-tax NPV @ 8%	M CAD	983.5
After-tax IRR	%	33.3
After-tax Payback Period	Years	3.1

A sensitivity analysis reveals that the Project's viability will not be significantly vulnerable to variations in capital and operating costs, within the margins of error associated with Feasibility-Study-level estimates. However, the Project's viability remains more vulnerable to the USD/CAD exchange rate and the larger uncertainty in future market prices. For further detail, please refer to section 19 – Marketing Study.

1.17.1 Financial Model and Results

Figure 1.10 illustrates the after-tax cash flow and cumulative cash flow profiles of the Project for base case conditions. Note that the total height of a particular bar (i.e., after-tax cash flow plus corporate and mining taxes) represents the before-tax cash flow. The intersection of the after-tax cumulative cash flow curve with the horizontal dashed line represents the payback period.

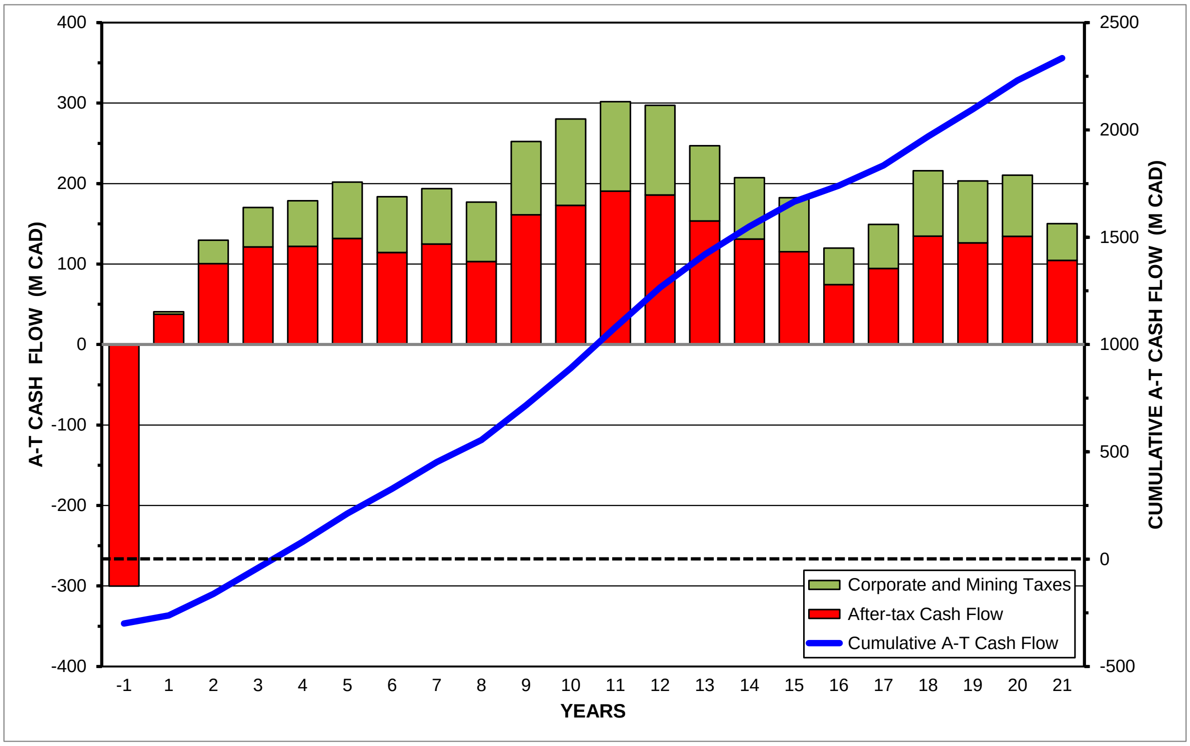


Figure 1.10 – After-tax Cash Flow and Cumulative Cash Flow Profiles

1.18 Interpretation and Conclusions

The Bloom Lake Mine re-start project is financially and technically feasible with a total estimated capital cost of C$326.8 M, including mine upgrade capital cost of C$157 M. The economic analysis of the re-start Project shows an IRR of 33.3% and a simple payback period of 3.1 years after taxes.

The level of accuracy of the capital and operating cost estimates is +/- 15%. The capital cost estimate includes a 8.3% contingency and a 6.2% risk allowance on construction costs. Costs for the contracts with the QNS&L railway and the SFPPN port authority are included in the operating costs.

This study clearly demonstrates the feasibility of re-starting the Bloom Lake mine with the restoration and improvement work planned for 2017.

1.18.1 Geology and Mineral Resources

- The geological interpretation for the Bloom Lake deposit is based on different data sources such as mapping (1998), multiple diamond drilling programs (from 1956 to 2014) and ground magnetic surveys (1967,1971-1972, 2008). The geology of the deposit is fairly well understood.
- The mineralization is found in bands of iron formations of different composition including the Hematite Iron Formation, Magnetite Iron Formation and Silicate Iron Formation. The mineralization controls of the deposit are also well understood.
- The protocols followed to collect sample data are consistent with industry best practices. The mineralized intervals are sampled as peripheral zones. The sample intervals respect the change

of lithology. The sampling is adequate for the mineralization style and samples taken are representative of the deposit.

- The duplicate samples taken from drill core (from 2010, 2012 and 2013 drilling programs) show acceptable to excellent correlations with the original samples.

- In 2012, the company started using blanks selected within waste material from the Bloom Lake deposit. These blanks indicate that the analytical results were not affected by contamination.

- Standard samples made from mineralized material from the Bloom Lake deposit were used in the 2013 drilling campaign. Insufficient description of the material and procedures surrounding the Standard analyses lead to the conclusion that the Standards are not appropriate for the QA/QC.

- Réjean Sirois, P. Eng., from G Mining, has taken core samples during the site visit in September 2016 to validate the grades of the assays in the drilling database of the Bloom Lake Project. G Mining is of the opinion that the check assay results are reasonably close to the grades of the original assays in the database. Consequently, the assay results included in the database of the Bloom Lake project are reliable and can be used for the resource estimation.

- The geological model includes a total of 8 lithology units which were designed on cross-sections and plan views. The plan views interpretation were extruded into 14 m thick solids (or 28 m for the inferior portion of the model) and integrated in the block model. The 3D wireframes are representative of the folded lithologies present in the Bloom Lake deposit.

- Each mineralization orientation is appropriately defined within the 9 structural domains dividing the geological model in the Bloom Lake project.

- Mineral Resources were estimated in the mineralization and structural domains, using GEMS from 7.0 m long composites and a large search ellipse, and using a single ordinary kriging interpolation pass. The interpolation parameters are appropriate for Mineral Resource estimation and are in line with industry standards and CIM guidelines.

- The performance of the block model to predict resource estimates was evaluated through reconciliation with production data. Bloom Lake's resource block model generally produces acceptable predictions of the production tonnages and Fe% grades, between 2012 and 2014.

- The Mineral Resources are reported within a Lerchs-Grossman open pit shell and are effective November 15th, 2016, using a cut-off of 15% Fe and a long-term iron price of USD $60/dmt of concentrate as follows:
    - Open pit Measured and Indicated Mineral Resources total 911.6 Mt at an average grade of 27.7% Fe.
    - Open pit Inferred Mineral Resources total 80.4 Mt at an average grade of 25.6% Fe.

- Mineral Resources were classified into Measured, Indicated and Inferred categories according to the CIM Definition Standards on Mineral Resources and Mineral Reserves as adopted by National Instrument 43-101 Canadian Standards of Disclosure for Mineral Projects ("NI-43-101").

1.18.2 Mining and Mineral Reserves

- Open pit optimization was conducted using Whittle software to determine the optimal economic shape of the open pit to guide the pit design process. Pit optimization is based on a reference iron ore price (Platt's 62% CFR China) of US$50/dmt of concentrate and an exchange rate of 1.30 C$/US$. A price adjustment of 1$/dmt per 1% iron was applied (i.e. US$4/dmt for a 66% iron concentrate).

- The mine design and Mineral Reserve estimate have been completed to a level appropriate for feasibility studies. Definitions for Mineral Reserve categories used in this report are consistent with the CIM definitions as adopted by NI 43-101.
- At a cut-off grade of 15% Fe, Proven and Probable Mineral Reserves are estimated to be 411.7 Mt an average grade of 30.0% Fe for 155.4Mt of iron concentrate at 66.2% Fe.
- All major mine equipment required for the restart of the project is present on site as this equipment was among the assets purchased by QIO from Cliffs.
- The majority of the loading in the pit will be done by two electric drive hydraulic face shovels equipped with a 23 m^3 bucket. The shovels are matched with a fleet of 218 t payload capacity mine trucks.
- The project already owns three Caterpillar 6060 electric drive hydraulic front shovels. Two Komatsu WA1200-6 units are available on site. The existing truck fleets consist of seven Caterpillar 793D and three Caterpillar 793F mechanical drive trucks which is sufficient for the project excluding equipment replacement.
- Mining of the Bloom Lake project is planned with four phases with a starter phase and a final pushback in both the East and West pits.
- Waste rock will be disposed of in two distinct waste dumps. In pit waste storage is initiated in 2022 once the East Pit Phase 1 is depleted. The West Pit Phase 1 in-pit dump will start in 2026 and will consist in filling the mined-out bottom portion of the west pit.
- The life-of-mine ("LOM") plan details 21 years of production, with a three month ramp up and commissioning period followed by a mining rate of 20Mt per year of ore for the remainder of the mine life. The peak mining rate of approximately 34.2 Mt is reached in 2025. The mining rate declines, starting in 2033, as sufficient ore for the mill is accessible.
- The open pit generates 198.9 Mt of overburden and waste rock for a strip ratio of 0.48:1.

1.18.3 Mineral Processing

A major objective of this study was to increase the iron recoveries. Mineral Technologies has performed metallurgical modelling and testwork to develop a process flowsheet which includes both gravity and magnetic separation technologies. It is estimated that this revised process design can achieve a minimum iron recovery of 83%, at the life of mine feed grade average of 30% Fe.

1.18.4 Environmental, Tailings and Surface Water Management

The mine has been authorized for operation under the federal environmental authorities and provincial governments (decree and numerous certificate of authorizations). A few of these authorizations will require modifications. Among these, are an update of the current authorized infrastructure and the operational certificate of authorization. There are no known significant issues that are believed to materially impact the mine's ability to operate.

The mine conducts routine monitoring of water, waste water and air as part of their decrees and authorizations. QIO must now provide a financial guarantee, which amount corresponds to the total anticipated cost of completing all the work set forth in its closure and restoration plan. The closure costs estimated by AMEC in 2013 were adjusted to include all aspects of the project. WSP estimates the mine closure and restoration costs for the Bloom Lake mine at CAD $76,435,740. This cost includes the direct and indirect costs of site restoration as well as post-operation and post-closure monitoring.

The previous tailings and surface water management strategies have been assessed and revised to meet regulations, industry standards and the new tailings and surface water management strategy. Investments on the surface water management network are required to meet the regulations as well as in the tailings storage facility in order to restart the mine and facilitate its operation over the planned mine life. The tailings management strategy has been developed with conservative assumptions and ensured safe containment of tailings and water. Staged over six years, upgrades on the existing booster pump house and the construction of a second booster pump house are required to achieve the tailings management strategy.

1.19 Recommendations

The following recommendations are put forward for the continuation of this Project into the next phases which are: detailed engineering, procurement, and construction:

- It is QIO's intent to be operational by Q1 2018. For this to become a reality, it is imperative that critical path purchase orders be placed in Q1 2017. Operational employees will have to be hired back in a timely fashion to allow time for training and participation in the commissioning activities planned for Q4 2017.

- In the development of the feasibility study engineering, drawings which were used as references (from the BBA & CIMA+ studies) for this study were not issued "For Construction" or "As Built". During the detailed engineering phase of this project, further field surveys will be required to determine the as-built conditions of the existing brown-field facilities.

1.19.1 Geology and Mineral Resources

- Silica blanks and standard reference material of industry standards, as well as detailed descriptions of the QA/QC procedures should be introduced in the future drilling programs.

- The geological model should be expanded to include the 23 drill holes located east of the Bloom Lake Project and south of Confusion Lake. The additional drilling information may lead to the modelling of new mineralization domains.

- Comparison analysis (reconciliation) between the resource and grade control block models (produced from future blast holes) should be continued to test the performance of the resource block model.

1.19.2 Mining and Mineral Reserves

- Hydrogeological investigations are recommended for the West Pit in particular to investigate groundwater infiltration and any incidences on the pit slope performance. The current pit elevation is above the water table.

- Additional waste rock storage options should be investigated. In the event of expanded larger open pit limits optimized for higher iron ore prices additional waste dump storage capacity will be required and may limit or defer the possibilities of in-pit waste storage.

- Pit slope recommendations were initially formulated for larger open pits. Pit slope recommendations could be reviewed for the smaller final open pit presented in this study or applied to interim pit walls.

1.19.3 Permitting

- Infrastructure such as the mining pit, waste rock stockpiles, tailings management facilities, water management structures as well as the water treatment plant have all been authorized. However, a few of the current authorizations will require modifications before site operation resumes in order to adjust them to the new mining plan. These include certificates of authorization associated with the new waste rock stockpiles and for the site operational plan which include the new mining pit, the new tailings and water management plan as well as the upgraded concentrator process.

2 Introduction

2.1 Background

In December 2006, an environmental impact assessment of the Bloom Lake mine project was submitted to the agencies. Decree 137-2008 authorizing the project was adopted on February 20, 2008 by the provincial government. Consolidated Thompson Iron Mines Limited began the construction of the mining infrastructure in 2008 and commenced mining operations in 2010 with the phase 1 concentrator plant (referred as phase 1 plant in the document). As part of an expansion plan to increase the mine production, the design and construction of a second concentrator plant (referred to as phase 2 plant in the document) was initiated to increase nominal capacity to about 15 million tons of concentrate per annum.

The mine was sold to Cliffs Natural Resources Inc. (Cliffs) in 2011, which continued the phase 2 construction project and conducted mining operations until they were suspended in December 2014. The site was employing about 600 people.

In January 2015, Cliffs sought creditor protection under Companies’ Creditors Arrangement Act (CCAA), resulting in the mine being then put on a care and maintenance program, and placed into creditor protection.

In April of 2016, Champion Iron Limited (Champion), acquired the Bloom Lake assets through its subsidiary Quebec Iron Ore Inc. (QIO) and the Quinto Claims for a cash consideration of C$10.5 million ($9.75 M for Bloom Lake and $0.75 M for Quinto) and the assumption of liabilities. Quebec Iron Ore Inc. is 63.2% owned by Champion Iron Limited, with the remaining 36.8% equity interest owned by Ressources Quebec through its fund “Mines & Hydrocarbons”, acting as a mandatory of the Government of Quebec. Under the asset purchase agreement, Quebec Iron Ore Inc. has become responsible for bonds securing obligations of Bloom Lake, totalling approximately C$1.1 million, plus the assumption of reclamation obligations in the amount of about C$41.7 million.

The monitor of the CCAA proceedings maintained the site idled from December 2014 up to April 2016 when QIO became its owner. During the care and maintenance period, Cliffs improved some of the water management infrastructure, in order to meet legal and environmental obligations.

The mine has already been authorized for operation under the federal environmental authority including Fisheries and Oceans Canada (DFO), Transport Canada, Natural Resources Canada and Environment Canada. The project was subject to an environmental impact assessment and review process under Section 31 of the Provincial Environment Quality Act, which led to the first decree issued by the Quebec government in 2008 authorizing mining activities at the Bloom Lake site.

Operations in 2014 produced about 6 million tonnes on an annualised basis of iron fines at slightly over 66% Fe. QIO has identified the potential to improve production capacity and recovery at Bloom Lake to over 7 million tonnes per year at a similar grade, mainly through the implementation of a new mine plan as well as improved process recovery.

QIO also plans significant cost reductions at the Bloom Lake Mine by bringing the operational FOB costs per ton down substantially from previous levels.

Given the amount of work that Cliffs has already committed to preparing the site for idling, the extended care and maintenance and planned upgrades to the facilities, the Bloom Lake Mine could become one of the lowest capital cost iron ore mines in the world due to the low acquisition price from CCAA and limited investment requirement for the restart.

2.2 Scope

The scope of this feasibility study was to identify areas for improvement or correction prior to the planned re-start of the Bloom Lake Mine. Feasibility Study level engineering was performed on each of these areas to outline work to be performed. Associated capital and operating cost estimates were generated to allow for the Bloom Lake financial model to be developed.

2.3 Basis of the Report

Information presented in this technical report is based on the following:

- Information provided by Quebec Iron Ore
- Metallurgical modelling and confirmatory testing performed by Mineral Technologies in their metallurgical testing facilities using samples taken from the Bloom Lake mine on August 28th 2016
- Information from the original BBA phase I design drawings and specifications
- Information from the CIMA+ phase II design drawings and specifications
- Previous Operations data
- AG Mill grinding performance studies by SGS
- Hatch – Bloom Lake Phase II Process Review (2014-09-30)
- COREM – Metallurgical test work for the Bloom Lake West deposit (2011-06-23)

2.4 Description of the Project

The Bloom Lake Mine restart project includes the following elements:

- A new mining plan for Bloom Lake, which will include additional support mobile equipment
- A dome to cover the crushed ore storage pile
- Process flowsheet upgrade within the existing Phase 1 concentrator. The flowsheet upgrade focus is to improve the recovery of iron by the concentrator, with specific attention given to improving recoveries of the coarser (+425 microns) and fine (-106 microns) iron minerals while having no adverse effect on the recovery of other size fractions.

  Modifications to the Phase 1 concentrator required for the upgrade to the iron recovery circuit flowsheet include:

  - Removal of the existing Phase 1 spirals that have proven to be sub-optimal for the processing application
  - Installation of new spirals in a revised circuit configuration

    The new spirals are sourced largely from the existing Phase 2 concentrator and these are augmented with additional new manufactured spirals
  - Installation of up-current classifiers complementing the spirals

This complementary use of the two types of gravity separation technology works well to maximize iron recovery in a robust manner across a broad range of particle sizes.

Close coupling the UCCs with a scavenging spiral stage allows the installation of two process stages on a single floor level, ensuring the additional processing equipment can be installed in the existing concentrator footprint.

  - Installation of an iron-scavenging magnetic circuit.

    This circuit uses both LIMS and WHIMS to target recovery of fine iron that otherwise reports to the gravity circuit tailings. This circuit provides and incremental increase to plant iron recoveries.

  - Additional process equipment modifications to ensure ancillary equipment specifications match the required duty of the upgraded flowsheet.

    This includes replacement of the feedwell for the existing thickener to accommodate higher slurry inflow rates and upgrade of the existing slurry pumps to match new flow conditions.

- Revised tailings management plan and storage facilities
- Revised water management plan
- Several small restoration and improvement jobs

2.5 Division of Responsibility

At a high level, the division of responsibilities is as follows:

Development of the mine pit, overburden removal and required mining infrastructures; geological settings and mineralization; mining plan; mining methods; explosives:	G-Mining
Covering of the crushed ore stockpile for dust containment; Modifications to the A-Frame building to contain the fugitive dust:	Ausenco
Mineral processing: reviewing of Crushing, crushed ore reclaiming and milling area	Ausenco
Mineral processing, metallurgical testing, & recovery methods; increase in concentrate production by modifications to the gravity separation circuit along with the addition of a magnetic circuit; metallurgical testing; includes design, fabrication and installation; excludes electrical and instrumentation:	Mineral Technologies
Tailings pumping and pipeline; from the inlet of the plant tailings pumps to the inlet of the tailings booster pumps BPH #1:	Mineral Technologies
Tailings pumping and pipeline: from the inlet of the tailings booster pumps BPH #1 to the tailings storage:	WSP
Surface water management plan, water management structures and pumping stations	WSP
Tailings storage management; development of a new tailings filling plan; containment infrastructures:	WSP
Cost update of the site restauration plan	WSP
Transportation of the concentrate to the port facilities:	QIO
Port facilities:	QIO

2.6 Qualified Persons

The qualified persons responsible for the creation of this report are:

- Louis-Pierre Gignac, Eng. – G Mining
- Rejean Sirois, Eng. – G Mining
- Etienne Bernier, Eng. – G Mining
- Stéphane Rivard, Eng. – Ausenco
- Robin Jones, Eng. – Ausenco
- Michel Bilodeau – Ausenco
- Edward Hart, MAusIMM. – Mineral Technologies
- Philippe Rio Roberge, Eng. – WSP Canada Inc.

2.7 Site Visits

All "qualified persons" who worked on this study have visited the site either in the past or as part of this current mandate. The exceptions to this rule would be Metalytics for the Marketing Study, M. Bilodeau for the Financial Analysis and S. Rivard for the metallurgical test work.

G Mining's team consisting of LP Gignac and R. Sirois visited the mine site on August 28, 2016.

Robin Jones visited the mine site as part of a previous due diligence team in March 2014.

Mineral Technologies' team visited on a number of occasions:

- Matthew Urquhart and Peter Dunn visited in April 2016.
- Matthew Urquhart and Dale Rowney visited during the week of 19 September 2016.
- Carl Millen and Matthew Urquhart visited during the week of 26 September 2016.
- Edward Hart visited the mine site on 24 and 25 October 2016.

WSP's team consisting of PR. Roberge, Frederic Choquet, David Bedard, Claire Hayek and Simon Latulippe visited the mine site on August 24th to 25th.

3 Reliance on Other Experts

The authors have written this report using existing information gathered from previous studies and engineering design work undertaken for the Phase I and II operations, historical operational data from the Phase I concentrator, historical data from the operation of the Bloom Lake mine, technical field surveys and a metallurgical test work campaign. The existing technical data and information was sourced from the document archives located at the Bloom Lake mine. The authors of this report have not carried out a thorough review of each consultant's work. The sections provided for this report were supplied by reputable consultants, and there is no reason to doubt the validity of the information.

The marketing section 19 was provided by Metalytics. Metalytics is a specialist economics consultant in the metals and mineral resources sector. They provide high-level or in-depth, independent advisory and consulting services, market analysis, and project reviews across a range of mineral and metals industries for resources and infrastructure companies, investment organisations, financial institutions, public sector enterprises, consultancies, and legal firms.

4 Property, Description and Location

The Bloom Lake property is located in the Labrador Trough area straddling the border between Quebec and Labrador. There are several iron ore mines in the area including Mont-Wright owned by ArcelorMittal and Carol Lake owned by Iron Ore Company of Canada (IOC). Wabush Mines, located in Labrador and once owned by Cliffs Natural Resources (Cliffs), ended its activities in 2014.

The Bloom Lake property is owned by Quebec Iron Ore Inc. (QIO). QIO has owned the property and the facilities at the Bloom Lake mining site since April 12, 2016.

4.1 Property Description and Location

The mining site is located in the north-eastern part of the province of Quebec, adjacent to the Labrador/Newfoundland border, in Normanville Township, Kaniapiskau County. The property is centred at latitude 52° 50’ North and longitude 67° 16’ West, 13 km west of the town of Fermont and 30 km southwest of the municipalities of Wabush and Labrador City (Figure 4.1).

All of the surface rights are property of the Crown (that is, the federal government of Canada).

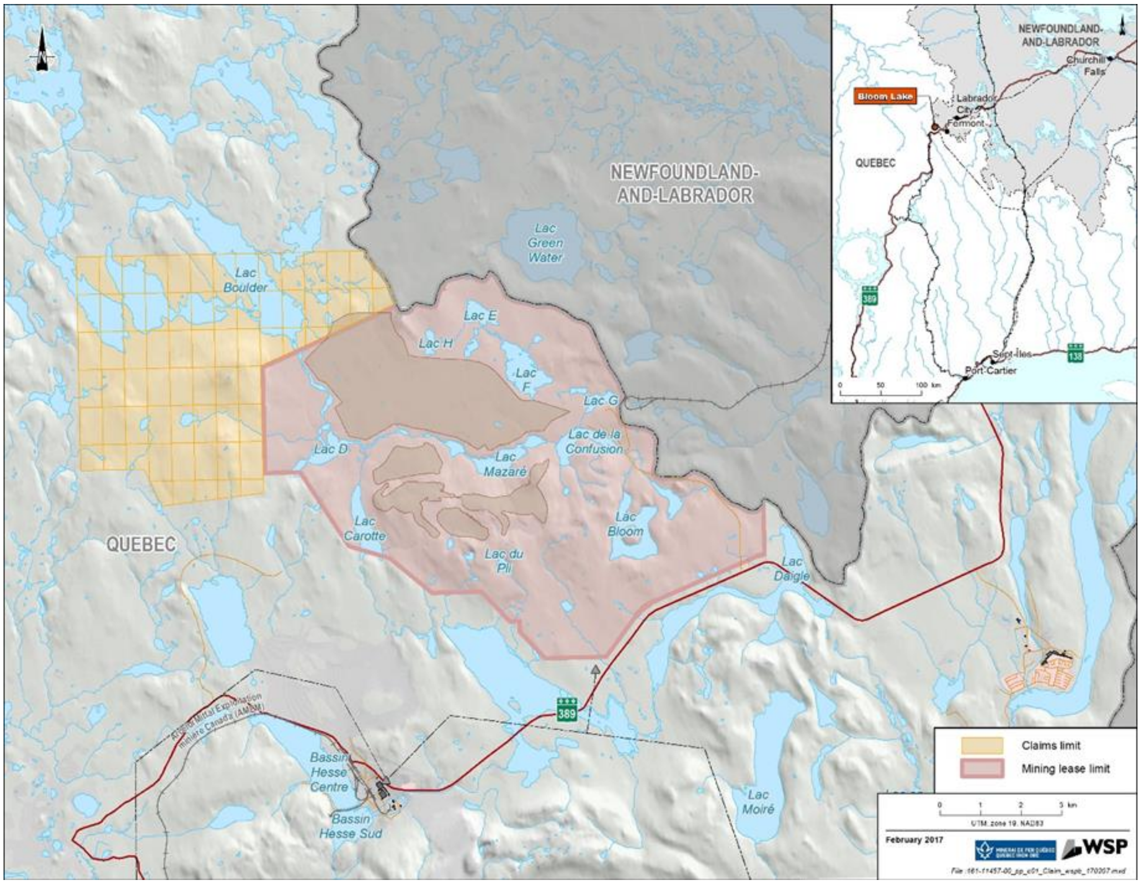


Figure 4-1: Property Overview Map

4.2 Mineral Titles

4.2.1 Nature and Extent of Issuer's Interest

In 2016, QIO was holding 100% of 114 active claims outside of the Mining Lease (BM 877) which has a total of 6857.7 ha. QIO requested the renewal of 69 claims in October 2016. Those claims outside the mining lease remain active. The QIO Mining Lease and claims are listed below:

BM 877
CDC 99894
CDC 99895
CDC 99902
CDC 99903
CDC 99910
CDC 99911
CDC 99918
CDC 99919
CDC 99935
CDC 99936
CDC 99937
CDC 99938
CDC 99939
CDC 99965
CDC 99966
CDC 99967
CDC 99968
CDC 99969
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CDC 2082981
CDC 2188096

4.3 Royalties, Agreement and Encumbrances

There are no royalties, agreements or encumbrances on the mining site.

4.4 Permitting

The mine has already been authorized for operation under the federal environmental authority including Fisheries and Oceans Canada, Transport Canada, Natural Resources Canada and Environment Canada. There is only one pending process with the federal government associated with the 2008 authorization for destruction of fish habitats. The authorization from DFO should be issued in 2017. This process does not prevent QIO from operating the mine.

Overall, a total of 38 certificates of authorization have been issued by the provincial government to the Bloom Lake iron mine in the past and the most relevant are listed in Table 20-1, Section 20. Note that infrastructure such as the pit, waste rock piles, tailing management facilities, water management structure as well as the treatment plant have all been authorized. A few of these authorizations will require modifications to consider the new mine plan including the new waste rock dumps.

4.5 Other Significant Factors and Risks

There are no other known significant factors or risks which have not been disclosed in this report.

5 Accessibility, Climate, Local Resources, Infrastructure and Physiography

5.1 Access

The mine site lies approximately 13 km west of the town of Fermont (central geographical coordinates 52° 50' N and 67° 16' W). A 5-km access road has been constructed to connect the Bloom Lake mine with Highway 389. It is accessible by road from Baie-Comeau on the north shore of the Saint Lawrence River, as well as by road from the Wabush airport in Newfoundland & Labrador. The Wabush airport is located approximately 30 km from the Bloom Lake mine. The mine site is located approximately 950 km northeast of Montreal.

The rail access to port consists of three separate segments. The first segment is the rail spur on site, consisting of a 31.9-km long segment that is operational and connects to the Quebec North Shore and Labrador (QNS&L) railway at the Wabush Mines facilities in Wabush, Labrador. This first segment belongs to QIO. The second segment employs the QNS&L railway from Wabush to Arnaud Junction in Sept-Îles and from there, the third section is from Arnaud junction to Pointe-Noire (Sept-Îles), property of “Les Chemins de Fer Arnaud”, Sept-Îles, Quebec, where the concentrate will be unloaded, stockpiled, and loaded onto vessels. The third segment is owned by the Government of Quebec through the Société du Plan Nord, which acquired these assets from Cliffs’ CCAA.

5.2 **Climate** (Source: Environment Canada)

The climate at Fermont is defined as sub-arctic with temperatures ranging from -40 C to +25 C. The prevailing winds are mostly from the west at an average speed of 14 km/h. Average daily maximum temperatures above freezing normally starts in April and falls below freezing by end of October.

5.3 Local Resources, Infrastructure

The town of Fermont has a population of 2874 as per Statistics Canada, and is the residential town for employees working for ArcelorMittal’s Mont-Wright mine operations. The town has all the required infrastructure to support the employees and families who live in this town. As part of the purchase of the Bloom Lake mine, QIO acquired the following accommodations, which are in the town of Fermont:

- 4 houses located on *rue des Mélèzes* (with 5 rooms each and built in 2012)
- 22 houses, fully furnished, located on *rue des Bâtisseurs* (12 with 8 rooms each, 6 with 7 rooms each and 4 with 5 rooms each and built in 2009)
- Two blocks (motels) of 99 rooms of lodging located on *rue du Fer* (built in 2013)

These accommodations are fully equipped with furniture, linen, and wiring for communications and entertainment and can host up to about 700 people on a fly-in-fly-out basis.

The electrical power supply which is currently installed is supplied by Hydro Quebec from the Normand sub-station which is located 12 km from the mine. The previous owner, Cliffs, was preparing for an expansion of the operations which would have doubled the production capacity. As part of this preparation, the high voltage power lines were upgraded to be able to handle a further 30 Mw. QIO owns a 315 kV station including 2 x 80 MVA transformers. QIO’s current plans for a moderate increase in production capacity and further tailings pumping will use only a small fraction of this surplus electrical power availability (68 MW authorized by Hydro-Québec).

A spare parts inventory representing a total of CAN $43.6 M, as estimated in October 2014 (before the mining operations stopped), is currently available for the future operations. Moreover, all equipment including a mining fleet sufficient to support future operations and infrastructure dedicated to future expansion planned by the previous owner is still at the site, and is available for the current project. The following is a partial list of equipment that can be used for spares or will be used to reduce the actual project cost:

- Water and slurry pumps ranging from 25hp – 1250hp (qty.: 70)
- Automatic sliding gate or butterfly valves ranging from 6 in to 24 in (qty.: 120)
- Flowmeters ranging from 1.5 in to 20 in (qty.: 70)
- Full set of Metso AG mill liners and wear components
- AG mill gear and 2 complete motor/gearbox/pinion set
- Complete AG mill electrical drive components and lubrication system
- Phase 2 electrical cabling (control cables (100%), low voltage cables (75%) and medium voltage cables (10%))
- Medium and low voltage variable speed drives and motor starters up to 2000 hp for complete plant
- Power distribution components (protection relays, MCC, distribution panels, medium and low voltage transformers, etc.)
- Complete automation system and control panels
- Miscellaneous accessories related to plant services (fire protection, air/steam distribution, etc.)

5.4 Physiography

The relief of the claims area is relatively hilly. The average elevation varies between 671 m and 762 m and the highest peaks culminate at about 808 m.

6 History

6.1 Prior Ownership and Exploration

In 1951, following the discovery of a cobalt showing at Bloom Lake, James and Michael Walsh staked claims for Mr. Bill Crawford of Sursho Mining Corporation (SMC). In February 1952, Quebec Cobalt and Exploration Limited (QUECO) was incorporated to acquire the claims held by SMC.”

In 1952, a crew of six prospectors under the supervision of Mr. K. M. Brown began a program to prospect an area that included the Bloom Lake property. In June 1952, Mr. R. Cunningham, a mining geologist with Québec Metallurgical Industries, began to map the various cobalt occurrences at Bloom Lake. Although the results for cobalt were disappointing, several zones of magnetite-hematite iron formation (IF) were identified between Bloom Lake and Lac Pignac and were sampled. Further exploration was conducted in 1953.

In 1954, Cunningham supervised a program to investigate the iron occurrences through line cutting, geological mapping, and magnetometer surveys. In 1955, Jones and Laughlin Steel Corporation (J&L) optioned the property from QUECO. Cleveland-Cliffs Iron Company (CCIC) joined with J&L and conducted a diamond drill program from 1956 through 1957. Two drills were brought to the property and two series of holes, the "QC" and the "X" series, were drilled to test IF on the Bloom Lake property. Holes X-1 to X-11 (XRT - ¾" diameter core) amounted to 446 m and Holes QC-1 to QC-30 (AXT size 1.28" diameter core) totalled 4,769 m. The holes were largely drilled on sections 800 to 1,000 ft. apart (244 to 305 m). Four of these drillholes were drilled on the west part of the property.

More drilling was conducted in 1966 by Boulder Lake Mines Incorporated, a subsidiary of CCIC, and Jalore Mining Company Limited (Jalore), a subsidiary of J&L. Holes X-12 to 20, totalling 175 m, and other holes were drilled as part of this campaign, but these were not on the present property. Some ground magnetometer surveying was also conducted in 1966. J&L's option on the property was terminated in 1968.

In 1971, exploration on the property was renewed by a QUECO-sponsored program that was managed by H. E. Neal & Associates Ltd. (HEN). The exploration program consisted of line cutting, geological mapping, gravity and magnetometer surveys, and diamond drilling in 1971 and 1972.

These holes were drilled to investigate the potential for IF beneath the amphibolite on the eastern side of the property. Nine drillholes were done in 1971 for a total of 1,834.23 m (341 samples) and 12 were drilled in 1972 (3,497.79 m and 341 samples). Eight of the drillholes were done on Bloom Lake West in 1971 and five were drilled in 1972. The mapping and magnetometer surveys were designed to fill in areas not previously surveyed. The gravity survey was conducted to help evaluate the potential for IF beneath the amphibolite.

In 1973, Republic Steel Corporation optioned the property and HEN prepared a “Preliminary Evaluation” of the property that consisted of currently held property and claims further to the west. This work was conducted until 1976. The evaluation included “mineral reserve” estimates, a metallurgical test program, and preliminary mine design. The mine design included pit outline, dump area, access roads, and railway spur. Dames and Moore prepared the mine design and “reserve” estimates. Lakefield Research (Lakefield) conducted the metallurgical test work.

In 1998, a major exploration program was conducted by Watts, Griffis and McOuat (WGM) for QCM, which then held the Bloom Lake property under option from Consolidated Thompson-Lundmark Gold Mines Limited (CLM). QCM held the option on the property until 2001, but no work was conducted between 1998 and 2005. The 1998 program included line cutting, surveying, road building, camp construction, diamond drilling, geological mapping, mini-bulk sampling, bench-scale preliminary metallurgical test work, preparation of a "mineral resource" estimate, camp demobilization, and site clean-up.

In 2005, CLM retained WGM to conduct a technical review, including the preparation of a mineral resource estimate for the Bloom Lake iron deposit to assist CLM in making business decisions and future planning. The technical review was prepared in compliance with the standards of NI 43-101 in terms of structure and content. The mineral resource estimate was prepared in accordance with NI 43-101 guidelines and CIM standards. In 2006, Consolidated Thompson-Lundmark Gold Mines Limited changed the name of the Company to Consolidated Thompson Iron Mines Limited. This name change reflected the Company's focus on iron ore mining and exploration.

From 2006 to 2007, CLM drilled 17 drill-holes (2,884.36 m) on the site of the future pit in order to get a sample for metallurgical test work. The Lakefield laboratory performed these tests. In 2006, bulk sampling took place in the area of the future pit.

Cliffs acquired CLM in May 2011. Quebec Iron Ore Inc., owns the Bloom Lake property and the facilities since April 12, 2016.

Overall, 243 drill-holes were made between 1957 and 2009 for a total of 45,386 metres and 273 drill-holes in 2010, 2012 and 2013 for a total of 89,197 meters. Four geotechnical holes have been drilled in 2014. The complete description of the drill programs are described in section 10.

6.2 Historic Production

In 2008, CLM started the construction of the plant. In December 2009, the plant was in the starting phase. Tables 6-1 show production from 2010 to 2014 in Dry Metric Ton per Year.

Table 6-1 : Production at the Bloom Lake Mine from 2010 to 2014 in Dry Metric tonnes per Year

	2010	2011	2012	2013	2014 [1]	2015	2016
Iron Ore mined	10,254,914	16,860,407	16,984,149	17,615,793	19,306,207	0	0
Iron Ore processed	8,201,688	15,604,183	15,833,945	18,429,598	18,883,848	0	0
Iron Ore concentrate production	3,166,297	5,466,155	5,450,228	5,876 761	5,940,442	0	0

[1] Production halt in mid-December 2014

7 Geological Setting

7.1 Regional Geology

The Bloom Lake Iron Deposit lies within the Fermont Iron Ore District (FIOD), a world-renowned iron-mining camp at the southern end of the Labrador Trough within the geological Grenville Province. Figure 7–1 shows the geographic location of the Bloom Lake mine. The Labrador Trough extends along the margins of the eastern boundary of the Superior-Ungava craton for more than 1,200 km and is up to 75 km wide at its central part. The Bloom Lake deposit, including the Bloom Lake West property, is located within the Parautochton Deformation Belt of the Grenville Province of the Canadian Shield, just south of the Grenville Front. The Grenville Front, the northern limit of the Grenville Province, truncates the Labrador Trough, separating the Churchill Province greenschist metamorphic grade part of the Labrador Trough rocks from the highly metamorphosed and folded amphibolite to granulite metamorphic grade rocks, which are their equivalent in the Grenville.

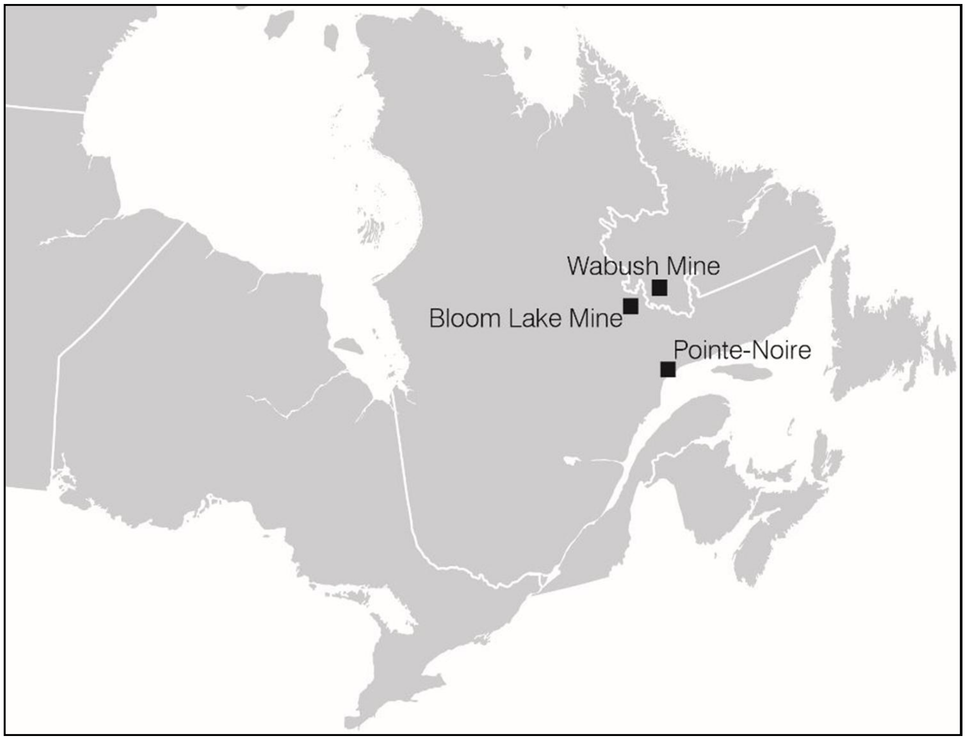


Figure 7–1: Geographical Location of the Bloom Lake Mine

The western half of the Labrador Trough, consisting of a thick sedimentary sequence, can be divided into three sections based on changes in lithology and metamorphism (north, central and south). The Trough is comprised of a sequence of Proterozoic sedimentary rocks including iron formations, volcanic rocks and mafic intrusions known as the Kaniapiskau Supergroup. The Kaniapiskau Supergroup consists of the Knob Lake Group in the western part of the Trough and the Doublet Group, which is primarily volcanic, in the eastern part. The Kaniapiskau Supergroup within the Grenville is highly metamorphosed and complexly folded and is named the Gagnon Group. It occurs as numerous isolated segments. From the base to the top, it includes a sequence of gneisses and schists, a group of chemically precipitated sediments, and more schists, including some distinctive aluminous varieties. Gabbro sills intrude parts of the Gagnon Group, and granites are found in the gneiss.

The Central or Knob Lake Range section extends for 550 km south from the Koksoak River to the Grenville Front located 30 km north of Wabush Lake. The principal iron formation unit, the Sokoman Formation, part of the Knob Lake Group, forms a continuous stratigraphic unit that thickens and thins from sub-basin to sub-basin throughout the fold belt.

The southern part of the Trough is crossed by the Grenville Front. The rocks in the Grenville Province to the south are highly metamorphosed and complexly folded. Iron deposits in the Grenville part of the Labrador Trough comprise Bloom Lake, Lac Jeannine, Fire Lake, Mounts Wright and Reed, and the Luce, Humphrey and Scully deposits in the Wabush area. The high-grade metamorphism of the Grenville Province is responsible for recrystallization of both iron oxides and silica in primary iron formation, producing coarse-grained sugary quartz, magnetite, specular hematite schists (meta-taconites) that are of improved quality for concentrating and processing.

Figure 7–2 shows the simplified geological map of the Labrador Trough.

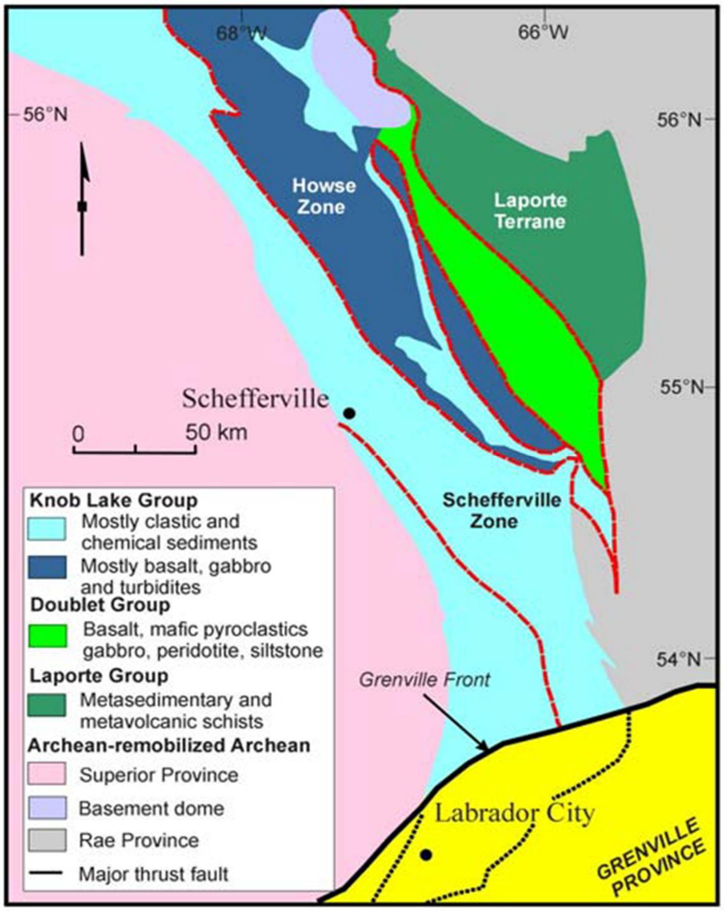


Figure 7–2: Simplified Geological Map of the Labrador Trough (from Gross, 2009)

In the region, at least two stages of deformation are recognized. The first stage produced linear belts that trend northwest, like the well-defined structural trends in the central part of the Labrador geosyncline; the second stage formed linear belts that trend east to northeast, parallel with the major structural trends developed in the Grenville Province. Folds now present reflect both stages of deformation in form and orientation. For example, in the Wabush Lake area, folds trend N20ºE and in the central part of the area, around Lamelee Lake and Midway Lake, N35°W. Isoclinal and recumbent folds overturned to the west or southwest are common, and it is inferred that this deformation produced thrust faults striking northwest and dipping east. Structures developed during the earlier stage of deformation are believed to have been similar to those now seen in the central part of the Labrador geosyncline, and it is highly probable that the structures produced by this early stage of deformation in the south and those in the central and northern regions were the result of the same orogeny.

The second stage of structural deformation took place during the Grenville orogeny between 0.8 and 1.2 Ga years ago. Its effects are not so intense north of Wabush Lake near the margin of the Grenville belt as they are throughout the region to the south. Near the margin of the Grenville belt cross-folds trending east or northeast appear to be superimposed on the earlier northwest-trending structures. Around Mount Wright and farther south, the trend of the overall structure is east to northeast and the prevailing dip of foliation is 55°N. Tightly folded and faulted structures developed during the earlier stage of deformation were further deformed by folding and faulting during the Grenville orogeny. Oblique sections through the resulting complex fold structures are exposed at the present erosion surface. Many of the minor folds appear to plunge steeply to the northwest, but the axes of these folded folds are not straight for any appreciable distance.

Regional structures developed during the Grenville orogeny play out against the stable craton area of the ancient Superior Province. Folds and faults along the northwest margin of the Grenville Province trend west, and the general pattern of folds overturned to the south or southeast formed in conjunction with north-dipping reverse faults indicates overriding of the northerly blocks towards the southeast. The relative amount of movement between adjacent fault blocks is suggested by the position of iron-formation in local structures. At Bloom Lake, iron-formation is present in a relatively simple syncline which extends to a much greater depth than that in the Boulder Lake basin situated at the north. Still farther south at Mount Wright, the erosion surface cuts the upper part of steeply plunging folds. Southeast from the margin of the Grenville belt, the dips of westerly striking faults are progressively less steep, and the greatest amount of movement appears to have taken place between the Bloom Lake fault block and the Mount Wright block.

The iron-formation and associated metasedimentary rocks, which were derived from an assemblage of continental shelf-type sediments, do not appear to extend south beyond a line trending northeast from the Hart-Jaune River linear to Plaine Lake and northeast to Ossokmanuan Lake. Granite-gneisses, charnockites, and anorthosites are part of the rock assemblage south of this line. These typical deep-seated Grenville rocks may have been thrust northwest along a system of faults that coincide with this line. The large suite of gabbro intrusions in the area between Wabush Lake and Ossokmanuan Lake probably were intruded along faults in this linear zone.

7.2 Local Geology

7.2.1 General

The geology and geological interpretation for the Bloom Lake property are based on data from a number of sources. These sources include the diamond drilling and mapping done on the property as part of the 1998 program, presented by Watts, Griffs and McOuat in 2005, as well as the drilling conducted in 1956, 1957, 1967, 1971, 1972 and 2007-2014 programs. The geological interpretation relies heavily on the mapping programs conducted in 1952 and the ground magnetic surveys carried out in 1967 and 1971/72 as compiled in 1973 and the survey done in April 2008. The Calculated Magnetic Vertical Gradient in the Bloom Lake area is presented in Figure 7–3.

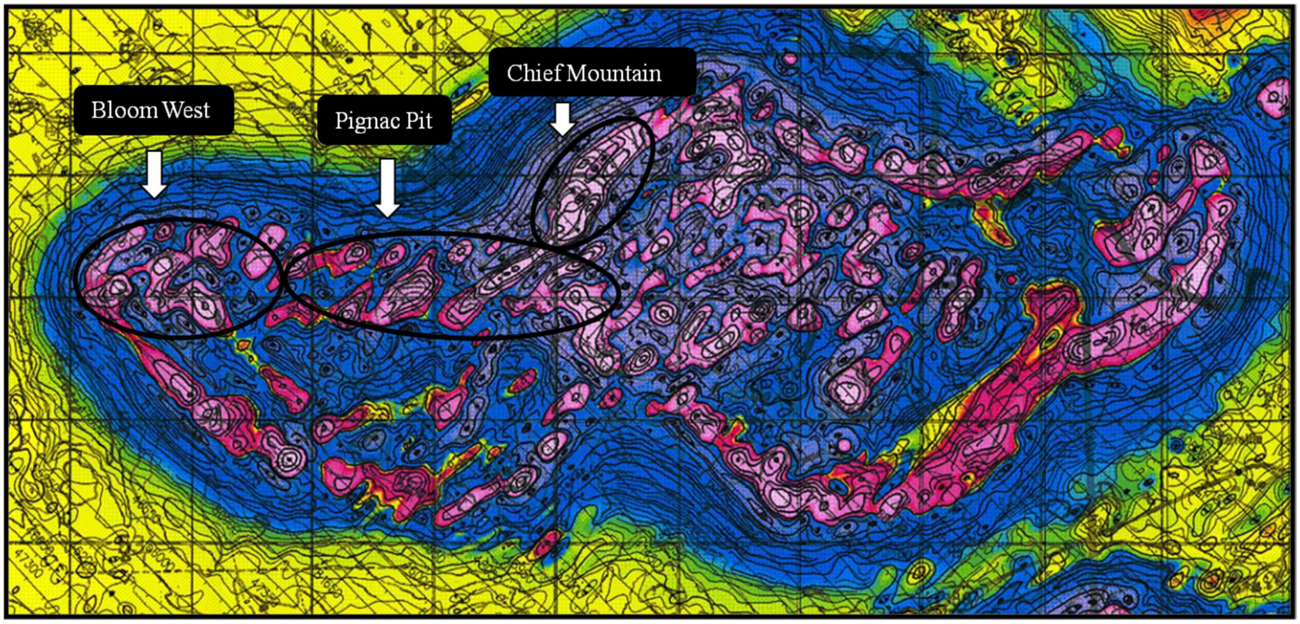


Figure 7–3: The Calculated Magnetic Vertical Gradient in the Bloom Lake Area

The following local geology description and structural interpretation are mostly from Genivar's Technical Report (2009).

Several rock type codes are hybrid codes of the main rock types and are not described separately.

Gneiss (GN)

With the current knowledge, gneiss constitutes the basic unit for meta-sedimentary rocks. This rock presents a typical banding varying from 1 cm to 2 m. Most of its composition is mafic, the felsic bands are dominated by feldspars with quartz in minor quantity. Biotite is abundant through the gneiss and many transitions to mica schists occur. The gneiss contains less mica but more feldspar and quartz than QRMS (see below). The basal QRMS sequence consists mostly of muscovite and biotite schist with characteristic porphyroblasts of garnet and feldspar.

Quartz Rock (QR) and its Related Variant Quartz Rock Iron Formation (QRIF)

QR is used to define a rock type consisting mostly of quartz, 95%+, vitreous, grey or pinkish color, with minimal to nil specularite and/or magnetite content. This material may have been derived from chert, quartzite or quartz pebble conglomerate and the various textural varieties are not distinctly coded or distinguished.

QRIF intervals were defined on the basis of a quartz dominant rock containing less than 15% total iron, but containing some iron in the form of specularite and/or magnetite or silicate. QRIF is therefore a rock often transitional between IF and QR, or SIF and QR. The QRIF may contain minor actinolite-SIF.

Quartz Rock Mica Schist (QRMS)

It is used mainly for the schist sequence at the base of the IF sequence beneath the QR unit. QRMS has occasionally, however, been used for coding biotite-rich units within the IF sequence, which are likely genetically related to AMP.

Silicate Iron Formation (SIF)

Two main types have been recognized on the property. One of these is dominated by actinolite, while in the other, grunerite is most prevalent. The two types can be transitional into one another and likely there is also some tremolite-rich SIF present. Actinolite-SIF also tends to occur on the borders of the thinner amphibolite units towards the lower part of the stratigraphic sequence. The IF in these areas is also often enriched in magnetite as compared with specularite. These units are less abundant in the west part of the property than in the eastern half of the Bloom Lake pit area and Chief's Peak.

Amphibolite (AMP)

It is dominantly a competent, dark green to black, medium to coarse grained rock consisting mainly of hornblende, biotite and feldspar. This rock is relatively homogeneous and marked by a very pronounced foliation. Grain size varies widely. The occurrence of millimetric reddish garnet is observed over distances of 10 metres. The amphibolite-IF contacts are sharp. A narrow argillized zone of amphibolite often occurs immediately above the IF contact.

Gabbro

Bodies of medium-grained gabbro and amphibolite stand as hills among the quartz-bearing rocks of the Gagnon Group. They were apparently injected into the competent rocks during deformation and themselves remobilized during the later stages of metamorphism. The gabbro was originally ophitic in texture with speckled textures into foliated amphibolite. Gabbro is more common in the northern part of the injected zone and amphibolite is more present in the southern part. In places, gabbro cores remain in the centre of thick amphibolite sills. The typical gabbro of this type contains 40 to 50 percent plagioclase with other mafic minerals (olivine, hypersthene) and a few percent of opaque oxides.

7.2.2 Structural Geology

The Bloom Lake deposit comprises gently plunging synforms on a main east-west axis separated by a gently north to northwest plunging antiform. One of these synforms is centred on Triangle Lake, while the centre for the other is located just north of Bloom Lake. The Bloom Lake property is centred primarily on the eastern synform but covers a portion of the northern limb of the western synform.

These synforms are the result of a minimum of two episodes of folding and are of regional scale.

In addition to these regional scale folds, which have created the deposit scale synforms shaping the Bloom Lake deposit, there are several other folds of diverse orientation on the property. It is not clear if all folding directions represent distinct folding episodes or progressive change in fold orientation with time.

Figure 7–4 shows the structural features of the Bloom Lake deposit as defined in 2013 in the geological model which interpretation was based on exploration drill holes and ore control data.

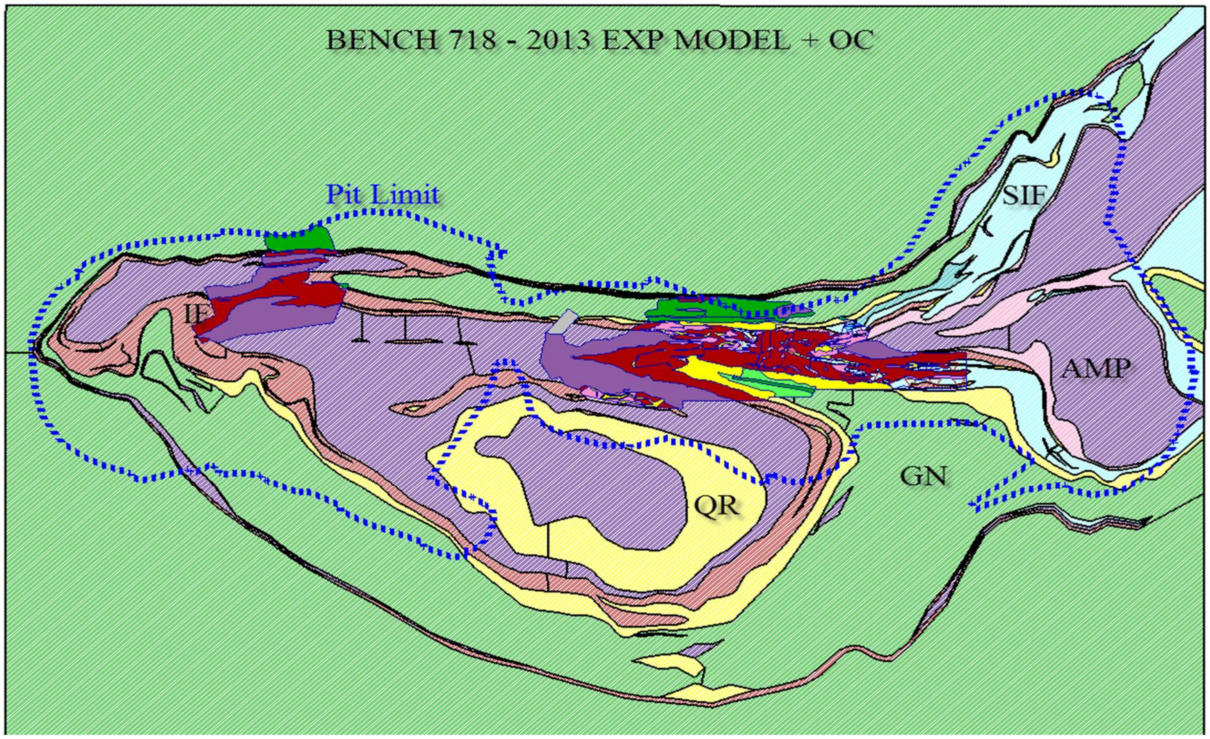


Figure 7–4: The Structural Features of the Bloom Lake Deposit

Clearly visible on the ground magnetic survey map, a major discontinuity oriented north-north-east can be seen in the central portion of the west part. In drill hole, many gravels, gouges, muddy and brecciated zones are clearly associated with it, suggesting a fault zone. More so, difficulties in correlating orebodies on each side of the possible fault strongly militate in that direction.

Also, thorough interpretation of geomorphic lineaments from aerial photographs demonstrates a north-north-east tendency, it is important to note that Triangle Lake and associated stream configuration suggest a north-north-west discontinuity associated with the north-north-east one.

7.3 Mineralization

The Bloom Lake deposits are about 24 km southwest of Labrador City and about 8 km north of the Mount Wright range. The western 6 km of this range contains very large reserves of specular hematite-magnetite iron-formation in a synclinal structure that is regarded as a southwest extension of the Wabush Lake ranges.

The iron-formation and quartzite are conformable within a metasedimentary series of biotite-muscovite-quartz-feldspar-hornblende-garnet-epidote schists and gneisses in a broad synclinal structure. This succession, following the first stage of folding and faulting, was intruded by gabbroic sills which were later metamorphosed and transformed into amphibolite gneiss with foliation parallel with that in adjacent metasediments. Two separate iron-formation units are present; these join northwest of Bloom Lake, but are separated by several dozen meters of gneiss and schist in the southern part of the structure. Quartzite, present below the upper member throughout the eastern part of the area, pinches out near the western end. Folded segments and inclusions of iron-formation in the central part of the syncline that are surrounded by amphibolite, are in most cases thought to be part of an overlying sheet that was thrust over the main syncline during the first period of deformation. The large amphibolite mass in the central part of the area was apparently emplaced along the zone of weakness created by this early thrust fault.

Iron-formation in the western 5 to 6 kilometers of the structure is predominantly of the magnetite-hematite-quartz facies that forms the major zones of potential ore. Hematite is distributed in two ways through the quartzite. The hematite is of the specularite type and has a silvery-grey colour and is non-magnetic. It is most often occurring as anastomosing to discontinuous stringers and bands less than 10 cm thick in a quartz or actinolite-quartz matrix. Bands tend to be folded and deformed but also can be regular and tabular. Quartz is milky and granular.

Magnetite typically occurs in narrow millimetric veinlets associated with quartz-carbonate veining material. The crystals are sub- to euhedral and demonstrate the typical dull to sub- metallic luster. When associated to hematite-enriched mineralization, the magnetite occurs as blebs of porous grains, often granoblastic, that may extend up to several centimetres. Enriched magnetite horizons are mostly found, but not always, in the upper portion of the iron formations in close contact with the amphibolite mass.

With the actual state of geological knowledge in the western sector of the Bloom Lake deposit, magnetite-rich IF are less important in volume than in the eastern half of the Bloom Lake pit area. The thickness of drillhole intercepts is lower than 10 vertical metres. Many drill holes did not return significant magnetite intersections. Very few actinolite or grunerite minerals associated with magnetite mineralization were described in the western holes.

A fairly abrupt change in facies takes place along strike east of a line passing northwest across Bloom Lake, east of which the grunerite-Ca-pyroxene-actinolite-magnetite-carbonate facies predominates. The oxide facies to the west is uniform.

The lower unit is less than 30 meters thick in some places and is considerably thinner than the upper unit. The iron content ranges from 32 to 34 per cent in this facies. In places the silicate-carbonate facies to the east contains more than 50 per cent cummingtonite, which in part is magnesium rich, and the manganese content ranges from 0.1 to more than 2.0 per cent. Mueller (1960) has studied the complex assemblage of minerals in this rock and has discussed chemical reactions during metamorphism in considerable detail. He has shown that a close approach to chemical equilibrium in the amphibolite metamorphic facies is indicated by the orderly distribution of Mg, Fe, and Mn among coexisting actinolite, Ca-pyroxene, and cummingtonite, and the restriction in the number and type of minerals in association with each other. Furthermore, a comparison between the composition of the silicates and the presence or absence of hematite shows that the Mg to Mg plus Fe ratio is increased, but is much less variable when hematite is present.

Recent re-modelling of the deposit (2014) added 2 new domains in the ore classification (MAG – Magnetite Iron Formation and WSIF – Grunnerite-rich Iron Formation) in addition to the existing HEM (Hematite Iron Formation) and SIF (Silicate Iron Formation). Figure 7–5 presents the distribution of the four domains.

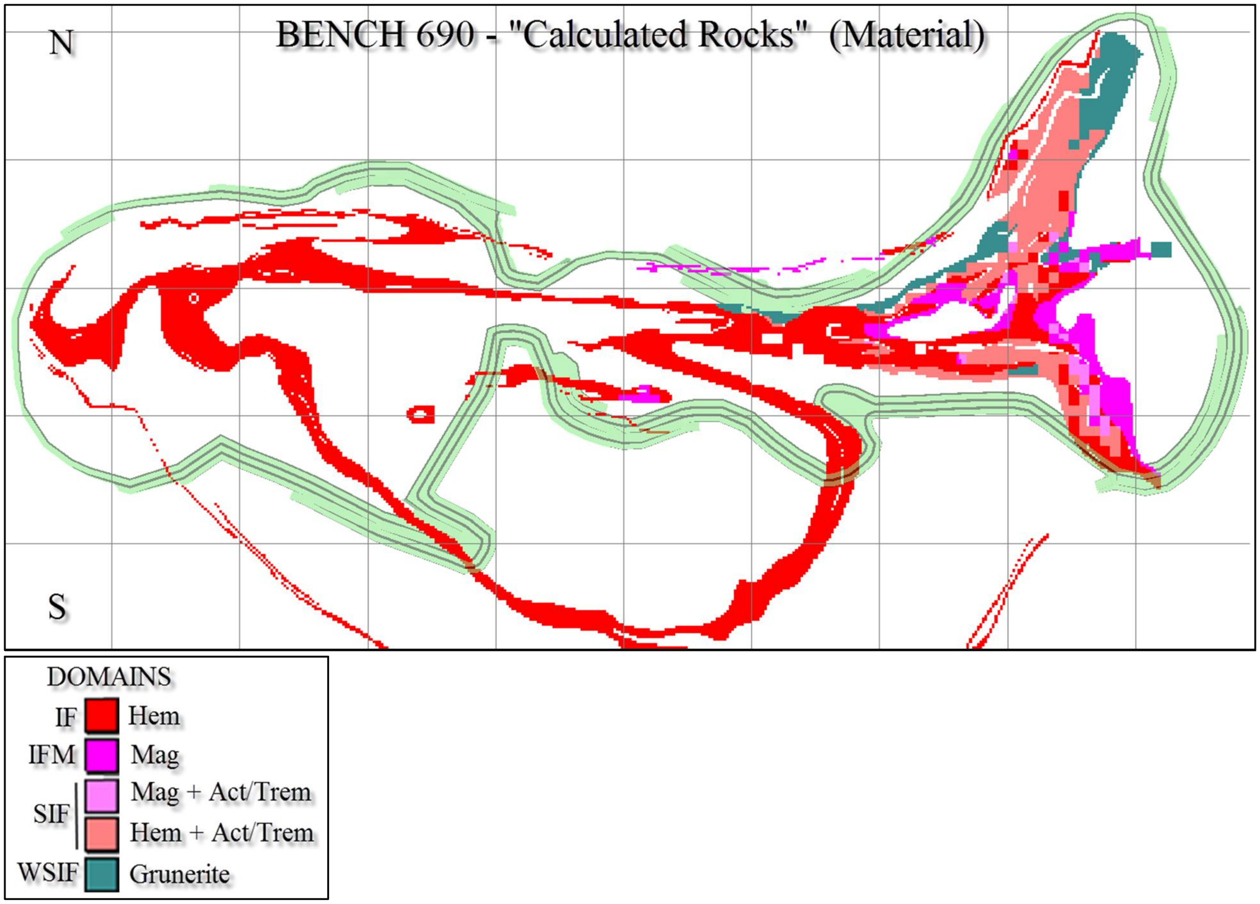


Figure 7–5: The Distribution of the 4 IF Domains

The iron-formation forms a long doubly plunging syncline which is canoe-shaped but buckled across the centre to produce two distinct oval-shaped basins. Although this structure appears to be relatively simple in form, it seems to have been developed during two stages of deformation. Folding along northwest-trending axes and overthrusting of the upper iron-formation during the first stage of deformation appear to have been followed by gabbro intrusion, folding along east-west axes, faulting, and metamorphism during the Grenville orogeny.

8 Deposit Types

Bloom Lake property mineralization style is a deposit typical of the Superior-Lake type.

The peaks in iron sedimentation took place between ~2.65 and 2.32 Ga and again from ~1.90 to 1.85 Ga. Their deposition is linked to geochemical and environmental evolution of Earth, the Great Oxidation Event (GOE) at ca. 2.4 Ga, the growth of continents as well as to mantle plume activity and rapid crustal growth (see Figure 8–1).

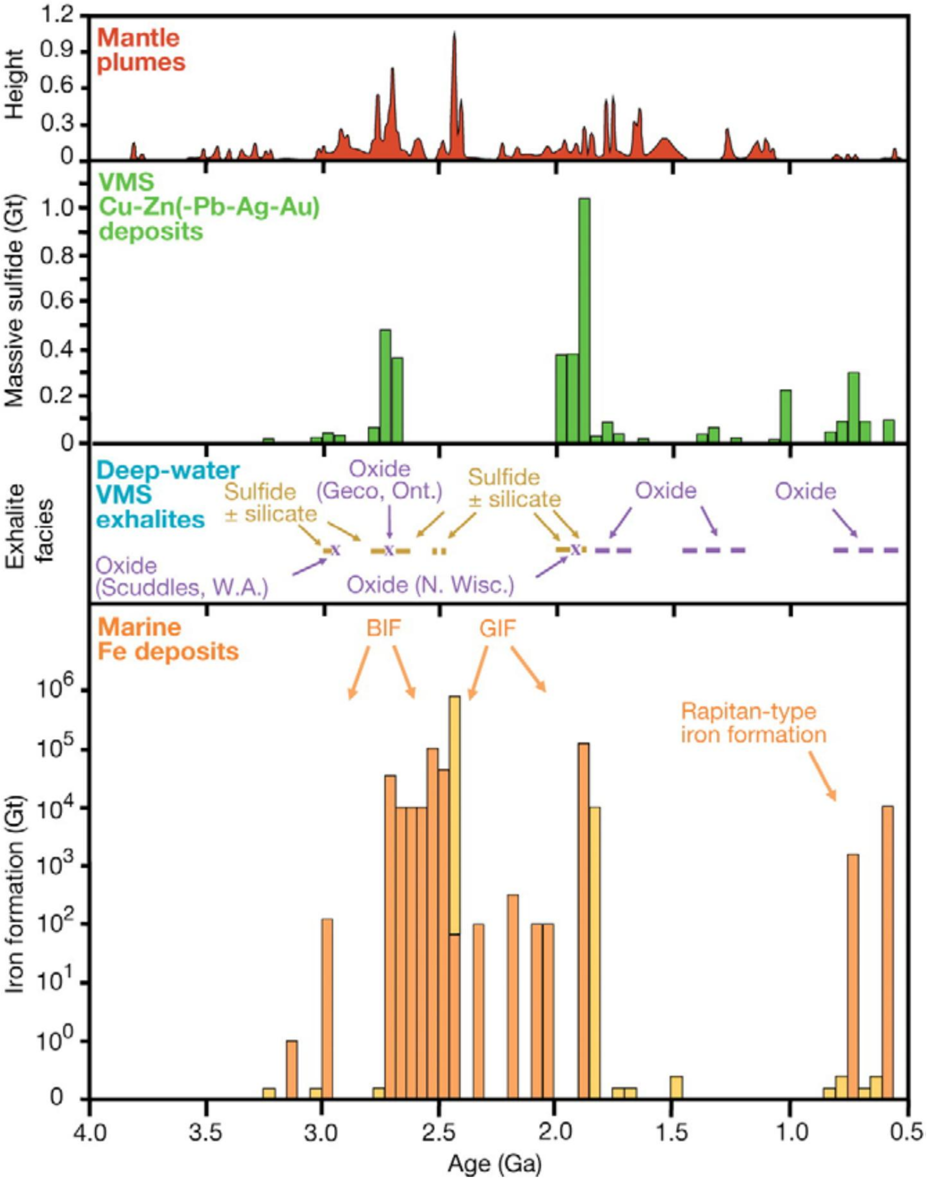


Figure 8–1: Time Distribution of the Iron Formation Deposition (from Bekker et al., 2010)

The Labrador Trough contains four main types of iron deposits:

1. Soft iron ores formed by supergene leaching and enrichment of the weakly metamorphosed cherty iron formation; they are composed mainly of friable fine grained secondary iron oxides (hematite, goethite, limonite).
2. Taconites, the fine-grained, weakly metamorphosed iron formations with above average magnetite content and which are also commonly called magnetite iron formation.
3. More intensely metamorphosed, coarser-grained iron formations, termed metataconites which contain specular hematite and subordinate amounts of magnetite as the dominant iron minerals.
4. Minor occurrences of hard high-grade hematite ore occur southeast of Schefferville.

Secondary enrichment included the addition of secondary iron and manganese which appear to have moved in solution and filled pore spaces with limonite-goethite. Secondary manganese minerals, i.e., pyrolusite and manganite, form veinlets and vuggy pockets. The types of iron ores developed in the deposits are directly related to the original mineral facies. The predominant blue granular ore was formed from the oxide facies of the middle iron formation. The yellowish-brown ore, composed of limonite-goethite, formed from the carbonate-silicate facies, and the red painty hematite ore originated from mixed facies in the argillaceous slaty members.

All iron ore deposits in the Labrador Trough formed as chemical sediments on a continental margin which were lithified and variably affected by alteration and metamorphism that had important effects upon grade, mineralogy and grain size. Faulting and folding led to repetition of sequences in many areas, increases the surface extent and mineable thicknesses of the iron ore deposits. Underlying rocks are mostly quartzite or mica schist. Transition from these rocks and the mineralized iron formation may take place over up to 10 meters vertically. All rock sequences have been heavily metamorphosed by intense folding phases that are part of the Grenville Orogen.

IF sequences range commonly from 25% to 40% iron oxide, mainly hematite of the specularite type with minor amount of magnetite (remainder mostly quartz) and can have thicknesses (ignoring minor intercalated bands of schist and quartz rock) of up to 200 m. It is these sequences that are of economic importance.

For iron formation to be mined economically, the iron content must generally be greater than 30%, but also iron oxides must be amenable to concentration (beneficiation) and the concentrates produced must be low in manganese and deleterious elements such as silica, aluminum, phosphorus, sulphur and alkalis. For bulk mining, the silicate and carbonate lithofacies, as well as other rock types interbedded within the iron formation, must be sufficiently segregated from the magnetite. Iron formations repeated by folding are often required to produce sufficiently thick sections for mining in the Mont-Wright / Wabush area.

9 Exploration

While construction phases were implemented at the Bloom Lake project, CLM continued to explore west of the future pit operation, between Triangle and Carrot lakes. This sector was targeted, based upon a regional airborne magnetometric survey made by the Geological Survey of Canada.

253 drill holes were made between 1957 and 2009 for a total of 45,694 metres and 278 drill holes in 2010, 2012 and 2013 for a total of 90,096 meters. Four geotechnical holes have been drilled in 2014 (GT-14-07, GT-14-08, GT-14-09, GT-14-10).

The complete description of the drill programs is described in the following section.

A detailed ground magnetometric survey was done between longitudes 612200 m E and 614100 m E and between latitudes 5854600 m N and 5855800 m N. Geophysique TMC of Val D'Or, Quebec did the survey in April 2008 using a Geonics GEM-19 magnetometer.

Drilling and geophysics outlined several outcropping mineralized zones that were subsequently targeted for mechanical stripping.

10 Drilling

10.1 Introduction

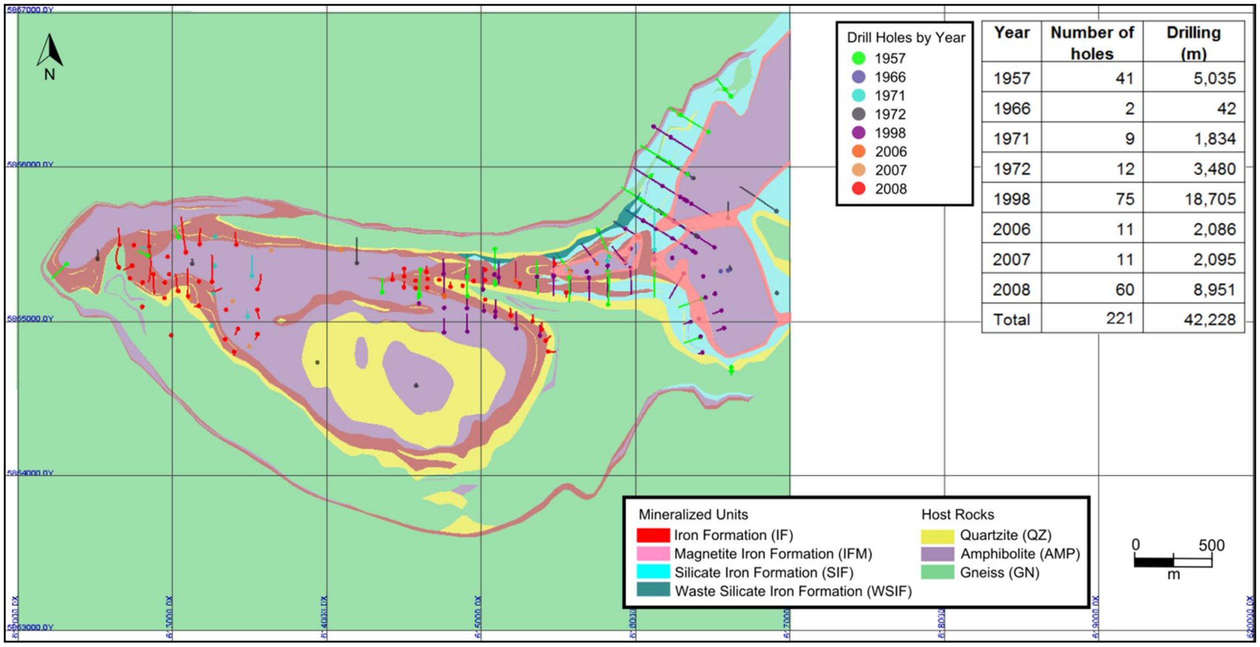
All of the data related to drilling done on the property are on the UTM NAD 83 geographical coordinates. The territory is covered by zone 19. All the previous coordinates were converted in that system.

10.2 Previous Drilling

Most of information for the 1957 - 2008 drilling programs have been summarized in Genivar report (2009) and are presented below. This drilling information was used by BBA to create a block model in 2009. The drilling programs continued in 2009, 2010, 2012 and 2013, and the new information was used to create a new block model in 2014.

10.3 Drilling Programs 1957 - 2008

The Bloom Lake west area was drilled during the years 1957 to 2008, following two dominant axes. The first one, EW oriented, is located approximately at latitude of 5855400N and the second, on a NS axis at 613250E and 613550E, where cross-sections were established. Figure 10–1 illustrates their position on the property.



Year	Number of holes	Drilling (m)
1957	41	5,035
1966	2	42
1971	9	1,834
1972	12	3,480
1998	75	18,705
2006	11	2,086
2007	11	2,095
2008	60	8,951
Total	221	42,228

Figure 10–1: Exploration Drilling between 1957 and 2008

Following the compilation of the previous results, planning of the first phase of the campaign carried out between November 2006 and December 2008 was based on historical data related to geological compilation and property ground magnetic surveys, as well as on a few existing drill holes. A new ground magnetic survey performed in April 2008 was used to do the interpretation required to plan the next phases of the campaign to better define the zones and their extensions. A set of sections was produced at 75 m intervals at the end of the campaign and covered the whole western area. The drill holes of 2008 were planned in order to properly cover the zones with a 3D spacing of 150 m.

Forage André Roy from St-Isidore, Quebec, was the contractor who did the drilling during this campaign and a BQ size drill core was produced. Towards the end of the campaign, Forage La Virole from Rimouski, Quebec, was the contractor who carried out drilling and NQ size core was produced.

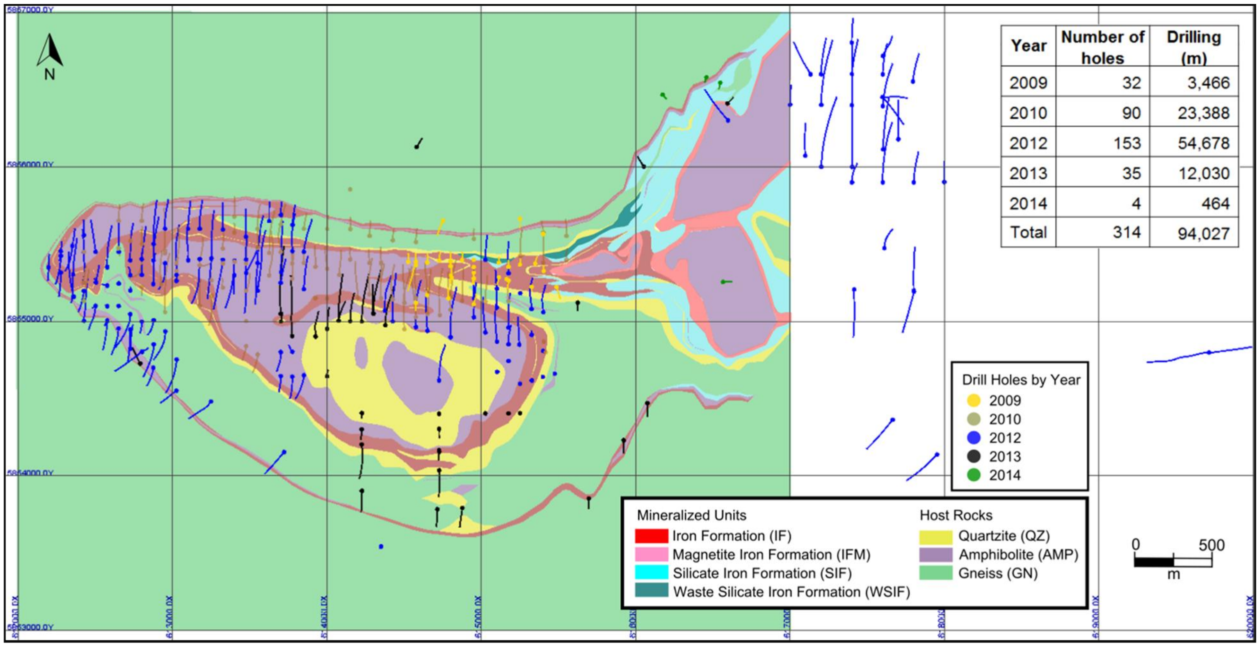
10.4 Drilling Programs 2009 - 2014

The drilling campaigns continued in 2009, 2010, 2012, and 2013. Figure 10–2 illustrates their position on the property.

Most of the holes were drilled in the West Bloom area, as well as in the Bloom Pignac area. Much less drilling was in the Confusion Lake, Carrot Lake and central Bloom areas. All this new information was added to the previous one and a new block model was created in 2014.

In 2014, an exploration drilling campaign was planned, but only four (4) geotechnical holes were drilled.

The drilling contractors have been Forage CCL and Les Forages Lantech Drilling Services Inc. They produced both BQ and NQ size core.



Year	Number of holes	Drilling (m)
2009	32	3,466
2010	90	23,388
2012	153	54,678
2013	35	12,030
2014	4	464
Total	314	94,027

Figure 10–2: Exploration Drilling between 2009 and 2013

Figure 10–3 shows the drill hole location in and near the pit as 2014.

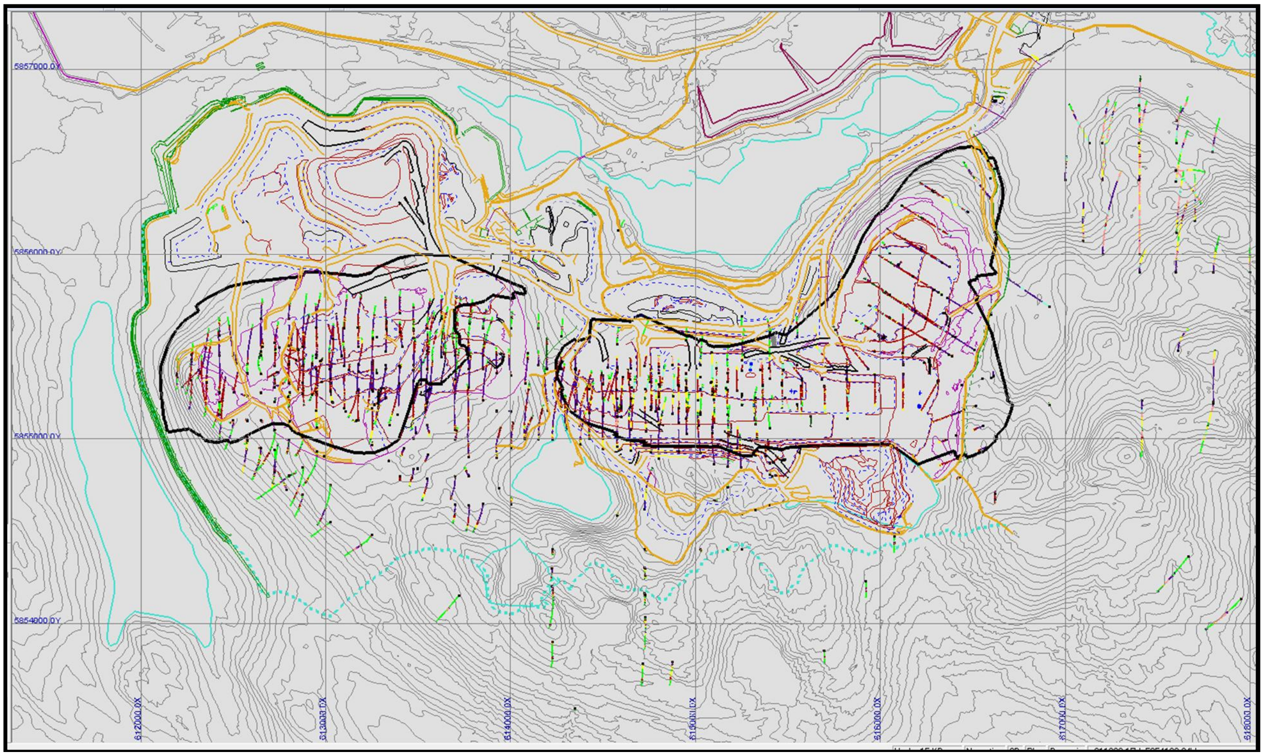


Figure 10–3: The Drill Hole Location in and Near the Pit as 2014

10.5 Drill Hole Locations

The holes were collared on-site with a portable Garmin GPS. This position could vary from a few meters to accommodate drilling, depending on the ground conditions but still, was maintaining the relative position and spacing relative to the other holes.

Drilling azimuth reference was provided through points of coordinates. The use of a compass was not recommended, due to the high level of magnetism developed by some horizons of the underlying iron formations.

10.6 Deviation Tests

Deviation and inclination tests were carried out in the holes. Tests with hydrofluoric acid (HF) were done for the drilling of 2006 - 2008 while, starting 2009, a Flexit instrument was used to measure both orientation and inclination of all the drill holes. This instrument provided useful magnetic susceptibility values. Readings were taken every 15 or 30 meters. All the data obtained with the Flexit instrument were analysed and all the inappropriate data were eliminated if deviation was too large and/or if the magnetic susceptibility was too high. For some 45 holes drilled in 2012 and 2013, deviation and inclination readings were taken with a Gyro instrument every 5 m.

Deviation readings were not taken for many drill holes that were lost or abandoned.

10.7 Collar Surveying

All the drill hole collars were surveyed. The firm of land surveyors, Roussy Michaud from Sept-Îles, put in place stations on the pit site. These points were used as references for positioning the west zone. Surveyors of Roussy Michaud and Consolidated Thompson used a Trimble R8 instrument to survey the drill hole collars.

The inclination and direction of the drill collars were not precisely surveyed. An approximate direction was obtained in aiming at a 3 m rod inserted into the drill hole tubing and then, the direction was verified against Flexit readings for most holes, and against Gyro readings for a few holes.

10.8 Core Shack

The core shack was established in the industrial area of the town of Fermont. It is situated in a large warehouse building used for various purposes. In the core shack area, a number of inclined tables were installed for core logging with several core racks for boxes storage. An area was also organized for sampling and shelves were put in to store sample bags before being shipped to the assay laboratory.

Another closed and locked section contained core boxes of the drilling programs from previous and current campaigns.

Until July 2008, 10 feet drill rods were used. The drillers identified the marks in the boxes using the imperial system and then, a conversion into the metric system was done at the core shack. After July, 3 m rods replaced the 10 feet rods. Drillers also took care of marking the core portions not recovered with wooden sticks. At the drill rig, all the used core boxes were carefully closed with tape and were transported by either snowmobile or ATV to a pick-up truck which brought them to the core shack in the Town of Fermont at the end of each shift. No core box was left outside the core shack.

All the boxes were labelled, photographed in lots of five and most of them were photographed in detail, 3 to 4 pictures being taken for each box. The core boxes were systematically measured to validate the marks of the drillers. Measuring was also done to calculate the RQD and the core recovery.

Most of the core was stored at the mine site.

10.9 Core Logging

The core was logged using standard verified methods. Rock types were identified and intervals were measured according to the marks done by the drillers. Geological logging took into account the general colour of the rock, the relative percentage of constituents, the grain size distribution, the alteration, the contact with other rocks, the texture and the variation of these elements, when significant. A particular attention was given to the orientation of foliations relative to the core axis. This was very useful in the structural interpretation. Geotechnical features in the core, such as core recovery, rock quality designation (RQD), fractures and joints, foliation, granulometry, friability, rock strength, and weathering, were also described in the logs.

The mineralized units to be sampled were marked with a grease pencil at 1 to 6 m intervals, depending on the mineral content.

All the data were stored in the Geovia GEMS logging tool, CoreLogger, which uses a SQL database platform. The rock type codes used in the database are indicated in Table 10-1.

Table 10-1: Summary – Rock Type Codes

Lithology	Lithology Description	Code
MT	Overburden	10
IF	Iron Formation – Hematite	20
IFM	Iron Formation – Magnetite	21
LIMO	Limonite	22
SIF	Silicate Iron Formation	23
SIFA	Silicate Iron Formation – Actinolite	24
SIFG	Silicate Iron Formation – Grunerite	25
QR	Quartzite	30
QRIF	Quartzite – Iron Formation – Low Grade (< 15% Fe)	31
QRMS	Quartzite – Mica Schist	32
MS	Mica Schist	33
WSIF	Quartzite – Silicated Iron Formation – Low Grade (< 15% Fe)	34
AMP	Amphibolite	40
GN	Gneiss	50
GNF	Felsic Gneiss	51
GNM	Mafic Gneiss	52
CNR	Core Not Recovered	60
FAI	Fault	70

11 Sample Preparation, Analyses and Security

11.1 Sampling Method and Approach

The sampling procedure for the various analyses is relatively simple. The two factors that are taken into consideration are the grade cut-off for samples and the length of the samples. Samples are taken before, through and after the potentially mineralized zone.

In case of planned heavy liquids tests, head chemistry results are required before selecting samples for gravity separation.

11.1.1 Cut-off Grade

The iron content of samples must be equal to or greater than 15%. This estimate is done visually by the person core logging. In addition, a sample is taken directly before and after the potentially economic ore and its rock type is noted (quartzite or amphibolite). An argillized contact between iron formation and amphibolite is generally included in the amphibolite. Overall, sample intervals respect the lithological contacts (upper or lower) and does not overlap two distinct lithologies. Samples must isolate, if possible, areas of equal content, but also potentially contaminated zones.

11.1.2 Division of the Sample

The geologist indicates the beginning and end of the sample to guide employees responsible for physical sampling. The sample still in its box is broken into fragments of 10 cm or less. Each fragment is divided into two portions using a hydraulic splitter. One of the fragments is placed in the same order in the core box and is stored as a Save. The other fragment is deposited in a numbered bag with the hole number and "FROM / TO". Generally, a chalk line marks the entire sample. To facilitate the repositioning of the fragments in the box, the sample was cut along the line.

11.1.3 Length of Sample

BQ or NQ Diameter

The standard length of a sample is six (6) meters, the equivalent of a box of BQ core. Obviously, the sample is half the core previously divided. However, the sample must be between three (3) to six (6) meters to a maximum of seven (7) meters in length. For the NQ core the standard sample length is 4.5 meters.

11.1.4 Core Not Recovered (CNR)

Samples are composed of at least 1.6 m of core. If the core sequence is intersected by CNR intervals, core pieces are added up to create a sample measuring at least 1.6 m long.

11.1.5 Storage of Core

Core boxes are handled with care during transportation and storage. Boxes are kept horizontal at all times to avoid jostling the core.

Upon arrival at the core shack, the boxes are placed on a table and opened. The core intervals are carefully measured and compiled on a list that will then be used to identify each box using aluminum tape affixed to its end. The following is affixed to the front of each box: the number of the hole, the number of the box and "FROM / TO".

When all the work of description and sampling is completed, the boxes are placed on stands to keep the remaining core intact as a reference or, if required, for further testwork.

11.2 Sample Preparation

At the Bloom Lake site, sample bags are stored in a core shack until removed to go, via pick-up trucks, to TST Overland Express in Wabush, which then transported them to SGS Lakefield Research Limited (Lakefield), in Lakefield, Ontario. Once delivered to TST Overland in Wabush, the bags were put on pallets that were sealed with plastic wrap-ups.

At SGS Lakefield, the samples were dried at ~70 +/-10°C for a suitable amount of time, if received wet. The next step involved crushing to reduce each sample size to 2 mm (9 mesh). The sample was then split with a riffle splitter to divide the sample into two representative 0-2 mm portions. One portion was for analysis and the other for reject.

11.2.1 Assaying

A whole rock analysis was done on each sample to measure the following parameters (in %): SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO, Cr_2O_3, V_2O_5, loss on ignition ("LOI") and S (in ppm).

Samples are crushed and pulverized to -150 mesh. This method is used to report, in percentage, the whole rock suite (SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, P_2O_5, MnO, TiO_2, Cr_2O_3, V_3O_5. Sample preparation entails the formation of a homogenous glass disk by the fusion of 0.2 to 0.5 g of rock pulp with 7g of lithium tetraborate/lithium metaborate (50/50). The disc specimen was then analyzed by WDXRF spectrometry. The detection limits for all analyzed oxides is 0.01%.

This method has been fully validated for the range of samples typically analyzed. Method validation includes the use of certified reference materials, replicates and blanks to calculate accuracy, precision, linearity, range, limit of detection, limit of quantification, specificity and uncertainty measurement.

The LOI at 1000°C is determined separately gravimetrically. The LOI is included in the matrix-correction calculations, which are performed by the XRF instrument software.

Additional analysis included determination of magnetic iron with a Satmagan magnetic analyser. The instrument is an equilibrated, level and clean magnet potentiometer scale (Satmagan). The magnetic force is read from the potentiometer scale. The magnetic Fe is calculated using the formula:

$$\%\ \text{magnetic Fe} = \text{Reading from scale} \times \text{calibration factors} \times 0.724$$

Other additional analysis included determination of sulphur by combustion-infrared detection on LECO instrumentation.

Specific gravity was determined using an air comparison pycnometer. It should be noted that this method does not take into account existing porosity in a rock and some of the oxide iron formation does contain vugs due to calcite removal. Although the degree of porosity has not been quantified, it is estimated on the basis of visual examination of drill core to be generally less than 2%. It should be noted that specific gravity was not measured for all drill holes.

Total iron was calculated from Fe_2O_3 by dividing total iron expressed as Fe_2O_3 by a factor of 1.4295.

12 Data Verification

A database was provided to G Mining by Quebec Iron Ore Inc. The database contained coordinates of drill hole collars, deviation tests, lithological contacts, measures of contact and foliation, geotechnical data and assay results. Verifications were done with the provided digital copies of the original log books and assay certificates.

The conversion of the old drill holes coordinates was done by Watts, Griffis and McOuat Limited when the resource was calculated for the pit in 2005. The method of conversion was not specified in their 43-101 Technical Review and Mineral Resource Estimate, dated May 26, 2005.

12.1 Quality Assurance/Quality Control

All the assays on the core samples were done by SGS Lakefield. In 1998, Lakefield was accredited by the Standards Council of Canada under ISO Guide 25. The routine quality control program at Lakefield was modelled after guidelines provided by the International Standards Organization (ISO), the Ontario Ministry of Environment and Energy, Environment Canada and the Canadian Association of Environmental Analytical Laboratories and included the processing of method blanks, replicate samples and standard reference materials. Quality control for the routine sample analysis included Lakefield's own quality control procedures, involving internal and external checks. Approximately 6% of laboratory throughput was quality control material of which, 5% were duplicates and 1% blanks. The reference material (standards) has been used for the 2013 drilling campaign only.

No external check was carried out with respect to the precision and accuracy of the various analytical methods used during these drilling programs.

12.1.1 Duplicates

A number of 170 duplicates coming from the core of the 2010, 2012 and 2013 drilling programs were analysed for major oxides and sulphurs. Table 12-1 presents the list of duplicates and the major oxides results.

In order to validate the assays results from the analytical laboratory, a series of graphs were produced (Table 12-1). These graphs, shown in the next pages, present the correlation between the samples and the duplicates of the same samples.

In all cases, the curves demonstrate no significant difference, which means a correlation varying from acceptable to excellent. The graphs (for Fe, Mag Fe, MgO and CaO) show a few outliners that are considered to be typing errors.

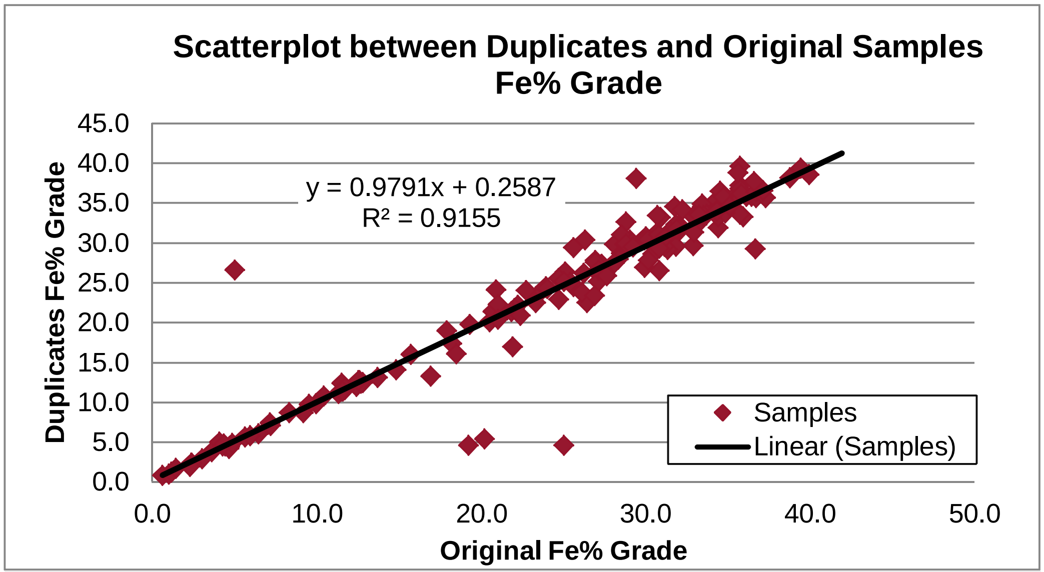
Table 12-1: List of the Duplicate Samples (n = 170)

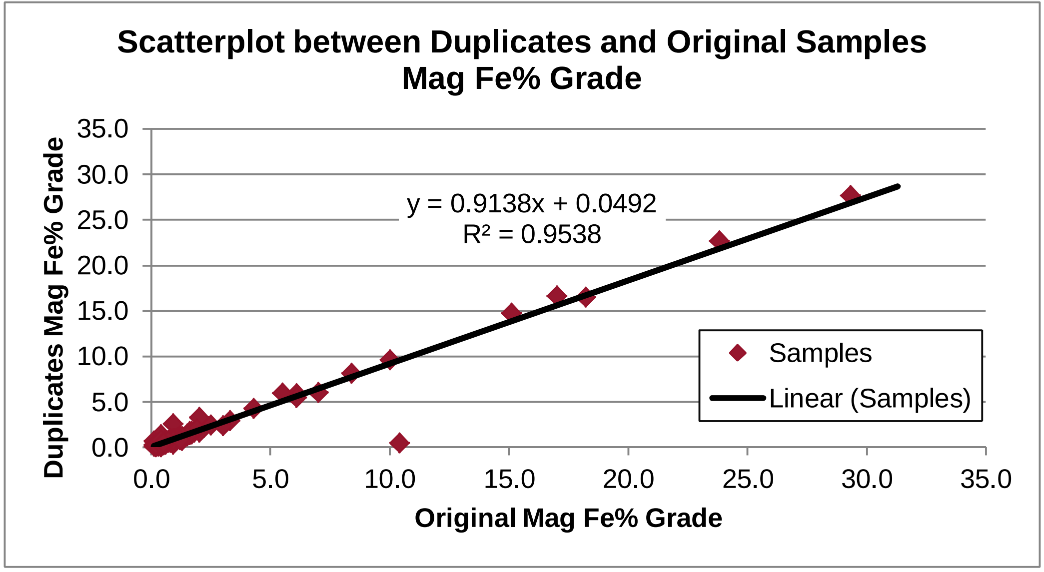
Hole ID	Distance	Length	Sample No	Duplicate of	Fe	Mag Fe	SiO_2	Al_2O_3	MgO	CaO	K_2O	TiO_2	MnO	P_2O_5
	(m)	(m)			(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
BL-10-20A	336.35	4.55	7890	7889	11.30	0.90	45.00	14.90	7.05	7.16	1.39	2.84	0.18	0.79
BL-10-23A	297.00	6.00	8740	8741	7.13	0.60	89.10	0.04	0.02	0.01	0.01	0.01	0.01	0.02
BL-10-39	-	-	8401	8400	31.73	-	56.70	0.13	0.06	0.02	0.01	0.01	0.02	0.02
BL-10-42	-	-	6326	6325	33.20	-	53.20	0.16	0.06	0.02	0.01	0.02	0.01	0.01
BL-10-44	-	-	6377	6376	37.26	-	43.00	1.66	0.42	0.61	0.14	0.40	0.03	0.24
BL-10-44	-	-	6400	6399	36.63	-	48.90	0.16	0.06	0.02	0.01	0.02	0.01	0.01
BL-10-48	-	-	8425	8424	35.58	-	49.90	0.21	0.06	0.02	0.01	0.02	0.02	0.02
BL-10-48	-	-	8450	8449	32.22	-	55.00	0.12	0.06	0.02	0.01	0.02	0.01	0.01
BL-10-50	-	-	8476	8475	11.53	-	44.90	14.80	7.57	7.48	1.44	3.01	0.26	0.74
BL-10-56	-	-	6476	6475	35.09	-	51.00	0.20	0.06	0.02	0.01	0.02	0.01	0.01
BL-10-56	-	-	6500	6499	29.22	-	60.40	0.11	0.06	0.06	0.01	0.01	0.01	0.05

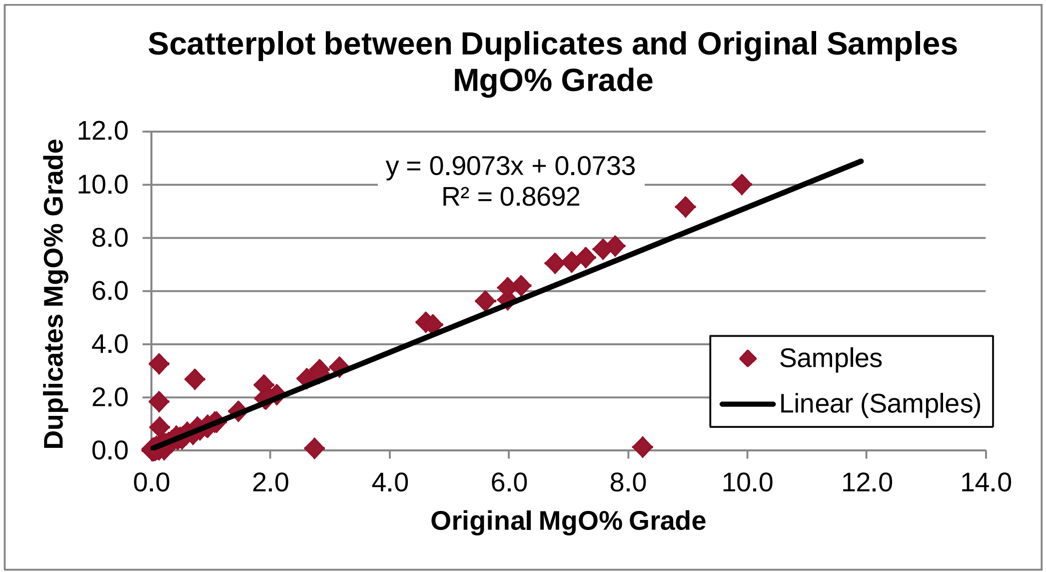
Hole ID	Distance (m)	Length (m)	Sample No	Duplicate of	Fe (%)	Mag Fe (%)	SiO_2 (%)	Al_2O_3 (%)	MgO (%)	CaO (%)	K_2O (%)	TiO_2 (%)	MnO (%)	P_2O_5 (%)
BL-10-60	-	-	8501	8500	7.20	-	62.50	13.60	4.72	0.60	6.48	0.52	0.08	0.19
BL-10-62	-	-	6526	6525	30.90	-	56.60	0.13	0.06	0.02	0.02	0.01	0.05	0.02
BL-10-63	-	-	8526	8525	31.46	-	55.70	0.35	0.08	0.06	0.04	0.04	0.01	0.03
BL-10-65	-	-	6577	6576	34.32	-	50.10	0.27	0.06	0.01	0.01	0.02	0.01	0.01
BL-10-69	-	-	8550	8549	30.13	-	57.00	0.77	0.06	0.03	0.12	0.12	0.01	0.04
BL-10-69A	492.00	6.00	9040	9039	30.90	0.60	55.30	0.20	0.05	0.01	0.01	0.03	0.01	0.01
BL-10-72	-	-	6676	6675	30.76	-	57.00	0.33	0.06	0.02	0.01	0.02	0.01	0.02
BL-10-73	-	-	6628	6627	31.18	-	56.30	0.17	0.06	0.02	0.01	0.02	0.01	0.01
BL-10-73	-	-	6648	6647	5.92	-	86.60	3.60	0.58	0.25	0.88	0.14	0.01	0.15
BL-10-74	-	-	6697	6696	32.92	-	53.80	0.38	0.06	0.02	0.03	0.04	0.01	0.02
BL-10-74	-	-	6741	6740	30.83	-	57.40	0.15	0.06	0.02	0.01	0.01	0.01	0.01
BL-10-78	-	-	6812	6811	37.12	-	47.60	0.12	0.06	0.02	0.01	0.01	0.04	0.01
BL-10-79	-	-	6832	6831	31.87	-	56.20	0.18	0.06	0.02	0.01	0.02	0.01	0.02
BL-10-79	-	-	6849	6848	36.56	-	48.30	0.49	0.06	0.02	0.01	0.10	0.05	0.04
BL-10-80	-	-	6877	6876	28.10	-	60.60	0.18	0.06	0.02	0.01	0.01	0.14	0.06
BL-12-01	167.00	3.30	6965	6964	30.40	15.10	55.70	0.26	0.16	0.21	0.06	0.03	0.01	0.03
BL-12-03	95.00	6.00	7000	7001	28.50	0.60	59.60	0.03	0.01	0.01	0.01	0.01	0.01	0.01
BL-12-03	162.00	6.00	7015	7016	2.38	0.50	93.30	1.90	0.82	0.44	0.29	0.09	0.02	0.06
BL-12-06	380.00	6.00	7096	7095	25.00	0.60	61.50	0.26	0.13	0.42	0.02	0.02	0.05	0.15
BL-12-09	38.20	4.80	7156	7155	4.99	0.40	65.60	14.60	2.74	0.61	4.89	0.42	0.05	0.09
BL-12-09	230.00	6.00	7172	7171	35.90	0.60	48.30	0.35	0.07	0.05	0.01	0.03	0.01	0.03
BL-12-100	276.90	4.00	A00113640	A00113641	11.70	0.50	45.40	14.80	7.05	7.46	1.42	3.31	0.25	0.84
BL-12-100	417.00	6.00	A00110560	A00110559	33.00	29.30	40.90	0.09	7.29	4.61	0.01	0.01	0.19	0.01
BL-12-101	242.00	6.00	A00110580	A00110581	2.34	0.70	93.20	2.20	0.94	0.25	0.42	0.13	0.01	0.02
BL-12-11	189.00	6.00	7218	7217	30.60	4.30	44.30	0.28	6.20	3.50	0.01	0.01	0.09	0.02
BL-12-13	262.00	6.00	7198	7197	31.10	0.40	55.90	0.09	0.02	0.01	0.01	0.01	0.03	0.01
BL-12-17A	137.00	6.00	7308	7307	34.80	0.30	50.50	0.13	0.01	0.01	0.01	0.01	0.01	0.01
BL-12-19	115.00	5.45	7347	7346	31.80	0.50	54.10	0.17	0.04	0.06	0.01	0.02	0.01	0.07
BL-12-20	83.50	6.00	8617	8616	34.10	0.20	50.10	0.17	0.03	0.01	0.01	0.02	0.01	0.01
BL-12-21	32.00	6.00	8640	8639	34.60	0.20	50.30	0.29	0.03	0.01	0.01	0.04	0.01	0.01
BL-12-21A	7.60	7.05	8660	8659	18.20	0.30	73.50	0.34	0.07	0.05	0.04	0.01	0.01	0.01
BL-12-21A	177.60	3.10	8680	8678	12.40	6.10	72.90	3.50	1.92	1.51	0.68	0.39	0.08	0.15
BL-12-23	10.50	3.83	7360	7359	36.70	0.20	46.30	0.10	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-24	163.00	6.00	8700	8699	31.80	0.40	54.10	0.13	0.04	0.02	0.01	0.01	0.11	0.03
BL-12-25	370.00	6.00	7380	7381	36.40	0.40	47.90	0.15	0.02	0.03	0.01	0.01	0.01	0.01
BL-12-25	484.00	6.00	7400	7401	26.90	0.60	62.40	0.13	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-26	59.00	6.00	7460	7461	34.40	0.30	51.10	0.12	0.02	0.01	0.01	0.02	0.09	0.01
BL-12-26	176.00	6.00	7480	7481	39.90	0.40	42.80	0.25	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-26	428.00	4.00	7500	7443	30.10	0.30	57.10	0.13	0.03	0.01	0.01	0.01	0.01	0.01
BL-12-27	55.00	4.60	7420	7421	6.43	0.40	91.60	0.02	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-29	231.00	6.00	7520	7519	27.30	0.40	59.70	0.09	0.02	0.02	0.01	0.01	0.01	0.03
BL-12-30	73.90	6.10	7560	7559	26.20	0.10	60.90	0.13	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-30	289.00	7.50	7600	7599	21.90	0.30	67.90	0.16	0.03	0.01	0.01	0.01	0.02	0.02
BL-12-31	428.00	6.00	7640	7641	4.64	3.30	89.30	1.48	1.10	0.86	0.13	0.09	0.03	0.12
BL-12-32	384.50	4.50	9060	9061	13.70	0.70	80.40	0.22	0.01	0.01	0.01	0.02	0.01	0.02
BL-12-33	272.00	6.00	7680	7681	35.70	0.40	47.60	0.13	0.04	0.35	0.01	0.01	0.03	0.11
BL-12-35	21.00	8.00	9081	9080	30.70	0.50	55.20	0.21	0.04	0.02	0.02	0.01	0.03	0.01
BL-12-35	136.90	9.10	9100	9099	3.62	0.20	67.70	16.60	0.92	0.01	5.42	0.39	0.02	0.03
BL-12-36	282.00	4.00	7728	7727	35.50	0.50	47.80	0.19	0.13	0.31	0.01	0.02	0.01	0.03
BL-12-36	336.00	5.70	7740	7739	30.80	0.20	55.90	0.16	0.04	0.01	0.01	0.01	0.01	0.01
BL-12-36	462.60	5.40	7760	7759	0.61	0.30	99.10	0.16	0.05	0.04	0.01	0.01	0.01	0.02
BL-12-37	572.25	3.00	9142	9141	21.10	2.00	67.90	0.17	0.16	1.36	0.01	0.02	0.02	0.03
BL-12-38	50.00	6.00	9160	9159	28.10	0.20	59.40	0.07	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-38	318.90	5.00	9180	9181	26.90	2.20	58.50	1.56	0.44	0.21	0.53	0.09	0.04	0.05
BL-12-41	198.00	6.00	7780	7779	22.20	0.40	67.70	0.14	0.19	0.01	0.01	0.01	0.01	0.02
BL-12-42	486.00	6.00	7870	7871	1.01	0.10	97.40	0.42	0.15	0.07	0.02	0.02	0.01	0.01
BL-12-44	367.50	5.50	9240	9239	11.50	1.60	76.20	0.06	1.90	2.50	0.01	0.01	0.08	0.01
BL-12-44	467.00	4.00	9260	9259	30.00	1.20	56.70	0.12	0.10	0.17	0.01	0.01	0.01	0.02
BL-12-45	338.50	6.00	7830	7829	27.00	1.30	60.10	0.16	0.07	0.52	0.01	0.02	0.01	0.32
BL-12-45	435.50	4.50	7850	7849	29.00	2.20	56.60	0.42	0.22	0.27	0.04	0.04	0.02	0.03
BL-12-47	21.00	3.50	9300	9299	26.40	0.40	62.60	0.03	0.03	0.01	0.01	0.01	0.01	0.01
BL-12-47	120.00	6.00	9320	9319	29.40	0.80	57.50	0.23	0.12	0.06	0.02	0.01	0.01	0.02
BL-12-47	459.00	3.50	9360	9361	20.20	0.90	70.10	0.19	0.13	0.35	0.04	0.01	0.01	0.03
BL-12-48	208.50	3.50	8790	8791	28.50	0.80	45.70	6.39	0.33	0.29	0.05	1.59	0.44	0.25
BL-12-48	419.00	6.00	8810	8811	25.10	1.20	60.50	0.03	1.46	0.61	0.01	0.01	0.03	0.01
BL-12-49	104.00	6.00	9380	9381	26.30	0.40	62.80	0.03	0.01	0.01	0.01	0.01	0.01	0.01
BL-12-50	222.00	2.60	9420	9419	14.80	8.40	73.80	1.27	0.60	1.07	0.26	0.26	0.04	0.07
BL-12-52	246.00	3.20	9440	9441	12.80	2.00	42.10	12.80	9.90	7.72	1.48	2.39	0.22	0.66
BL-12-53	47.00	6.00	8850	8851	35.70	0.40	48.00	0.15	0.06	0.01	0.01	0.04	0.01	0.01
BL-12-54	251.00	3.70	9480	9479	27.10	1.70	55.00	3.30	0.77	0.16	1.29	0.12	0.02	0.04
BL-12-55	74.00	6.00	8870	8871	23.30	0.90	66.30	0.03	0.03	0.01	0.01	0.01	0.01	0.01
BL-12-56	282.65	3.00	8910	8909	4.08	0.20	65.30	15.00	2.82	2.04	4.06	0.48	0.06	0.14
BL-12-57	114.00	6.00	9500	9499	34.50	0.40	49.70	0.18	0.05	0.25	0.01	0.02	0.02	0.07
BL-12-57	324.00	6.00	9540	9539	32.00	0.40	53.40	0.22	0.06	0.04	0.01	0.02	0.01	0.04
BL-12-58	323.00	6.00	9560	9559	31.30	0.20	53.10	0.23	0.01	0.01	0.01	0.03	0.01	0.01
BL-12-60	344.00	3.00	9600	9599	22.70	0.70	66.90	0.16	0.34	0.56	0.01	0.01	0.01	0.02
BL-12-60	428.30	2.70	9620	9621	28.80	1.70	57.60	0.29	0.11	0.15	0.01	0.05	0.01	0.06
BL-12-61	54.00	4.20	8950	8949	28.70	0.50	57.80	0.22	0.03	0.01	0.01	0.03	0.01	0.01
BL-12-61	153.00	6.00	8970	8969	19.30	0.30	73.50	0.05	0.01	0.01	0.01	0.01	0.01	0.01
BL-12-65	48.00	6.00	9660	9661	35.70	0.50	48.30	0.09	0.21	0.02	0.01	0.01	0.32	0.02

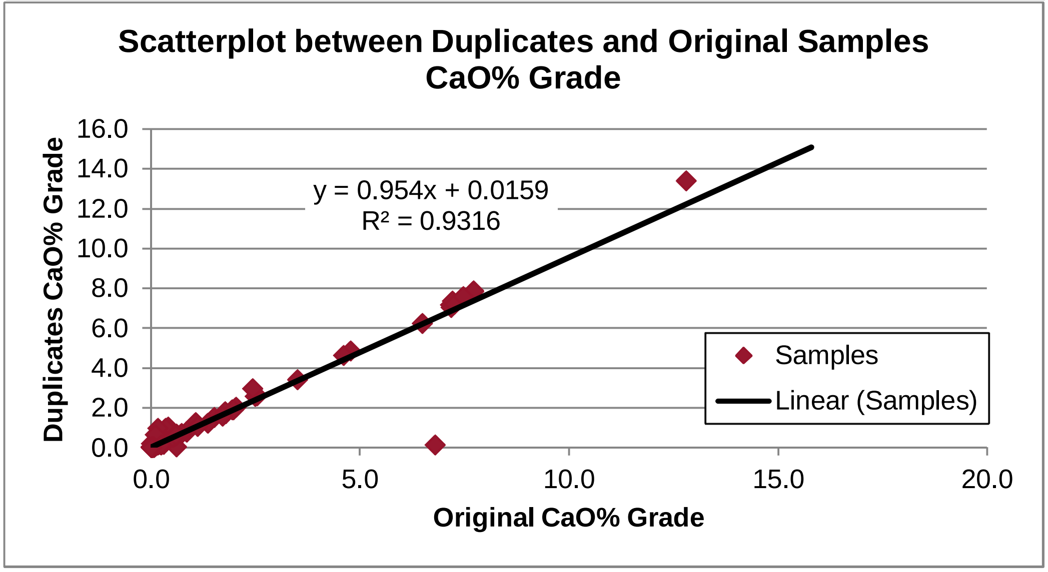
Hole ID	Distance	Length	Sample No	Duplicate of	Fe	Mag Fe	SiO_2	Al_2O_3	MgO	CaO	K_2O	TiO_2	MnO	P_2O_5
	(m)	(m)			(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
BL-12-65	159.00	5.10	9680	9681	20.50	0.80	68.90	0.49	0.34	0.33	0.04	0.02	0.04	0.02
BL-12-66	189.00	6.00	A00109090	A00109091	24.70	0.40	64.00	0.07	0.03	0.35	0.01	0.01	0.01	0.03
BL-12-67A	362.00	5.70	A00109011	A00109010	24.70	0.40	65.00	0.09	0.01	0.01	0.01	0.01	0.01	0.01
BL-12-67A	488.00	6.00	A00109020	A00109019	22.00	0.80	59.60	0.04	4.60	2.54	0.01	0.01	0.08	0.01
BL-12-67A	571.20	3.00	A00109040	A00109039	4.28	0.60	65.50	14.40	2.61	1.94	4.29	0.45	0.06	0.13
BL-12-68	64.80	3.40	A00109260	A00109259	39.40	1.10	43.40	0.26	0.03	0.02	0.01	0.02	0.09	0.03
BL-12-69	27.00	6.00	A00109280	A00109279	29.90	0.70	55.80	1.04	0.17	0.03	0.09	0.14	0.01	0.04
BL-12-70	98.85	2.55	A00109320	A00109319	5.61	1.80	66.80	12.80	3.16	0.33	5.07	0.42	0.04	0.13
BL-12-71	103.90	3.00	A00109340	A00109339	4.42	0.10	64.90	15.40	2.81	1.79	4.56	0.49	0.06	0.14
BL-12-72	357.30	3.45	A00109360	A00109359	10.40	2.00	82.50	0.37	0.53	0.88	0.08	0.04	0.02	0.04
BL-12-75	465.00	6.00	A00109115	A00109116	31.10	0.40	54.70	0.18	0.13	0.23	0.01	0.01	0.01	0.05
BL-12-76	117.00	6.00	A00109390	A00109391	9.93	0.30	80.20	3.13	0.08	0.02	0.22	0.05	0.04	0.16
BL-12-77	108.00	6.00	A00109145	A00109146	31.80	0.20	55.20	0.06	0.02	0.01	0.01	0.02	0.01	0.01
BL-12-77	174.00	6.00	A00109157	A00109158	35.70	0.20	49.60	0.18	0.01	0.01	0.01	0.02	0.01	0.01
BL-12-79	299.75	3.25	A00109420	A00109419	33.10	0.60	52.80	0.11	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-80	251.00	6.00	A00109450	A00109449	4.68	1.50	91.20	0.84	0.48	0.17	0.13	0.04	0.01	0.05
BL-12-81	286.60	3.00	A00109191	A00109190	12.60	0.50	43.70	14.70	5.98	6.50	1.07	3.33	0.33	0.89
BL-12-81	525.00	6.00	A00109210	A00109209	23.30	6.10	61.70	0.17	0.94	1.78	0.08	0.01	0.04	0.01
BL-12-82	86.00	3.10	A00109464	A00109463	20.70	0.60	69.40	0.43	0.25	0.07	0.01	0.01	0.01	0.03
BL-12-82	332.00	6.00	A00109494	A00109493	3.01	1.00	94.30	1.35	0.34	0.12	0.12	0.06	0.01	0.05
BL-12-82	434.00	6.00	A00113514	A00113513	33.40	0.80	52.10	0.09	0.09	0.01	0.01	0.01	0.01	0.01
BL-12-83	296.00	4.70	A00113544	A00113543	25.60	0.50	63.70	0.07	0.03	0.01	0.01	0.01	0.01	0.01
BL-12-83	432.00	4.70	A00113560	A00113559	21.80	0.20	42.20	0.03	8.96	12.80	0.01	0.01	0.37	0.01
BL-12-84	313.50	6.00	A00109250	A00110001	19.20	10.40	63.30	4.64	0.73	0.17	2.28	0.16	0.02	0.04
BL-12-85	495.00	6.00	A00110017	A00110016	30.10	2.00	55.80	0.54	0.29	0.10	0.12	0.07	0.01	0.03
BL-12-86	299.00	6.00	A00110050	A00110049	4.86	2.50	82.30	0.75	1.06	4.78	0.02	0.03	0.07	0.06
BL-12-88	98.00	6.00	A00113655	A00113656	36.10	1.00	47.50	0.20	0.03	0.02	0.01	0.02	0.01	0.02
BL-12-89	318.80	2.20	A00110095	A00110096	27.10	23.80	57.60	1.02	0.70	1.97	0.05	0.19	0.10	0.16
BL-12-91	66.00	6.00	A00113680	A00113679	25.60	0.50	62.90	0.10	0.03	0.01	0.01	0.01	0.01	0.01
BL-12-91	273.00	6.55	A00113695	A00113694	21.10	0.50	69.60	0.28	0.02	0.01	0.02	0.01	0.02	0.05
BL-12-91	339.00	6.00	A00113710	A00113709	33.70	0.60	51.60	0.36	0.07	0.30	0.02	0.05	0.01	0.05
BL-12-92	38.00	6.00	A00110105	A00110106	35.20	0.80	48.50	0.23	0.03	0.01	0.01	0.01	0.02	0.04
BL-12-94	59.00	6.00	A00110520	A00110519	20.90	0.70	67.50	0.17	0.08	0.01	0.01	0.01	0.01	0.02
BL-12-95	72.00	3.00	A00113600	A00113599	26.10	1.60	61.80	0.16	0.06	0.01	0.01	0.01	0.05	0.02
BL-12-95	87.50	5.50	A00113605	A00113604	35.80	0.60	46.90	0.13	0.01	0.01	0.01	0.02	0.01	0.01
BL-12-96	20.70	4.20	A00113720	A00113719	15.70	1.80	77.40	0.45	0.06	0.07	0.01	0.08	0.01	0.05
BL-12-96	218.65	6.00	A00113740	A00113739	36.70	0.70	47.70	0.14	0.02	0.01	0.01	0.02	0.01	0.02
BL-12-96	258.00	6.00	A00113750	A00113749	33.50	0.60	51.80	0.08	0.02	0.01	0.01	0.01	0.01	0.01
BL-12-96	271.35	6.25	A00110055	A00110054	8.32	0.90	88.60	0.14	0.02	0.01	0.01	0.01	0.01	0.04
BL-12-98	165.00	3.00	A00113620	A00113619	11.50	0.50	45.30	14.80	6.77	7.72	1.16	3.26	0.22	0.81
BL-13-01	123.80	3.00	A00165520	A00165519	1.15	0.80	98.90	0.25	0.06	0.02	0.01	0.01	0.01	0.02
BL-13-02	97.70	4.30	A00165540	A00165539	32.00	0.60	53.90	0.14	0.06	0.01	0.01	0.01	0.01	0.02
BL-13-03	112.70	6.30	A00165560	A00165559	11.60	1.10	83.70	0.16	0.06	0.07	0.02	0.01	0.01	0.03
BL-13-05A	112.00	6.00	A00164440	A00164439	2.28	1.50	94.40	1.63	0.52	0.11	0.36	0.07	0.01	0.03
BL-13-07	86.00	4.20	A00165624	A00165623	23.90	1.90	66.20	0.19	0.06	0.05	0.01	0.01	0.01	0.07
BL-13-07	294.00	6.00	A00165645	A00165644	21.00	0.90	67.20	0.09	0.11	0.01	0.01	0.01	0.01	0.02
BL-13-08	266.00	3.00	A00165690	A00165689	28.80	1.00	58.70	0.02	0.02	0.01	0.01	0.02	0.04	0.01
BL-13-08	350.00	6.00	A00165710	A00165709	32.00	0.40	54.20	0.09	0.04	0.01	0.01	0.02	0.01	0.01
BL-13-13	14.40	8.60	A00165780	A00165779	21.00	0.80	67.20	0.86	0.07	0.02	0.01	0.16	0.01	0.16
BL-13-13	375.10	1.40	A00165812	A00165811	27.60	18.20	60.60	0.16	0.12	0.05	0.01	0.02	0.04	0.05
BL-13-14	191.00	1.20	A00165841	A00165840	4.33	0.54	93.00	1.16	0.09	0.04	0.03	0.03	0.01	0.02
BL-13-15	248.00	6.00	A00164410	A00164409	11.70	0.60	82.80	0.09	0.04	0.02	0.01	0.01	0.08	0.01
BL-13-16	44.60	2.40	A00165893	A00165892	25.40	10.00	59.80	0.39	2.10	1.71	0.06	0.05	0.06	0.02
BL-13-17	65.50	16.70	A00165910	A00165909	25.00	17.00	60.70	0.91	1.95	1.12	0.22	0.02	0.04	0.01
BL-13-19	335.00	6.00	A00165960	A00165961	28.33	0.50	60.00	0.06	0.02	0.01	<0.01	0.02	<0.01	<0.01
BL-13-20	425.00	3.30	A00164484	A00164483	11.47	0.80	45.70	14.00	5.98	7.18	1.67	3.35	0.21	0.87
BL-13-21	110.90	2.43	A00165995	A00165994	12.66	0.80	44.80	14.40	5.60	7.26	2.05	3.30	0.17	0.82
BL-13-21	310.70	6.30	A00166110	A00166109	29.93	1.10	56.90	0.58	0.14	0.11	0.03	0.08	0.09	0.04
BL-13-21	455.00	6.00	A00166140	A00166139	28.33	0.90	59.60	0.33	0.04	0.02	<0.01	<0.01	<0.01	<0.01
BL-13-22	101.00	2.80	A00166051	A00166052	9.51	0.40	45.60	17.10	7.78	7.22	1.76	2.36	0.15	0.63
BL-13-22	130.60	6.40	A00166060	A00166059	18.46	7.00	73.50	0.22	0.15	0.13	0.03	<0.01	<0.01	0.05
BL-13-22	374.00	6.00	A00166085	A00166084	22.38	0.80	67.10	0.75	0.01	0.03	0.02	0.03	0.49	0.02
BL-13-23	83.70	3.00	A00166160	A00166159	12.52	0.40	42.90	15.50	8.24	6.80	1.48	2.80	0.21	0.71
BL-13-23	365.00	6.00	A00166190	A00166189	32.87	0.90	51.80	1.03	0.14	0.06	0.05	0.09	<0.01	0.02
BL-13-24	122.00	6.00	A00166210	A00166209	9.16	0.50	86.90	0.05	0.07	0.05	<0.01	0.01	<0.01	0.02
BL-13-24	380.00	6.00	A00166240	A00166239	16.93	0.50	76.70	0.07	0.01	0.01	<0.01	<0.01	<0.01	<0.01
BL-13-24	503.00	3.00	A00166005	A00166006	38.75	0.90	45.60	0.07	0.02	0.01	<0.01	<0.01	<0.01	0.02
BL-13-25	191.00	6.00	A00166280	A00166279	17.90	1.30	75.10	0.08	0.01	0.05	<0.01	<0.01	<0.01	0.04
BL-13-25	455.00	9.00	A00166358	A00166357	34.83	0.70	50.70	0.03	0.01	0.01	<0.01	<0.01	<0.01	0.02
BL-13-26	437.00	5.40	A00166040	A00166039	32.87	0.60	53.00	0.12	0.03	0.01	<0.01	0.03	<0.01	<0.01
BL-13-26	640.40	6.60	A00166410	A00166409	23.99	5.50	64.70	0.29	0.18	0.74	0.04	0.04	<0.01	0.03
BL-13-27	332.00	6.00	A00166386	A00166385	34.69	0.70	51.10	0.11	0.01	0.03	<0.01	<0.01	<0.01	0.02
BL-13-28	263.00	6.00	A00166440	A00166439	30.70	0.50	56.00	0.14	0.01	0.01	0.02	0.01	<0.01	<0.01
BL-13-28	422.00	6.00	A00163690	A00163689	26.86	1.20	61.80	0.09	0.01	0.01	<0.01	<0.01	0.02	0.04
GT-13-01	308.10	6.00	A00166499	A00166498	31.10	0.60	54.90	0.03	0.24	0.52	0.01	0.01	0.01	0.02
GT-13-03	35.00	6.00	A00166310	A00166311	28.50	3.00	53.70	0.12	1.89	2.43	0.01	0.01	0.05	0.02
GT-13-06	44.20	6.00	A00166340	A00166339	2.39	1.00	96.30	0.52	0.10	0.03	0.02	0.02	0.04	0.02
GT-13-06	280.80	6.00	A00165860	A00165859	34.40	0.70	50.90	0.18	0.06	0.04	0.01	0.02	0.01	0.02
GT-13-06	475.80	3.00	A00165890	A00165889	1.42	0.60	97.40	0.35	0.12	0.03	0.01	0.01	0.01	0.02

Figure 12–1: Original Samples vs Duplicates for Fe%, Mag Fe%, MgO% and CaO%









12.1.2 Blanks

Until 2009, quartz samples have been used as blanks. These blank samples were obtained from the Daviault Lake silica quarry of Blackburn Quartz. This property, entirely owned by Quebec/ Labrador Exploration, is located 7 km north of Fermont. The samples of quartz were visually selected prior to their use as blanks, to avoid the presence of any impurity. The samples were crushed to 2 - 3 cm. A complete description and assay results of the silica blanks are provided in the Technical Reports of Consolidated Thompson Iron Mines and Breton Banville & Associates (2007) and Genivar (2009).

Starting with the 2012 drilling campaign, the silica blanks have been replaced by samples coming from the waste lithology, mainly amphibolites. Even if they were considered as blanks, these 69 samples have a variable amount of oxides that is related to the mineralogical composition and alteration of the selected samples. Because of this reason, these blanks cannot offer any indication if the sample preparation and analytical results have been affected by contamination. The list of the blanks is presented in Table 12-2, but we did not consider these blanks as part of the QAQC procedures.

Table 12-2: List of Blanks (n=69), Iron Content and Major Oxide Results

Hole ID	Sample No	Fe	Mag Fe	SiO_2	Al_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5	LOI	S
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)
BL-10-48A	A00109173	9.65	0.30	46.50	16.00	7.19	8.32	2.97	1.15	2.62	0.18	0.71	0.60	0.10
BL-10-67A	9280	9.79	0.20	45.60	16.30	7.14	8.48	2.99	1.14	2.46	0.17	0.65	0.93	0.10
BL-12-101	A00110570	10.30	0.40	47.10	15.50	6.09	8.14	3.53	0.94	3.07	0.16	0.81	0.80	0.12
BL-12-24	8720	11.40	0.10	44.10	14.30	7.56	7.54	2.53	1.23	2.96	0.27	0.80	1.73	0.09
BL-12-27	7440	10.20	0.10	45.00	16.00	6.15	8.54	3.15	1.30	2.90	0.18	0.78	0.67	0.12
BL-12-28	9020	10.40	0.30	45.80	15.40	7.32	8.31	2.80	1.22	2.80	0.22	0.70	0.82	0.06
BL-12-29	7540	10.50	0.20	45.60	16.10	6.16	8.32	2.92	1.20	3.05	0.23	0.80	0.64	0.12
BL-12-30	7580	11.10	0.20	44.70	14.60	8.27	8.00	2.76	1.20	2.81	0.24	0.74	0.60	0.14
BL-12-31	7620	11.10	0.10	44.50	14.40	8.19	7.88	2.79	1.22	2.77	0.24	0.73	0.59	0.08
BL-12-33	7660	10.70	0.10	45.30	15.30	6.65	8.04	2.55	1.14	3.13	0.33	0.78	0.98	0.11
BL-12-37	9120	10.50	0.30	45.70	15.90	6.10	8.15	2.80	1.20	3.02	0.22	0.78	0.47	0.12
BL-12-42	7800	10.70	0.10	45.30	15.10	6.71	8.11	2.52	1.07	3.06	0.32	0.79	0.86	0.11
BL-12-43	9220	9.72	0.40	48.70	14.80	6.99	6.90	2.88	1.38	2.41	0.19	0.52	1.04	0.09
BL-12-45	7810	10.30	0.40	44.20	15.50	6.90	8.07	2.88	1.18	2.75	0.20	0.74	0.81	0.12
BL-12-46	8771	9.79	0.40	45.40	16.80	6.88	8.52	3.17	1.11	2.41	0.19	0.63	1.13	0.10
BL-12-47	9340	11.50	0.10	43.60	13.40	10.90	7.58	2.30	1.20	2.68	0.24	0.67	1.16	0.09
BL-12-49	9400	11.70	0.30	43.60	13.40	10.70	7.57	2.26	1.19	2.68	0.25	0.68	0.80	0.08
BL-12-51A	8830	11.50	0.70	45.00	14.40	7.76	7.83	2.43	1.30	3.16	0.24	0.80	0.78	0.11
BL-12-54	9460	11.50	0.10	45.30	14.40	7.72	7.67	2.44	1.33	3.01	0.24	0.75	0.74	0.12
BL-12-56	8890	10.20	0.30	45.30	15.90	6.42	8.23	3.09	1.24	2.74	0.21	0.70	0.68	0.11
BL-12-57	9520	10.10	0.10	45.90	16.10	6.47	8.33	3.16	1.21	2.74	0.21	0.71	0.66	0.13
BL-12-59	8930	10.40	0.10	45.50	15.70	7.69	8.56	2.90	0.68	2.42	0.31	0.62	0.52	0.09
BL-12-60	9580	10.10	0.30	44.80	15.10	8.88	8.08	2.63	1.42	2.30	0.18	0.59	0.65	0.08
BL-12-62	9640	11.30	0.10	44.10	14.30	10.50	8.15	1.98	1.56	2.22	0.23	0.60	0.74	0.08
BL-12-63	A00109060	10.50	0.40	45.40	16.00	6.29	8.28	3.31	0.78	2.67	0.31	0.73	0.49	0.11
BL-12-64	8990	9.51	1.20	46.50	17.10	6.96	8.68	2.90	0.99	2.34	0.16	0.61	0.42	0.11
BL-12-66	9700	9.51	0.30	46.20	17.00	6.16	8.82	3.10	1.11	2.46	0.19	0.65	0.74	0.09
BL-12-67A	A00109022	10.50	0.50	45.30	16.00	6.49	8.42	3.32	0.78	2.68	0.29	0.75	0.83	0.10
BL-12-69	A00109300	9.16	0.30	46.50	17.00	6.19	8.90	3.05	1.09	2.58	0.17	0.66	0.55	0.10
BL-12-72	A00109350	9.37	0.10	46.90	17.00	6.16	8.87	3.32	0.80	2.55	0.18	0.70	0.57	0.09
BL-12-74	A00109380	8.95	0.20	47.20	17.50	6.07	8.89	3.52	0.57	2.60	0.22	0.67	0.29	0.10
BL-12-77	A00109130	9.51	0.40	46.70	17.00	6.50	8.36	3.24	0.76	2.45	0.26	0.69	0.42	0.07
BL-12-80	A00109435	12.70	0.40	46.60	14.80	8.22	4.02	1.44	2.29	2.89	0.19	0.71	0.55	0.01
BL-12-82	A00109484	9.86	0.50	46.10	15.90	7.09	8.26	3.00	1.15	2.61	0.17	0.71	0.63	0.11
BL-12-83	A00113534	10.00	0.30	46.90	16.00	6.83	8.41	3.20	1.07	2.68	0.17	0.70	0.40	0.13
BL-12-84	A00109235	9.93	0.60	46.00	15.40	7.90	8.14	2.72	1.20	2.50	0.17	0.62	0.85	0.07
BL-12-86	A00110035	10.50	0.10	45.90	15.40	7.78	7.89	2.75	1.21	2.46	0.15	0.63	1.02	0.08
BL-12-91	A00113675	11.00	0.40	46.80	14.80	5.35	8.61	3.04	1.11	3.51	0.20	0.93	0.46	0.15
BL-12-91	A00113700	11.30	0.40	46.80	14.00	6.29	8.27	2.79	1.19	3.52	0.20	0.93	0.96	0.15
BL-12-96	A00113730	9.79	0.50	46.80	15.80	6.77	8.32	3.22	1.06	2.69	0.17	0.71	0.70	0.12
BL-12-96	A00110075	11.00	0.40	47.30	14.30	5.27	8.48	2.98	1.18	3.61	0.20	0.94	0.44	0.15
BL-12-98	A00113625	11.10	0.40	47.00	14.40	5.20	8.31	2.94	1.23	3.55	0.21	0.95	0.40	0.15
BL-12-99	A00110125	10.90	0.40	46.60	14.70	5.47	8.65	3.01	1.14	3.54	0.20	0.96	0.34	0.15
BL-13-02	A00165526	11.20	0.50	45.20	15.20	7.14	7.45	2.79	1.48	3.11	0.22	0.81	0.88	0.09
BL-13-03	A00165575	11.10	0.30	44.40	14.70	9.28	8.07	2.71	0.89	2.63	0.20	0.69	0.68	0.08
BL-13-04	A00165580	10.00	0.40	45.70	16.50	6.29	8.55	2.85	1.16	2.67	0.19	0.71	0.68	0.11
BL-13-05A	A00164425	10.30	0.50	46.20	15.80	7.58	8.21	2.84	1.13	2.61	0.16	0.69	0.59	0.10
BL-13-06	A00165610	13.30	0.40	43.90	13.50	8.13	7.57	2.29	1.16	2.57	0.16	0.64	0.56	0.08
BL-13-08	A00165675	9.44	0.40	47.00	17.00	6.52	9.02	3.06	1.04	2.46	0.17	0.64	0.67	0.11
BL-13-08	A00165725	9.37	0.30	46.30	17.00	6.32	8.85	3.04	1.05	2.35	0.17	0.60	0.59	0.10
BL-13-10	A00165750	9.79	0.50	47.00	16.50	7.22	8.27	2.79	0.97	2.20	0.15	0.58	0.92	0.08
BL-13-11	A00165771	9.44	0.50	46.00	17.20	7.47	8.17	2.93	1.10	2.29	0.18	0.59	0.85	0.06
BL-13-13	A00165816	14.30	2.80	43.40	13.40	6.76	6.16	2.02	1.92	3.00	0.25	0.74	1.45	0.06
BL-13-14	A00165825	10.30	0.30	46.30	15.80	7.41	8.15	2.94	1.01	2.61	0.19	0.67	0.47	0.09
BL-13-18	A00165925	10.40	0.40	45.60	15.80	8.20	7.85	2.65	1.56	2.58	0.16	0.68	0.77	0.10
BL-13-19	A00165980	10.42	0.40	45.40	15.80	7.85	7.85	2.74	1.29	2.58	0.18	0.71	0.92	0.07
BL-13-20	A00164470	10.00	0.40	45.50	16.10	7.12	8.56	3.10	0.72	2.61	0.16	0.71	0.49	0.12
BL-13-21	A00166125	10.07	0.40	46.60	16.10	7.05	8.51	3.21	0.73	2.65	0.17	0.69	0.43	0.12
BL-13-22	A00166065	10.70	0.40	45.70	15.50	5.55	7.44	3.16	1.62	3.56	0.15	0.87	1.16	0.12
BL-13-23	A00166175	10.28	0.40	46.30	15.60	7.55	8.33	2.64	1.17	2.61	0.17	0.67	0.51	0.14
BL-13-24	A00166225	12.45	0.40	47.40	12.80	4.33	9.38	2.45	0.92	4.29	0.23	1.18	0.40	0.22

Hole ID	Sample No	Fe	Mag Fe	SiO_2	Al_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5	LOI	S
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)
BL-13-24	A00166014	10.35	0.40	46.20	16.00	6.59	8.03	3.10	1.08	2.60	0.18	0.62	0.78	0.13
BL-13-25	A00166269	9.86	0.40	49.40	16.20	4.05	8.13	3.45	1.57	2.72	0.18	0.98	0.54	0.12
BL-13-27	A00166374	10.00	0.40	47.50	16.00	6.91	8.29	3.09	0.86	2.47	0.16	0.60	0.58	0.14
BL-13-28	A00166425	10.63	0.50	47.80	15.10	4.21	8.72	3.13	1.23	3.59	0.21	0.98	0.69	0.16
BL-13-28	A00163675	11.61	0.40	49.50	12.90	3.65	8.87	2.66	0.82	3.45	0.24	1.42	0.41	0.20
GT-13-01	A00166487	11.00	0.30	44.90	14.30	9.12	8.29	2.44	1.05	2.66	0.18	0.68	0.76	0.11
GT-13-03	A00166325	8.95	0.40	46.20	17.40	6.66	8.99	3.08	1.01	2.33	0.15	0.61	0.60	0.10
GT-13-06	A00165875	9.93	0.40	45.90	16.80	8.26	8.39	2.56	1.14	2.23	0.17	0.56	1.09	0.08

12.1.3 Standard Analyses

Twenty-seven (27) Standards have been used in the 2013 drilling campaign. They are presented in Table 12-3. These Standards were not of industrial type, but rather made from samples collected from mineralized material from the Bloom Lake deposit. The Standards analysed reported grades varying between 26.90% Fe and 28.40% Fe and an average of 27.80% Fe.

Table 12-3: Standards Analyses (n=27)

Hole ID	Distance	Sample No	Fe	Mag Fe	SiO_2	Al_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	P_2O_5	LOI	S
	(m)		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)
BL-13-02	70.50	A00165550	27.60	11.10	53.30	1.21	2.68	2.15	0.32	0.19	0.07	0.08	0.06	0.78	0.01
BL-13-03	119.00	A00165562	27.00	11.10	54.60	1.20	2.64	2.13	0.31	0.19	0.07	0.08	0.05	0.63	0.01
BL-13-05A	131.00	A00164444	27.40	10.70	54.50	1.15	2.62	2.16	0.30	0.18	0.06	0.08	0.05	0.52	0.01
BL-13-06	45.50	A00165601	27.80	11.10	53.00	1.22	2.69	2.16	0.32	0.19	0.07	0.09	0.06	0.71	0.01
BL-13-07	269.00	A00165638	27.60	10.90	53.50	1.22	2.67	2.17	0.29	0.19	0.07	0.08	0.07	0.63	0.01
BL-13-08	269.00	A00165692	27.80	11.20	52.90	1.21	2.70	2.15	0.34	0.19	0.07	0.09	0.06	0.64	0.01
BL-13-09	182.00	A00165735	27.50	10.80	53.80	1.15	2.69	2.14	0.32	0.19	0.06	0.09	0.06	0.81	0.01
BL-13-10	83.00	A00165752	27.50	10.70	54.00	1.21	2.68	2.17	0.28	0.19	0.07	0.09	0.06	0.83	0.01
BL-13-13	87.30	A00165796	28.00	11.70	53.30	1.17	2.62	2.14	0.32	0.18	0.07	0.06	0.07	0.55	0.01
BL-13-15	55.10	A00165850	27.80	10.80	54.20	1.17	2.62	2.12	0.29	0.19	0.07	0.09	0.07	0.71	0.01
BL-13-15	299.80	A00164420	27.60	10.70	52.40	1.15	2.60	2.07	0.27	0.18	0.06	0.09	0.07	0.50	0.02
BL-13-16	49.45	A00165896	28.10	11.10	53.40	1.35	2.76	2.27	0.29	0.20	0.09	0.07	0.07	0.60	0.01
BL-13-17	110.00	A00165921	27.60	10.70	52.90	1.19	2.64	2.13	0.30	0.19	0.08	0.07	0.06	0.53	0.01
BL-13-18	71.00	A00165931	28.30	11.10	53.10	1.15	2.62	2.13	0.30	0.19	0.07	0.06	0.05	0.73	0.01
BL-13-19	104.00	A00165936	27.84	10.80	53.80	1.15	2.64	2.15	0.28	0.19	0.06	0.07	0.06	0.48	0.02
BL-13-19	436.00	A00165978	28.05	10.80	53.20	1.21	2.66	2.16	0.28	0.19	0.06	0.08	0.08	0.85	0.01
BL-13-20	279.10	A00164465	27.80	10.80	53.60	1.27	2.71	2.19	0.31	0.19	0.08	0.08	0.07	0.56	0.01
BL-13-21	365.00	A00166120	28.05	11.30	54.00	1.18	2.61	2.13	0.34	0.18	0.06	0.07	0.05	0.33	0.02
BL-13-21	491.00	A00166147	28.05	10.60	53.40	1.12	2.62	2.14	0.29	0.20	0.06	0.08	0.07	0.64	0.01
BL-13-22	320.00	A00166075	28.33	10.70	52.60	1.19	2.70	2.14	0.28	0.20	0.05	0.09	0.06	0.61	0.01
BL-13-22	470.00	A00166151	28.40	10.60	52.50	1.23	2.68	2.16	0.28	0.19	0.07	0.09	0.08	0.57	0.01
BL-13-23	425.00	A00166251	27.70	10.60	53.60	1.20	2.58	2.15	0.30	0.20	0.06	0.09	0.07	0.80	0.01
BL-13-24	272.00	A00166220	28.12	10.80	53.80	1.19	2.69	2.20	0.32	0.19	0.07	0.07	0.07	0.60	0.01
BL-13-26	39.50	A00166025	28.12	10.80	53.00	1.20	2.75	2.17	0.29	0.18	0.07	0.07	0.07	0.69	0.19
BL-13-26	482.60	A00166401	27.56	10.90	53.00	1.16	2.66	2.12	0.29	0.18	0.07	0.07	0.06	0.75	0.01
BL-13-28	239.00	A00166433	27.98	11.00	53.20	1.25	2.65	2.13	0.29	0.20	0.08	0.08	0.07	0.90	0.01
GT-13-01	326.10	A00166303	26.90	10.80	53.90	1.25	2.72	2.16	0.32	0.19	0.07	0.09	0.06	0.59	0.01

Due to insufficient information about the procedures surrounding Standard analyses, no conclusions can be drawn from the Standard results in terms of QA/QC.

12.2 Independent Core Sampling

G Mining has taken core samples to compare with assay grades available in the drilling database of the Bloom Lake project. The sampling was carried out independently by the qualified person responsible for the resource estimate, Réjean Sirois, during the site visit in September 2016. A total of 12 samples were selected and analysed for iron content. The check samples generally returned higher iron grades than those of the original assays in the database. Results are presented in Table 12-4 and illustrated in a scatterplot in Figure 12–2 below.

G Mining is of the opinion that the check assay results are reasonably close to those of the original assays and that consequently, the assay results included in the database of the Bloom Lake Project are reliable and can be used for the resource estimation.

Table 12-4: Samples Assayed for Independent Check of the Assays of the Drilling Database

Hole Id	From	To	Sample Length (m)	Original	Checks		Fe Difference
				Fe Grade (%)	Sample Number	Fe Grade (%)	(%)
98DN-41	232.0	234.0	2.0	26.86	A00111624	43.80	63%
98DN-45	208.0	212.0	4.0	34.69	A00111625	41.00	18%
BL-12-02	10.0	12.0	2.0	30.90	A00111617	46.20	50%
BL-12-20	21.0	25.0	4.0	34.85	A00111626	36.50	5%
BL-12-20	30.0	31.5	1.5	30.60	A00111615	28.40	-7%
BL-12-20	31.5	33.0	1.5	30.60	A00111616	29.90	-2%
BL-12-24	435.0	436.0	1.0	27.15	A00111618	32.90	21%
BL-12-24	436.0	437.0	1.0	33.90	A00111619	39.90	18%
BL-12-24	444.0	446.0	2.0	31.90	A00111620	39.00	22%

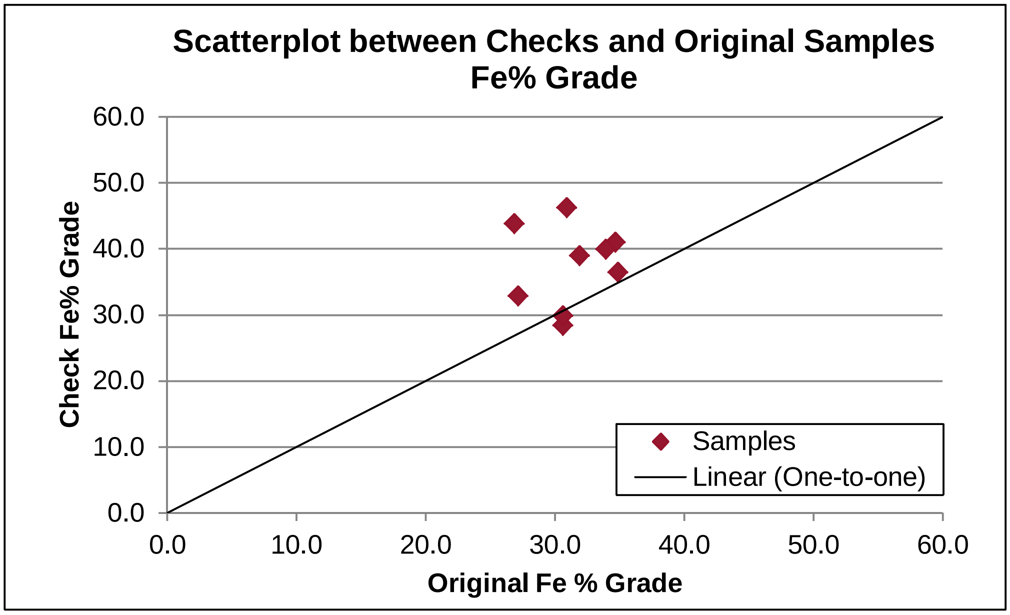


Figure 12–2: Scatterplot between Independent Checks and Original Sample Fe% Grades

13 Mineral Processing and Metallurgical Testing

13.1 Introduction

Historical laboratory data has demonstrated that the Phase 1 flowsheet proved to be unsatisfactory at recovering sufficient levels of coarse (+425 microns) and fine (-106 microns) iron minerals. In-plant pilot-scale testing was therefore conducted in 2010 to test alternate flowsheet options and equipment for possible selection in the planned Phase 2 concentrator (note that construction of the Phase 2 concentrator was not completed prior to the Bloom Lake plant shut down).

Four spiral models from three different manufacturers were tested side-by-side with feed from several different sources of the Bloom Lake orebody to simulate different applications within the circuit. This testing demonstrated that the WW6+ spirals provide consistently superior iron recovery compared to other spiral models. The WW6+ is a version of a spiral widely used at all the operating iron ore mines in the Labrador Trough region. This spiral features a trough profile very well suited to the recovery of specular hematite from granitic host rock, as well as the facility to improve removal of contaminant silicate minerals by metered wash-water addition. Further information on these spirals is given in Section 17.

Up-Current Classifiers are used in industrial minerals processing for separation of minerals exhibiting differences in specific gravity. Their effectiveness in iron ore processing has been demonstrated in similar operating iron ore beneficiation plants in the Labrador Trough region, with their application (in combination with the WW6+ spiral) leading to an improvement in recovery of the coarser iron minerals without any adverse effects on the recovery of other size fractions. Further information on UCC's is given in Section 17.

Following on from the Phase 1 in plant testing, an alternative gravity concentration flowsheet was developed for implementation in the planned Phase 2 concentrator. This flowsheet incorporated WW6+ spirals in the Rougher duty, UCCs in a cleaner duty to produce the final concentrate and another stage of WW6+ spirals for scavenging the UCC overflow to recover misplaced fine iron.

The Phase 1 upgrade flowsheet development was initially based on historical Phase 1 data, pilot testing data undertaken during the Phase 1 operation, the proposed Phase 2 flowsheet design and Mineral Technologies design data and information on spiral and UCC performance in iron ore applications in the Labrador Trough area.

Mineral Technologies proposed two processing routes for the Phase 1 upgrade flowsheet:

1. A gravity-only primary case comprising Rougher spirals, Rougher Middlings scavenging spirals, an Up-Current Classifier (UCC) and a final UCC Overflow scavenging spiral stage.
2. A bonus case which also includes recovery of iron ore through the treatment of the gravity circuit tailings by a series of Low Intensity Magnetic Separators (LIMS) and Wet High Intensity Magnetic Separators (WHIMS).

The proposed flowsheet including the bonus case is shown in Figure 13-1.

This flowsheet is similar to that developed for the planned Phase 2 concentrator; however, it includes a mids scavenger spiral stage. This stage has been included in the flowsheet to enable:

- Improved iron recovery through the production of a lower grade gravity circuit tailings stream – by treating a middlings stream from the Rougher stage spirals, less iron can be discarded in the Rougher tailings than would otherwise be.

- An alternative method of Rougher spiral middlings treatment (compared to recirculating middlings back to Rougher spiral feed) that negates the deleterious impacts of middling recirculation upon total Rougher spiral throughput of fresh feed.

- “Buffer” capacity that serves to recover minerals that would otherwise be lost to tailings in the event of an increase in feed grade to a Rougher spiral stage performing a simple 2-product (concentrate & tailings only) separation.

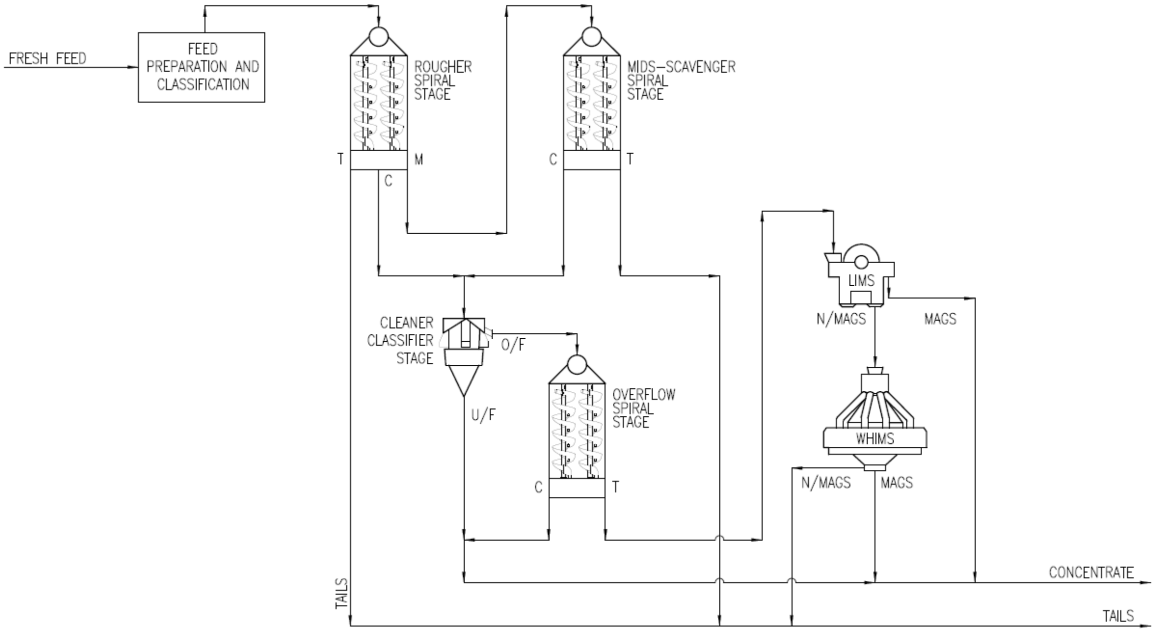


Figure 13-1: Phase 1 Upgrade Conceptual Flow Diagram

Data from the in-plant pilot testing, Phase 1 operations, and historical laboratory data were all used as inputs to the development of a metallurgical model of the proposed flowsheet. A desktop study examined three different flowsheet options to predict plant recoveries at varying feed Fe grades, and a summary of the findings of this study are given in Table 13-1 below.

Table 13-1: Metallurgical Model Predicted Recovery from Desktop Study Prior to Feasibility Study

Flowsheet Option	Feed 29% Fe		Feed 31% Fe		Feed 33% Fe	
	Fe Recovery %	Con t/hr	Fe Recovery %	Con t/hr	Fe Recovery %	Con t/hr
Base Case (Phase 2 Flowsheet)	76.8	842	77.4	910	79.1	988
MT Flowsheet	80.3	880	81.3	953	82.2	1026
MT Flowsheet + WHIMS Circuit	82.4	905	83.1	975	83.8	1046

To verify and confirm the outcomes of the desktop study, further metallurgical testing was required to:

1. Verify the gravity separation equipment performance and models.
2. Confirm the benefit of additional iron recovery through WHIMS scavenging.
3. Verify production of iron ore concentrate with less than 4.5% SiO_2 content at the recovery levels indicated by the desktop study.
4. Confirm suitability of the proposed flowsheet to meet product size requirements.
5. Confirm suitability of the fine tailings thickener and concentrate pan filters to deal with variations in mass flow and particle size distributions away from their design duties.
6. Serve as the basis of design for the feasibility study to determine ±15% levels of accuracy for CAPEX and OPEX requirements of the eventual operating plant.

Metallurgical testing has been conducted using bulk samples from various zones of the Bloom Lake deposit and composite core samples.

13.1.1 Feed Samples

13.1.2 Feed Samples Selection

The Bloom Lake ore-body has been modelled as a block geology model (indicating ore types and grades in discrete blocks within the deposit), and this has been used as the basis of feed sample selection. Six blocks were selected from three zones of the Bloom Lake deposit, with the intention that these would result in a spread of feed assays between 29-33% Fe.

Two of these samples (WEST1 & WEST2) represent the material that is expected to be mined and processed in the first two years of operation after commissioning.

Samples HEM1, HEM2, and HEM3 represent the area to be processed after the West zone

BCHEF1 sample was selected to give insight into processing sections of the orebody containing higher levels of magnetite.

Samples were obtained by surface digging with an excavator at the area corresponding to the block model. The sample for each block was approximately three tonnes and a sub sample of nominally one tonne from each block was sent for testing. The remaining portion of each sample was retained for possible future use.

All samples were prepared to a size range suitable for beneficiation and characterised in terms of assay by size and assay by density fractions. The first five bulk samples were processed concurrently as feed for the flowsheet design test work, with the BCHEF1 sample being set aside for later processing.

13.1.3 Samples Comminution

Each of the ore samples listed previously was sent to SGS Canada Ltd’s facilities in Quebec City for initial preparation. Each sample was crushed and then screened at 1mm with oversize (coarser) particles being crushed again until it was finer than 1mm, to mimic the effect of the classifying screens installed in the concentrator prior to the Rougher spirals as shown in Figure 13-2. The undersize material (<1mm) was placed in drums for shipment to Australia.

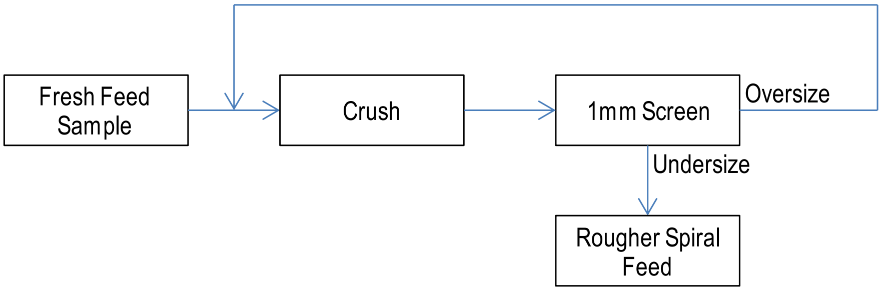


Figure 13-2: Sample Preparation (crushing and screening) Testwork Flow Diagram

13.1.4 Samples Homogenisation and Characterisation

13.1.4.1 Samples Characterisation Overview

Each of the samples was individually homogenised using a carousel splitter, and representative sub-samples were extracted for reference and characterisation purposes.

Characterisation of the representative sub-samples involved:

- Slime (defined as -45µm) content determination by wet sieving.
- Particle size distribution (PSD) analysis of the +45µm material by dry sieving.
- Density separation by sink/float technique of the +45µm material at SG 2.85 to determine the proportion of total heavy mineral (THM, particle with specific gravity greater than 2.85).
- Further density separation of the THM fraction at SG 3.3, 3.6 and 4.05 with XRF assay analysis of the density fractions.

13.1.4.2 Sizing and Assay

Sub-samples of each of the feed samples were wet screened at 45µm. The -45µm fractions were collected, filtered, dried and weighed. The +45µm material for each sample was dry screened to determine the particle size distribution for each sample. Figure 13-3 below depicts the particle size distribution of the crushed samples. The figure also includes the typical particle size distribution of the rougher spiral feed of the operating plant before shut-down in 2014.

- The D_{50}[1] of the 6 bulk samples are all between 223 and 273 microns, while the D_{80} ranges between 428 and 489 microns, indicating that the samples are all very similar in particle size distribution. Should any difference in separation performance between samples become apparent during testing, this would indicate that iron ore grains in a poorly-performing sample

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[1] The term "D_{50}" and "D_{80}" are commonly used to describe particle size distribution data. D_{50} & D_{80} (similarly D_{25}, D_{75} etc.) describe the diameter of a particle falling in the 50th & 80th percentile respectively. These figures give the reader insight into both absolute particle size and the range of particle sizes.

would not be properly liberated. Given the close sizing results, this scenario is not expected. If it was however, any lower than optimal liberation may require additional grinding which would lead to lower throughput and finer material. In turn, the finer material may lead to higher iron in the tailings streams and increase the recovery work for any magnetic circuit installed.

- HEM1, HEM3 and BCHEF1 contained the most slimes (approximately 10%), compared to the other samples having slimes levels under 5%, suggesting there may be increased solids loading to the thickener when processing ore from the HEM1, HEM3 and BCHEF1 zones.
- The particle size distribution of the crushed samples was also very similar to the typical particle size distribution of the plant rougher spiral feed before shut-down, thereby validating the adequacy of the sample preparation method used (crushing).

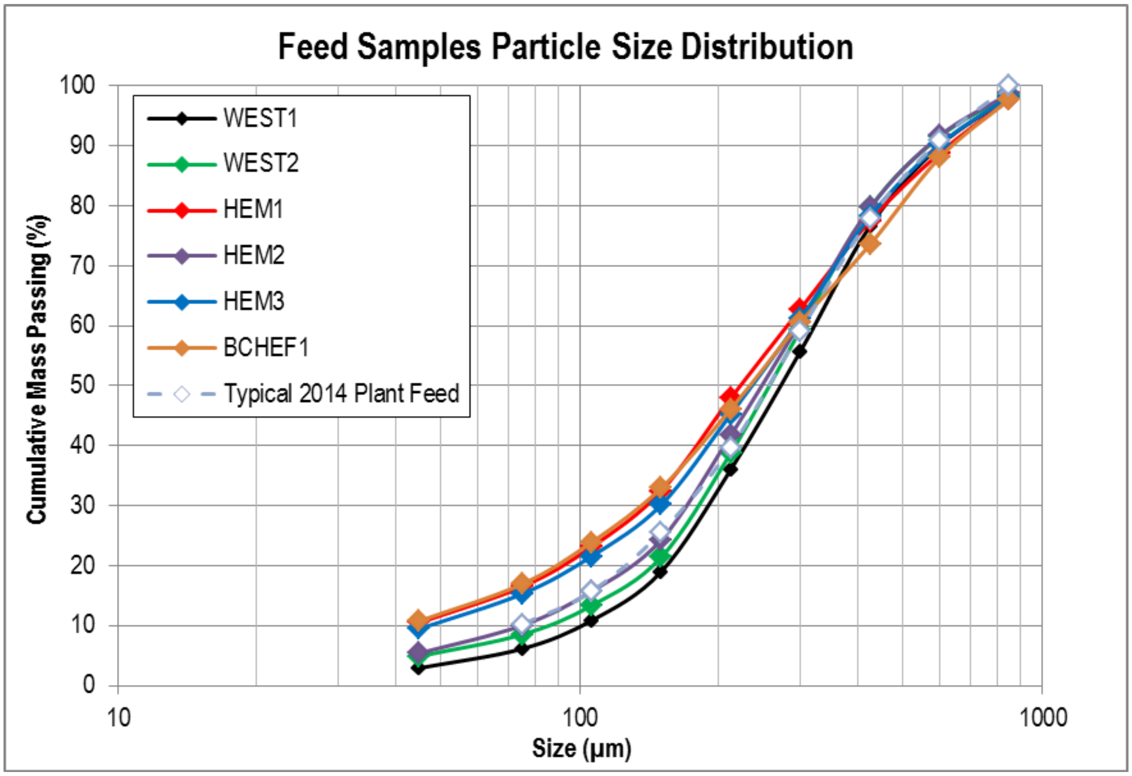

Figure 13-3: PSD of the Feed Samples

Each of the size fractions for the samples was dispatched for X-ray fluorescence spectrometry (XRF) assay analysis. The fused bead XRF technique was used throughout the test program to determine elemental composition of various samples. For this technique, the samples are typically first pulverised in a tungsten carbide ring mill to homogenise the sample. A sub-sample is taken and melted together with flux material, which is then cast to form a glass bead. The glass bead is then analysed using the XRF technique. Table 13-2 gives an overview of the sample assays.

Table 13-2: Testwork Head Sample Assays

Sample	XRF assay Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %
WEST 1	37.9	44.0	0.82	0.02	0.01	0.29	0.15	0.01	0.31
WEST 2	23.5	63.4	1.18	0.02	0.01	0.51	0.18	0.02	0.64
HEM1	35.8	46.8	0.37	0.03	0.01	0.11	0.04	0.05	0.16
HEM2	34.0	48.5	0.88	0.02	0.01	0.65	0.15	0.06	0.57
HEM3	35.2	47.3	0.74	0.03	0.01	0.30	0.10	0.10	0.37
BCHEF1	39.1	42.5	0.17	0.02	0.01	0.95	0.02	0.05	1.34

The feed sample assays showed that the Fe grades of the six samples ranged from 23.5 to 39.1%.

While this does not present any specific issue for flowsheet development testwork, as no specific sample was in the expected feed grade range a decision was made to process an additional 500kg sample that was representative of the plant feed for the first 5 years of the mine operation. This sample was prepared from drill core samples on hand at Bloom Lake.

The assays also confirmed that the BCHEF1 sample contained significantly more magnetite than the other samples.

13.1.4.3 Density Profile and Assay

Density profile of the feed samples was conducted using heavy liquid separation sink/float separation technique. Separations were done first at SG 2.85 using bromoform with the sink fraction successively separated at SG 3.3 using methylene iodine then at SG 3.6 and 4.05 using Clerici's solution prepared at the required specific density. Sub-samples of each density fractions were extracted for analysis by XRF assay. The densimetric fractionation overview for each sample is given in Figure 13-4.

- The -2.85SG content in all the samples ranged from 27.7% (BCHEF1) to 61.3% (WEST2). The higher proportion of light minerals with SG <2.85 in WEST2 sample is consistent with the lower % Fe grade reported in table 2 whilst the lower proportion of light minerals in BCHEF1 is also consistent with the higher % Fe grade for this sample.
- The +4.05SG content in all the samples ranged from 29.9% (WEST2) to 47.5% (BCHEF1). The ranges are also consistent with the sample feed grade.
- Particles that report to the -2.85SG fraction consist of quartz and other particles containing very high SiO_2.
- Particles that report to the +4.05SG fraction consist of hematite, magnetite and other particles containing very high Fe.
- Whilst the mass proportion of +4.05SG particles varied between samples, the distribution of Fe to the +4.05SG fraction was >80% for all samples except HEM2. This observation indicates that the Fe-minerals in the samples are well liberated.

- The 1.2 SG differential between the light minerals (<2.85SG) and very heavy minerals (>4.05SG) indicate that the samples are amenable to separation using gravity techniques on equipment such as spirals and UCCs which require a SG differential between the product and the gangue.
- The relative low proportion of particles with intermediate SG in the range +2.85-3.6 and +3.6-4.05 is also expected to assist in achieving good separation performance.
- Regarding HEM2 sample, whilst the proportion of Fe reporting to the +4.05SG fraction was modest at 60.4%, it was noted that the proportion of Fe reporting to the total +3.6SG fraction was 90.1% and in line with all other samples which reported % Fe distribution to +3.6SG fraction ranging from 87.7% to 94.7%.
- Gravity separators like spirals and UCC can be operated to recover minerals with SG >3.6 so no specific difficulties are expected from the processing of HEM2 sample.

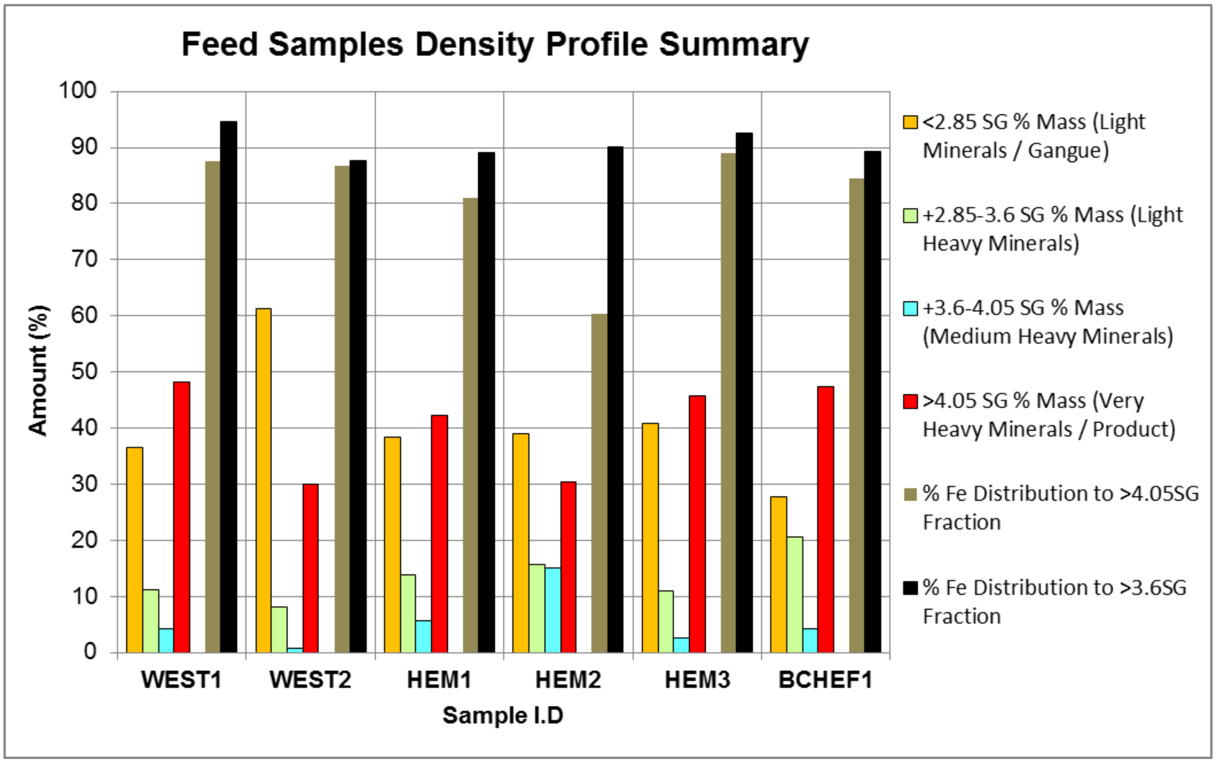

Figure 13-4: Density Profile Summary of the Feed Sample

13.2 Rougher Spiral Testwork

As noted previously, sample BCHEF1 was set aside for later processing.

The other five bulk samples were processed separately in the Rougher stage to gain better understanding of the variability in rougher stage spiral separation performance across the ore zones (the variability in feed grades is shown in Table 13-2). During the Rougher testwork, the spirals are operated such that they produce similar concentrate, middlings and tailings grades across the five different bulk samples, because of this, the rougher concentrates produced from the individual bulk processing operations were then combined to form a single concentrate for subsequent separation.

Similarly, the rougher middling spiral products were also combined before Mid scavenger spiral testwork evaluation and processing.

Bulk separation operating conditions (feed solids rate, feed slurry density, wash water rate) for the separation of each sample in the rougher stage were conducted at the nominated design feed conditions. Rougher release tests were conducted during their bulk processing to allow the derivation of the recovery models for each bulk sample. In addition, a series of closed circuit spiral performance tests at varying feed rates, slurry density and wash water flow were performed using sample HEM2[2] to give an indication of sensitivity to these factors.

During the release test work, spiral splitters were adjusted between tests in order to define the spiral performance over a range of mass yield. XRF assay was used to determine the elemental composition of the test fractions generated during this release test work The assays provide detail on the content of a broad range of elements in the samples; however, the focus for this application is on iron (Fe) and silica (SiO_2) content. This is due to both the limited inclusion of all other elements which represent less than 2.5% by weight of the total oxides and the nature of this Rougher stage of processing, which is required to recover the Fe while rejecting the SiO_2 from the feed material.

The flow rate and assay data were tabulated and release curves for recovery/yield, and grade/yield were generated from the data for each series of tests. The objective was to define the performance of the WW6+ spiral model over a wide range of operating parameters. The performance data also provided parameters for simulation purposes.

13.2.1 Loading Effect Release Tests

The loading tests were conducted at nominally 40% solids slurry density and 18L/min wash water. Feed rates of 1.7, 1.9 and 2.5t/h were tested. Figure 13-5 shows the recovery release curves for Fe.

The recovery curves show how much of the Fe is recoverable at a given mass yield to the concentrate stream. The dotted lines shown with the recovery curves show the theoretical perfect separation in which 100% of the Fe is recovered without inclusion of any other elements. The mass yield at which the 100% Fe recovery is achieved corresponds to the feed grade.

The nature and shape of the recovery curve is defined by the ore being treated and its characteristics (which include, grade, particle size distribution, density profile, degree of liberation of the gangue and valuable minerals), the equipment used for the separation and the operating parameters used for the equipment. A good typical separation is one in which the separation is relatively closer to ‘perfect’, i.e. valuable mineral particles are mostly recovered to concentrate while gangue mostly reports to tailings.

- The curves depict good separation for Fe in the range of the feed rate tests. The release data shows that the Rougher concentrate target grade of ~52% Fe can be attained at ~65% mass yield with ~90% Fe recovery.
- The Fe separation performance is very similar at the different feed rates and indicates that there is negligible difference in performance in the 1.5-2.5 t/h range under the tested conditions. This correlates well with the design feed rate for the rougher stage spirals which is nominally 2t/h.

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[2] Sample HEM2 was selected for the initial closed circuit spiral testwork as its % Fe grade was the closest to the expected life of mine grade and it was also the first sample received for testwork

- During the spiral testing, it was observed that a high mass yield of the feed sample readily reported to the concentrate auxiliary splitters. This caused particle crowding and overflowing on closed splitters which initially resulted in limited control over the mass cut to concentrate. Splitter extensions as shown in Figure 13-6, as well as the closing of some auxiliary splitters, were implemented to regulate the mass yield to concentrate for all spiral tests. This is a simple modification to standard supply which will be included as part of the equipment supply for the plant upgrade.

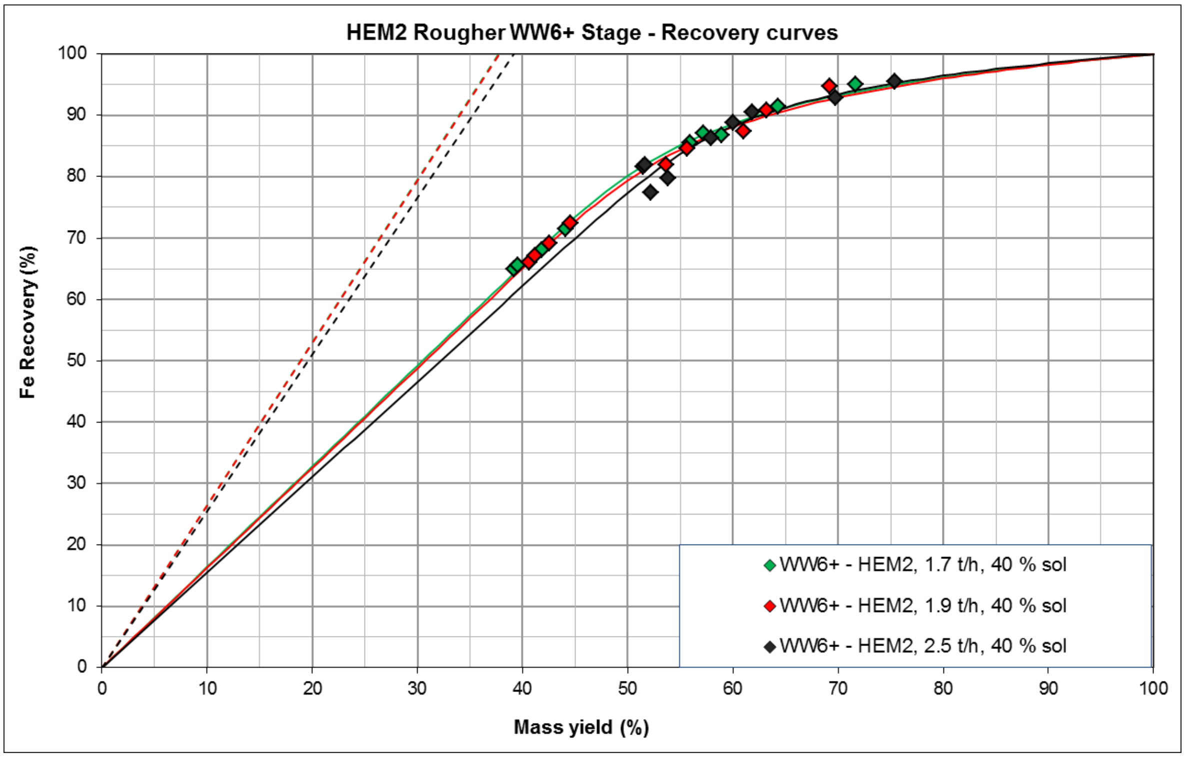
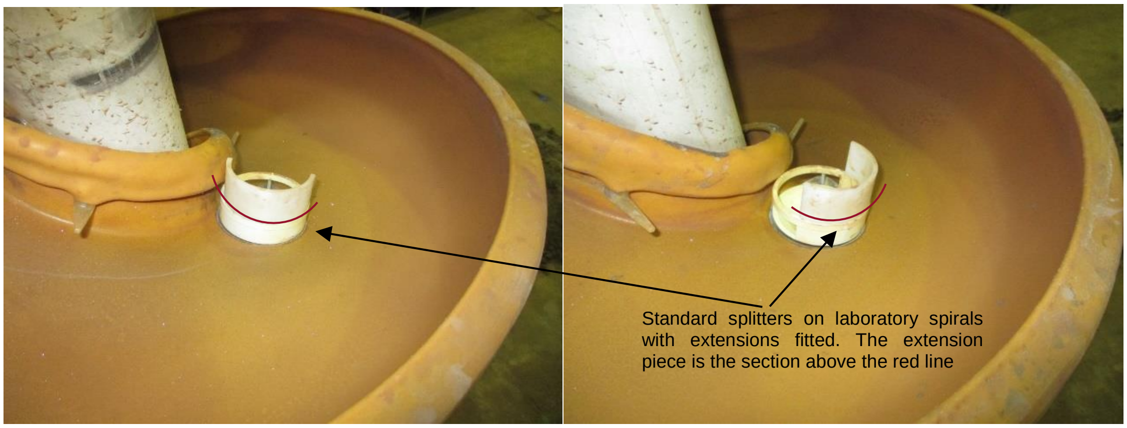


Figure 13-5: Rougher WW6+ Comparative Fe Recovery Curves at Varying Loadings



Standard splitters on laboratory spirals with extensions fitted. The extension piece is the section above the red line

Figure 13-6: Splitter Extensions on a Closed off and Open Splitter on Turns 2 and 4

13.2.2 Density Effect Release Tests

The feed slurry density tests were conducted at the nominal design tonnage and wash water rates of 1.96 t/h and 18 L/min respectively. Slurry densities of 35%, 40% and 45% were tested. Figure 13-7 shows the recovery release curves for Fe.

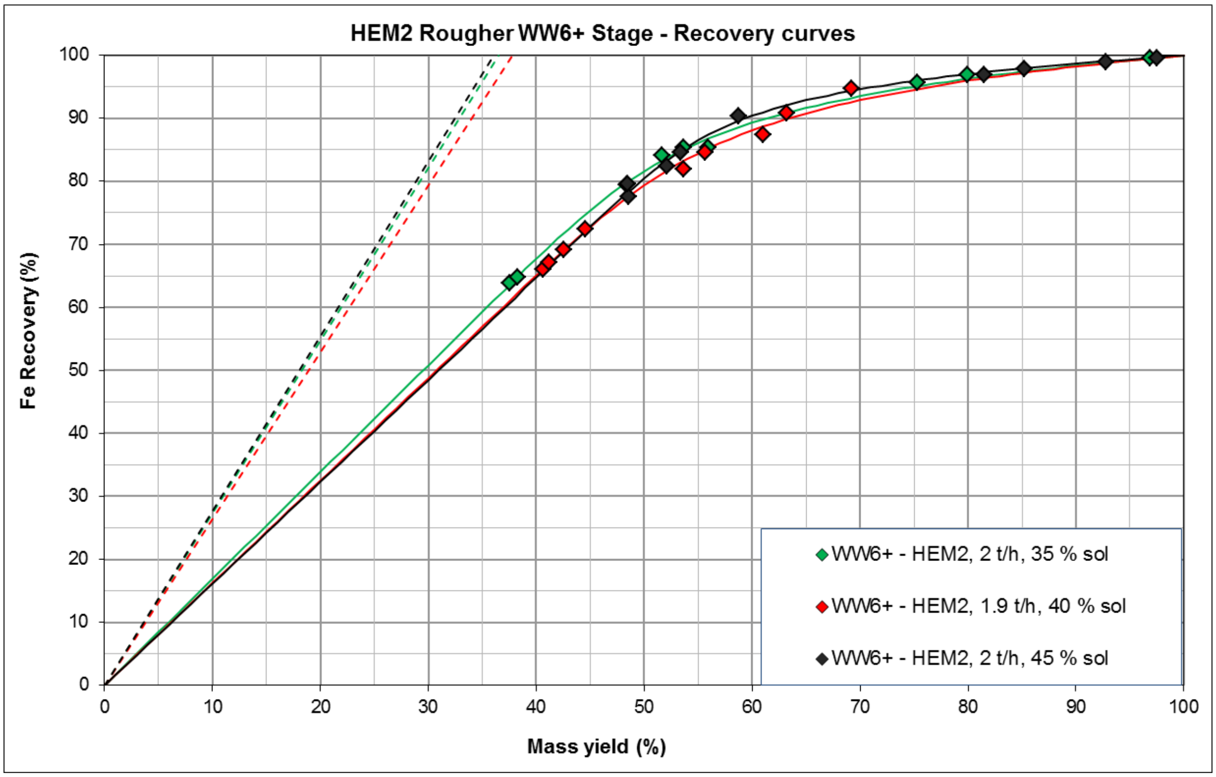


Figure 13-7: Rougher WW6+ Comparative Fe Recovery Curves at Varying Feed Densities

- The curves show that there was negligible difference in performance in the 35-45% pulp density feed range under the tested conditions. This indicates that the separation on the WW6+ spiral is robust, and that any variations in feed density within the above range that may present during plant operation should not cause concern regarding the plant separation performance.
- There is therefore potential to increase plant throughput incrementally following commissioning without adverse effects on recovery.

13.2.3 Wash Water Effect Release tests

The effect of wash water on the separation performance was tested at nominal wash water rates of 13, 18 and 25 L/min. The design feedrate and pulp density of 1.96 t/h and 40% solids respectively were used for these tests. Figure 13-8 shows the recovery release curves for Fe.

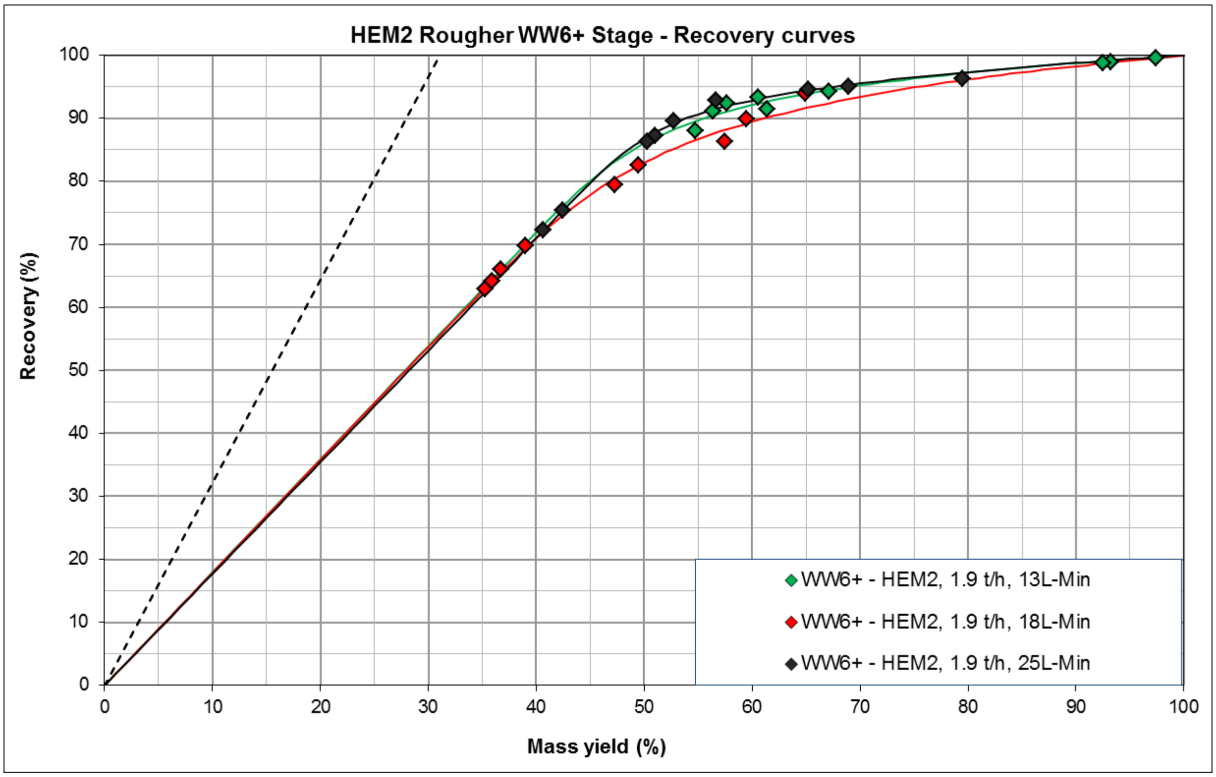


Figure 13-8: Rougher WW6+ Comparative Fe Recovery Curves at Varying Wash-Water Addition Rates

- The curves depict good separation for Fe in the range of the wash water rates tested and minimal impact of wash water variation on the shape of the separation performance curve at the tested conditions. In other words, comparable Fe recovery to product can be achieved by adjusting splitter position when operating at 13 L/min or 25 L/min
- It was noted that the back calculated feed grade for the spiral tests ranged between 35.5% and 37.8% Fe and this is due to normal variation inherent in the sampling process during testing procedures. The data was normalised[3] to a feed grade of 31% Fe to evaluate impact of the Wash Water rate on product grades.
- Further, the tests at 13 L/min and 25 L/min were conducted later than the tests at 18 L/min and at the same splitter position so that the impact of wash water rate on product yield and grade and same splitter position could be evaluated. Figure 13-9 shows the normalised grade release curves for Fe for the tests at 13 L/min and 25 L/min.

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[3] “Normalised” data is data which has been re-calculated to eliminate the effects of variation in feed grades on separation performance, thus allowing direct comparison of sample results.

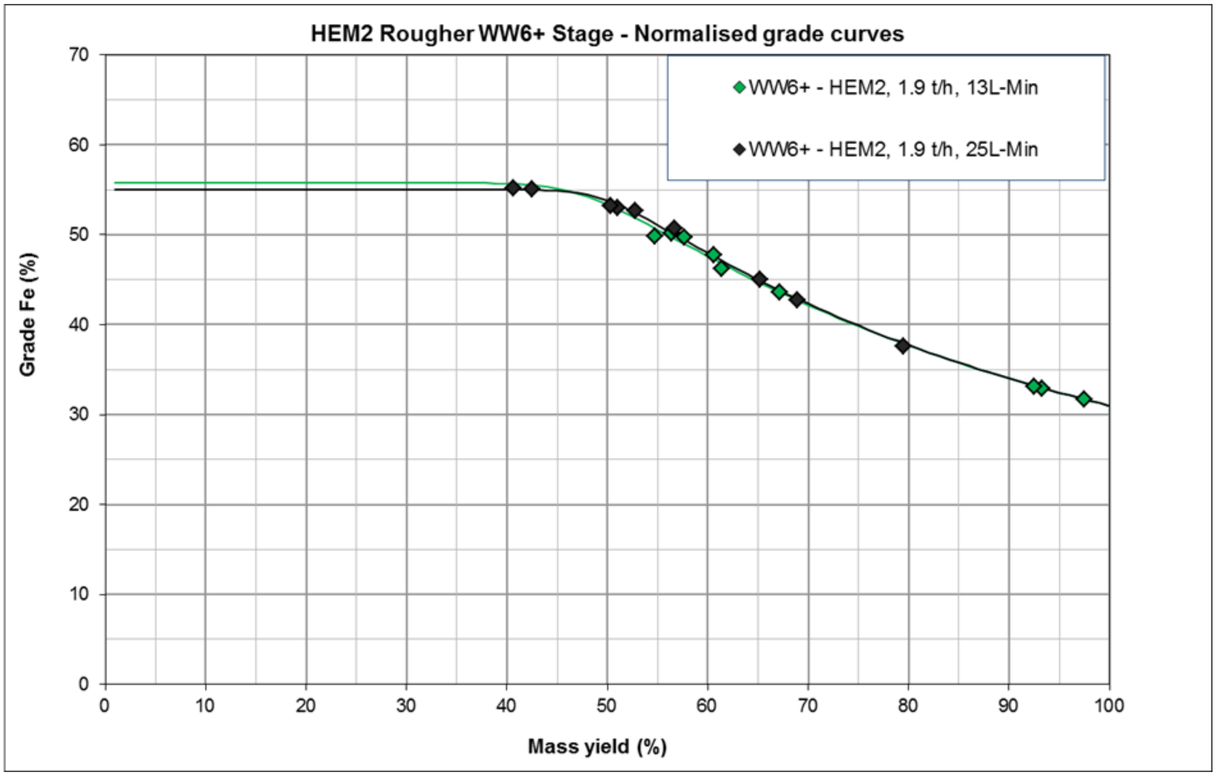

Figure 13-9: Rougher WW6+ Comparative Normalised Fe Grade Curves at Varying Wash-Water Addition Rates

- The normalised grade curves indicate that when operating at wash water rate of 13 L/min, a concentrate can be produced at yield of 54.7% and with a grade of 49.8% Fe. Without changing the splitter positions and by increasing the wash water rate to 25 L/min, the yield to the concentrate is shown to reduce to 40.6% and the grade increases to 55.2% Fe.
- The above observation demonstrates that the wash water rate can be adjusted to control the grade of the concentrate product.

13.2.4 Comparative Rougher Spirals Release Tests

Release tests were also conducted for the other 4 samples (HEM1, HEM3, WEST1 & WEST2) in order to define their separation performance individually prior to the bulk processing. These tests were conducted at nominal parameters of 1.96 t/h feed rate, 40% solids pulp density and 18 L/min wash water. The feed parameters were selected based on the normal equipment operating range and also to replicate design flowsheet conditions and plant pumping and material handling parameters.

Figure 13-10 shows the comparative recovery release curves in terms of Fe for the five samples and Figure 13-11 shows the same recovery release curves adjusted (or normalized) to reflect all samples having the design feed grade of nominally 31%[4].

- The performance curves showed some variation between samples due to the differences in feed grade.

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[4] The first 10 years of commercial operation have an expected feed grade averaging 30.6% Fe, with peaks over 31% Fe. For design purposes, a feed grade of 31% Fe was selected.

- The normalized performance data indicates a similar separation performance envelope for all samples.
  - The WEST2 material indicated comparatively better separation performance at lower yield (up to approximately 50% yield to concentrate) than the other material types, however above this yield the performance was comparable to the other samples tested.
  - The HEM1 material displayed slightly reduced separation performance compared to the other samples.
  - HEM2 and WEST1 materials demonstrated superior performance to the other samples, particularly for yields >60%.

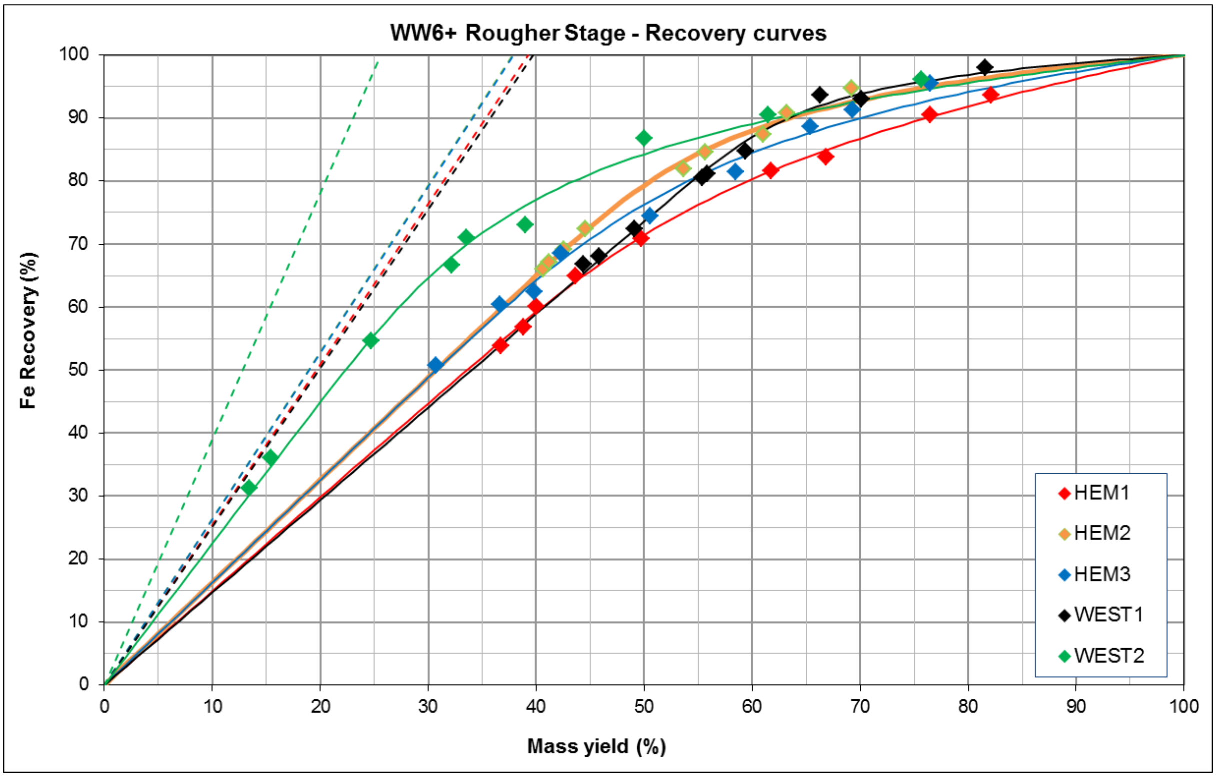


Figure 13-10: Rougher WW6+ Comparative Fe Recovery Curves at Design Conditions

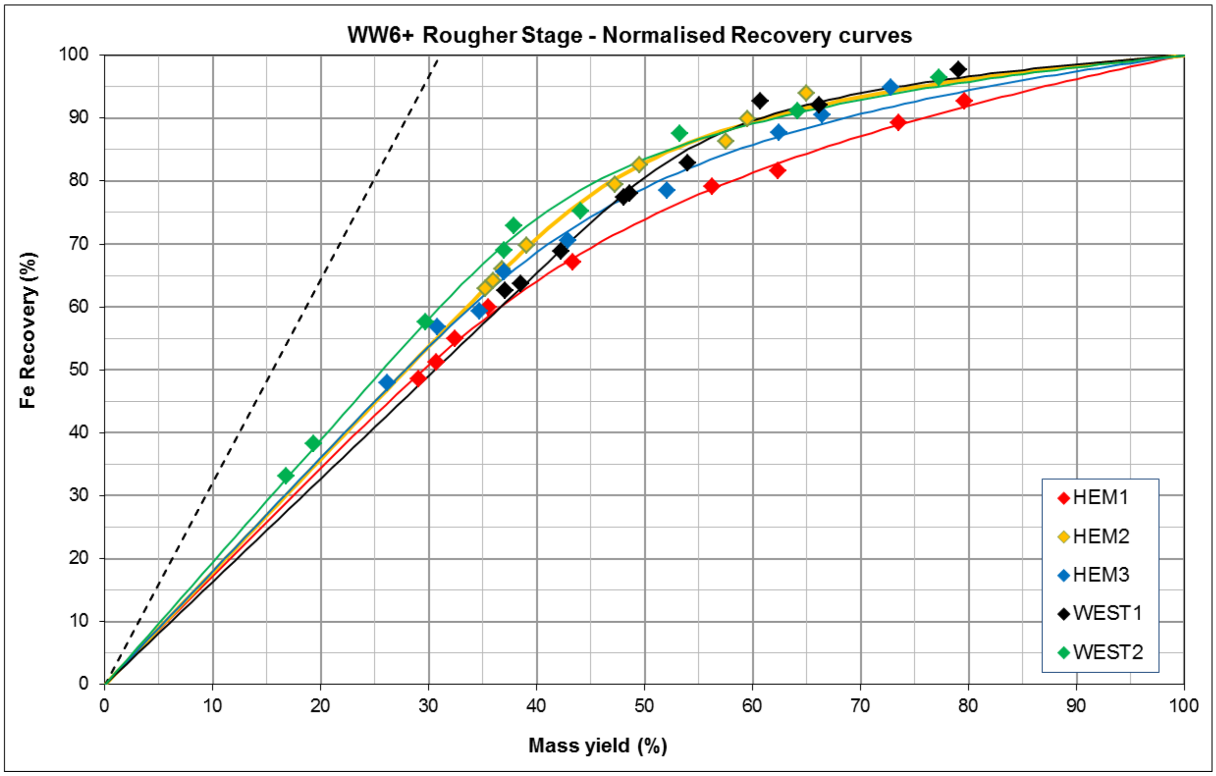


Figure 13-11: Normalised Rougher WW6+ Comparative Fe Recovery Curves at Design Conditions

13.2.5 Bulk Rougher Spiral Processing

The rougher bulk processing was conducted using the WW6+ spiral model operating at 1.96 t/h and 40% solids nominally. Each of the five samples were processed separately to produce combined streams of concentrate, middlings and tailings. The splitters were adjusted to produce a nominal yield to concentrate of approximately 50-55% and a middlings product of about 25% yield, based on the release performance of the HEM2 sample. Minor adjustment was made to the splitter settings for each of the samples to optimise the recovery of Fe minerals to concentrate and middlings. The adjustment of the splitter settings for each of the samples was done manually with the splitter position determined by the process metallurgist conducting the testwork using the visual difference between the dark Fe and the light coloured gangue. This visual adjustment is typical for spiral separators in a test or an operational situation.

Table 13-3 shows the calculated mass and assay data for the combined con, mid and tails streams from the five bulk samples. Note that this is weighted average data from the five separately processed bulk samples and not data from a single combined bulk sample.

Table 13-3: Bulk Rougher Metallurgical Summary

Rougher Spirals		XRF assay									Stage Distribution		
PRODUCT	% Mass	Fe	SiO_2	Al_2O_3	P	S	CaO	TiO_2	Mn	MgO	Fe	SiO_2	Al_2O_3
	Stage	%	%	%	%	%	%	%	%	%	%	%	%
Rougher Con	37.6	55.1	19.5	0.49	0.02	0.01	0.27	0.16	0.07	0.25	65.0	14.1	24.3
Rougher Middlings	28.1	27.9	57.7	0.81	0.02	0.01	0.43	0.11	0.04	0.46	24.6	31.1	30.1
Rougher Tails	34.2	9.74	83.4	1.01	0.02	0.01	0.43	0.09	0.03	0.53	10.4	54.8	45.6
Total	100	31.9	52.1	0.76	0.02	0.01	0.37	0.12	0.05	0.41	100.0	100.0	100.0

- The total mass yield to concentrate and middling was 37.6% and 28.1% respectively. Note that these mass splits are not necessarily those that are expected in the plant, but are a result of visual adjustments and variability between samples.
- The concentrate grade was 55.1% Fe, with a recovery of 65% of the Fe in the feed, which was in line with the model data.
- Approximately 25% of the Fe in the feed reported to middlings whilst 10.4% of the total Fe was lost to tailings.
- SiO_2 distribution to tailings was 54.8%, with 14.1% of the SiO_2 in the feed reporting to concentrate.
- The calculated weighted average overall feed grade for the five bulk samples was 31.9% Fe, 52.1% SiO_2, 0.76% Al_2O_3 and 0.02% P.

13.3 Mid Scavenger Spiral Testwork

The mids scavenger stage testwork was conducted using the combined rougher bulk middling streams from the five samples. Release spiral testing was performed at the design conditions to give a performance indication for the mids scavenger stage. Bulk separation conditions for the mids scavenger separation were then selected using the results from the release tests.

13.3.1 Mid Scavenger Spiral Release Tests

During the release testwork, spiral splitters were adjusted between tests to define the spiral performance over a wide mass yield range. The test fractions were analysed for Fe and SiO_2 content by XRF assay. The flow rate and assay data were tabulated and release curves for recovery/yield, separation efficiency and grade/yield were generated from the data. The objective was to define the performance of the WW6+ spiral model over a wide range of operating parameters prior to bulk processing. The performance data also provided parameters for simulation purposes.

The release tests were conducted at nominally 40% solids and 18 L/min wash water. A feed rate of 2.3 t/h was used in the release testing to fit within the flowsheet design parameters. Figure 13-12 shows the recovery release curves for Fe and SiO_2 in the mid scavenger stage.

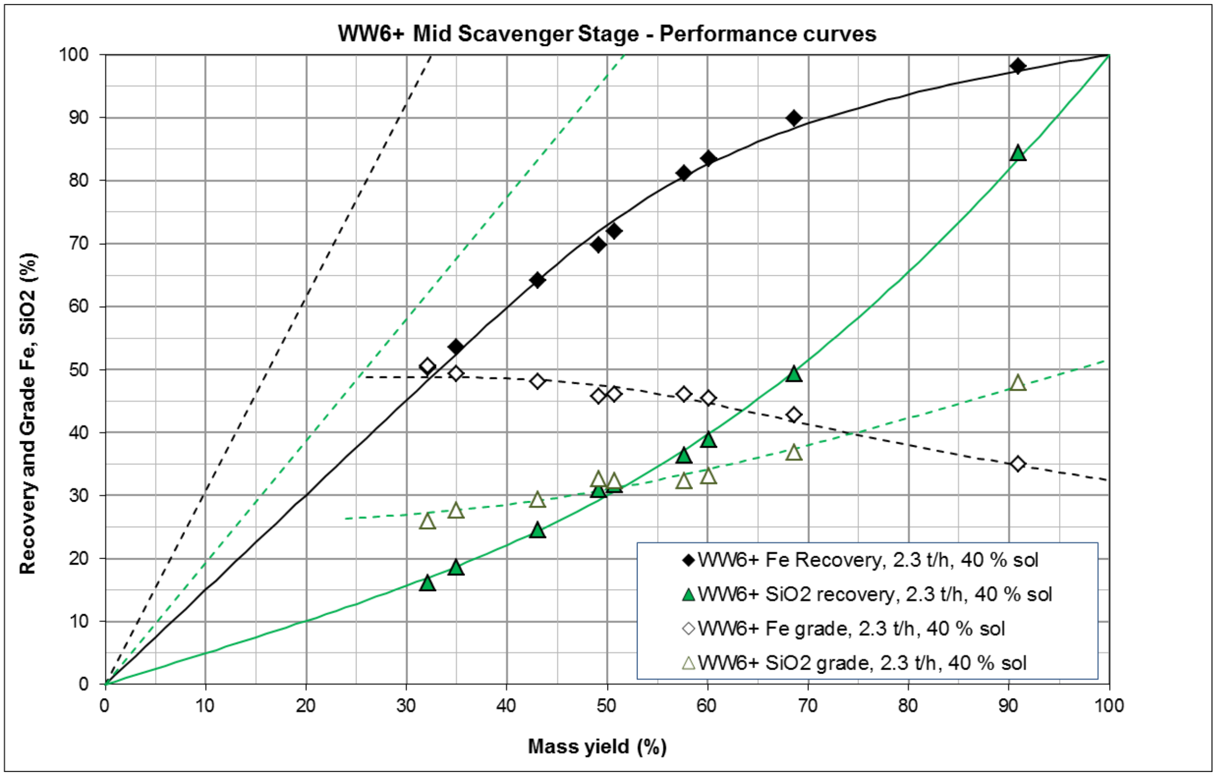


Figure 13-12: Mid Scavenger Recovery and Grade Curves at Design Conditions

- The curves depict a good recovery of Fe minerals with good rejection of SiO_2 from the Mid Scavenger stage.
- The release data showed that mids scavenger con target grade of ~45% Fe can be attained at ~50% mass yield and ~72% recovery.

13.3.2 Bulk Mids Scavenger Spiral Processing

The bulk Mid Scavenger test was conducted at the tested feed rate of nominally 2.4 t/h and 40% solids. The wash water was maintained at 18 L/min. The target mass yield to concentrate was ~50% while targeting a mass yield to tails of approximately 2%. The middlings splitter was therefore operated wide open to cut the smallest tail possible. Table 13-4 summarises the metallurgical balance results for the mid scavenger stage.

Table 13-4: Bulk Mids Scavenger Metallurgical Summary

Mid Scavenger Spirals		XRF assay									Stage Distribution		
PRODUCT	% Mass Stage	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
Mid Scavenger Con	52.5	39.4	41.4	0.68	0.02	0.01	0.39	0.11	0.05	0.40	76.9	36.8	45.5
Mid Scavenger Middlings	42.1	13.4	78.3	0.83	0.02	0.01	0.45	0.08	0.03	0.49	21.0	55.8	44.6
Mid Scavenger Tailings	5.38	10.3	81.1	1.44	0.04	0.01	0.58	0.11	0.04	0.75	2.1	7.4	9.9
Total	100	26.9	59.1	0.78	0.02	0.01	0.43	0.10	0.04	0.46	100.0	100.0	100.0

- The total mass yield to concentrate and middling was 52.5% and 42.1% respectively, while tailings accounted for 5.4% of the feed. Similarly to the bulk rougher stage, these mass splits are not necessarily those expected in the operating plant, but are instead a result of the high feed Fe grade resulting in a higher concentrate mass split (the desktop metallurgical model predicts feed Fe grade to be closer to 20% Fe) as well as splitter adjustments made while processing.
- The concentrate grade was 39.4% Fe, with a recovery of 76.9% of the Fe in feed, which was in line with the model data.
- The amount of Fe reporting to middlings was 21% whilst only 2.1% of the total Fe reported to tailings.

13.4 Cleaner UCC Testwork

13.4.1 Cleaner UCC Feed Characterisation

The rougher concentrate and the mids scavenger concentrate were combined and blended to constitute the feed to the cleaner Up-Current Classifier (UCC) stage. A sub-sample of the blended cleaner stage feed was taken for particle size distribution determination, and the size fractions were analysed for assay. Table 13-5 gives a summary of the assay-by-size analysis of the cleaner stage feed.

Table 13-5: Cleaner Feed Assay by Size Summary

UCC Feed (Measured)		XRF assay									Distribution		
Sieve Size µm	Mass % individual	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
850	1.3	62.7	8.79	0.35	0.02	0.01	0.15	0.06	0.16	0.16	1.6	0.5	0.9
600	7.2	64.4	6.73	0.30	0.01	0.01	0.12	0.09	0.10	0.13	9.0	1.9	4.0
425	10.7	63.4	8.37	0.30	0.01	0.01	0.11	0.08	0.07	0.12	13.2	3.6	6.0
300	15.1	58.3	15.4	0.33	0.01	0.01	0.13	0.08	0.05	0.15	17.1	9.4	9.3
212	17.6	50.3	26.8	0.43	0.01	0.01	0.20	0.12	0.04	0.22	17.2	19.0	14.1
150	21.0	43.2	36.5	0.58	0.01	0.01	0.31	0.17	0.04	0.33	17.7	31.0	22.8
106	12.8	43.0	36.2	0.76	0.03	0.01	0.46	0.21	0.05	0.44	10.7	18.7	18.1
75	8.0	46.2	30.8	0.90	0.05	0.01	0.63	0.26	0.06	0.56	7.2	9.9	13.3
45	3.7	49.9	25.2	0.96	0.07	0.01	0.69	0.32	0.09	0.57	3.6	3.8	6.7
<45	2.6	52.9	20.4	1.00	0.07	0.02	0.63	0.35	0.12	0.55	2.7	2.1	4.8
Total	100.0	51.4	24.8	0.54	0.02	0.01	0.29	0.15	0.06	0.29	100.0	100.0	100.0

- The UCC feed D_{50} was calculated to be 220 microns with the Fe D_{50} calculated to be 252 microns and the SiO_2 D_{50} calculated to be 180 microns.
- The data shows that coarser particles (>300µm) tend to have a high Fe grade. These particles will readily report to UCC underflow, requiring a very small rejection (in terms of mass %) of silicate minerals from these fractions to produce concentrate material of a suitable grade.
- Silicate minerals in the 106-212 µm range make up a higher proportion of this size range, but low SG mineral grains of this size are easy to reject using a UCC.

- About 14% of the Fe was distributed in the -106 µm ranges. These sizes tend to report to overflow (reject) more readily than coarser fractions. Fe minerals contained in this stream will therefore be scavenged by the Overflow Scavenger spirals.
- The calculated grade of the UCC feed was 51.4% Fe, 24.8% SiO_2 and 0.54% Al_2O_3, which agrees closely with the metallurgical modelling.

13.4.2 Preliminary UCC Testwork

The bulk Cleaner stage feed material was used to conduct preliminary tests for the UCC stage prior to the bulk UCC processing. The intent of the test is to confirm the quality of products at nominated conditions in relation to the predicted performance and adjust operating condition as required. A test was done in open circuit configuration in a 290 mm diameter laboratory UCC with an up-current water rate of 24 L/min (T7104), corresponding to a rising velocity of 6.1 cm/sec or just under the settling velocity of a sub-rounded to angular Fe particle with size of 250 microns (6.93 cm/sec).

A summary of the mass yield and assays is given in Table 13-6.

Table 13-6: UCC Cleaner Sighter Test Data at 24L/min Up-current Water

T7104		**XRF assay**									**Stage Distribution**		
Fraction	**Mass %**	**Fe %**	**SiO_2 %**	**Al_2O_3 %**	**P %**	**S %**	**CaO %**	**TiO_2 %**	**Mn %**	**MgO %**	**Fe %**	**SiO_2 %**	**Al_2O_3 %**
T7104 Overflow	33.0	21.5	66.0	1.03	0.04	0.01	0.66	0.16	0.05	0.62	13.5	92.6	70.8
T7104 Underflow	67.0	67.7	2.60	0.21	0.01	0.01	0.06	0.10	0.06	0.07	86.5	7.4	29.2
Total	100.0	52.4	23.5	0.48	0.02	0.01	0.26	0.12	0.06	0.25	100.0	100.0	100.0

T7104 resulted in a high recovery of Fe minerals to the UCC underflow (U/F) product of 86.5% whilst achieving an underflow grade of 67.7% Fe and 2.60% SiO_2, and these settings were selected for the bulk processing step.

13.4.3 Bulk UCC Processing

After UCC sighter testing, the bulk sample was processed through the UCC at the nominated conditions from test T7104 (24 L/min up-current water).

Table 13-7 summarizes the bulk UCC separation.

Table 13-7: Bulk UCC Cleaner Stage Summary

UCC		**XRF assay**									**Stage Distribution**		
PRODUCT	**% Mass Stage**	**Fe %**	**SiO_2 %**	**Al_2O_3 %**	**P %**	**S %**	**CaO %**	**TiO_2 %**	**Mn %**	**MgO %**	**Fe %**	**SiO_2 %**	**Al_2O_3 %**
UCC Overflow	36.9	25.3	60.7	1.03	0.04	0.01	0.67	0.19	0.05	0.63	18.0	91.7	72.3
UCC Underflow	63.1	67.2	3.19	0.23	0.01	0.01	0.06	0.12	0.08	0.06	82.0	8.3	27.7
Total	100	51.8	24.4	0.52	0.02	0.01	0.28	0.15	0.07	0.27	100.0	100.0	100.0

- The product (U/F) grade was 67.2% Fe and 3.19% SiO_2, which is well above the product specification of 66.2% Fe and <4.5% SiO_2.
- The data shows that most of the SiO_2 was rejected to overflow (O/F), but some fine Fe was also lost, as the O/F Fe grade is 25.3%.

- The mass yield to the underflow (U/F) was 63.1%, with an 82% recovery of the Fe and 8.3% SiO_2 distribution. These figures indicate a lower Fe recovery than the sighter test, indicating that the up-current water flowrate and bed pressure setting in the plant can both be lower than the levels used in either test to increase mass recovery to underflow.

13.5 Overflow Spiral Testwork

The Overflow spiral stage treats the Cleaner UCC overflow product to recover the fine Fe minerals. The concentrate product from this stage is combined with the Cleaner UCC underflow product to make up the gravity circuit concentrate.

13.5.1 Overflow Spiral Release Tests

Release tests were performed at the design conditions to give a performance indication for the overflow spiral stage. Bulk separation conditions were then selected using the results from the release tests. During the release testwork, spiral splitters were adjusted between tests to define the spiral performance over a wide mass yield range. The test fractions were analysed for Fe and SiO_2 content by XRF assay. The flow rate and assay data were tabulated and release curves for recovery/yield, separation efficiency and grade/yield were generated from the data. The objective was to define the performance of the WW6+ spiral model over a wide range of operating parameters prior to bulk processing. The performance data also provided parameters for simulation purposes.

The release tests were conducted at nominally 28% solids and 18 L/min wash water (these parameters were derived from the desktop study simulation). The design feed rate of 1.1 t/h was used in the release testing.

The Overflow spiral feed rate and feed slurry density is lower than those used for the Rougher and Middlings spiral stages due to the fact that the feed flows directly from the UCC overflow launder. There is no other processing step in between which dictates that the feed slurry density to the Overflow spirals is set by the UCC overflow conditions. When nominating the design feed rates for spirals it is important to consider the mass loading (t/hr) as well as the volumetric loading (m^3/hr) to the spiral trough. In this case for the Overflow spirals, the lower feed density dictates a lower mass feed rate to keep the volumetric loading within equipment design parameters.

Figure 13-13 shows the recovery and grade curves for Fe and SiO_2 in the Overflow spiral stage.

- The release testing data shows a good recovery of Fe minerals, with ~80% of the iron recoverable at 30% mass yield to concentrate.
- The release data shows that a concentrate grade of ~60% Fe can be achieved at 30% mass yield to concentrate. Concentrate grades greater than 65% Fe are also achieved at lower yields of 25% mass relative to the stage feed.
- As the Overflow spiral concentrate is to be blended with a far larger proportion of high grade UCC U/F (Overflow spiral concentrate makes up ~15% of final concentrate), it is not necessary that the Overflow spiral concentrate meets final concentrate quality requirements by itself. The addition of the O/F spiral concentrate to the UCC U/F stream serves to maximise the recovery of iron units whilst still meeting the desired >66.2% Fe and <4.5% SiO_2 level in the final product.

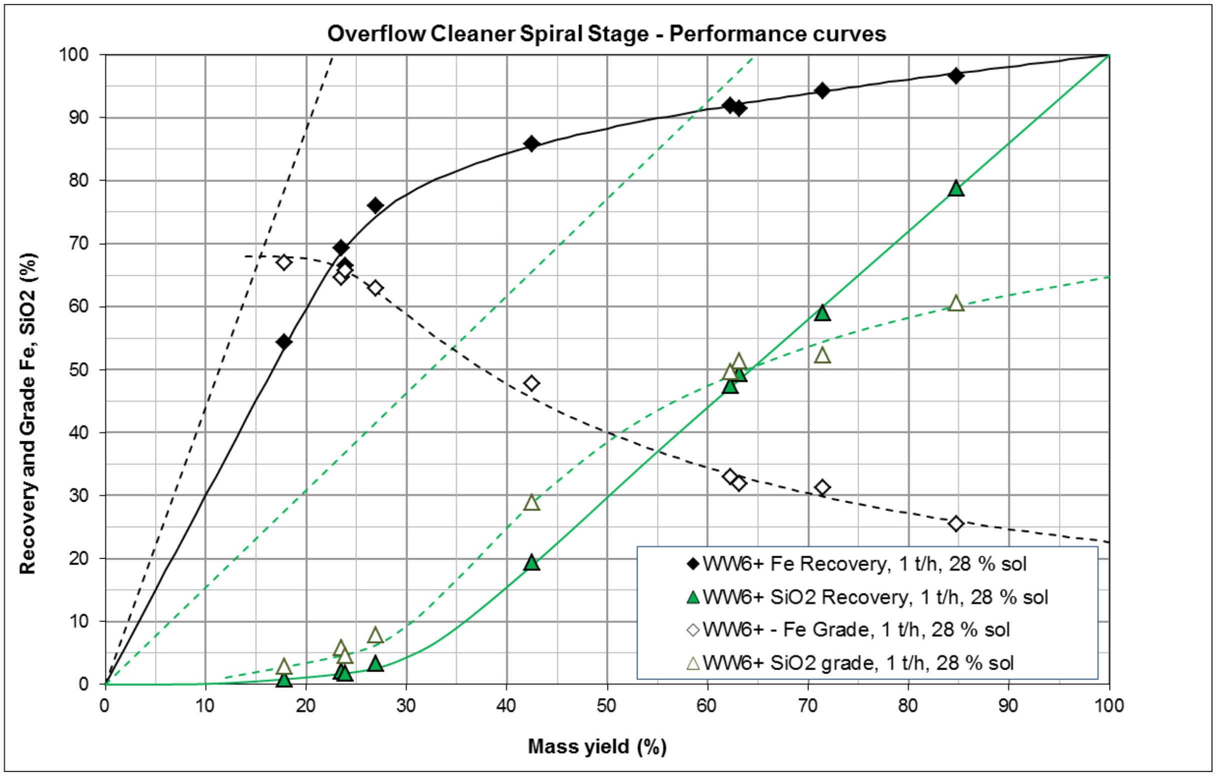


Figure 13-13: Overflow Cleaner Spiral Performance Curves at Design Conditions.

13.5.2 Bulk Overflow Spiral Processing

The bulk overflow spiral test was conducted at the tested feed rate of nominally 1.1 t/h and 28% solids. The wash water was maintained at 18 L/min. The target mass yield to concentrate was ~25%. Table 13-8 summarises the metallurgical balance results for the Overflow spiral stage.

Table 13-8: Bulk Overflow Cleaner Spiral Metallurgical Summary

OF Cleaner Spirals		XRF assay									Stage Distribution		
PRODUCT	% Mass Stage	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
OF Cleaner Spiral Con1	24.6	64.4	5.92	0.51	0.04	0.01	0.32	0.40	0.08	0.28	66.6	2.3	12.0
OF Cleaner Spiral Con2	6.99	21.6	64.4	1.45	0.06	0.01	1.03	0.21	0.06	0.95	6.3	7.2	9.7
OF Cleaner Spiral Middlin	52.6	8.61	84.3	1.21	0.03	<0.01	0.76	0.11	0.04	0.75	19.0	70.5	60.8
OF Cleaner Spiral Tailings	15.8	12.1	79.4	1.16	0.04	<0.01	0.59	0.12	0.04	0.65	8.0	20.0	17.5
Total	100	23.8	62.8	1.05	0.04	0.01	0.64	0.19	0.05	0.63	100.0	100.0	100.0

- The total mass yield to concentrate (con1) was 24.6% at a Fe grade of 64.4% which is in agreement with the release test work.
- The minimum attainable tailing fraction was 15.8% of the feed to the overflow spirals. This value correlates with the tailings fraction achieved with the splitter in the spiral product box adjusted to its widest position.
- The Fe recovery to concentrate was 66.6%, with only 2.3% of the SiO_2 in the UCC overflow reporting to concentrate.

- The remaining approximately 35% of the Fe in the UCC overflow reported to the overflow spirals' tailings streams (con2, mid and tail). It should be noted that these mass splits and recovery figures are not necessarily those expected in the plant, as these performance figures are the result of single stage processing of a small feed quantity. In an operating plant, continual processing offers the benefit of fine-tuning the separation.
- The calculated feed grade was 23.8% Fe, 62.8% SiO_2, 1.05% Al_2O_3 and 0.04% P; these figures agree closely with the assay of the UCC O/F stream.

13.6 Magnetic Circuit Evaluation – Overflow Spiral Middlings

13.6.1 Rougher WHIMS Stage

13.6.1.1 Rougher WHIMS Performance Tests

Release WHIMS tests were conducted using sub-samples of the O/F spiral middlings to define performance curves for the magnetic separation. Three release tests were done at a feed rate of ~52 t/h/unit and 35% solids density. Standard (100 L/min Mag wash water and 50 L/min N/Mag wash water) wash water (WW) rates were used in all the release tests. The tests were done using the narrow rotor at increasing magnetic intensities of 20%, 40% and 60% to vary the mass yield to the mag fraction.

Figure 13-14 shows the grade curves for Fe and SiO_2 for the release tests on the O/F spiral middlings.

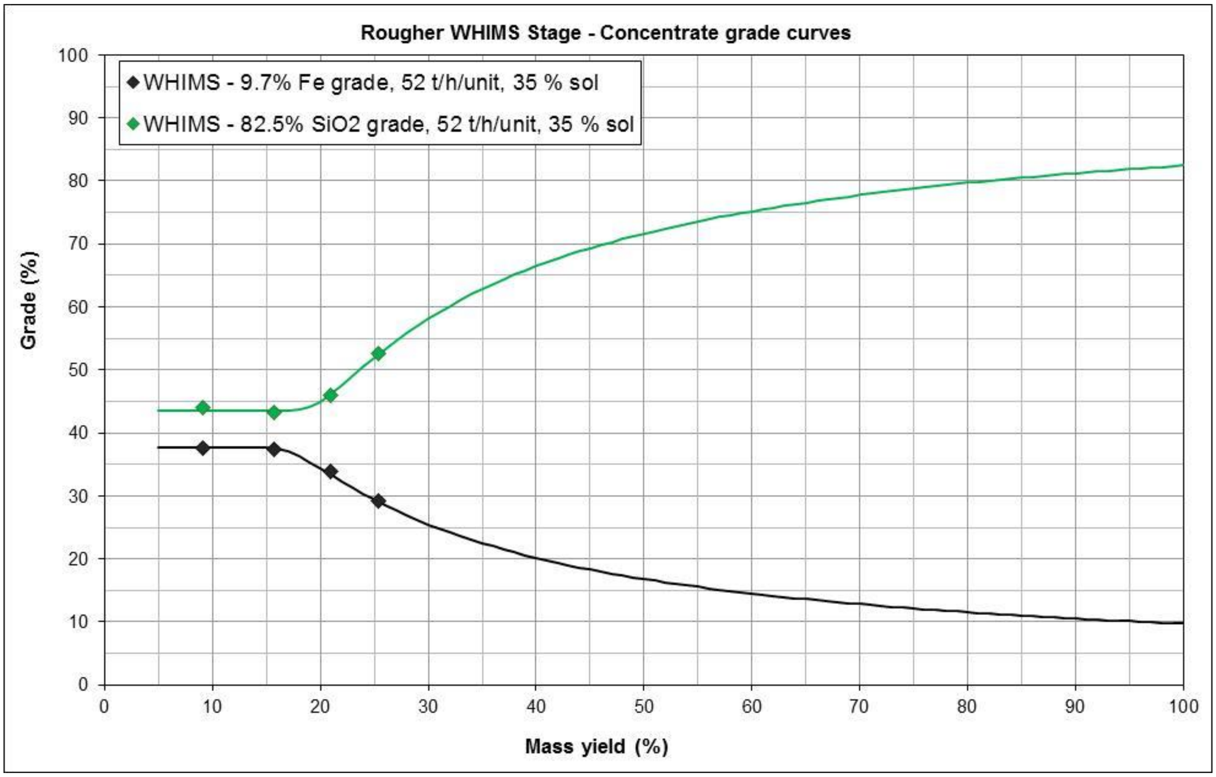


Figure 13-14: Release Grade Curves for Rougher WHIMS Testwork on Overflow Cleaner Spiral Middlings

- The release data showed that a grade of 35% Fe can be achieved at a mass yield ~20% to concentrate. This showed that the target product specifications cannot be achieved in a single stage WHIMS separation.
- It was noted that the magnetic concentrate produced was relatively clean based on a visual inspection compared to the Rougher test on the mid scavenger mids.
- The calculated feed grade was 9.7% Fe, 82.5% SiO_2, which is in agreement with the measured grade of the overflow cleaner spiral middlings.

13.6.1.2 Rougher WHIMS Bulk Test

The bulk WHIMS test was conducted using the bulk O/F spiral middlings sample. The bulk test was run at a feed rate of ~52 t/h/unit (equivalent for a 16 pole Readings Wide Rotor Separator) and 35% solids density. Standard mag WW rate (100 L/min) was used whilst the N/Mag WW rate was 50 L/min. The test was done using the narrow rotor simulation at 20% magnetic intensity. Table 13-9 gives a summary of the bulk WHIMS test on the O/F spiral middlings.

- The mass yield to mags was 22.3% at 33.2% Fe and 47.4% SiO_2 grade. Fe recovery was 72.1%. The data was in agreement with the release test results.
- The mags appeared to be mostly fine Fe minerals, with some coarse composites.
- The calculated feed grade for the bulk run was in line with the calculated feed grade for the release tests.

Table 13-9: Bulk Rougher WHIMS Metallurgical Summary – Overflow Cleaner Spiral Middlings

		XRF assay									Stage Distribution		
PRODUCT	% Mass Stage	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
Rougher WHIMS mags	22.3	33.2	47.4	1.61	0.03	0.01	1.12	0.32	0.09	1.18	72.1	12.9	29.4
Rougher WHIMS mids	3.50	6.88	84.5	1.99	0.04	0.01	1.24	0.14	0.04	1.36	2.3	3.6	5.7
Rougher WHIMS n/mags	74.2	3.53	92.3	1.07	0.04	0.01	0.67	0.06	0.02	0.58	25.5	83.5	65.0
Total	100	10.3	82.0	1.22	0.04	0.01	0.79	0.12	0.04	0.74	100.0	100.0	100.0

13.6.2 Cleaner WHIMS Stage

13.6.2.1 Cleaner WHIMS Performance Tests

Release WHIMS tests for the Cleaner stage were conducted using sub-samples of the mag fraction from the bulk Rougher WHIMS separation of the Overflow Cleaner Spiral middlings. Three release tests were done at a feed rate of ~38 t/h/unit and 23% solids density. Standard (100 L/min Mag wash water and 50 L/min N/Mag wash water) wash water (WW) rates were used in all the release tests. The tests were done using the narrow rotor at increasing magnetic intensities of 20%, 40% and 60% to vary the mass yield to the mag fraction.

Figure 13-15 shows the grade curves for Fe and SiO_2 for the release tests on the Rougher WHIMS mags.

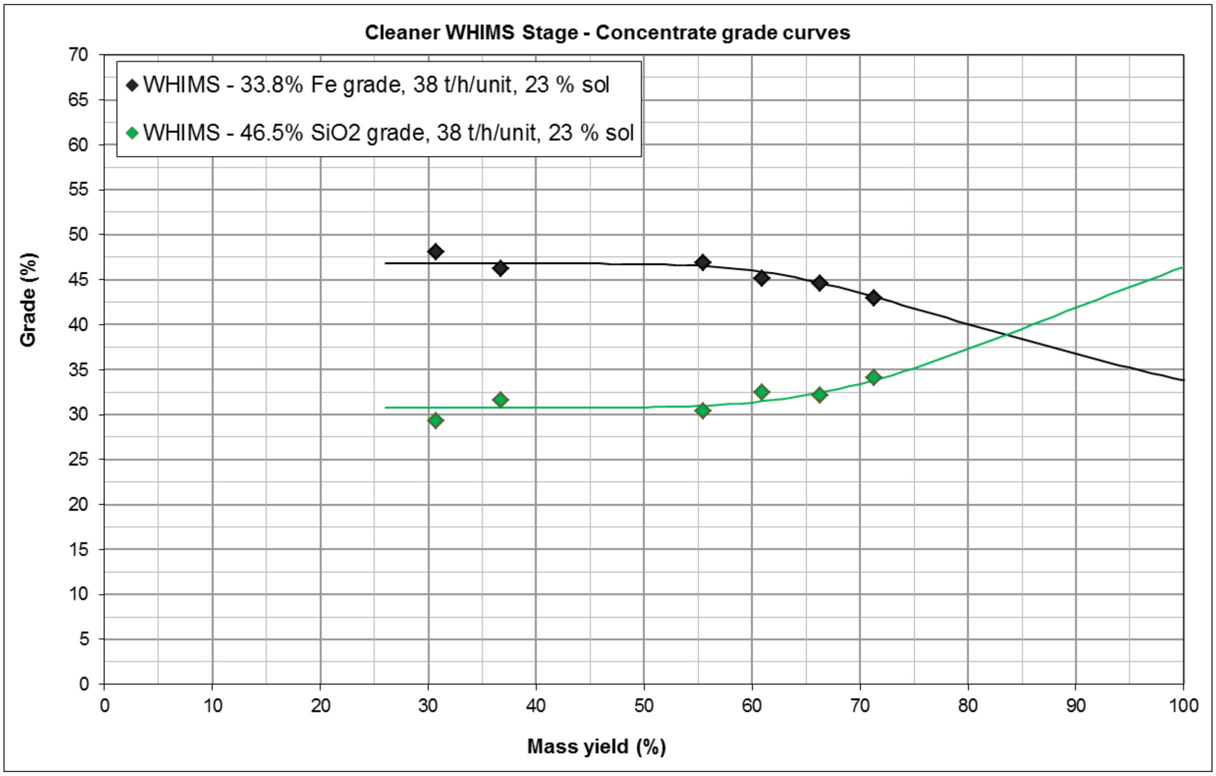


Figure 13-15: Release Grade Curves for Cleaner WHIMS Testwork – Overflow Cleaner Spiral Middlings

- The release data showed that a grade of ~46% Fe can be achieved at a mass yield <60% to concentrate from the Rougher WHIMS mags.
- The Cleaner WHIMS magnetics grades were higher than that achieved when processing the Mid Scavenger Spiral middlings sample however density separation of the Cleaner magnetic product still indicated high proportion of -4.05 SG minerals (37.8%) which affect upgradability.
- The calculated feed grade was 33.8% Fe and 46.5% SiO_2, which was in line with the Rougher WHIMS testwork.

13.6.2.2 Cleaner WHIMS Bulk Test

The bulk Cleaner WHIMS test was conducted using the bulk mag sample from the rougher WHIMS separation of the overflow cleaner spiral middlings. The bulk test was run at a feed rate of ~40 t/h/unit (equivalent for a 16 pole Readings Wide Rotor Separator) and 23% solids density. Standard mag WW rate (100 L/min) was used whilst the N/Mag WW rate was 50 L/min. The test was done using the narrow rotor simulation at 20% magnetic intensity. Table 13-10 gives a summary of the bulk WHIMS test on the rougher WHIMS mags.

- The mass yield to mags was 32.3% at 48.2% Fe and 29.3% SiO_2 grade. Fe recovery was 45.8%. The data was in agreement with the release test results.
- The total Fe recovery for the two-stage separation was 33.0% of the total Fe in the WHIMS feed.
- The calculated feed grade for the bulk cleaner processing was in agreement with the measured magnetic product grade for the bulk rougher processing.

Table 13-10: Bulk Cleaner WHIMS Metallurgical Summary – Overflow Cleaner Spiral Middlings

		XRF assay									Stage Distribution		
PRODUCT	% Mass Stage	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
Cleaner WHIMS mags	32.3	48.2	29.3	0.40	0.02	0.01	0.31	0.26	0.09	0.30	45.8	20.5	7.9
Cleaner WHIMS mids	6.35	35.5	45.0	1.19	0.03	<0.01	0.75	0.41	0.08	0.85	6.6	6.2	4.6
Cleaner WHIMS n/mags	61.3	26.3	55.1	2.33	0.04	0.01	1.46	0.37	0.11	1.64	47.6	73.3	87.5
Total	100	34.0	46.1	1.63	0.03	0.01	1.04	0.34	0.10	1.16	100.0	100.0	100.0

13.7 Magnetic Circuit Evaluation – Mid Scavenger Spiral Mids

Rougher and cleaner WHIMS tests were conducted at a range of magnetic field intensities using sub-samples of the mid scavenger middlings.

The rougher WHIMS tests showed that the target product specifications (as modelled in the desktop metallurgical model) could not be achieved in a single stage WHIMS process. Additionally, a visual inspection of the mags stream particles in this sample showed presence of composite (un-liberated) material (refer to Figure 13-16) and it is expected that this product would be difficult to upgrade further in a subsequent WHIMS stage.

This was confirmed with the cleaner WHIMS tests whereby the required Fe grade could not be achieved and the mags from the two stage WHIMS upgrade of the mids-scavenger mids stream will not be included as part of the final plant product.

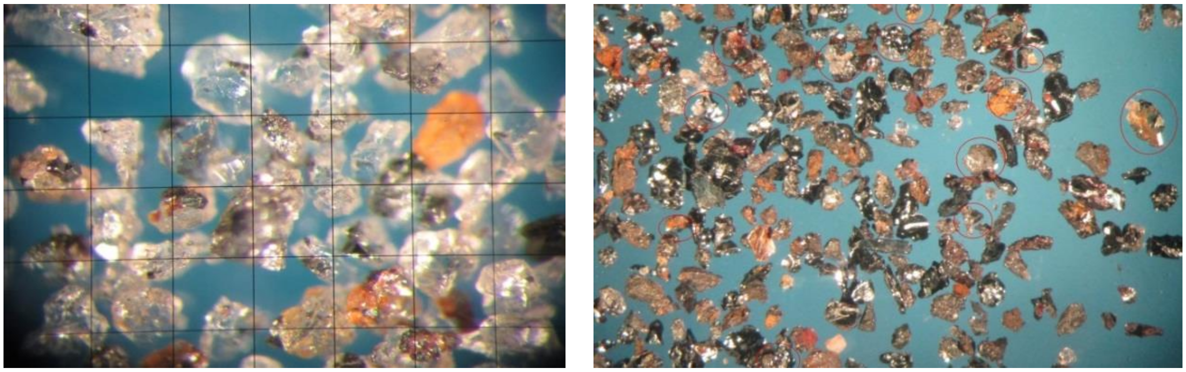


Figure 13-16: Microphotograph of Rougher WHIMS Magnetic Fraction – Mids Scavenger Middlings

13.8 Bulk Testwork Metallurgical Balance

13.8.1 Testwork Process Flow Diagram

The overall testwork process sequence is shown in Figure 13-17.

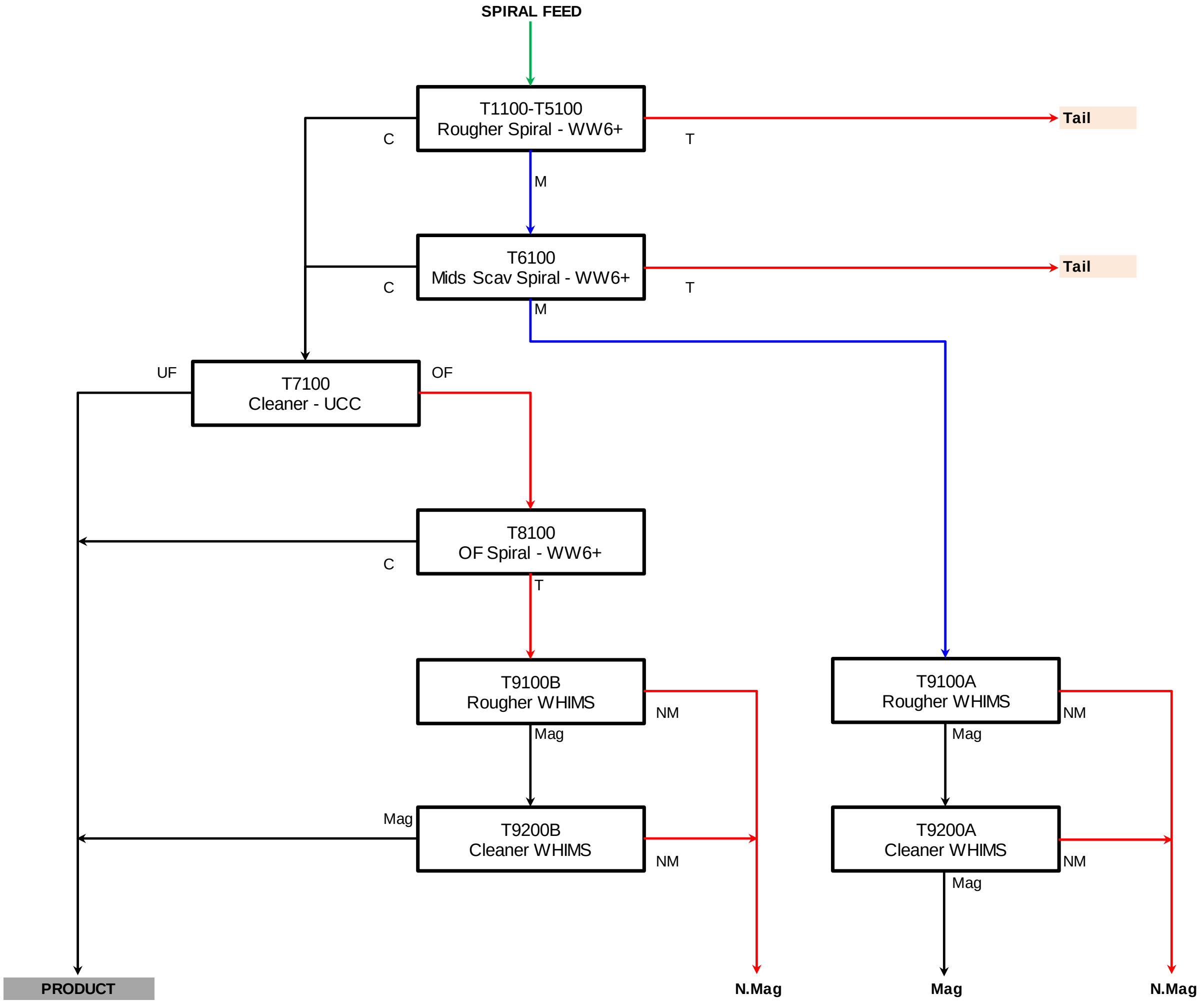


Figure 13-17: Bulk Testwork Flowsheet

13.8.2 Bulk Testwork Metallurgical Balance

The overall testwork metallurgical balance was calculated using stage by stage and end stream data. Table 13-11 summarises the balance by XRF assays.

Table 13-11: Testwork Bulk Processing Metallurgical Balance

		XRF assay									Distribution		
PRODUCT	% Mass	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
Gravity Concentrate *incl. UCC underflow and OF Spiral Con*	37.8	66.9	3.53	0.27	0.01	0.01	0.09	0.16	0.08	0.09	79.5	2.6	13.4
Magnetic Circuit Concentrate *incl. OF Spirals Cleaner WHIMS magnetics*	1.0	48.2	29.3	0.40	0.02	0.01	0.31	0.26	0.09	0.30	1.6	0.6	0.6
Magnetic Circuit Reject *incl. OF Spirals Rougher and Cleaner WHIMS non-mag*	13.5	7.50	85.8	1.29	0.04	0.01	0.81	0.11	0.03	0.77	3.2	22.1	23.4
Gravity Circuit Rejects *incl. Rougher and Mid Scavenger spiral tails*	47.6	10.5	82.3	0.98	0.02	0.01	0.43	0.09	0.03	0.53	15.7	74.8	62.6
Calculated Feed	100.0	31.8	52.4	0.75	0.02	0.01	0.35	0.12	0.05	0.39	100.0	100.0	100.0

- Mass yield to gravity concentrate was 37.8% of the plant feed with an additional 1% of the total feed also reporting to the final product as cleaner WHIMS mags.

- The bulk sample processing Fe recovery to the final product (gravity + WHIMS) was 81.1%. It is noted that the recovery achieved pertains to performance within the limits of stage by stage bulk sample processing in a laboratory environment. Plant operation would incorporate fully integrated circuitry which will allow greater control of the final product grade and plant recovery.

- The experimental data collected from the testwork program was used to update the metallurgical model, allowing it to be utilised for optimising and predicting plant circuit performance in terms of concentrate grade, production rate and recovery at various feed grades. The model predicts a theoretical maximum iron recovery from the flowsheet of 85.3% and an expected plant recovery of 83.3% from a continuous plant operation treating ore of similar characteristics to the sample tested at the expected life of mine feed grade of 30% Fe.

- The mass yield to gravity tails, which includes both the rougher spiral tailings and mid scavenger Spiral tailings, was 47.6% at a grade of 10.5% Fe and accounted for 15.7% of the Fe in the feed.

Table 13-12 summarises cumulative product quality from combining the gravity concentrate and the final WHIMS magnetic concentrates.

The data shows that including the cleaner WHIMS concentrate from the mid scavenger spiral middlings will cause a reduction in final concentrate quality below the desired levels of >66.2% Fe and <4.5% SiO_2.

Table 13-12: Cumulative Final Concentrate Quality Evaluation

		XRF assay								
PRODUCT	% Mass Head	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %
Gravity Concentrate	37.8	66.9	3.53	0.27	0.01	0.01	0.09	0.16	0.08	0.09
Gravity + Overflow Spiral mid Cleaner WHIMS Magnetic Con	38.9	66.4	4.23	0.27	0.01	0.01	0.10	0.16	0.08	0.09
Gravity + Overflow Spiral and Mid Scav mid Cleaner WHIMS Magnetic Con	40.2	65.3	5.68	0.27	0.01	0.01	0.10	0.16	0.08	0.10

13.8.3 Concentrate Products Characterisation

13.8.3.1 Characterisation Overview

Characterisation (particle size distribution and density profile) was done on the final gravity concentrate, and XRF analysis was done on both the gravity and magnetic concentrate products.

Filtration testing was performed on the gravity concentrate to determine if there would be adverse impacts on the performance of the filters installed at Bloom Lake when de-watering the concentrate.

Thickener testing was performed on a sample of fine tailings material to determine:

1. The amenability of thickening fine tailings with the thickener installed in the Bloom Lake Phase 1 concentrator at the rates indicated in the desktop metallurgical model.
2. Reagent dosage rates required for effective settling.

The final gravity concentrate was de-slimed at 45 µm before Heavy Liquid Separation and particle size characterisation. The undersize material (<45 µm) was collected, dried, weighed and assayed. The oversize material was then used in the subsequent characterisation steps.

13.8.3.2 Gravity Concentrate Sizing

Table 13-13 displays a summary of the assay-by-size data of the gravity concentrate (UCC underflow combined with Overflow spiral concentrate)

Table 13-13: Final Gravity Concentrate Assay-By-Size Summary

PRODUCT	% Mass	XRF assay									Distribution		
		Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
Gravity Concentrate *incl. UCC underflow and OF Spiral Con*	37.8	66.9	3.53	0.27	0.01	0.01	0.09	0.16	0.08	0.09	79.5	2.6	13.4
Magnetic Circuit Concentrate *incl. OF Spirals Cleaner WHIMS magnetics*	1.0	48.2	29.3	0.40	0.02	0.01	0.31	0.26	0.09	0.30	1.6	0.6	0.6
Magnetic Circuit Reject *incl. OF Spirals Rougher and Cleaner WHIMS non-mag*	13.5	7.50	85.8	1.29	0.04	0.01	0.81	0.11	0.03	0.77	3.2	22.1	23.4
Gravity Circuit Rejects *incl. Rougher and Mid Scavenger spiral tails*	47.6	10.5	82.3	0.98	0.02	0.01	0.43	0.09	0.03	0.53	15.7	74.8	62.6
Calculated Feed	100.0	31.8	52.4	0.75	0.02	0.01	0.35	0.12	0.05	0.39	100.0	100.0	100.0

- A D_{50} value of 257 µm was calculated for the gravity concentrate.
- The Fe was mainly (~80%) distributed in the 106-600 µm range.

13.8.3.3 Gravity Concentrate Density Profile

Table 13-14 summarises the gravity concentrate density profile.

Table 13-14: Gravity Concentrate Density Profile

		XRF assay									Distribution		
Density Fraction	Mass %	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
+4.05sg	95.9	68.8	0.81	0.13	0.01	0.01	0.01	0.15	0.06	0.01	98.3	27.3	51.2
-4.05+3.6sg	1.5	48.0	22.9	2.56	0.10	0.02	0.73	0.47	0.33	0.62	1.1	12.0	15.8
-3.6+3.3sg	0.6	32.7	47.3	1.57	0.04	0.02	1.59	0.52	0.13	1.09	0.3	9.1	3.6
-3.3+2.85sg	1.0	17.0	56.5	6.36	0.23	0.01	5.50	0.45	0.15	5.28	0.3	20.5	27.0
-2.85sg	1.0	8.20	87.0	0.57	0.02	<0.01	0.36	0.05	0.05	0.16	0.1	31.0	2.4
Total	100.0	67.2	2.85	0.24	0.01	0.01	0.09	0.16	0.07	0.08	100.0	100.0	100.0

- Approximately 96% of the gravity product reported to the +4.05 SG density fraction, with a Fe distribution of 98.3%.

- The amount of material (composites or lower SG Fe minerals) in the +2.85-4.05 SG was 3.1%, with less than 2% Fe distribution, reflecting the high quality of the concentrate produced.

- Minimal SiO_2 was entrained to the gravity concentrate as only 1% of the gravity product was below 2.85 SG.

13.8.3.4 WHIMS Concentrate Sizing

Table 13-15 displays a summary of the assay-by-size data of the magnetic circuit concentrate (cleaner WHIMS magnetic – overflow spiral middlings).

- A D_{50} value of 94 µm was calculated for the magnetic circuit concentrate.
- The Fe was mainly (~88%) distributed in the -150 µm range.

Table 13-15: Magnetic Concentrate Assay-By-Size Summary

		XRF assay									Distribution		
Sieve Size µm	Mass % individual	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
850	1.38	64.9	5.94	0.44	0.02	<0.01	0.07	0.06	0.29	0.08	1.3	2.8	2.3
600	9.00	66.4	4.26	0.28	0.01	<0.01	0.08	0.08	0.16	0.10	8.9	13.1	9.7
425	14.0	66.5	3.86	0.23	0.01	<0.01	0.06	0.07	0.08	0.09	13.8	18.5	12.4
300	18.1	67.4	2.64	0.26	0.01	<0.01	0.08	0.09	0.06	0.10	18.2	16.4	18.2
212	18.2	68.2	1.67	0.20	0.01	0.01	0.04	0.20	0.05	0.05	18.5	10.4	14.1
150	17.6	68.1	1.88	0.23	0.01	0.01	0.07	0.13	0.04	0.08	17.8	11.3	15.6
106	10.4	66.9	3.05	0.27	0.01	0.01	0.10	0.25	0.06	0.11	10.4	10.9	10.8
75	6.96	65.5	4.78	0.40	0.03	0.01	0.24	0.32	0.08	0.20	6.8	11.4	10.7
45	3.37	66.0	3.61	0.39	0.04	0.01	0.26	0.35	0.10	0.20	3.3	4.2	5.1
<45	0.98	67.3	2.68	0.30	0.03	0.01	0.16	0.33	0.11	0.14	1.0	0.9	1.1
Total	100.0	67.2	2.92	0.26	0.01	0.01	0.09	0.16	0.07	0.10	100.0	100.0	100.0

13.8.3.5 WHIMS Concentrate Density Profile

Table 13-16 displays a summary of the assay-by-density data of the magnetic circuit concentrate (cleaner WHIMS magnetic – overflow spiral middlings).

Table 13-16: Magnetic Concentrate Assay-By-Density Summary

		XRF assay									Distribution		
Density Fraction	Mass %	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
+4.05sg	61.3	68.1	1.46	0.12	0.01	0.02	0.02	0.37	0.09	0.03	87.7	3.0	19.3
-4.05+3.6sg	4.2	47.7	27.0	0.93	0.07	0.02	0.46	0.19	0.22	0.32	4.3	3.8	10.3
-3.6+3.3sg	4.7	30.7	50.6	1.14	0.03	0.02	1.75	0.13	0.16	1.46	3.0	7.9	13.9
-3.3+2.85sg	13.2	12.7	76.7	1.51	0.03	<0.01	1.43	0.11	0.07	1.54	3.5	33.7	52.2
-2.85sg	16.6	4.18	93.5	0.1	0.00	<0.01	0.17	0.02	0.02	0.08	1.5	51.7	4.3
Total	100.0	47.6	30.0	0.38	0.02	0.02	0.33	0.26	0.08	0.32	100.0	100.0	100.0

- Approximately 61% of the WHIMS concentrate product reported to the +4.05 SG density fraction, with a Fe distribution of 87.7%.
- The amount of material in the +2.85-4.05 SG was 22.1%, with 10.8% Fe distribution, reflecting the concentrate contains composites or lower SG Fe minerals

13.8.4 Bulk Testwork Performance by Size

The assay by size results of the UCC underflow product, Gravity concentrate product and Magnetic circuit concentrate product were utilised to determine the Fe recovery by size fraction relative to the Rougher spiral feed and the results are shown graphically in Figure 13-18. The UCC underflow recovered:

- Approximately 80% of the Fe minerals in the size ranges -600+425 and -425+300 microns
- Approximately 85% of the Fe minerals in the size ranges -300+212 and -212+150 microns.
- Approximately 72% of the Fe minerals in the size range -150+106 microns.
    - The recovery via the UCC underflow reduced with the finer size range Fe particles and this is consistent with the fine Fe minerals reporting to the UCC overflow product for recovery by the overflow spirals.
    - The scavenging of the UCC overflow product significantly increased the Fe mineral recovery, notably of the finer size range Fe minerals. The gravity concentrate is shown to have recovered:
        - 88% of the Fe minerals in the range -150+106 microns (from 72% in the UCC underflow)
        - 85% of the Fe minerals in the range -106+75 microns (from 17% only in the UCC underflow)
        - 50% of the Fe minerals in the range -75+45 microns (from 3% only in the UCC underflow)
        - The processing of the overflow spirals middlings through the WHIMS circuit further improved recovery of the fine Fe minerals.

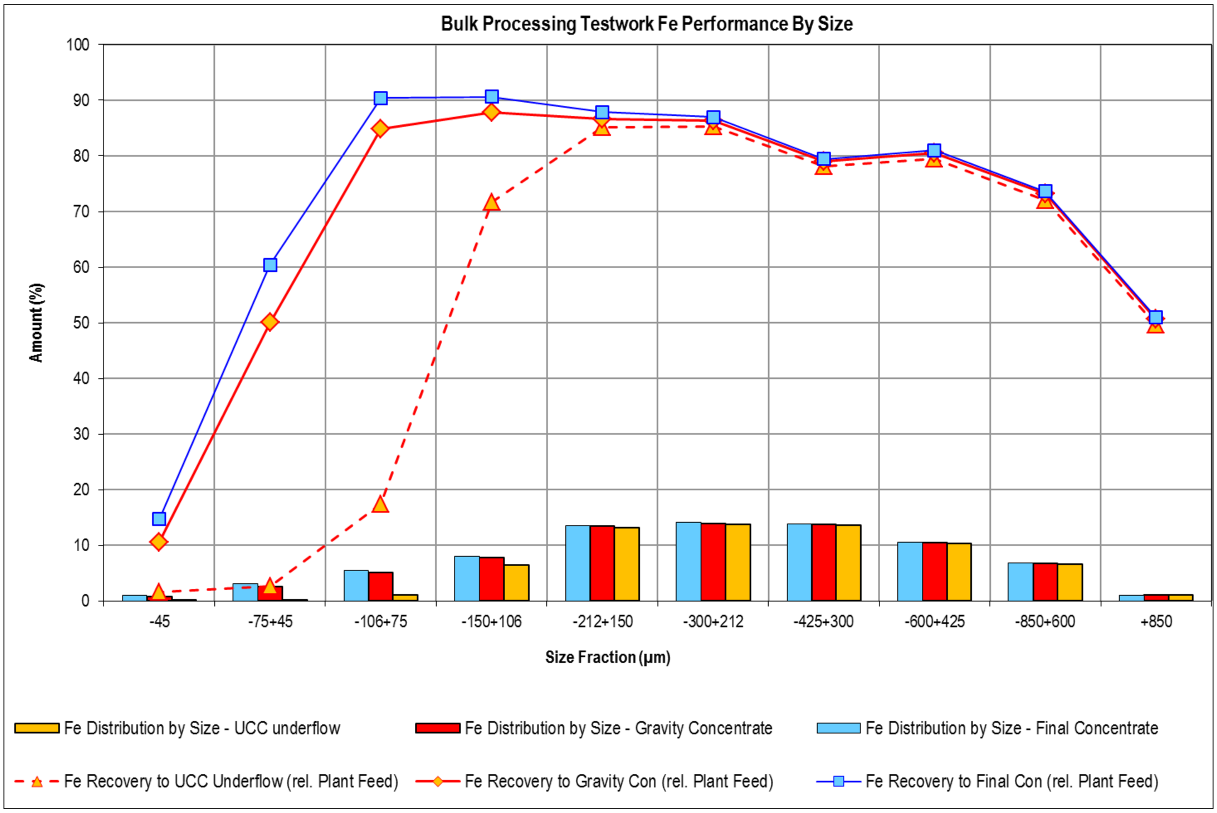


Figure 13-18: Bulk Testwork Fe Performance by Size

Table 13-17 displays a summary of the assay-by-size data of the gravity concentrate (UCC underflow combined with Overflow spiral concentrate)

Table 13-17: Final Concentrate Assay-By-Size Summary

		XRF assay									Distribution		
Sieve Size µm	Mass % individual	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
850	0.10	41.2	39.3	0.42	0.01	<0.01	0.27	0.03	0.09	0.18	0.1	0.1	0.1
600	0.32	41.2	39.3	0.42	0.01	<0.01	0.27	0.03	0.09	0.18	0.3	0.4	0.4
425	0.62	31.8	52.8	0.38	0.01	<0.01	0.3	0.03	0.06	0.23	0.4	1.1	0.6
300	2.64	17.8	73.5	0.13	0.01	<0.01	0.34	0.02	0.05	0.23	1.0	6.5	0.9
212	7.39	16.4	75.1	0.20	0.01	<0.01	0.44	0.05	0.05	0.32	2.6	18.5	3.9
150	15.8	22.5	65.8	0.36	0.02	0.01	0.49	0.1	0.07	0.42	7.5	34.7	15.0
106	16.7	40.7	39.5	0.48	0.02	0.02	0.42	0.27	0.08	0.42	14.2	21.9	21.1
75	17.9	55.4	18.5	0.49	0.02	0.01	0.33	0.34	0.08	0.36	20.9	11.1	23.2
45	25.1	64.5	5.80	0.39	0.02	0.01	0.2	0.37	0.10	0.25	34.0	4.8	25.7
<45	13.4	67.8	1.82	0.26	0.02	0.01	0.09	0.33	0.13	0.11	19.1	0.8	9.2
Total	100.0	47.6	30.0	0.38	0.02	0.01	0.31	0.26	0.09	0.31	100.0	100.0	100.0

13.9 Concentrate Product Filtration Test

Part of the testing program included verification of the expected pan filter performance in the upgraded flowsheet. The predominant reason for verification of the pan filter performance was to assess any impact on filtering performance due to the effect of a shift in concentrate particle size distribution (due to improvements in recovery of coarse and fine particles).

Following production of a final concentrate sample, a sub-sample was extracted and sent to FLSmidth (the pan filter manufacturer) so that filtration rate testing could be undertaken. The outcome of this testwork showed similar filtration performance for this sample when compared to the previous Phase 1 operation and confirmed suitability of the equipment for the new feed material.

One other consideration to assess for the pan filter suitability for the upgrade flowsheet is the concentrate feed rate, which is higher than for the previous operation due to the improved upgrade circuit recoveries. It has been confirmed that the design specification for the pan filters is to handle 8 million tonnes of concentrate per year which is within the range of the upgraded flowsheet conditions.

13.10 Tailings Thickening Test

A further aspect of the testing program included verification of the expected thickener performance in the upgraded flowsheet. This requires the performance of a dynamic thickener testing process by the thickener manufacturer. This test data will also be used in the design of an upgraded thickener feedwell, should it be required to enable the thickener to perform satisfactorily.

A sample of fine material was generated by de-sliming the rougher spiral tails product. This material was sent to Outotec for testing.

The test work demonstrated that the fine tailings material can be effectively thickened by a high-rate thickener (of the type installed at Bloom Lake) over a range of feed rates, including those expected to be on the high end of the feed rate range. It is recommended by Outotec to replace the existing thickener feed well with their ‘vane type’ feed well to meet the required upgraded flow sheet duties.

13.11 Process Circuit Performance Validation

As discussed in section 13.1.1, a sample collected from a zone containing higher proportion of magnetite (BCHEF1) was characterised and processed through the gravity and WHIMS circuit to validate the design and confirm performance.

Another 500 kg sample from material which was prepared from drill core samples representing the first 5 years of operation was also processed. The main purpose for treating this sample was to confirm rougher spiral performance using a sample at the expected 30-31% Fe, as well as further validate the circuit performance by processing the sample through the whole circuit.

The 500 kg core sample was crushed to -1 mm at SGS Canada using the same procedure described in section 13.1.3. A representative sub-sample was extracted for characterisation purposes.

13.11.1 Validation Sample Characterisation

The validation samples were characterised in terms of assay, size and density profile as per other bulk samples.

BCHEF1 sample characterisation data has been summarised in section 13.1.1. The 500 kg core sample characterisation is summarised in the following sections.

13.11.1.1 Sizing and Assay

The particle size distribution is shown graphically in Figure 13-19.

- The D_{50} of the 500 kg core sample was 320 microns, while the D_{80} was approximately 560 microns, indicating that the sample was slightly coarser than other sample processed. This is consistent with the material being prepared from drill cores.
- The slimes content (proportion of <45 microns particles) was 2.3% and similar to West1 zone sample.

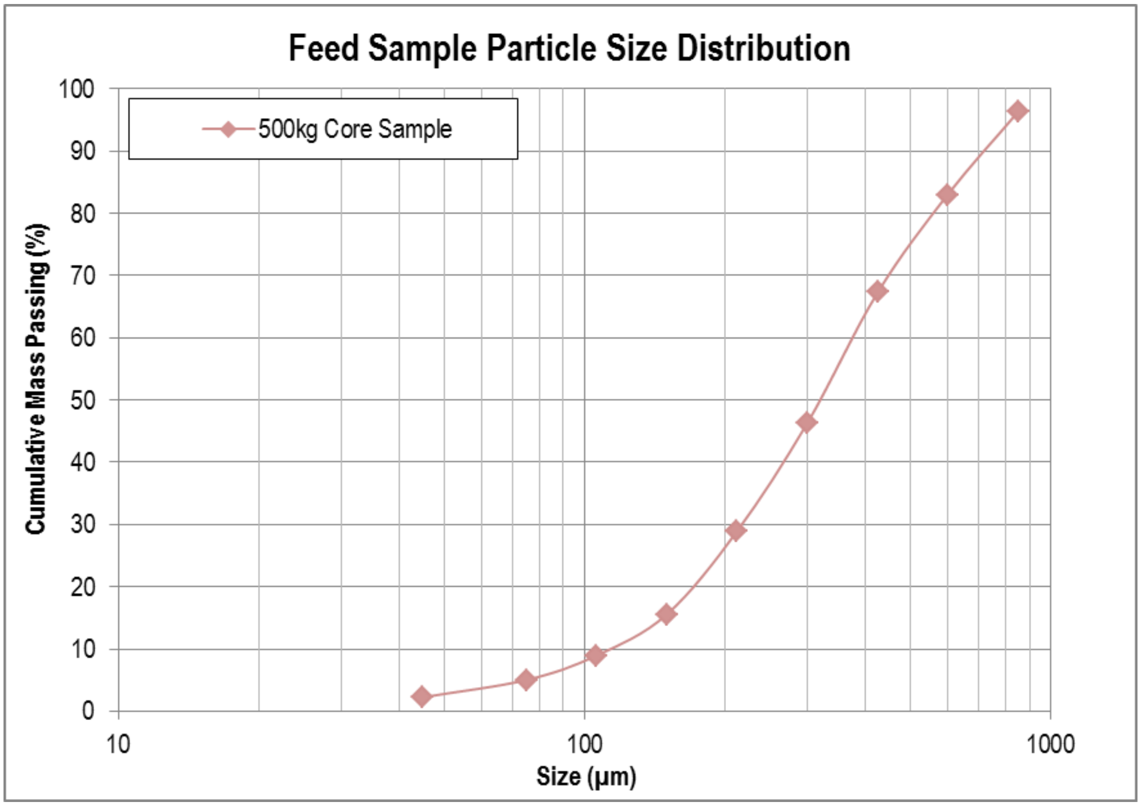


Figure 13-19: PSD of the 500 kg Core Feed Sample

Table 13-18 summarises the assay of the 500 kg core sample.

Table 13-18: 500 kg Head Sample Assays

	XRF assay								
Sample	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %
500kg Core	32.1	53.7	0.18	0.01	<0.01	0.06	0.02	0.03	0.05

The feed sample assays showed that the Fe grade of the core sample was 32.1% Fe and in line with expectations from the first 5 years of the Bloom Lake mine operation.

13.11.1.2 Density Profile and Assay

The density profile of the 500 kg core sample is summarised in Figure 13-20.

- The -2.85 SG content in the sample was 47.3% which is consistent with the % Fe grade.
- The +4.05 SG content in the sample was 41.8% with a distribution of Fe to the +4.05 SG fraction of 89% denoting that whilst this sample was coarser than other bulk sample processed, the Fe-minerals in the samples are well liberated.

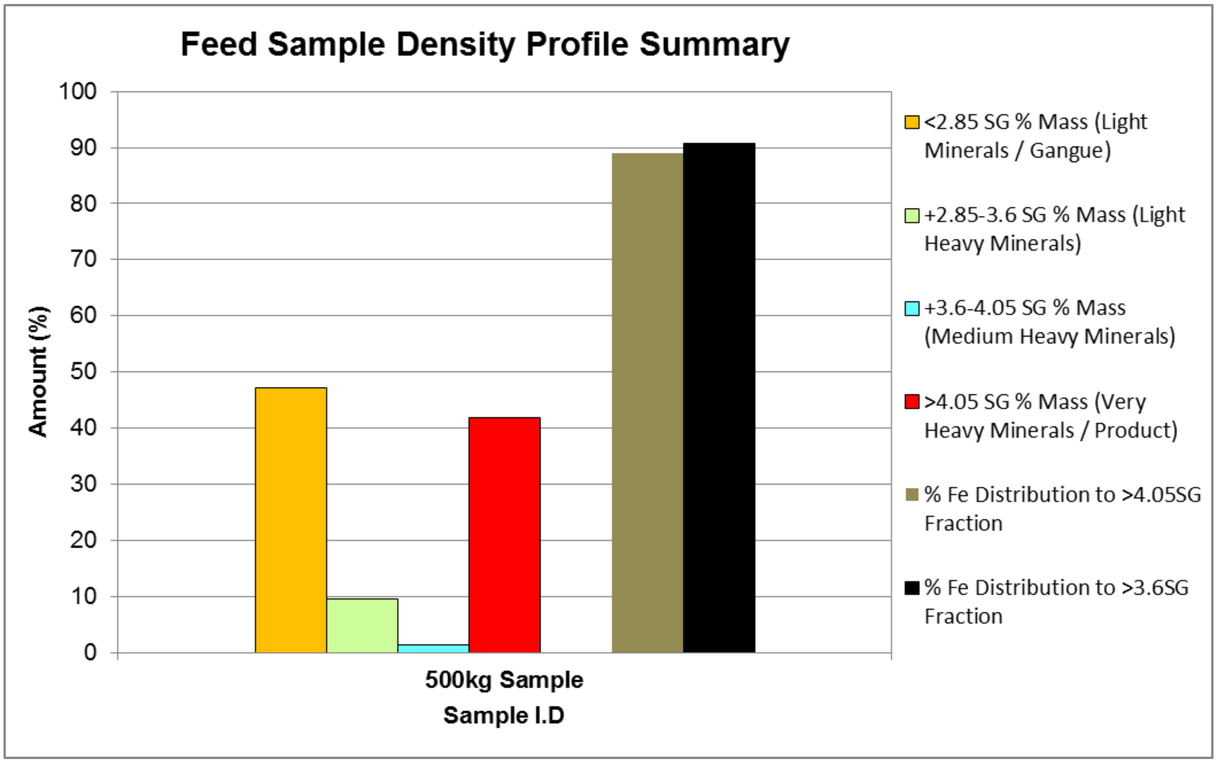


Figure 13-20: Density of the 500 kg Core Feed Sample

13.11.2 Rougher Spiral Stage Performance Validation

Rougher release tests were conducted before bulk processing for both the BCHEF1 and 500 kg sample to allow the derivation of the recovery models for each bulk sample.

During the release test work, spiral splitters were adjusted between tests in order to define the spiral performance over a range of mass yield. XRF assay was used to determine the elemental composition of the test fractions generated during this release test work. The flow rate and assay data were tabulated and release curves for recovery/yield, and grade/yield were generated from the data for each series of tests and are shown in Figure 13-21.

- The curves depict good separation for Fe and were consistent with expected performance from other samples tested.
- Notably, the performance of the rougher spiral treating material with Fe grade of 32.1% indicated that recoveries greater than 93% can be achieved whilst rejecting 35% mass to the tailings.
- The BCHEF1 recovery curves display a shift to the right which is in line with the higher feed grade.

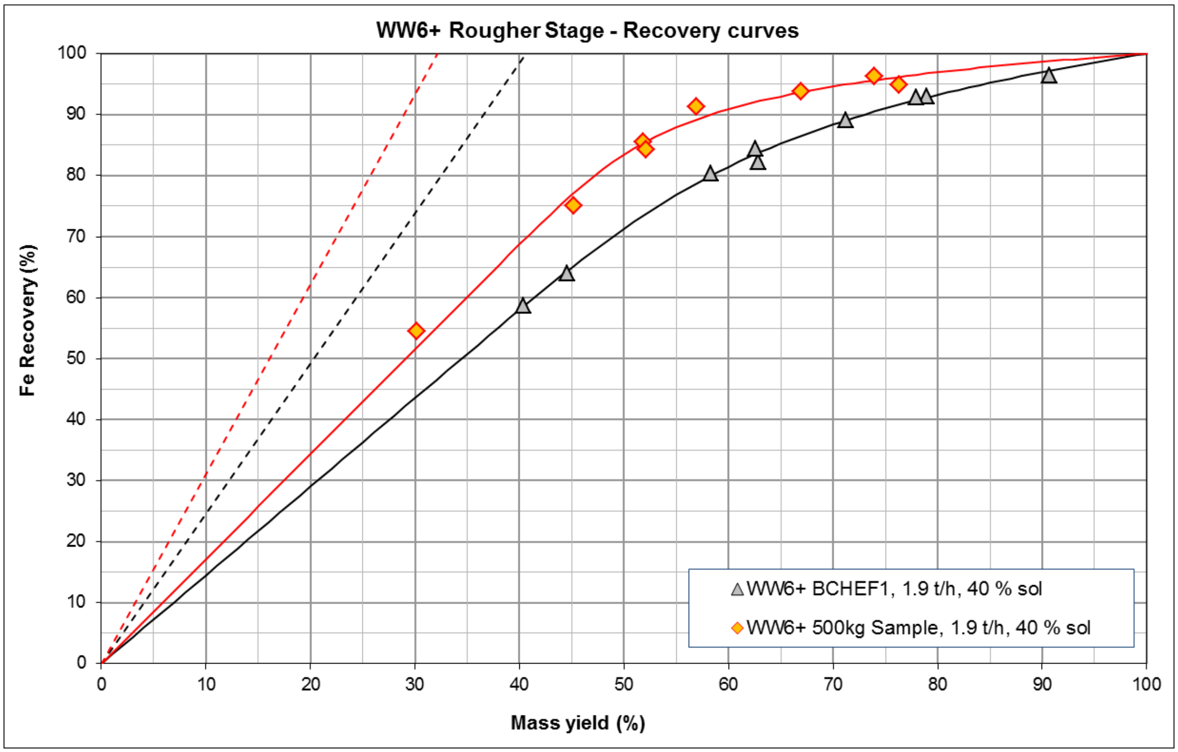


Figure 13-21: Rougher WW6+ Fe BCHEF1 and 500 kg Sample Recovery Curves

13.11.3 Overall Bulk Processing Metallurgical Balance

The BCHEF1 and 500 kg core sample were individually processed through the proposed Phase 1 upgrade process circuit to confirm grades and recoveries. The flowchart sequence followed in the laboratory processing is shown in Figure 13-17.

Metallurgical balances from the bulk processing are summarised in Table 13-19 for the BCHEF sample and Table 13-20 for the 500 kg sample. It should be noted that only the overflow spirals rejects were processed through the magnetic circuit.

Table 13-19: Testwork Bulk Processing Metallurgical Balance – BCHEF1

		XRF assay									Distribution		
PRODUCT	% Mass	Fe	SiO_2	Al_2O_3	P	S	CaO	TiO_2	Mn	MgO	Fe	SiO_2	Al_2O_3
		%	%	%	%	%	%	%	%	%	%	%	%
Gravity Concentrate *incl. UCC underflow and OF Spiral Con*	45.2	66.9	4.57	0.12	0.01	<0.01	0.23	0.05	0.02	0.37	76.3	5.0	29.9
Magnetic Circuit Concentrate *incl. OF Spirals Cleaner WHIMS magnetics*	1.59	39.0	35.0	0.10	0.01	<0.01	0.43	0.01	0.04	0.66	1.6	1.3	0.9
Magnetic Circuit Reject *incl. OF Spirals Rougher and Cleaner WHIMS non-mag*	19.3	15.8	72.9	0.26	0.03	0.01	1.77	0.01	0.05	2.46	7.7	33.9	27.9
Gravity Circuit Rejects *incl. Rougher and Mid Scavenger spiral tails*	33.9	16.9	73.2	0.22	0.02	0.01	1.10	0.01	0.05	1.46	14.4	59.8	41.3
Calculated Feed	100.0	39.6	41.5	0.18	0.01	0.01	0.82	0.03	0.03	1.15	100.0	100.0	100.0

- The processing of the BCHEF1 sample testwork achieved a final concentrate grade assaying 66.9% Fe with 4.57% SiO_2. Despite the relative high Fe grade of 66.9%, SiO_2 content was just above the target 4.5%.
- Iron recovery was calculated to be 76.3% relative to the feed. Note that this reduced recovery is due to the high quantity of magnetite in the BCHEF1 sample, which was 30.2% compared with the maximum expected during the life of mine being 8%.
- The WHIMS magnetic product could not be included with the gravity concentrate due to strong association between SiO_2 and iron which would further increase SiO_2 of the final product.
- High loss to gravity circuit tailings occurred due to presence of very fine magnetite reporting to the outer region of the spiral trough. A LIMS separation on the mid scavenger tailings indicated this stream contained 38.9% by weight of highly susceptible (500 Gauss) magnetic minerals with grade of 58.5% Fe and 17.7% SiO_2 thereby supporting a strong association between magnetite and SiO_2.
- The slightly higher SiO_2 content and reduced recovery is not considered a problem for the plant operation due to the following:
    - In a continuous process environment, it is expected that grade of 4.5% SiO2 would be achievable.
    - The BCHEF1 ore will not be processed as part of the mine plan for approximately 10 years, and when it is processed it is planned to be blended with other, lower magnetite ores such that the upgrade performance is more in line with the other ore types being processed

Table 13-20: Testwork Bulk Processing Metallurgical Balance – 500 kg Sample

		XRF assay									Distribution		
PRODUCT	% Mass	Fe %	SiO_2 %	Al_2O_3 %	P %	S %	CaO %	TiO_2 %	Mn %	MgO %	Fe %	SiO_2 %	Al_2O_3 %
Final Concentrate	39.4	67.2	3.45	0.18	0.01	0.01	0.04	0.04	0.03	0.02	85.7	2.4	47.0
incl. UCC underflow, OF Spiral Con and Magnetic Con													
Magnetic Circuit Reject	18.6	4.91	92.7	0.10	0.02	0.01	0.12	0.01	0.03	0.09	3.0	31.1	12.9
incl. OF Spirals Rougher and Cleaner WHIMS non-mag													
Gravity Circuit Rejects	42.0	8.30	87.8	0.14	0.01	0.01	0.07	0.01	0.03	0.08	11.3	66.4	40.1
incl. Rougher and Mid Scavenger spiral tails													
Calculated Feed	100.0	30.9	55.5	0.15	0.01	0.01	0.07	0.02	0.03	0.06	100.0	100.0	100.0

- The testwork achieved a final concentrate grade assaying 67.2% Fe with 3.45% SiO_2. Iron recovery was calculated to be 85.7% relative to the feed.
- The processing of the 500 kg sample confirmed the expected plant performance results developed throughout this metallurgical testing campaign.

14 Mineral Resource Estimate

14.1 Introduction

An external hard drive containing the data for the Bloom Lake project was transferred in the first week of July 2016 to G Mining. Access to the project's SQL server was also granted to G Mining in order to retrieve the most up-to-date backup copy of Bloom Lake's Geovia® Gems project. The backup, dated November 4th, 2016 was restored in a Gems SQL environment and converted to Gems Access. Only the relevant information regarding geology, modelling, grade control and resource estimation was included in the Gems Access project, as the original SQL version of the project contained significant amounts of data from other departments at the mine (surveying, engineering, etc.).

In 2014, Dassault Systemes, Geovia ("Geovia") was mandated to provide an internal resource evaluation for the Bloom Lake deposit. G Mining has reviewed the resource parameters presented by Geovia, including the following items: domaining strategy, statistical study of assays and composites, variography analysis, interpolation and search ellipse settings, estimation process and classification of the resource. Moreover, the 2014 resource model has demonstrated reasonable predictions of iron grade and tonnage in terms of reconciliation with production. G Mining concludes that the estimation methodology developed by Geovia in 2014 for the Bloom Lake deposit is suitable for the project and is compatible with industry standards.

The resource estimate presented herein is based on the estimation methodology developed by Geovia in 2014.

14.1.1 Drill Holes

The Gems drilling database holds 535 drill holes from historical and recent drilling programs which occurred between 1957 and 2014. A total of 136,255 m of drill core covers the Bloom Lake area.

The modelling and resource estimation focuses on the Bloom Lake Project delimited by the block model area and consequently excludes 30 holes located outside the area of interest (Table 14-1). The resource estimation is based on 505 drill holes totalling 124,103 m of core. A list of the holes is presented in Table 14-2 by year of drilling.

Table 14-1: List of Drill Holes Located Outside the Block Model Boundary

BLW-12-012	BLW-12-022	BLW-12-028	BLW-12-034	BLW-12-040
BLW-12-014	BLW-12-023	BLW-12-029	BLW-12-035	BLW-12-041
BLW-12-016	BLW-12-024	BLW-12-030	BLW-12-036	BLW-12-042
BLW-12-017	BLW-12-025	BLW-12-031	BLW-12-037	BLW-12-043
BLW-12-019	BLW-12-026	BLW-12-032	BLW-12-038	BLW-12-044
BLW-12-021	BLW-12-027	BLW-12-033	BLW-12-039	BLW-12-045

Table 14-2: List of Drill Holes Located Inside the Block Model Limits

Year	Hole ID	Number of Holes	Meterage (m)
1957	QC-01 to QC-30 including QC-04A, QC-09A, QC-25A	33	4,769
1957	X-02 to X-06, X-09 to X-11	8	266
1966	X-14, X-20	2	42
1971	71-01 to 71-09	9	1,834
1972	72-01 to 72-10 including 72-08A, 72-12	12	3,480
1998	98DN-001 to 98DN-073 including 98DN-08A, 98DN-065A	75	18,705
2006	BL-06-001, BL-06-002, BL-06-004 to BL-06-011, BL-06-016	11	2,086
2007	BL-07-003, BL-07-012 to BL-07-15, BL-07-017	6	797
2007	LBW-07-01 to LBW-07-04, LBW-07-07	5	1,298
2008	BL-08-01, BL-08-03 to BL-08-07, BL-08-09 to BL-08-18, BL-08-20 to BL-08-22, BL-08-25, BL-08-27 to BL-08-29, BL-08-31	24	1,364
2008	LBW-08-05, LBW-08-06, LBW-08-08 to BLW-08-11, LBW-08-13 to LBW-08-20, LBW-08-22 to LBW-08-41 including BLW-08-37A	36	7,587
2009	BL-09-01 to BL-09-32	32	3,466
2010	BL-10-01 to BL-10-81 including BL-10-07A, BL-10-20A, BL-10-23A, BL-10-48A, BL-10-67A, BL-10-69A, BL-10-76A	88	23,336
2010	CNTPIGN1, CNTPIGN3	2	52
2012	BL-12-01 to BL-12-102 including BL-12-17A, BL-12-21A, BL-12-51A, BL-12-57A, BL-12-67A	107	36,445
2012	BLW-12-001 to BLW-12-011, BLW-12-013, BLW-12-015, BLW-12-018, BLW-12-020, BLW-12-046	16	6,081
2013	BL-13-01 to BL-13-28 including BL-13-05A	29	10,515
2013	GT-13-01 to GT-13-06	6	1,515
2014	GT-14-07 to GT-14-10	4	464
Total number of holes within block model limits		505	124,103

The minimum drilled depth is 17 m and maximum is 720 m; on average, the holes are 246 m long. Holes were drilled to be as close to perpendicular to the mineralized beds as possible. Drill core recovery is of good quality and exceeds 96%. Note that core recovery information is not available for holes drilled before 1973.

Generally, the mineralized lithologies were sampled, and assay results stored in the database. Some 60 holes were not sampled because they were either barren or abandoned early as a result of technical difficulties, such as wrong positioning of the drill machinery, high deviation of the hole, drill rod problems, bad ground conditions, poor core recovery, etc.

From 445 holes, a total of 11,829 sample intervals were analysed for Fe% and Specific Gravity (SG), 11,793 for magnetic iron (Mag Fe or Satmagan) and some 10,000 for Oxides. The database also includes some 5,250 Heavy Liquid Separation samples (HLS) analysed for iron recovery (Fe Rec) and silica concentrate (Si Conc) which will help in the characterization of the quality of the material to process at the mill.

The database is divided into 63 historical holes and 439 recent drill holes representing, in number of holes, 12% and 88% of the available information, respectively. Main differences between historical and recent holes are described in Table 14-3. G Mining included the historical drill hole information into the resource estimation based on the following reasons: 1) historical information is accessible to the public and can be verified (paper logs, historical maps, etc.) and 2) recent drill holes were drilled in the vicinity of historical drill holes and the results show comparable geology and mineralization outlines.

The resource estimation for the Bloom Lake project relies mainly on recent drilling programs. Figure 14–1 shows the location of the different holes drilled on the deposit.

Table 14-3: Main Differences between Historical and Recent Holes

Differences	Historical Holes	Recent Holes	Summary
Years of drilling	1957 - 1972	1998 - 2014	1957 – 2014
Target	Exploration	Mineralization delineation	Exploration and Infill
Unit system	Imperial	Metric	Metric
Core size	BQ	Mostly NQ	BQ & NQ
Deviation measurement	None	Acid test and/or FlexIT	None to various test
Logging procedures	Paper drill logs	Computerized procedures	Paper and computer logs
Number of Holes	64	441	505
Meterage (m)	10,390	113,712	124,103
Grid Spacing	Varying from 150 to 300 m	Varying from 75 to 150 m	Varying from 75 to 300 m

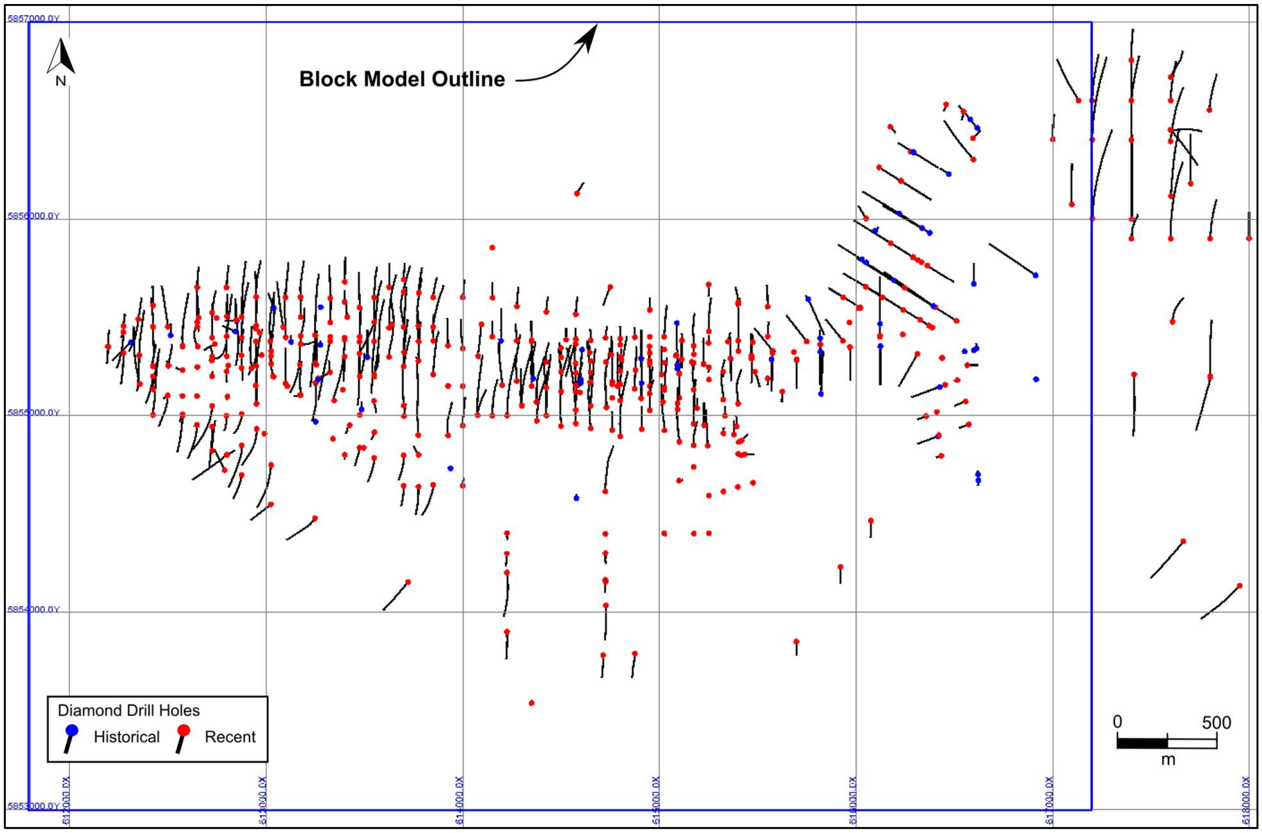


Figure 14–1: Plan View of the Diamond Drill Holes Located Inside the Block Model Area

The drilling database, which is organised in multiple tables and sub-tables (Header, Survey, Assays, Geology, Geotech, etc.) was validated before proceeding to the resource estimation. The following is a list of the validation checks executed on the drill hole database:

- Checked for duplicate drill hole collar locations and hole numbers
- Checked collar locations for zero or extreme values
- Performed visual inspection of drill holes for unusual azimuths, dips, and deviations
- Cross-checked collar lengths with final depths in secondary tables
- Ran validity checks for out-of-range values, missing intervals, overlapping intervals, out-of-sequence intervals, etc.
- Verified the Fe% content in assays by 1) evaluating Fe_2O_3% using stoichiometric calculations, and 2) retracing the sum of the elements/oxides analysed. The total should be close to 100%.

G Mining is of the opinion that the database is acceptable for the purposes of the resource estimation. No significant errors were found during the validation process.

14.2 Modelling

The Bloom Lake Gems project includes a geological model and structural domains.

14.2.1 Geology Model

The geology model was generated by Cliffs Bloom Lake geologists in 2014. The interpretation was based on diamond drill holes, geological maps, ground magnetic surveys and production data. Cross-sections were generated at 75 m to 150 m spacing, west to east. The geologists at Bloom Lake interpreted two sets of interpretation, vertical cross-section and plan view section, using software Geovia® Gems. Eight geological units were modelled:

a) Tabular to folded and anastomosing mineralized bands including: 1) Hematite Iron Formation (IF), 2) Magnetite Iron Formation (IFM), 3) Silicate Iron Formation (SIF), 4) Waste Silicate Iron Formation (WSIF)

b) Unmineralized units sitting below and above the mineralization as well as intercalated between the mineralized bands, including: 5) Amphibolite (AMP), 6) Quartzite (QZ), 7) Mica Schist (MS) and 8) Gneiss (GN).

The cross-section interpretations (example on Figure 14–2) were transferred to plan sections (example on Figure 14–3) through the use of traverses. In Gems, traverses are horizontal drill holes resulting from the intersection of the cross-section interpretation and the middle of the horizontal bench plan.

The plan sections are on 14 m bench heights from the top of the mine at elevation 816 m, down to bench 410 m. In the lower part of the deposit, for benches 410 m down to 18 m, bench heights are 28 m. The interpretation was done at the centre of the bench and then extruded to the bench height to create solids.

The modelling methodology used for the geology model of the Bloom Lake deposit is, as suggested by Geovia in their internal report written in 2014, ideal for complex models where conventional 3D solids can be very time consuming and susceptive to errors at the unit contacts.

G Mining reviewed the cross-section and plan view geological interpretations. Solids extruded from the interpretations are intersecting drill holes at lithology contact points described in the logs. The level of detail to which the geology model was constructed (14 m plan views in the upper portion of the model) represents adequately the complexity of the folded structures and stratigraphy. The lower plan views where interpretations were drawn every 28 m result in a more bulky model, but the latter is consequent to the fewer and sparser drill holes drilled at depth. The model also compares well to geological surface maps available in terms of fold geometry, fold axis orientation and stratigraphy.

G Mining is of the opinion that the geology model is suitable for the resource estimation of the Bloom Lake Project.

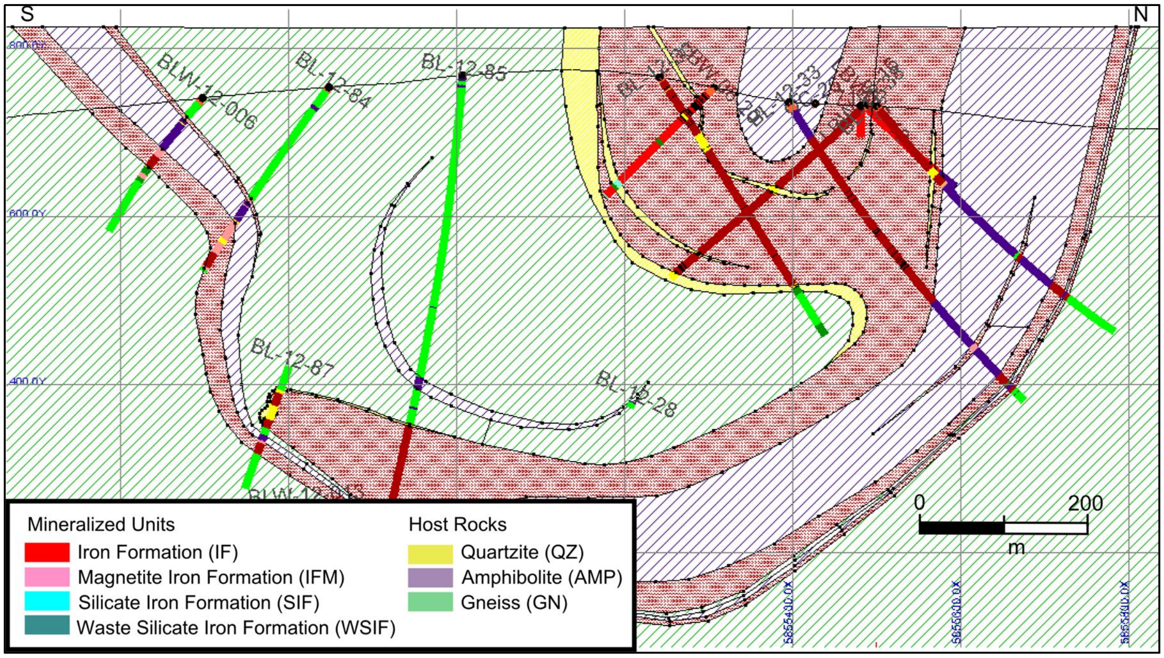


Figure 14–2: Cross-Section 612875 Looking West Showing the Geology Interpretation and Drill Holes

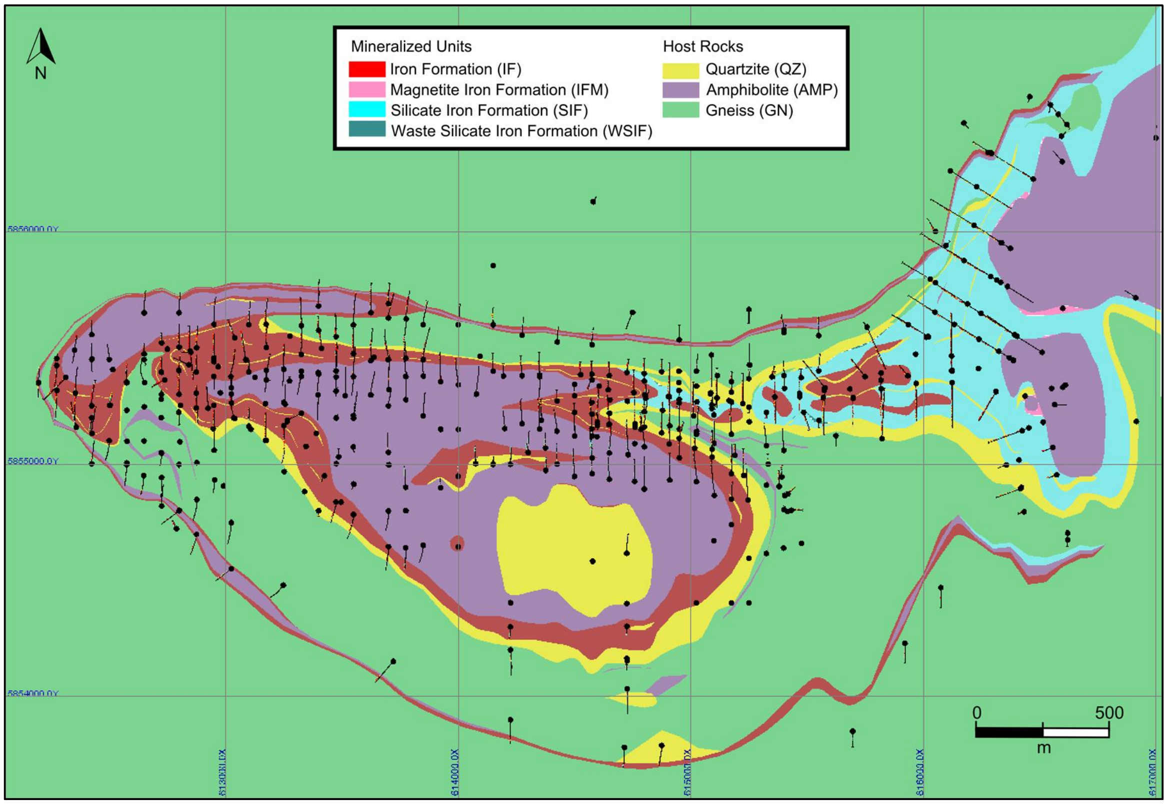


Figure 14–3: Plan View Interpretation at Elevation 564 m Showing the Geology Model and Drill Holes

14.2.2 Structural Domains

Because of the folded nature of the deposit at Bloom Lake, the geology model was divided into multiple structural domains. According to the principle of stationary, each domain was defined under the following requirements:

- Represents a single statistical population where mean and variance are consistent throughout the domain
- Is geologically homogenous
- Has a single orientation of grade continuity

Structural domains separate the mineralized units (IF, IFM, SIF, WSIF) into groups of single mineralization continuity orientation (strike and dip). Wireframes of the nine structural domains are illustrated in Figure 14–4 and Figure 14–5.

Table 14-4 lists the plane attitudes defining each of the nine (9) structural domains outlined at Bloom Lake. Subsequent codification of the lithologies into litho-structural domains was set as presented in Table 14-5.

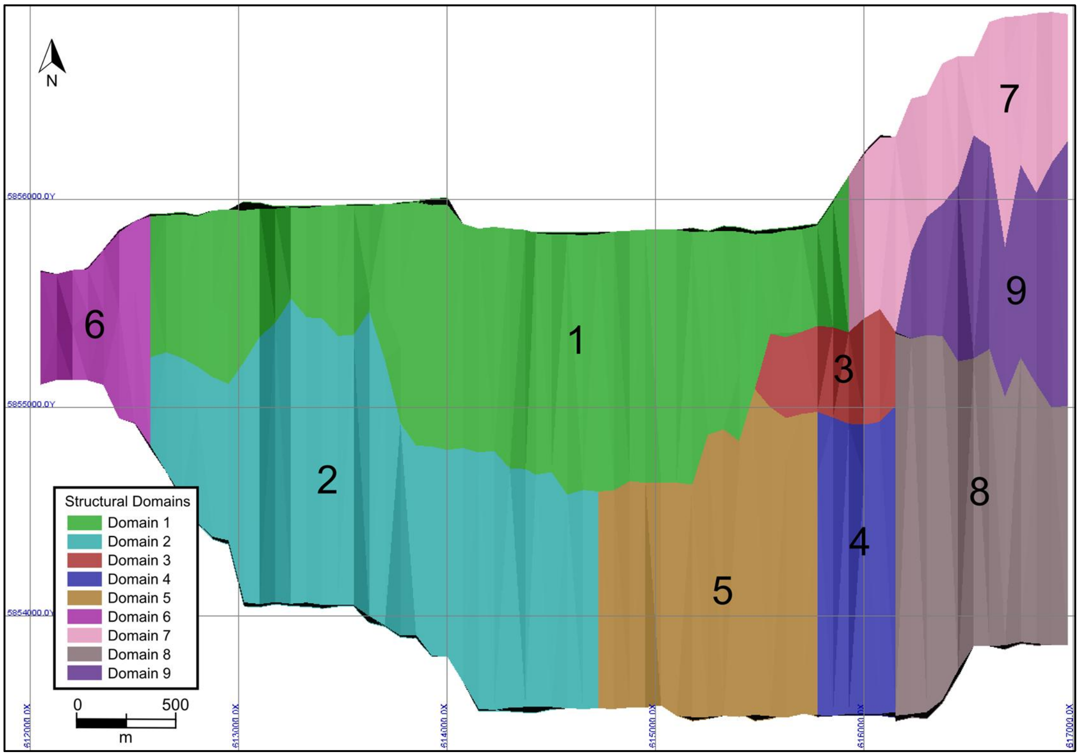


Figure 14–4: Plan View Showing the Structural Domain Definition

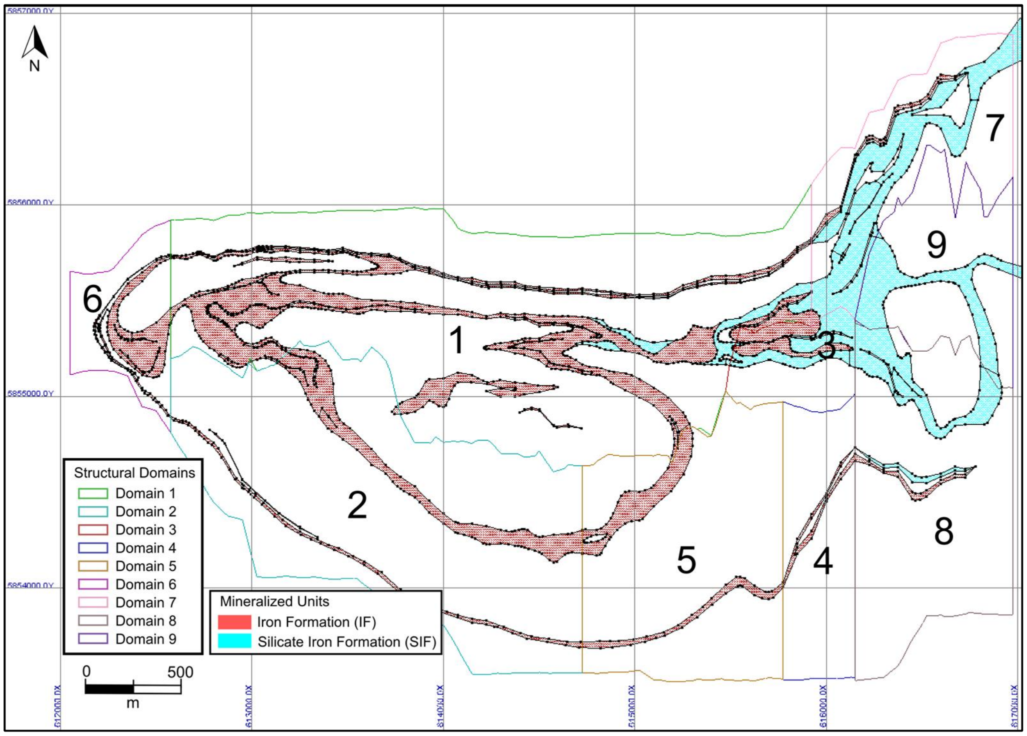


Figure 14–5: Plan View Showing the Structural Domains in Relation with the Mineralization Orientation

Table 14-4: List of Plane Attitudes Defining the Structural Domains

Domain	Plane Attitude	
	Dip Direction	Dip
1	185	-60
2	35	-45
3	5	-45
4	300	-40
5	320	-40
6	135	-60
7	120	-70
8	70	-40
9	175	0

Table 14-5: Litho-Structural Codification

Lithology	Domains								
	1	2	3	4	5	6	7	8	9
IF	1020	2020	3020	4020	5020	6020	7020	8021	-
IFM	1021	-	3021	-	-	-	7021	-	9021
SIF	1023	-	3023	-	-	-	7023	8023	9023
WSIF	1024	-	3024	-	-	-	7024	-	9024

G Mining has reviewed the structural domains, and is of the opinion that the wireframes adequately subdivide the geology model into individual orientation subsets of grade continuity. Consequently, G Mining considers the structural model to be appropriate for the resource estimation of the Bloom Lake Project.

14.2.3 Overburden

An overburden cover was modelled from the corresponding intervals described in the drill logs. The overburden layer is roughly 5 m thick.

14.2.4 Topography Surface

The topography surface covers the whole set of drill holes and represents pre-mining surface grounds. The surface used is named TopoMts\Original\2011.

14.3 Statistical Analysis

14.3.1 Assay Statistics

The drill hole intervals intersecting the mineralization wireframes were identified to the corresponding lithology unit, and assays were codified accordingly.

Statistics of the assays and Heavy Liquid Separation (HLS) samples, including iron and oxides content, magnetic iron (Satmagan), specific gravity, iron recovery (Fe Rec) and silica concentrate (Si Conc) results, were computed using the geostatistical functions in Geovia® Gems. Note that the HLS samples were tested with a solution of 2.95 g/cm^3 density.

Statistics were studied for assays grouped by mineralized lithology domains (IF, IFM, SIF, WSIF) and are presented in Table 14-6 to Table 14-9. Statistics for Rock Quality Designation (RQD) intervals are also tabulated by lithology types in Table 14-10.

Table 14-6: Descriptive Statistics for Assays in IF Unit

										HLS Samples	
Variable	**Fe (%)**	**Sat (%)**	**CaO (%)**	**MgO (%)**	**Al_2O_3 (%)**	**MnO (%)**	**P_2O_5 (%)**	**TiO_2 (%)**	**SG**	**Fe Rec (%)**	**Si Conc (%)**
Number	6,788	6,771	6,370	6,374	6,071	6,372	6,002	6,363	6,788	3192	3192
Minimum	1.11	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.66	0.00	0.00
Maximum	68.74	61.20	16.00	12.50	19.50	4.69	1.00	4.34	5.22	97.83	92.45
Mean	30.21	1.94	0.18	0.23	0.47	0.40	0.04	0.06	3.45	83.68	4.79
Median	31.04	0.70	0.02	0.06	0.16	0.01	0.02	0.02	3.46	83.68	4.2
Variance	57.91	16.95	0.42	0.56	2.46	0.02	0.01	0.07	0.06	71.45	17.43
Standard Deviation	7.61	4.12	0.65	0.75	1.57	0.14	0.07	0.27	0.24	8.45	4.17
Coefficient of Variation	0.25	2.12	3.61	3.26	3.33	3.20	1.92	4.64	0.07	0.10	0.87

Table 14-7: Descriptive Statistics for Assays in IFM Unit

										HLS Samples	
Variable	**Fe (%)**	**Sat (%)**	**CaO (%)**	**MgO (%)**	**Al_2O_3 (%)**	**MnO (%)**	**P_2O_5 (%)**	**TiO_2 (%)**	**SG**	**Fe Rec (%)**	**Si Conc (%)**
Number	344	337	204	204	204	204	204	200	344	150	150
Minimum	1.65	0.29	0.01	0.05	0.01	0.01	0.01	0.01	2.61	54.62	2.81
Maximum	52.40	50.90	15.60	9.08	22.80	1.78	1.24	3.40	4.13	90.60	41.07
Mean	29.81	22.67	1.86	2.14	0.60	0.23	0.05	0.07	3.45	73.21	16.10
Median	32.30	23.20	0.98	1.68	0.18	0.11	0.03	0.02	3.51	73.18	15.33
Variance	75.68	105.75	5.71	3.52	5.15	0.09	0.01	0.08	0.07	49.46	69.15
Standard Deviation	8.70	10.28	2.39	1.88	2.27	0.30	0.12	0.29	0.26	7.03	8.32
Coefficient of Variation	0.29	0.45	1.28	0.88	3.78	1.27	2.23	3.91	0.08	0.10	0.52

Table 14-8: Descriptive Statistics for Assays in SIF Unit

										HLS Samples	
Variable	**Fe (%)**	**Sat (%)**	**CaO (%)**	**MgO (%)**	**Al_2O_3 (%)**	**MnO (%)**	**P_2O_5 (%)**	**TiO_2 (%)**	**SG**	**Fe Rec (%)**	**Si Conc (%)**
Number	2,009	1,999	1,345	1,346	1,346	1,346	1,345	1,338	2,009	526	526
Minimum	2.80	0.06	0.06	0.08	0.01	0.01	0.01	0.01	2.64	46.18	1.36
Maximum	53.80	50.80	16.20	12.40	14.20	2.11	0.99	3.85	4.17	93.49	49.25
Mean	27.51	8.74	3.62	3.52	0.46	0.17	0.06	0.07	3.40	80.78	8.71
Median	28.20	4.70	3.28	3.23	0.16	0.11	0.03	0.01	3.42	83.43	4.92
Variance	50.58	89.94	5.83	4.40	1.78	0.03	0.01	0.10	0.05	78.59	88.81
Standard Deviation	7.11	9.48	2.41	2.10	1.34	0.19	0.10	0.32	0.22	8.86	9.42
Coefficient of Variation	0.26	1.09	0.67	0.60	2.93	1.12	1.71	4.27	0.06	0.11	1.08

Table 14-9: Descriptive Statistics for Assays in WSIF Unit

										HLS Samples	
Variable	**Fe (%)**	**Sat (%)**	**CaO (%)**	**MgO (%)**	**Al_2O_3 (%)**	**MnO (%)**	**P_2O_5 (%)**	**TiO_2 (%)**	**SG**	**Fe Rec (%)**	**Si Conc (%)**
Number	303	303	208	208	208	208	208	208	303	47	47
Minimum	1.82	0.01	0.67	0.89	0.01	0.01	0.01	0.01	2.62	0.00	0.00
Maximum	40.30	31.51	18.70	16.20	12.60	2.15	0.78	3.02	3.76	83.15	47.29
Mean	16.36	8.75	11.10	8.80	0.39	0.39	0.06	0.04	3.16	57.71	17.97
Median	16.99	8.00	11.65	9.49	0.10	0.40	0.02	0.01	3.20	66.29	14.82
Variance	44.72	50.84	17.14	7.80	1.51	0.05	0.01	0.05	0.05	434.24	163.58
Standard Deviation	6.69	7.13	4.14	2.79	1.23	0.23	0.11	0.23	0.22	20.84	12.79
Coefficient of Variation	0.41	0.82	0.37	0.32	3.17	0.58	1.90	5.24	0.07	0.36	0.71

Table 14-10: Descriptive Statistics of % RQD Records by Lithology

Variable	**IF**	**IFM**	**SIF**	**WSIF**	**QR**	**AMP**	**GN**
Number	10,246	455	2,656	389	3,371	11,179	6,646
Minimum	0	8	0	10	0	0	0
Maximum	100	100	100	100	100	100	100
Mean	73	93	96	94	76	94	92
Median	87	97	100	100	90	98	98
Variance	981	116	118	250	895	160	263
Standard Deviation	31	11	11	16	30	13	16
Coefficient of Variation	0	0	0	0	0	0	0

Most assays are located in the IF unit (6,788 assays) and SIF unit (2,009 assays) while IFM and WSIF units represent smaller domains (<350 assays). The average iron grades in the IF and IFM units vary around 30% Fe while in SIF, the average is slightly lower with 27% Fe. The WSIF hosts low ranges of iron grades with an average of approximately 16% Fe and significant quantities of oxides in comparison to the other mineralized units. Some small percentages of oxides (calcium and magnesium <3%) are also present inside the SIF unit.

Distributions of the assay populations located within each mineralized lithology unit were also evaluated through histogram and cumulative graphs (refer to Figure 14–6). The histograms indicate normal to negatively skewed distributions.

There was no top cutting applied to higher iron grade assays.

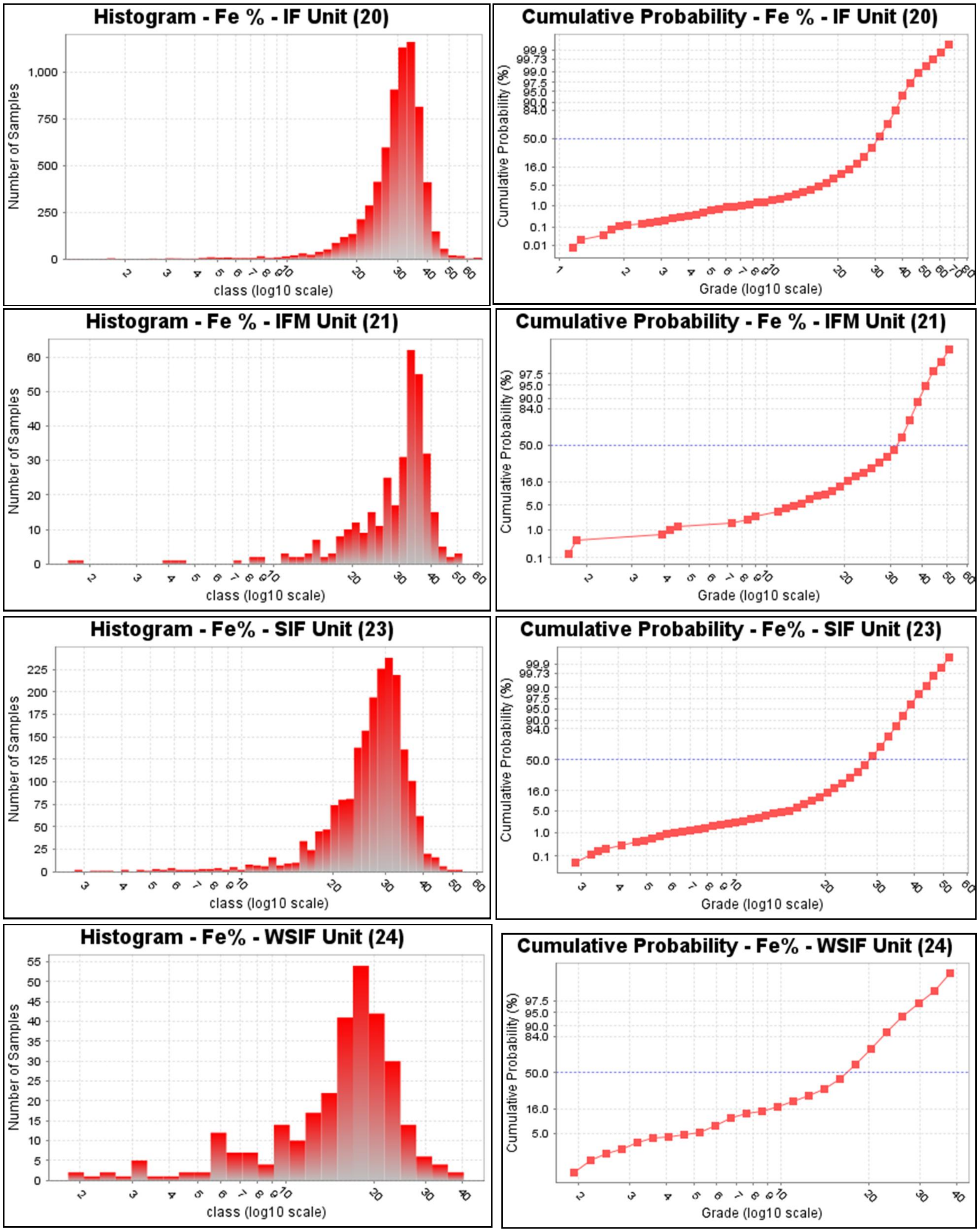


Figure 14–6: Histogram and Cumulative Probability Graphs for Iron Grade Assays inside the Mineralized Units

14.3.2 Compositing

The assay interval length varies from 0.3 to 35.3 m with an average of 4.7 m. The raw-assays and HLS samples were composited into 7.0 m run length (down-hole) within the mineralized units (IF, IFM, SIF and WSIF). Intervals shorter than 7.0 m were distributed evenly among above composites in the mineralized intercept. Only composites greater than 2 m were used in the resource estimation, smaller ones generated at the end of a mineralized intercept or hole were discarded. Composite intervals with less than 2 m assay results, mainly due to bad core recovery, were also deleted.

The determination of composite length was based on assay average length, mineralization wireframe thicknesses and bench height (14 m) at the Bloom Lake mine. The selected composite length corresponds to half of the mining bench height, but also to a percentile ranking of 98% of samples meaning most composites are less than 7 m long.

Descriptive statistics of the 7.0 m composites generated inside the four mineralized domains at Bloom Lake are summarized in Table 14-11, Table 14-12, Table 14-13 and Table 14-14.

Table 14-11: Descriptive Statistics of IF Composites

										HLS Composites	
Variable	**Fe (%)**	**Sat (%)**	**CaO (%)**	**MgO (%)**	**Al_2O_3 (%)**	**MnO (%)**	**P_2O_5 (%)**	**TiO_2 (%)**	**SG**	**Fe Rec (%)**	**Si Conc (%)**
Number	4,594	4,579	4,423	4,423	4,297	4,420	4,275	4,409	4,594	2,449	2,449
Minimum	2.37	0.03	0.01	0.01	0.01	0.01	0.01	0.01	2.71	3.08	0.89
Maximum	66.61	43.96	17.25	16.66	14.20	4.29	0.75	2.98	5.22	96.15	85.00
Mean	30.40	1.77	0.17	0.22	0.41	0.04	0.03	0.05	3.46	83.69	4.62
Median	31.04	0.73	0.03	0.06	0.17	0.01	0.02	0.02	3.46	84.93	4.15
Variance	42.83	11.87	0.23	0.41	0.90	0.01	0.00	0.02	0.04	60.10	11.59
Standard Deviation	6.54	3.45	0.48	0.64	0.95	0.12	0.04	0.14	0.21	7.75	3.40
Coefficient of Variation	0.22	1.95	2.83	2.92	2.31	2.93	1.27	2.99	0.06	0.09	0.74

Table 14-12: Descriptive Statistics of IFM Composites

										HLS Composites	
Variable	**Fe (%)**	**Sat (%)**	**CaO (%)**	**MgO (%)**	**Al_2O_3 (%)**	**MnO (%)**	**P_2O_5 (%)**	**TiO_2 (%)**	**SG**	**Fe Rec (%)**	**Si Conc (%)**
Number	257	247	191	191	191	191	191	183	257	135	135
Minimum	5.67	0.72	0.01	0.02	0.05	0.01	0.01	0.01	2.72	56.81	2.90
Maximum	44.93	40.90	12.35	8.60	14.50	1.49	0.85	3.40	3.90	89.05	46.58
Mean	29.78	21.35	1.65	1.96	0.40	0.21	0.04	0.07	3.44	74.26	16.15
Median	31.62	20.93	0.87	1.60	0.19	0.12	0.03	0.02	3.48	73.64	14.51
Variance	50.00	81.81	4.42	2.97	1.34	0.07	0.00	0.07	0.05	42.71	88.32
Standard Deviation	7.07	9.04	2.10	1.72	1.16	0.26	0.07	0.27	0.22	6.54	9.40
Coefficient of Variation	0.24	0.42	1.27	0.88	2.91	1.23	1.50	4.12	0.06	0.09	0.58

Table 14-13: Descriptive Statistics of SIF Composites

Variable	Fe (%)	Sat (%)	CaO (%)	MgO (%)	Al_2O_3 (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	SG	HLS Composites Fe Rec (%)	HLS Composites Si Conc (%)
Number	1,221	1,211	955	957	957	957	956	947	1,221	384	384
Minimum	2.80	0.13	0.06	0.17	0.01	0.01	0.01	0.01	2.64	47.36	1.89
Maximum	45.37	43.96	15.00	11.58	12.01	2.04	0.78	3.04	3.95	93.00	48.94
Mean	27.96	8.26	3.67	3.53	0.42	0.17	0.06	0.07	3.41	80.96	8.52
Median	28.73	4.86	3.42	3.31	0.17	0.11	0.03	0.02	3.43	83.48	4.89
Variance	34.33	74.10	4.56	3.37	0.80	0.03	0.01	0.05	0.03	70.59	85.22
Standard Deviation	5.86	8.61	2.13	1.84	0.90	0.18	0.07	0.22	0.18	8.40	9.23
Coefficient of Variation	0.21	1.04	0.58	0.52	2.12	1.07	1.32	3.12	0.05	0.10	1.08

Table 14-14: Descriptive Statistics of WSIF Composites

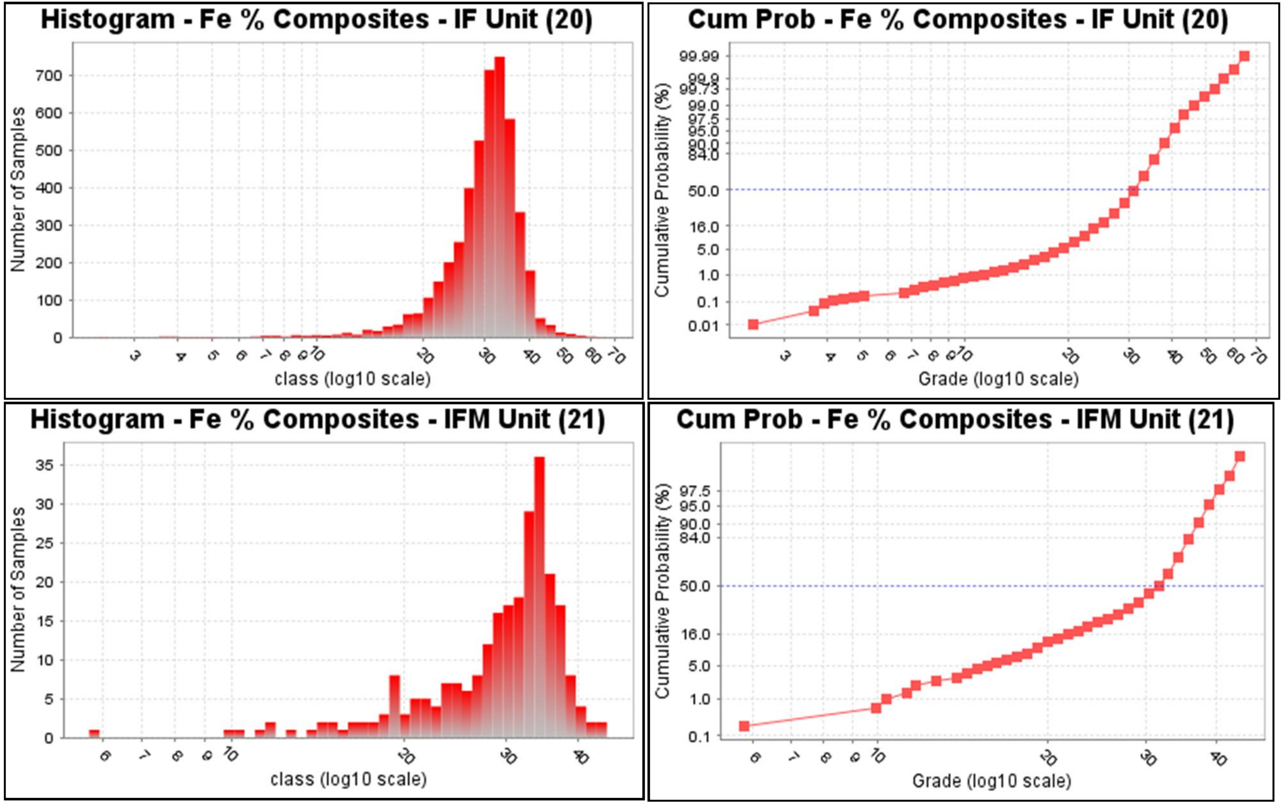
Variable	Fe (%)	Sat (%)	CaO (%)	MgO (%)	Al_2O_3 (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	SG	HLS Composites Fe Rec (%)	HLS Composites Si Conc (%)
Number	161	161	130	130	130	130	130	130	161	29	29
Minimum	2.46	0.03	1.80	1.34	0.01	0.02	0.01	0.01	2.67	5.58	2.17
Maximum	28.33	31.10	17.25	14.72	8.84	1.05	0.54	0.92	3.60	79.65	37.46
Mean	16.23	9.13	10.88	8.60	0.44	0.37	0.06	0.04	3.17	54.46	16.85
Median	17.33	8.00	11.79	9.31	0.13	0.40	0.02	0.01	3.21	62.67	17.14
Variance	31.19	40.58	14.15	7.34	1.08	0.03	0.01	0.02	0.04	414.15	83.12
Standard Deviation	5.58	6.37	3.76	2.71	1.04	0.18	0.09	0.13	0.19	20.35	9.12
Coefficient of Variation	0.34	0.70	0.35	0.32	2.39	0.49	1.51	2.85	0.06	0.37	0.54

A great number of composites are located in the major units of IF (>4,500 composites) and SIF (> 1,200 composites) as opposed to minor units where the combined number of composites located inside IFM and WSIF reaches approximately 420 composites. Composites in the IF unit show a wide range of iron content varying from 2.4 up to 66.6% Fe and an iron average grade of 30.4% Fe. In the IFM and SIF units, average composite grades (29.8% Fe and 28.0% Fe) and maximum grades (approximately 45.0% Fe) are slightly lower than those in the IF unit. Similar coefficients of variation, between 0.2 and 0.3, are calculated in all mineralized units and are considered low and representative of a single grade population.

Other major oxides were analysed and composited using the same iron composite intervals. As indicated by its name, the IFM unit includes high average of magnetic iron with approximately 21% Fe compared to SIF and WSIF units showing about 8% to 9% of magnetic Fe and only 2% Fe in the hematite-rich IF unit. Contents of CaO and MgO oxides are highest in the silicate iron formations (SIF and WSIF).

Figure 14–7 shows a series of histograms and cumulative probability graphs for iron grade composites, presented by mineralized unit.

Figure 14–7: Histogram and Cumulative Probability Graphs for Iron Grade Composites inside the Mineralized Units

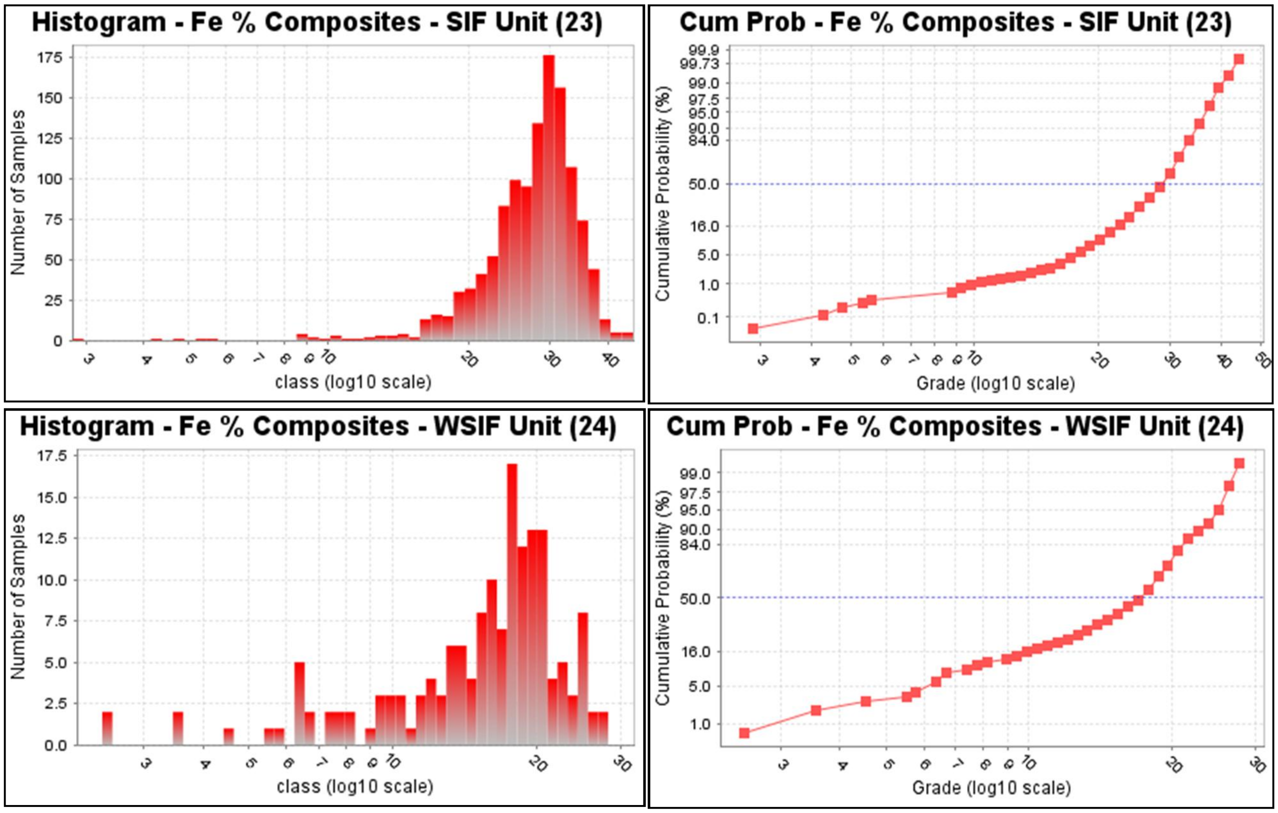


Histogram - Fe % Composites - IF Unit (20)

Cum Prob - Fe % Composites - IF Unit (20)

Histogram - Fe % Composites - IFM Unit (21)

Cum Prob - Fe % Composites - IFM Unit (21)



As for geotechnical measurements, 95% of the sample intervals were 3.0 m in length. Traditional weighted linear combination process of compositing is not necessarily recommended for RQD measurements, as it is not clear whether RQD values can be added or not. Therefore, the samples were treated as follows: 3.0 m long samples were not composited and were kept as is, samples less than 2.25 m were discarded, and intervals longer than 3.75 m were split into subsections of 3.0 m and were attributed the parent RQD value. Table 14-15 tabulates descriptive statistics by lithology for the 3.0 m RQD composites.

Table 14-15: Descriptive Statistics of % RQD Composites by Lithology

Lithology	**IF**	**IFM**	**SIF**	**WSIF**	**QR**	**AMP**	**GN**
Number	10,401	517	2,688	380	3,178	11,055	6,556
Minimum	0	8	0	10	0	0	0
Maximum	100	100	100	100	100	100	100
Mean	73	92	96	94	77	94	92
Median	87	97	100	100	90	98	98
Variance	977	144	111	242	849	145	257
Standard Deviation	31	12	11	16	29	12	16
Coefficient of Variation	0	0	0	0	0	0	0

14.3.3 Variography

Grade variography analyses were completed based on 7 m composites grouped by litho-structural domains. The overall approach used to generate and model the variography for each attributes by domain is described below:

- Orientations and dips of the structural domains were examined to help in the determination of the axes of better continuity.
- Nugget effect (C_0) was evaluated for each attribute through generation and modelling of downhole linear semi-variograms by lithology combining all structural domains.
- Major, semi-major and minor axes of continuity were estimated and modelled.

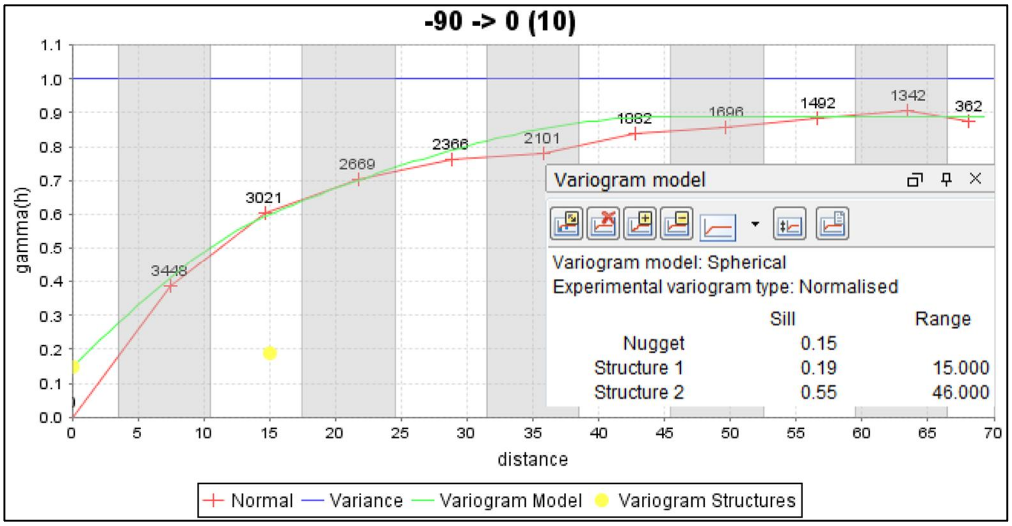
Orientations and dips of the nine (9) structural domains are described in Table 14-16.

Table 14-16: Orientation and Dip of Structural Domains

Domain	Plane Attitude	
	Dip Direction	Dip
1	185	-60
2	35	-45
3	5	-45
4	300	-40
5	320	-40
6	135	-60
7	120	-70
8	70	-40
9	175	0

Downhole, linear semi-variograms were generated for each attribute, analyzing composites from two units, IF (refer to Figure 14–8) and SIF. Because IFM and WSIF units contain a smaller number of composites, the nugget effect in these lithologies was assumed to be similar to the nugget effect estimate in SIF. For HLS composites, the nugget effect was determined for grouped IF and SIF units, otherwise the dataset was too small to get a representative value.

Table 14-7 summarizes the results of the nugget effect analysis. Overall, the nugget effect values for iron were in the low range varying from 10% to 15% and were considered to be typical of iron deposits. As for the oxide elements, the nugget effect was also low with a 10% value.



Variogram model: Spherical
Experimental variogram type: Normalised

	Sill	Range
Nugget	0.15	
Structure 1	0.19	15.000
Structure 2	0.55	46.000

Figure 14–8: Downhole Fe % Semi-Variogram in IF

Table 14-17: Nugget Effect Evaluated for all Attributes by Lithology

Unit	Fe	MagFe	CaO	MgO	Al_2O_3	MnO	P_2O_5	TiO_2	Fe_Rec$^{(2)}$	Si_Conc$^{(2)}$	SG	RQD
IF	15%	15%	10%	10%	10%	10%	10%	10%	15%	10%	10%	10%
IFM$^{(1)}$	10%	10%	10%	10%	10%	10%	10%	10%	15%	10%	10%	10%
SIF	10%	10%	10%	10%	10%	10%	10%	10%	15%	10%	10%	10%
WSIF$^{(1)}$	10%	10%	10%	10%	10%	10%	10%	10%	15%	10%	10%	10%
QR	-	-	-	-	-	-	-	-	-	-	-	10%
AMP	-	-	-	-	-	-	-	-	-	-	-	10%
GN	-	-	-	-	-	-	-	-	-	-	-	10%

(1) SIF nugget effect was attributed to this unit.
(2) For HLS composites, nugget effect was analysed from the combination of IF and SIF units.

Directional semi-variograms were generated for each attribute by lithologies, for IF and SIF, starting with composites inside the structural domain with the most data followed by the second most populated domain. The ranges were evaluated first in domain 1 and confirmed through the variography analysis of composites in domain 2 for IF unit. The same methodology was used for SIF unit, performing the variography study in domain 7 and domain 3 afterwards. Because the number of composites is too low to perform adequate variography analysis, semi-variograms for units IFM and WSIF were assumed comparable to those created for the SIF unit.

The directional semi-variograms were created using Geovia® Gems software. Lag distances were set according to drill hole grid spacing specific to the structural domain analysed. For example, lag distances of 75 m in domain 1 and 150 m in domain 7 were applied for the generation of the 3D semi-variograms.

All variography was modelled with a nugget effect, as determined from the downhole semi-variograms and one or two spherical structures. The parameters of the semi-variograms modelled are summarized in Table 14-18 for IF unit and in Table 14-19 for SIF unit including IFM and WSIF.

Table 14-20 and Table 14-21 present the rotation angles defining the anisotropy for each unit, attribute and structural domain.

Table 14-18: Variogram Parameters for Attributes in Iron Formation (IF)

Variable	C_0	First Spherical Structure				Second Spherical Structure			
		Sill	Ranges (m)			Sill	Ranges (m)		
			Major	Semi-Major	Minor		Major	Semi-Major	Minor
Fe	5.793579	18.153213	37	37	11	10.428442	200	200	60
Mag Fe	2.035688	1.221413	100	100	30	4.88565	200	200	60
CaO	0.017022	0.017022	100	91	12	0.039151	230	209	27
MgO	0.045802	0.128244	100	67	25	0.082443	200	133	50
Al_2O_3	0.074415	0.066974	100	77	25	0.297662	200	154	50
MnO	0.001885	0.004712	60	38	12	0.009047	150	94	30
P_2O_5	0.000174	0.000208	125	63	31	0.000886	175	88	44
TiO_2	0.001924	0.003655	75	50	15	0.005002	150	100	30
SG	0.004212	0.020217	50	36	15	0.013057	200	143	60
Fe Rec	4.532529	10.878069	100	77	20	10.273732	200	154	40
Si Conc	0.441168	0.573519	80	67	27	2.426427	175	146	58
RQD	107.106554	492.690147	75	38	25	160.65983	150	75	50

Table 14-19: Variogram Parameters for Attributes in Magnetite Iron Formation (IFM), Silicate Iron Formation (SIF), Waste Silicate Iron Formation (WSIF)

Variable	C_0	First Spherical Structure				Second Spherical Structure			
		Sill	Ranges (m)			Sill	Ranges (m)		
			Major	Semi-Major	Minor		Major	Semi-Major	Minor
Fe	4.445038	8.001068	100	50	25	25.336715	250	125	63
Mag Fe	4.465276	34.382622	210	84	47	0.00322	210	84	47
CaO	1.839686	0.970016	75	63	38	0.237544	200	167	100
MgO	1.353998	0.54635	100	50	40	0.015172	175	88	70
Al_2O_3	0.036412	0.075858	60	30	15	0.003887	150	75	3
MnO	0.00622	0.012828	125	125	31	0.00074	225	225	56
P_2O_5	0.002666	0.001037	120	100	40	0.000438	200	167	67
TiO_2	0.001402	0.001752	26	100	130	10.080629	230	177	46
SG	0.014951	0.014951	55	55	30	0.334488	285	285	155
Fe Rec	10.080629	34.274137	175	97	35	-	-	-	-
Si Conc	5.215412	29.206306	175	175	35	-	-	-	-
RQD	107.106554	492.690147	75	38	25	160.65983	150	75	50

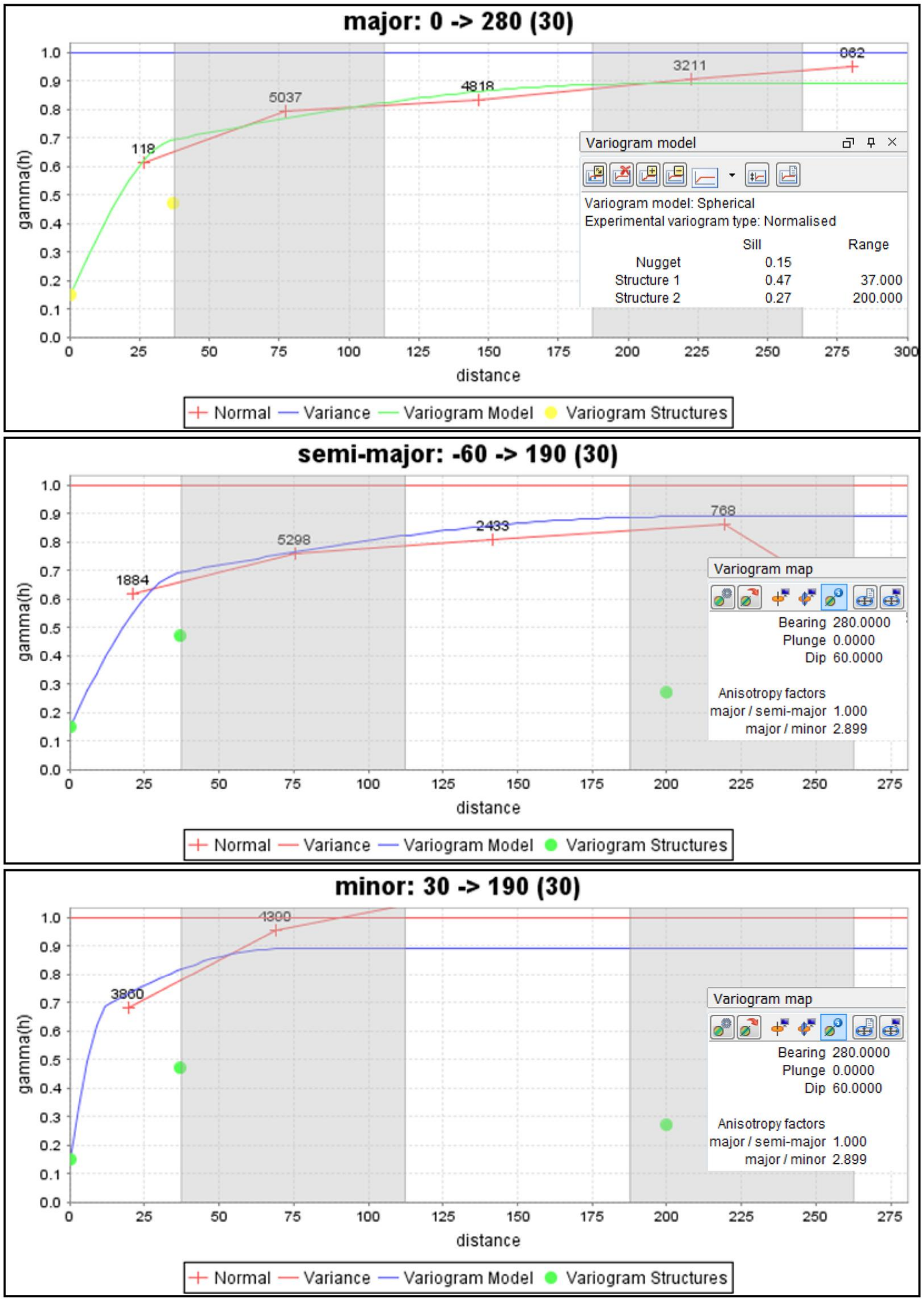
Table 14-20: Rotation Angles Defining the Anisotropy Presented by Structural Domain and Valid for Most Lithology Domain and Attributes Evaluated (see the following Table 14-21 for exceptions)

Structural Domain	Rotation		
	Z	X	Z
1	170	-60	0
2	-35	-45	0
3	175	45	0
4	60	-40	0
5	40	-40	0
6	225	-60	0
7	60	70	0
8	110	40	0
9	175	0	0

Table 14-21: Rotation Angles Defining the Anisotropy for Specific Lithology and Attributes

Structural Domain	Unit	Attribute	Rotation	
			X	Y
2	AMP	RQD	-35	-55
	GN	RQD	-35	-55
7	IF	Al_2O_3	60	60
	IF	Mag Fe	60	60
	IF	MgO	60	60
	IF	MnO	60	60
	IF	P_2O_5	60	60
	IF	Fe Rec	60	60
	IF	SG	60	60
	IF	Si Conc	60	60
	IF	TiO_2	60	60
	SIF	Al_2O_3	60	60
	QR	RQD	60	60

The variography study for the Bloom Lake project was extensively developed by Dassault Systems, Geovia in 2014. G Mining has validated the parameters and considers those appropriate to be used in the Ordinary Kriging estimation. Figure 14–9 shows the directional semi-variograms in IF for structural domain 1.



Variogram model

Variogram model: Spherical

Experimental variogram type: Normalised

	Sill	Range
Nugget	0.15	
Structure 1	0.47	37.000
Structure 2	0.27	200.000

Bearing 280.0000
Plunge 0.0000
Dip 60.0000

Anisotropy factors
major / semi-major 1.000
major / minor 2.899

Figure 14–9: Directional Fe % Semi-Variograms for Major, Semi-Major and Minor Axis in IF for Structural Domain 1

14.4 Block Modelling

The block model for the Bloom Lake project was set in Geovia® GEMS 6.7.3.

14.4.1 Block Model Parameters

The drilling pattern, the thickness of the zones, the complexity of the geology model and the open pit mine planning considerations guided the choice of block dimension. The block model parameters are summarized in Table 14-22.

Table 14-22: Block Model Settings (RE14_10m_V3)

Axis	Origin(1) (m)	Block Size (m)	Number of Blocks	
X	611,800	10	540	Columns
Y	5,853,000	10	400	Rows
Z	830	14	59	Levels

(1) The origin is at the minimum X, minimum Y and maximum Z.

A series of attributes needed during the block modelling development were incorporated into the block model project. Table 14-23 presents the list of attributes found in the block model project RE14_10m_V3 in the Standard folder. The attributes represent either 3D wireframes (Rock Type for example), interpolation results (multiple grade variables), or interpolation result indicators (slope of regression, number of holes, etc.).

Table 14-23: List of Attributes found in the Block Model RE14_10m_V3

Origin of Attribute	Model Name (units)	Description
Geology and structural models	Rock Type	Lithology codification
	Domain	Structural domain codification
	Rock Type Domain	Litho-structural domain codification
Variable interpolation from 7.0 m composites	Density (g/cm^3)	Specific gravity
	Fe (%)	Grade estimation by Ordinary Kriging
	Sat (%)	Magnetic iron (Fe_3O_4) from Satmagan instrument (referred to Mag Fe)
	CaO (%)	Calcium oxide, grade estimation by Ordinary Kriging
	MgO (%)	Magnesium oxide, grade estimation by Ordinary Kriging
	MnO (%)	Manganese oxide, grade estimation by Ordinary Kriging
	Al_2O_3 (%)	Aluminium oxide, grade estimation by Ordinary Kriging
	P_2O_5 (%)	Phosphate oxide, grade estimation by Ordinary Kriging
	TiO_2 (%)	Titanium oxide, grade estimation by Ordinary Kriging
	Fe Rec (%)	Iron recovery from Heavy Liquid Separation (HLS) composites, estimation by Ordinary Kriging
	Si Conc (%)	Silica concentrate from Heavy Liquid Separation (HLS) composites, estimation by Ordinary Kriging
	RQD (%)	Rock Quality Designation, estimation by Ordinary Kriging
Interpolation result indicators	B-VAR	Block variance
	K-VAR	Kriging variance

	SR	Slope of regression
	NEG	Number of negative weights
	Holes NUM	Number of holes used in the estimation
	Sample Dist (m)	Mean distance of composites used in the estimation
	Sample NUM	Number of composites used in the estimation
	Sample Mean (Fe %)	Mean value for composites used in the estimation
	Sample Close (Fe %)	Grade of true closest composite
Determined from interpolation indicators	Class	Resource categories

14.4.2 Rock Type Model

Rock type models, or domain coding, relied on the litho-structural wireframes as presented in Section 14.2.

Blocks in the rock type attribute were coded based on geology wireframes including the following mineralized and non-mineralized lithologies: Iron Formation (IF), Iron Formation Magnetite (IFM), Silicate Iron Formation (SIF), Waste Silicate Iron Formation (WSIF), Quartzite (QR), Mica Schist (MS), Amphibolite (AMP) and Gneiss (GN). Rock codes were attributed to each block according to the highest proportion of lithology included in the block. A similar codification was performed in the domain attribute to assign structural domain codes based on the nine (9) structural wireframes. Additionally, blocks which were located at least 50% inside the overburden solid and at least 99% above the topography surface were identified as overburden and air, respectively.

The Rock Type Domain model combines lithology and structural codes as described in Table 14-24. Views of the Rock Type Domain attribute are illustrated in Figure 14–10 and Figure 14–11.

Table 14-24: Description of Rock Codes Assigned to Blocks in the Rock Type Model

Geology Unit	Lithology Code	Rock Codes(1) by Structural Domains								
		1	2	3	4	5	6	7	8	9
Iron Formation	IF	1020	2020	3020	4020	5020	6020	7020	8020	9020
Iron Formation Magnetite	IFM	1021	-	3021	-	-	-	7021	8021	9021
Silicate Iron Formation	SIF	1023	-	3023	-	-	-	7023	8023	9023
Waste Silicate Iron Formation	WSIF	1024	-	3024	-	-	-	7024	-	9024
Quartzite	QR	1030	2030	3030	4030	5030	6030	7030	8030	9030
Mica Schist	MS	1033	2033	-	-	-	-	-	-	-
Amphibolite	AMP	1040	2040	3040	4040	5040	6040	7040	8040	9040
Gneiss	GN	1050	2050	3050	4050	5050	6050	7050	8050	9050
Other		Air - 99, Overburden - 10, Host rock exterior to geology model – 50								
(1) First digit in rock codes represent structural domains and last two digits, represent the lithology code.										

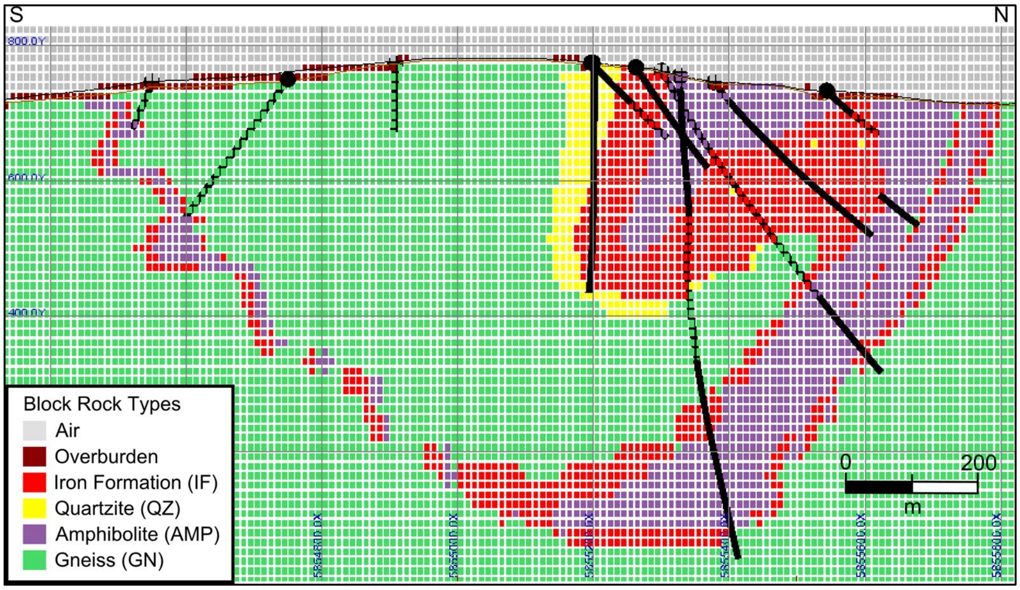


Figure 14–10: Cross-Section 613025 Showing the Rock Type Block Model

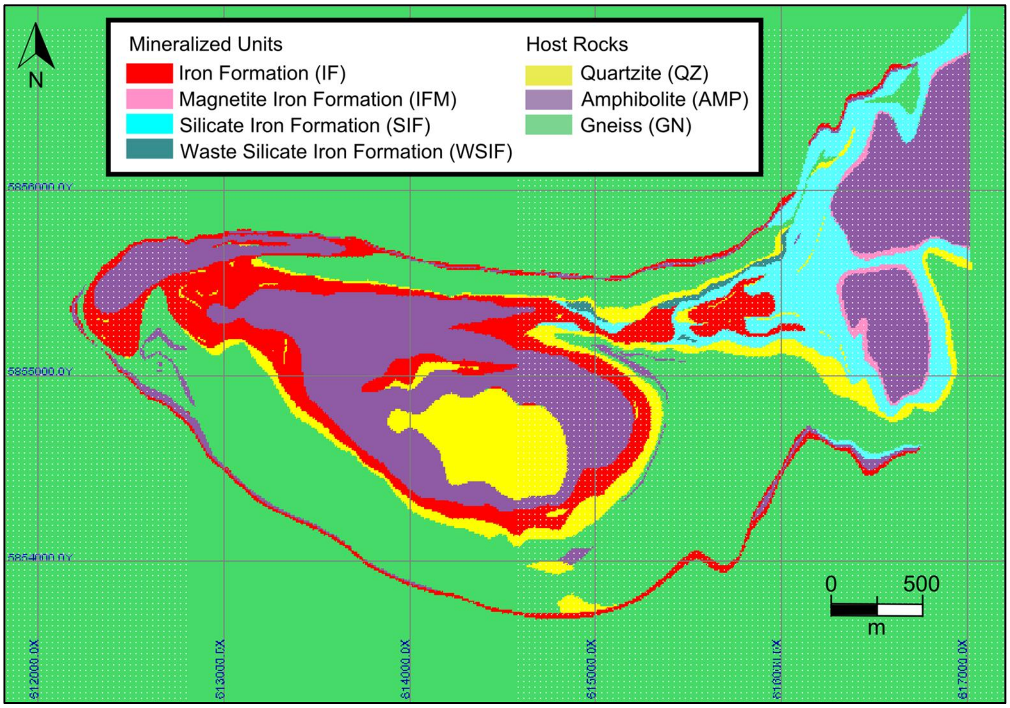


Figure 14–11: Plan View 620 m Showing the Rock Type Block Model

14.4.3 Density Model

The density model was first adjusted for each block depending on the lithology units. Density values presented in Table 14-25 were attributed uniformly for each corresponding unit before proceeding with the interpolation of specific gravity composites as described in Section 14.4.4.

Table 14-25: Background Density Values

Geology Unit	Lithology Code	Rock Code	Density (g/cm^3)
Overburden	OVB	10	1.80
Iron Formation	IF	20	3.37
Iron Formation Magnetite	IFM	21	3.37
Silicate Iron Formation	SIF	23	3.37
Waste Silicate Iron Formation	WSIF	24	3.30
Quartzite	QZ	30	2.77
Mica Schist	MS	33	2.80
Amphibolite	AMP	40	3.19
Gneiss	GN	50	2.81

14.4.4 Estimation Methodology

Grade estimates were carried out using Ordinary Kriging (OK) constrained inside the mineralized wireframes. Grade interpolations were produced using the 7.0 m composites. A single interpolation pass, using a large range search ellipsoid oriented as indicated in the variography study, was performed for each rock type to estimate different variables including Fe (%), Sat (%), CaO (%), MgO (%), MnO (%), Al_2O_3 (%),TiO_2 (%), P_2O_5 (%), Fe Rec (%),Si Conc (%), RQD and SG (g/cm^3).

Estimation and search parameters were evaluated through sensitivity analysis, QKNA (Quantitative Kriging Neighbourhood Analysis) and contact analysis. With a large search ellipse and one pass run strategy, the number of composites to be used during the interpolation becomes a key estimation parameter. Multiple sensitivity analysis and QKNA were run for all attributes to evaluate maximum number of composites using a minimum of three (3) composites within the search neighbourhood and a maximum of four (4) composites per hole. The maximum number of composites varies among attributes and lithologies; numbers are summarized in Table 14-26 below.

Table 14-26: Maximum Number of Composites Used for the Estimation of Each Element

Element	Lithology		
	IF	IFM, SIF, WSIF	QR, AMP, GN
Fe	30	25	NA
Mag Fe	15	20	NA
CaO	20	30	NA
MgO	20	30	NA
Al_2O_3	15	30	NA
MnO	20	15	NA
P_2O_5	15	15	NA
TiO_2	30	20	NA

Element	Lithology		
	IF	IFM, SIF, WSIF	QR, AMP, GN
Fe Rec	30	25	NA
Si Conc	15	15	NA
SG	30	25	NA
RQD	30	30	30

Differences in grades across the structural domains are usually small and gradational; they are based on the structural features of the folded lithologies. For most cases, soft boundaries were applied to adjacent structural domains with similar mean grades, but also between some lithology domains. Composites used for the interpolation of each domain are listed in Table 14-27. The choice of using soft boundaries between some lithologies in some domains is based on contact and sensitivity analysis.

Table 14-27: Relations between Structural and Lithology Boundaries as Defined for the Interpolation of Grades

Domain	Lithology	Block Rock Code	Composite Used for the Interpolation		
			Hard Boundary	Soft Structural Boundary	Soft Lithological Boundary
Domain 1	IF	1020	1020	3020 6020	NA
	IFM	1021	1021	3021	NA
	SIF	1023	1023	3023	1020
	WSIF	1024	1024	3024 7024	NA
Domain 2	IF	2020	2020	5020	NA
Domain 3	IF	3020	3020	1020 7020	3021 3023
	IFM	3021	3021	1021 7021	3020
	SIF	3023	3023	1023 7023	3020
	WSIF	3024	3024	1024 7024	NA
Domain 4	IF	4020	4020	NA	NA
Domain 5	IF	5020	5020	1020 2020 4020	NA
Domain 6	IF	6020	6020	1020	NA
Domain 7	IF	7020	7020	1020 9020	NA
	IFM	7021	7021	9021	7023
	SIF	7023	7023	9023	7021
	WSIF	7024	7024	9024	NA
Domain 8	IFM	8021	8021	NA	8023
	SIF	8023	8023	NA	8021
Domain 9	IFM	9021	9021	7021	9023
	SIF	9023	9023	7023	9021
	WSIF	9024		7024	

One search ellipsoid was used for each structural domain in the interpolation of all grade attributes. Table 14-28 details search parameters by structural domain. Ranges and orientations of the ellipses are representative of the anisotropy ratios and directions as determined from the variography analysis. For some attributes, restrictions on search ellipsoid ranges were applied to composites of high grade to limit their influence during interpolation. High grade transition limits, or high grade thresholds, ensure that those composites of higher grade are only selected within the ranges of a smaller search ellipsoid before being used for the estimation. High grade transition limits were chosen based on the statistical analysis of the 7.0 m composites and are summarized in Table 14-29. No restrictions were applied to iron grades as those are thought to be geologically representative of the mineralization. High grade limitations did not apply for other variables such as Iron Recovery (Fe Rec %), Rock Quality Designation (RQD) and Specific Gravity (SG).

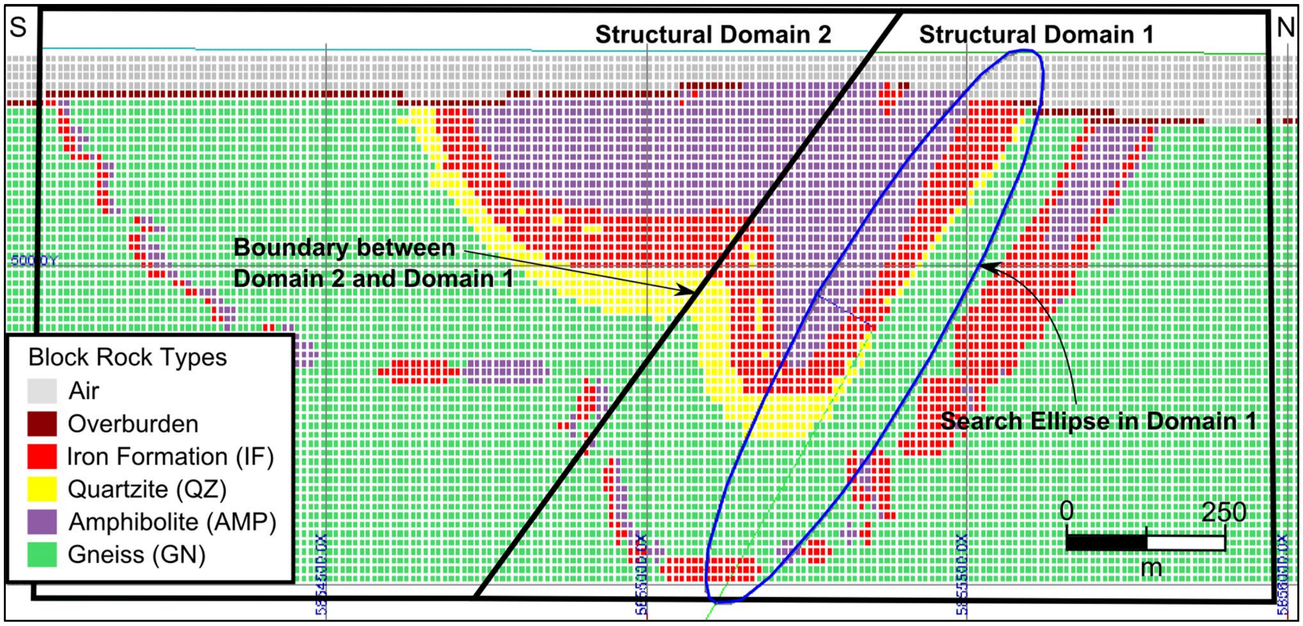


Figure 14–12: Cross Section 613550 Showing Rock Type Blocks and Search Ellipse in Structural Domain 1

Table 14-28: Anisotropy Search Ellipsoid Orientation and Ranges Presented by Structural Domain

Domain	Rotation (GEMS ZXZ in Degrees)			Ranges (m)		
	Z	X	Z	X	Y	X
1	175	-60	0	500	500	100
2	-35	-45	0	900	600	90
3	175	45	0	300	300	100
4	60	-40	0	900	600	100
5	40	-40	0	900	600	100
6	225	-60	0	300	300	90
7	60	60	0	400	400	100
8	110	40	0	300	300	100
9	175	0	0	300	300	150

Table 14-29: High Grade Transition Limits Imposed to Search Ellipsoids and Assigned by Rock Codes and Elements

Block Rock Code	High Grade Transition Limit for Interpolated Attributes											
	Fe	**Mag Fe**	**CaO**	**MgO**	**Al_2O_3**	**MnO**	**P_2O_5**	**TiO_2**	**Fe Rec**	**Si Conc**	**SG**	**RQD**
1020	NA	9.00	0.80	2.00	3.00	0.50	0.20	0.50	NA	NA	NA	NA
1021		NA	0.20	0.30	1.00	0.10	NA	0.05		16.50		
1023		30.00	10.00	10.00	1.00	0.40	0.10	0.10		20.00		
1024		32.00	17.50	15.00	1.50	1.00	0.20	0.20		35.00		
2020		8.00	2.00	1.00	3.00	0.10	0.15	0.30		15.00		
3020		20.00	2.00	3.00	1.00	0.10	0.10	0.05		15.00		
3021		30.00	1.00	2.00	1.00	0.10	0.10	0.20		35.00		
3023		20.00	8.00	7.00	2.50	0.50	0.15	0.50		40.00		
3024		20.00	15.00	10.00	1.00	0.45	0.40	0.04		15.00		
4020		20.00	2.00	3.00	8.00	0.50	0.30	0.90		15.00		
5020		2.50	0.40	0.30	1.50	0.03	0.08	0.15		15.00		
6020		2.00	0.50	1.00	1.50	0.30	0.10	0.20		15.00		
7020		15.00	3.00	5.00	1.00	0.20	0.08	0.07		15.00		
7021		38.00	10.00	7.00	2.00	0.60	0.15	0.15		35.00		
7023		30.00	10.00	10.00	3.00	0.60	0.25	0.40		25.00		
7024		27.00	NA	NA	3.00	NA	0.50	0.50		NE		
8021		40.00	4.00	6.00	0.80	0.30	0.10	0.10		35.00		
8023		40.00	7.50	6.00	2.00	0.30	0.10	0.30		20.00		
9021		40.00	5.00	4.00	0.50	0.60	0.10	0.06		35.00		
9023		40.00	9.00	8.00	0.40	0.80	0.20	0.06		40.00		
9024	NE											
Notes: NE - Rock code was not estimated; NA - No high grade transition limit applicable for this attribute												

14.5 Mineral Resource Classification

The CIM Definition Standards on Mineral Resources and Mineral Reserves, prepared by the CIM Standing Committee on Resource Definitions and adopted by the CIM council on May 10th, 2014, provide standards for the classification of Mineral Resources and Mineral Reserves estimates into various categories. The category to which a resource or reserve estimate is assigned depends on the level of confidence in the geological information available on the mineral deposit, the quality and quantity of data available, the level of detail of the technical and economic information which has been generated about the deposit, and the interpretation of that data and information. Under CIM definition standards:

- An *"Inferred Mineral Resource"* is that part of a mineral resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological or grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes.

- An "*Indicated Mineral Resource*" is that part of a mineral resource for which quantity, grade or quality, densities, shape, and physical characteristics can be estimated with a level of confidence sufficient to allow appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough for geological and grade continuity to be reasonably assumed.
- A "*Measured Mineral Resource*" is that part of a mineral resource for which quantity, grade or quality, densities, shape, and physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough to confirm both geological and grade continuity.

In addition, the classification of interpolated blocks was undertaken by considering the following criteria:

- Quality and reliability of drilling and sampling data
- Distance between sample points (drilling density)
- Confidence in the geological interpretation
- Continuity of the geological structures and the continuity of the grade within these structures
- Statistics of the data population
- Quality of assay data

In the block model, all the interpolated Fe% blocks were first categorized as inferred resources. Then, according to criteria based on data density and estimation efficiency, measured and indicated resources were identified leaving resources not meeting the criteria into the inferred category. The resources were ranked depending on slope of regression, number of holes and distance between composite and block as described in Table 14-30. A post processing interpretation of the resource classification was done on cross-section to homogenize the groups of resources by removing artificial features and isolated blocks or group of blocks. Figure 14–13 illustrates the resource categories attributed to the estimated blocks.

Table 14-30: High Level Guidelines Used to Classify Resources at Bloom Lake

Data Density and Kriging Efficiency Indicators	**Measured**	**Indicated**	**Inferred**
Slope of regression	0.8 - 1.0	0.5 - 1.0	All blocks where Fe % > 0 and where the measured and indicated resource category criteria are not met
Minimum number of holes	8	8	
Average distance between composites and block (m)	0 - 150	100 - 300	

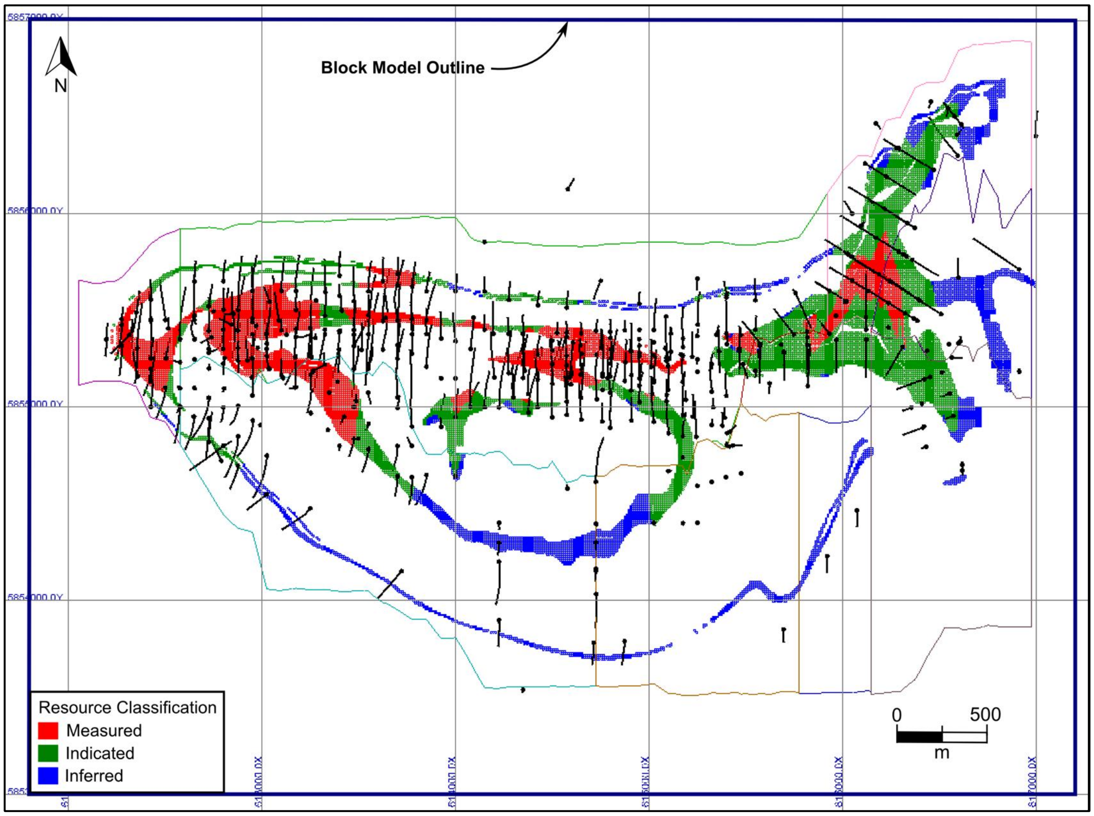


Figure 14–13: Plan View at Elevation 592 m Showing Blocks of Resource Classification

14.6 Block Model Estimation Validation

Every step of the block modelling process, including assay and composite database, topography, drill hole location, down-hole survey, geology interpretation, geological coding, block model development and resource estimation and classification, was revised to ensure fair representation of the available data in the Bloom Lake resource model.

More specific validations were completed on the Bloom Lake block model including visual checks, graphical validation (swath plots), statistical analysis of the model, comparison to other estimation techniques and reconciliation with production data.

14.6.1 Visual Validation

The visual checks consisted of visualization of slices of the block model, mineralized zones and drill hole database. The slicing was performed vertically on 75 m intervals and horizontally on 14 m intervals. The data source was visually compared with the different model attributes (rock type and domains, density, grades) along the strike length of the deposit.

The rock-type attribute adequately replicates the plan view geology solids for most of the deposit; however, on multiple cross-sections at deeper elevations, some units seem discontinuous while they should appear as continuous bed units. Figure 14–14 shows blocks of amphibolite and iron formation units coded alternately instead of continuously, as two juxtaposed layers. This issue is due to the lower precision (interpretations on every 28 m levels) in the geology model at lower elevations. It is not problematic for this resource estimation as it does not affect the constrained resources which are located in the upper portion of the block model. However, G Mining recommends adjusting the modelling to every 14 m elevation or using cross-section interpretations for the bottom portion of the block model to delineate more continuous lithology beds.

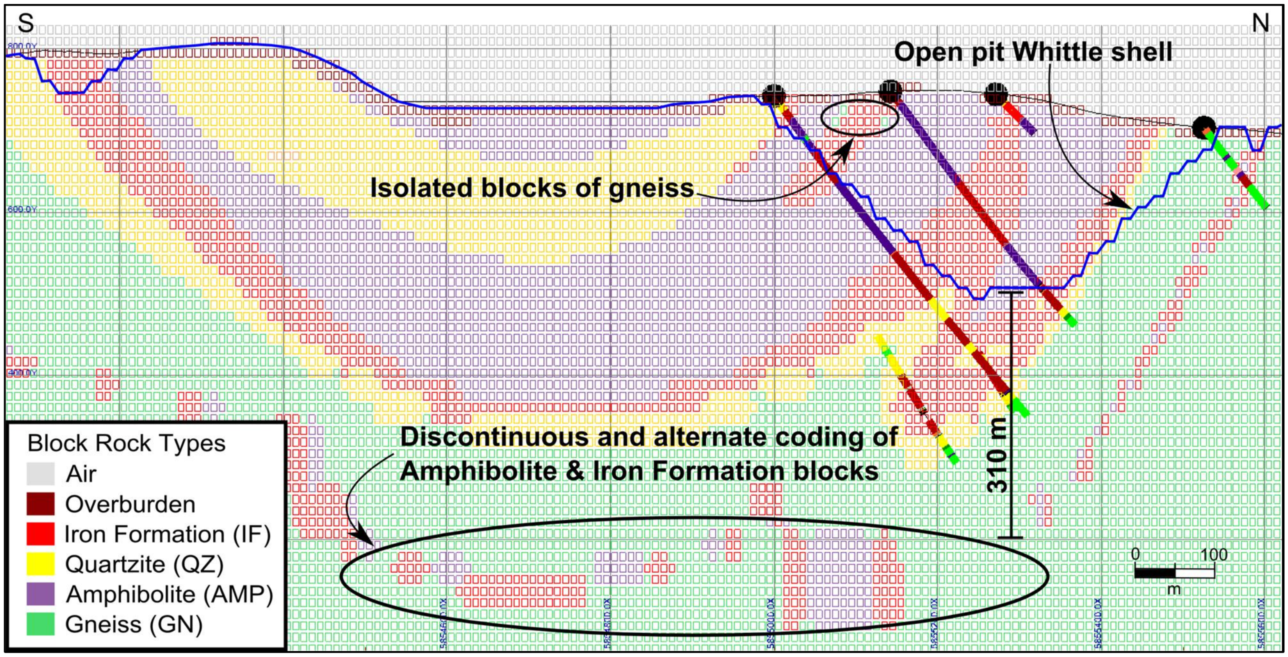


Figure 14–14: Cross-Section 614425 Illustrating Minor Issues in Codification of Rock Type Model

Additionally, blocks were initially coded with the background value, the gneiss unit, and then coded again from the set of geology wireframes. This caused some rock type blocks to be identified as background units (refer to Figure 14–14), even though the geology model or surrounding drill holes do not show any gneiss rock in the area.

Globally, the geology and structural domains are adequately represented in their proper attribute model.

The ordinary kriging-based iron resource estimate was found to be a good representation of the drill hole composites.

14.6.2 Swath Plots

Swath plots were generated to assess the correlation between the grades of the composites used in the interpolation of each block versus the iron grade estimated. Swath plots were produced by vertical slices of 75 m and 14 m increments in elevation. This validation method works as a visual mean to compare estimated grades against data source, but also to identify possible bias in the interpolation.

Figure 14–15 illustrates a series of swath plots grouping Measured and Indicated Mineral Resources located inside the open pit shell (details in Section 14.7.1) by cross-section and by bench. Generally, the grades estimated in the blocks are close to the average grades provided by the data source; no bias was found in the resource estimate in this regard.

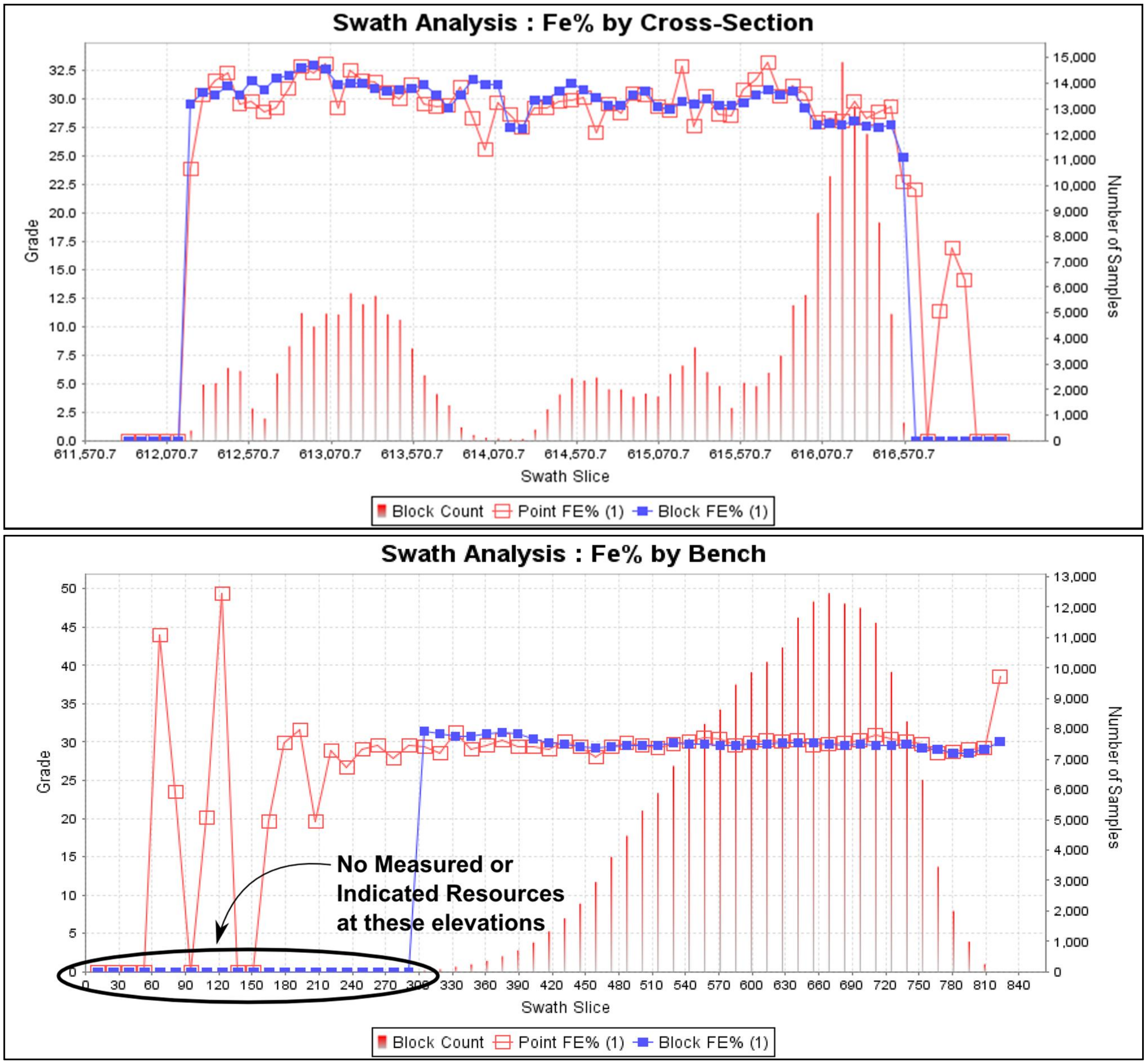


Figure 14–15: Cross Section and Bench Swath Plot for Fe%

14.6.3 Statistics for Assays, Composites and Blocks

Descriptive statistics of iron grades were tabulated in Table 14-31 for the assays, composites and blocks for each mineralized lithology. The average iron grade found in the interpolated blocks is lower than the average grade available from the composites. The assay, composite and block statistics compare well for all the lithologies. This is a good indication that the initial grades were preserved throughout the estimation process.

Table 14-31: Assays, Composites and Blocks Statistics for Fe % by Lithology

	Lithology	Number	Minimum	Maximum	Mean	Median	Standard Deviation	Coefficient of Variation
			(Fe %)	(Fe %)	(Fe %)	(Fe %)	(Fe %)	
Assays	IF	6,788	1.11	68.74	30.21	31.04	7.61	0.25
	IFM	344	1.65	52.40	29.81	32.30	8.70	0.29
	SIF	2,009	2.80	53.80	27.51	28.20	7.11	0.26
Composites	IF	4,594	2.37	66.61	30.40	31.04	6.54	0.22
	IFM	257	5.67	44.93	29.78	31.62	7.07	0.24
	SIF	1,221	2.80	45.37	27.96	28.73	5.86	0.21
Blocks	IF	334,821	8.71	53.44	28.87	29.31	3.72	0.13
	IFM	20,603	7.23	40.35	26.76	27.42	5.71	0.21
	SIF	155,047	5.62	39.23	25.61	26.77	5.38	0.21

14.6.4 Comparison to other Estimation Techniques

The Ordinary Kriging (OK) based iron resource model was compared to an Inverse Distance Cubed (ID^3) estimate. The interpolation results produced from both estimation methodologies are presented side by side in Table 14-32 and are tabulated by resource class and rock type. Note that the resources presented herein are constrained within the conceptual open pit shell as detailed in Section 14.7.1.

The average iron grades generated by Inverse Distance weighting are very close to those reported from the selected estimation method, the Ordinary Kriging. This information provides a general indication that the resource model is reasonable.

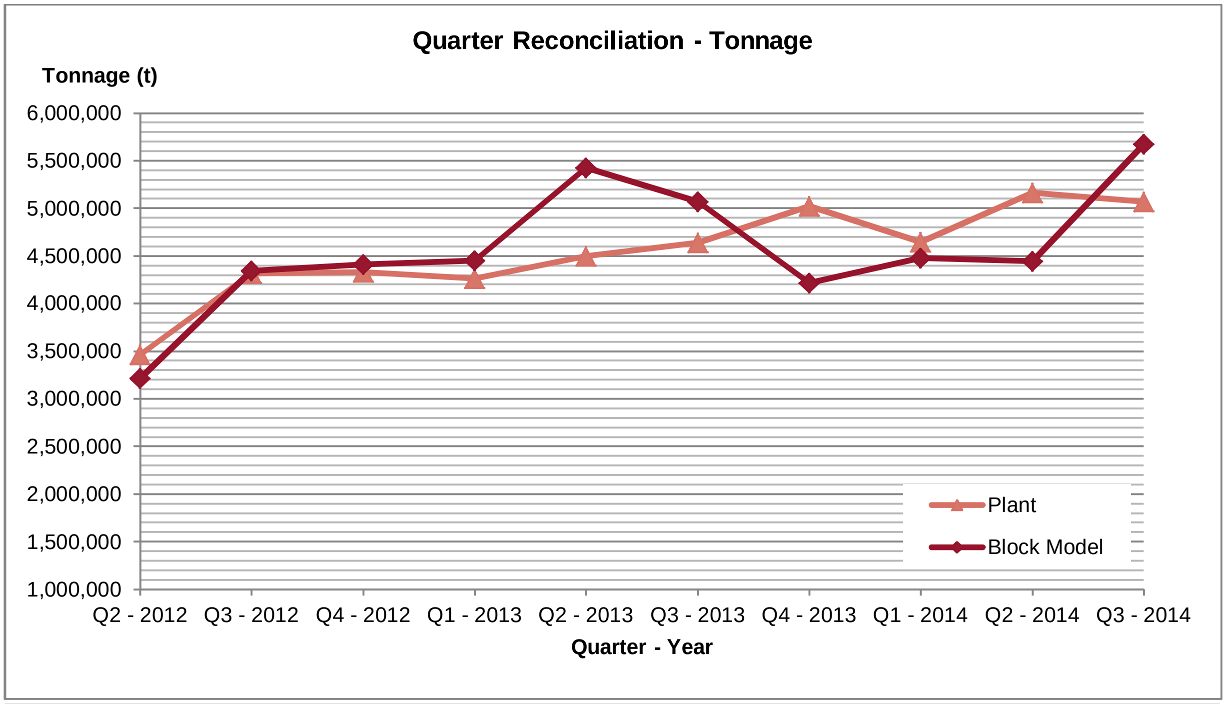
Table 14-32: Comparison between Ordinary Kriging (OK) and Inverse Distance Cubed (ID^3) Based Iron Resource Estimates

Class	**Rock Type**	**OK**		**ID^3**		**Difference**
		Tonnage	Fe	Tonnage	Fe	Fe
		kt	%	kt	%	%
Measured + Indicated	IF	518,633	31.0	518,633	31.1	-
	IFM	39,960	30.4	39,960	30.7	1%
	SIF	353,031	27.7	353,031	28.1	1%
Inferred	IF	34,052	25.3	34,052	25.3	-
	IFM	9,565	23.5	9,565	23.8	2%
	SIF	36,737	26.4	36,737	27.1	3%

14.6.5 Block Model Reconciliation

Iron ore material was sent to the feeder during production years at the mine, between 2010 and 2014. The performance of the block model for the Bloom Lake project to predict resource estimates was evaluated through reconciliation comparisons using quarter end pit surfaces, between 2012 and 2014. The reconciliation results are illustrated in Figure 14–16 where mined tonnes and Fe %

grade are reviewed on a quarterly basis. Based on this review, the block model generally produced acceptable predictions of the actual production numbers despite some variations.



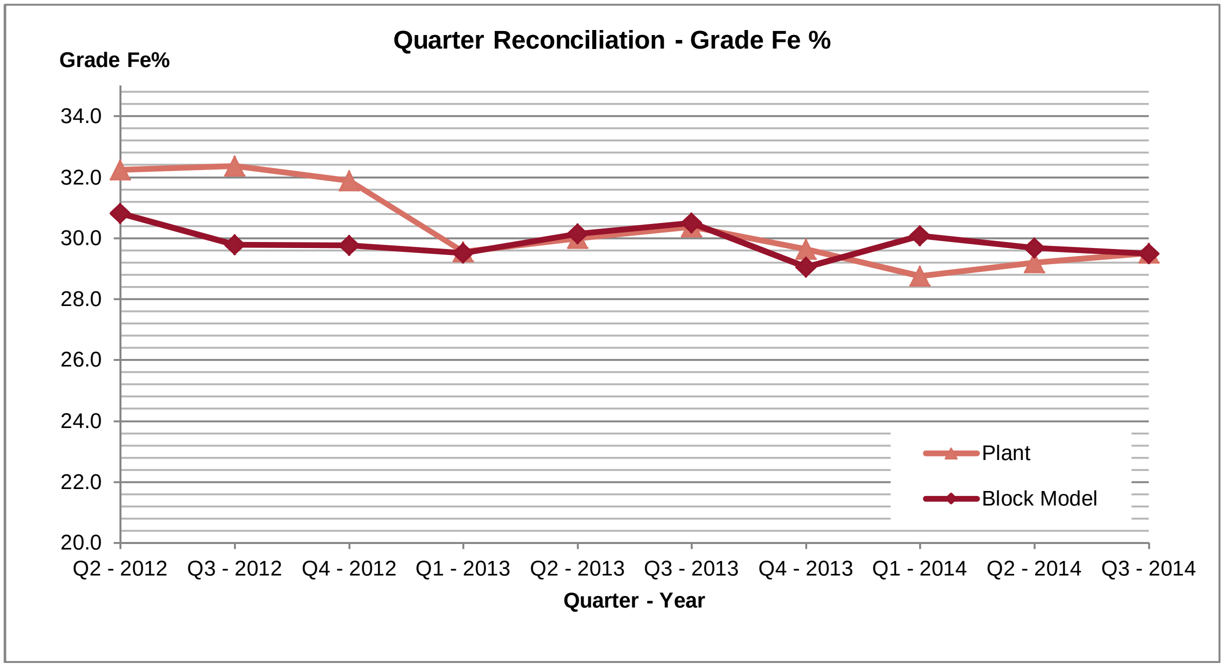


Figure 14–16: Quarterly Reconciliations Comparing Mined Tonnes and Fe % Grade between Production Data and Resource Model

14.7 Constrained Mineral Resources

14.7.1 Optimization Parameters

Before exporting the block model to the Whittle pit optimization software, each block was given a material code, following different quality constraints based on iron and oxides content as presented in Table 14-33. The standard requirements regarding the quality of the material sent to the mill, which support the determination of these limits, are discussed in Mineral Processing and Metallurgical Testing.

Table 14-33: Contaminant Restriction Limits by Lithology Domain

Material Type	Lithology Domain		Material Code	% Fe	% CaO	% MgO	% Sat
	Resource Model	Grade Control Model					
Ore	IF	HEM	1	> 15.0	0.0 - 2.5	0.0 - 3.0	0.0 - 12.0
	IFM	MAG	2	> 15.0	0.0 -2.5	0.0 - 3.0	12.0 - 100.0
	SIF	MAG_ACT_TREM	6	> 15.0	2.5 -8.0	3.0 - 8.0	12.0 - 100.0
		MAG_ACT_TREM_1	7	> 15.0	2.5 -8.0	0.0 - 8.0	12.0 - 100.0
		MAG_ACT_TREM_2	8	> 15.0	0.0 -8.0	3.0 - 8.0	12.0 - 100.0
		HEM_ACT_TREM	9	> 15.0	2.5 - 8.0	3.0 - 8.0	0.0 - 12.0
		HEM_ACT_TREM_1	10	> 15.0	2.5 - 8.0	0.0 - 8.0	0.0 - 12.0
		HEM_ACT_TREM_2	11	> 15.0	0.0 - 8.0	3.0 - 8.0	0.0 - 12.0
Waste	WSIF	GRUN	3	0.0 - 100.0	8.0 - 100.0	8.0 - 100.0	0.0 - 100.0
		GRUN_1	4	0.0 - 100.0	0.0 - 100.0	8.0 - 100.0	0.0 - 100.0
		GRUN_2	5	0.0 - 100.0	8.0 - 100.0	0.0 - 100.0	0.0 - 100.0

A Lerchs-Grossman open-pit shell was produced using Whittle and the optimization parameters tabulated in Table 14-34. Blocks from all Mineral Resource categories were included in the optimization process.

Table 14-34: Bloom Lake Optimization Parameters

Optimization Parameters		**Resource Case**
Ore tonnage	Mt/an	20.00
In-situ grade	% Fe	29.3%
Mining dilution	%	3%
Mining recovery	%	100%
Royalty	%	0%
Plant feed grade	% Fe	28.4%
Weight recovery	%	34.5%
Fe recovery	%	80.0%
Revenues		
Concentration ratio	t con./t ore	0.345
Fe metal mined	t metal/t ore	0.228
Concentrate production	Mt con.	6.90

Optimization Parameters		**Resource Case**
Concentrate Fe grade	% Fe	66.0%
Concentrate moisture content	%	3.5%
Reference price (Platt's 62%)	US$/dmt con.	60.00
Fe concentrate price adj.	US$/dmt con.	4.00
Concentrate adjusted price CIF China (66%)	US$/dmt con.	64.00
Exchange rate	C$/US$	1.30
Concentrate adjusted price CIF China (66%)	C$/dmt con.	83.20
Land Logistics (Mine to Sept-Iles Port)	C$/dmt con.	16.58
Port & shiploading	C$/dmt con.	0.00
Ocean freight (Sept-Iles to China)	C$/dmt con.	16.72
Marketing	C$/dmt con.	0.00
Concentrate logistics costs	C$/dmt con.	33.30
Concentrate adjusted price FOB Bloom Lake	C$/dmt con.	49.90
Ore value	C$/dmt ore	17.22
Ore Based Costs		
Processing cost	C$/dmt ore	3.41
Crushing cost	C$/dmt ore	0.56
Tailings and water mgmt cost	C$/dmt ore	1.03
Sustaining capital costs	C$/dmt ore	0.00
G&A costs	C$/dmt ore	2.15
Total ore based cost	C$/dmt ore	7.15
Operating margin	C$/dmt ore	10.07
Operating margin (before mining)	%	58%
Annual G&A cost	M$/an	43.00
Mining Costs & Parameters		
Diesel price (colored)	C$/litre	1.00
Reference mining cost	C$/dmt mined	2.85
Incremental bench cost	US$/t/14m	0.029
Reference elevation	RL	704

14.7.2 Open-Pit Constrained Mineral Resource

The Measured and Indicated Mineral Resource for the Bloom Lake project is estimated to 911.6 Mt at an average grade of 27.7% Fe, and Inferred Mineral Resource to 80.4 Mt at an average grade of 25.6% Fe. Table 14-35 presents the resource estimation tabulation by category.

The Mineral Resources are reported within the conceptual open pit shell at a cut-off grade of 15% Fe (Figure 14–17). The contaminant limits as defined in Table 14-33 also apply to the Mineral Resource reported.

Table 14-35: Mineral Resources Estimate for the Bloom Lake Project

Classification	Tonnage (dry)	Fe	CaO	Sat	MgO	Al_2O_3	Concentrate Tonnage
	kt	%	%	%	%	%	kt
Measured	439,700	31.0	0.6	3.0	0.7	0.3	165,200
Indicated	471,900	28.5	2.5	6.8	2.3	0.4	163,200
Total M&I	911,600	29.7	1.6	5.0	1.5	0.4	328,400
Inferred	80,400	25.6	1.9	7.9	1.7	0.3	24,900

Notes:

1. The Mineral Resources were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Standards for Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council May 10th, 2014.
2. The independent and qualified person for the 2016 Bloom Lake, as defined by NI 43-101, is Réjean Sirois, P.Eng., from G Mining. The effective date of the estimate is November 15, 2016.
3. The Mineral Resources are estimated at a cut-off grade of 15% Fe.
4. The Mineral Resources are estimated using a long-term iron price of USD $60/dmt con and an exchange rate of 1.30 CAD/USD.
5. The concentrate tonnage is normalised to 66% Fe and 80% metal recovery.
6. The Mineral Resources are reported within an optimized Whittle open pit shell
7. The average strip ratio is 0.97:1 (w:o).
8. “Sat” stands for Satmagan or Saturation Magnetization Analyser, an instrument which measures magnetite in ore ores.
9. Mineral Resources which are not Mineral Reserves do not have demonstrated economic viability. There is no certainty that all or any part of the Mineral Resource will be converted into Mineral Reserves.
10. The number of metric tons was rounded to the nearest hundred. Any discrepancies in the totals are due to rounding effects; rounding followed the recommendations in NI 43-101.

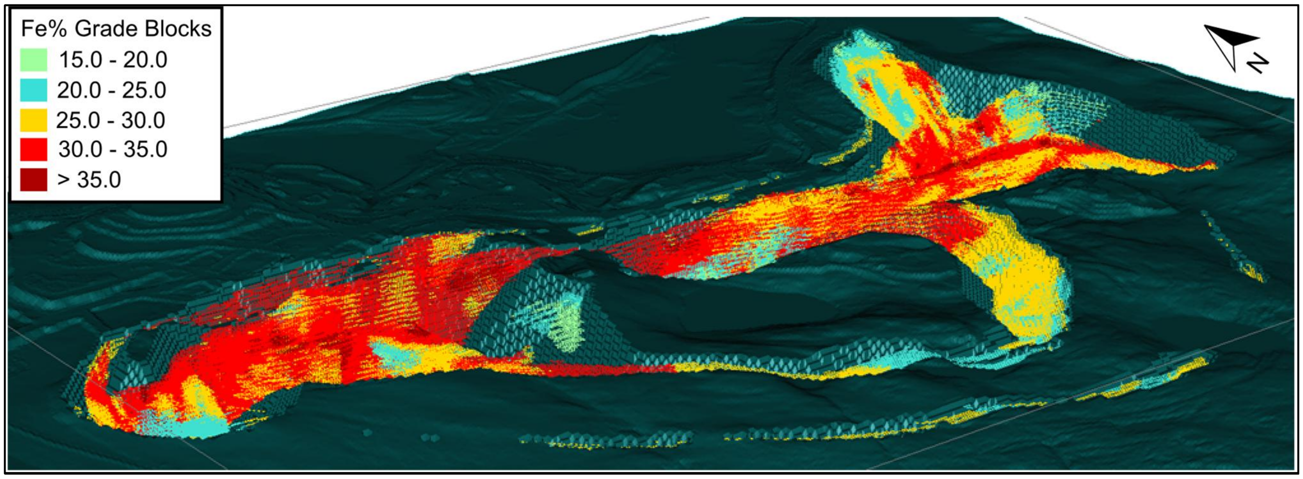


Figure 14–17: 3D View Showing Fe % Grade Blocks Located Inside the Open Pit Whittle Shell

14.7.3 Grade Sensitivity Analysis

The sensitivity of the block model estimates to the iron cut-off grade selection is illustrated in Table 14-37 for Measured and Indicated resources, and in Figure 14–18 for Inferred resources. Only resources located within the USD $60/dmt optimized shell were used for this analysis. Tonnage quantities and iron grades are presented in Table 14-36 and Table 14-37 for cut-off grades ranging from 10% to 40%. It is noteworthy that iron ore grading over 30% Fe represents 50% of the Bloom Lake Measured and Indicated Resource.

As the cut-off grade increases, the Bloom Lake Measured and Indicated resources above cut-off decrease and the average grade increases until 30% Fe cut-off grade is reached. From that point, the resource tonnages above cut-off grade decrease rapidly and the average iron grade rises steadily. Similar observations are noted for the Bloom Lake Inferred resources where the sensitivity seems higher when 25% Fe cut-off is reached.

Table 14-36: Grade and Tonnage Sensitivity to Cut-Off Grade (Measured and Indicated Resources)

Cut-Off Grade Fe	**Tonnage (dry)**	**Fe**	**CaO**	**Sat**	**MgO**	**Al_2O_3**
%	Mt	**%**	**%**	**%**	**%**	**%**
10%	984	29.7	1.7	5.4	1.6	0.3
15%	**912**	29.7	1.6	4.9	1.5	0.3
20%	906	29.8	1.6	4.9	1.5	0.3
25%	820	30.5	1.4	4.7	1.4	0.3
30%	462	32.4	0.7	3.8	0.8	0.3
35%	40	36.5	0.2	3.0	0.3	0.4
40%	2	41.9	0.1	1.1	0.1	0.5

Table 14-37: Grade and Tonnage Sensitivity to Cut-Off Grade (Inferred Resources)

Cut-Off Grade Fe	Tonnage (dry)	Fe	CaO	Sat	MgO	Al2O3
%	Mt	%	%	%	%	%
10%	91	25.2	1.9	8.5	1.7	0.3
15%	80	25.6	1.9	7.9	1.7	0.3
20%	78	25.8	2.0	7.7	1.7	0.3
25%	51	27.0	1.9	8.0	1.7	0.3
30%	3	31.3	2.8	12.6	2.6	0.2
35%	0	35.5	2.3	33.8	1.7	0.2

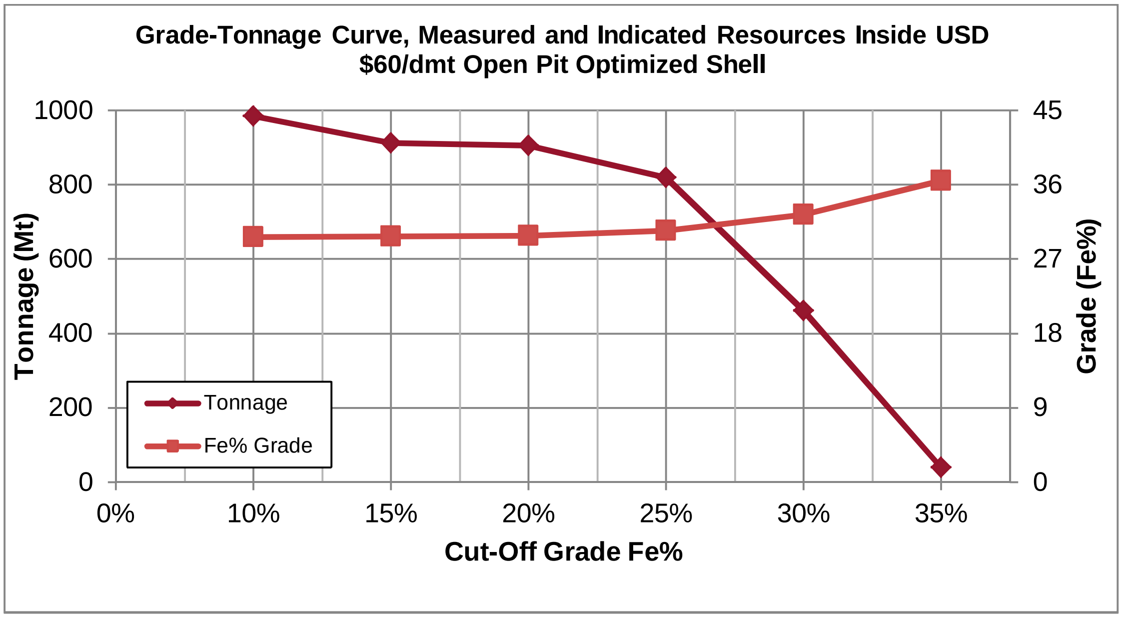


Figure 14–18: Grade-Tonnage Curve, Measured and Indicated Resources inside USD $60/dmt Open Pit Optimized Shell

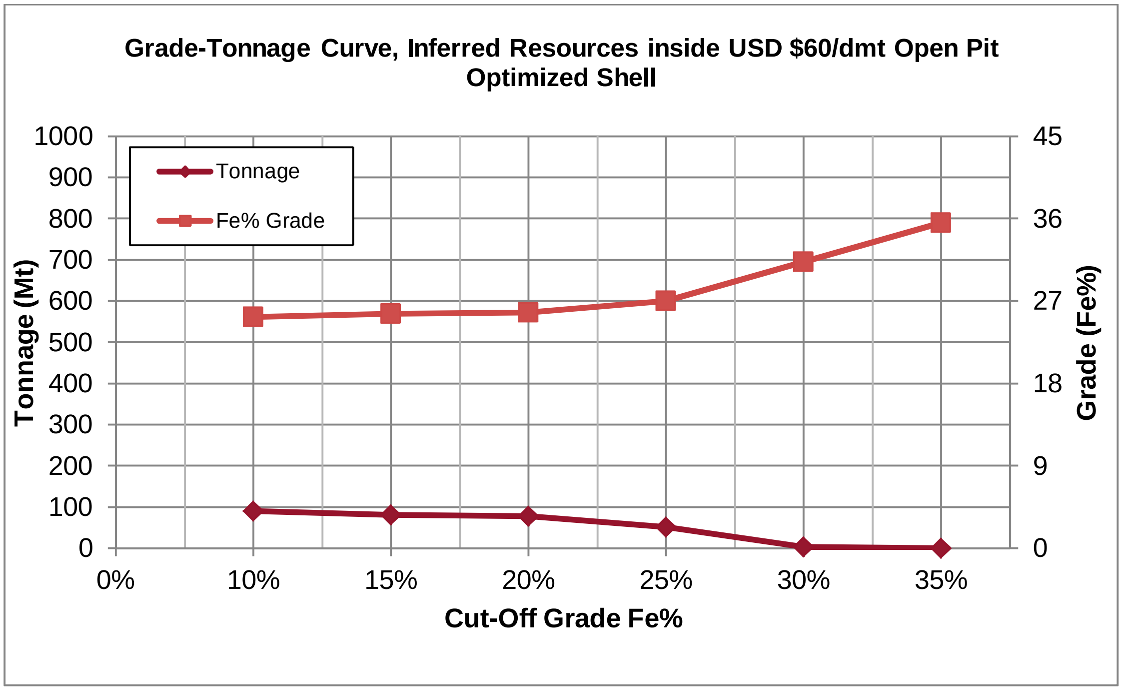


Figure 14–19: Grade-Tonnage Curve, Inferred Resources inside USD $60/dmt Open Pit Optimized Shell

15 Mineral Reserves Estimate

15.1 Summary

The Mineral Reserve for the Bloom Lake project is estimated at 411.7 Mt at an average grade of 30.0% Fe as summarized in Table 15.1. The Mineral Reserve estimate was prepared by G Mining Services Inc. (“GMS”). The resource block model was also generated by GMS.

The mine design and Mineral Reserve estimate have been completed to a level appropriate for feasibility studies. The Mineral Reserve estimate stated herein is consistent with the CIM definitions and is suitable for public reporting. As such, the Mineral Reserves are based on Measured and Indicated (“M&I”) Mineral Resources, and do not include any Inferred Mineral Resources. The Inferred Resources contained within the mine design are classified as waste.

Table 15.1: Mineral Reserve Estimate

Classification	**Diluted Ore Tonnage (dry)**	**Fe**	**CaO**	**SAT**	**MgO**	**Al_2O_3**
	kt	**%**	**%**	**%**	**%**	**%**
Proven	264,160	30.73	0.48	2.98	0.56	0.32
Probable	147,554	28.71	2.84	6.68	2.72	0.40
Total P&P	**411,713**	**30.01**	**1.33**	**4.30**	**1.33**	**0.35**

Notes on Mineral Reserves:

1. CIM definitions were followed for Mineral Reserves.
2. Mineral Reserves based on September 28, 2016 LIDAR survey.
3. Mineral Reserves are estimated at a cut-off grade of 15% Fe.
4. Mineral Reserves are estimated using a long-term iron price reference price (Platt’s 62%) of $50/dmt and an exchange rate of 1.30 CAD/USD. An Fe concentrate price adjustment of $4.00/dmt was added.
5. Bulk density of ore is variable but averages 3.63 t/m^3.
6. The average strip ratio is 0.48:1.
7. The mining dilution factor is 4.3%.
8. Numbers may not add due to rounding.

15.2 Resource Block Model

The block model was prepared by G Mining in November 2016 and was named “BM RE14_10m_V3”. The block model framework information is presented in Table 15.2. In addition to the modeled iron grade other interpolated attributes include calcium oxide (CaO), Satmagan (SAT), Magnesium Oxide (MgO) and aluminum oxide (Al_2O_3) which are tracked in the schedule.

Table 15.2: Block Model Framework

Model Setting	Value
X Origin	611,800
Y Origin	5,853,000
Z Origin	830
Block Size in X Direction	10
Block Size in Y Direction	10
Block Size in Z Direction	14
Number of Blocks in X Direction	540
Number of Blocks in Y Direction	400
Number of Blocks in Z Direction	59

15.3 Pit Optimization

Open pit optimization was conducted to determine the optimal economic shape of the open pit to guide the pit design process. This task was undertaken using the Whittle software which is based on the Lerchs-Grossmann algorithm. The method works on a block model of the ore body, and progressively constructs lists of related blocks that should, or should not, be mined. The method uses the values of the blocks to define a pit outline that has the highest possible total economic value, subject to the required pit slopes defined as structure arcs in the software. This section describes all the parameters used to calculate block values in Whittle.

For this Feasibility Study, Measured and Indicated resource blocks were considered for optimization purposes. However, sensitivities were run using the complete resource by including the Inferred resource blocks.

15.3.1 Pit Slope Geotechnical Assessment

Golder Associates Ltd. (“Golder”) was mandated in 2014 to produce a feasibility level pit slope design study by the previous owner to support the mine designs. The conclusions of this study have been used as an input to the pit optimization and design process. The Golder scope included geotechnical and hydrogeological field investigations and providing slope designs for the open pit.

A total of nine domains were defined according to changes in the rock mass fabric, with separations roughly along the axes of the overall folding structures, by changes in pit wall orientation, and by available structural data sources.

“Groundwater levels generally follow the topography and are found within 25 m from the ground surface. It has been assessed that the open pit will be developed in a good rock mass where rock mass failure is not a concern. Rather, potential instability will involve structural controls, the most significant being the foliation control on bench face angle and the potential control of flat sets on bench crest backbreak angles. No major faults have been identified that will adversely daylight on the final pit walls.

In overburden, a minimum design slope of 2H:1V with 8 m bench width at each 15 m height is recommended. The pit slope recommendations for double bench configuration are presented in the next figure. The bench face angle varies from 70 degrees to 75 degrees and the berm width varies from 13.3 m to 15 m. This bench geometry results in an inter-ramp angle between 48 and 52 degrees.

Table 15.3: Pit Slope Design Sectors

Geotechnical Pit Design Profiles	1	2	3
Design Sector	I, II, VI, X	III, IV, V, VII, IX	XI
Bench face angle (^{0})	75	70	70
Avg. catch berm width (m)	14.0	13.3	15.0
Inter-ramp (^{0})	52.5	50.0	48.0
Ramp width (m)	35	35	35
Geotechnical Bench width (m)	20	20	20
Overall slope angle (^{0})	45.7	43.7	42.1

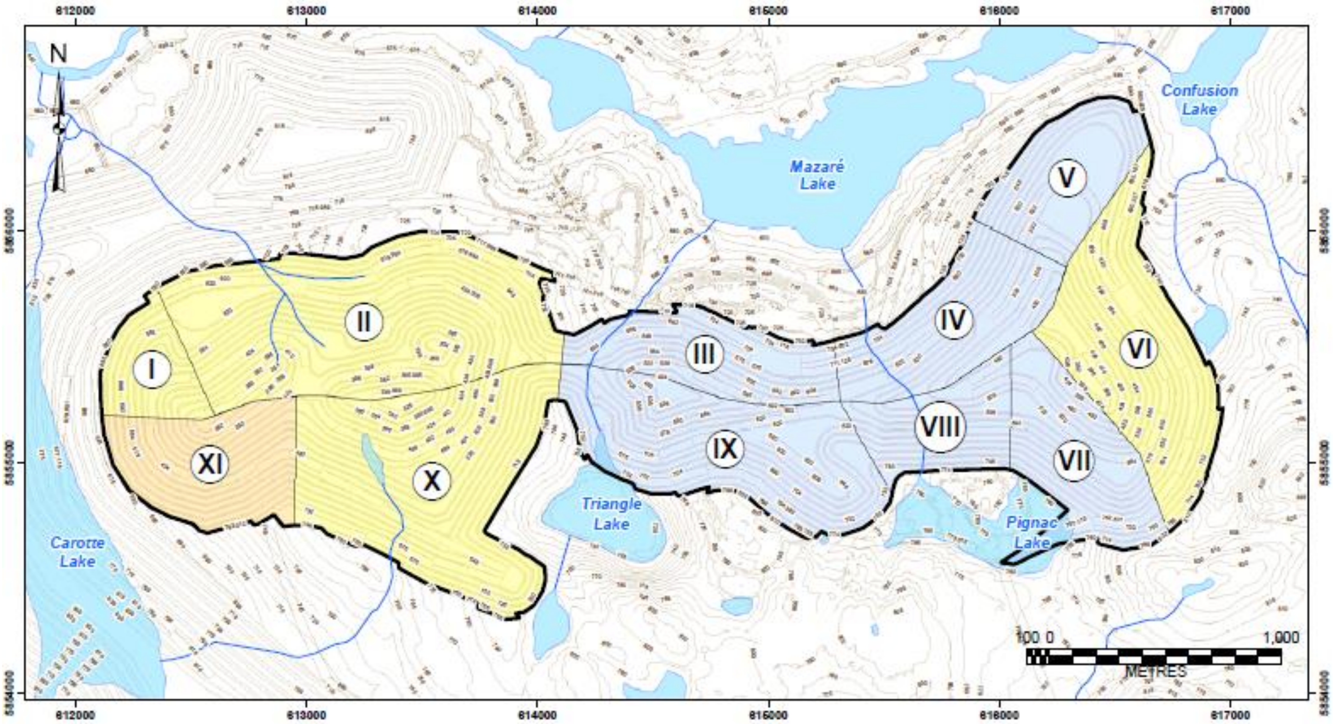


Figure 15.1: Bloom Lake Final Wall Geotechnical Recommendations

15.3.2 Mining Dilution and Ore Loss

A mining dilution assessment was made by evaluating the number of contacts for blocks above an economic cut-off grade (“COG”). The block contacts are then used to estimate a dilution skin around ore blocks to estimate an expected dilution during mining. The dilution skin consists of 1.5 m of material in a north-south direction (across strike) and 1.5 m in an east-west direction (along strike). The dilution is therefore specific to the geometry of the ore body and the number of contacts between ore and waste.

For each mineralized block in the resource model a diluted grade and density are calculated by taking into account the grade and density of the surrounding blocks.

Ore blocks surrounded by eight (8) waste blocks were treated as ore loss and were excluded from the reserve. Furthermore, waste blocks surrounded by eight (8) ore blocks were treated as internal dilution and were included in the reserve.

For pit optimization in Whittle an average mine dilution of 3% was applied at zero grade. This dilution estimate included in the mineral reserves was estimated slightly higher at 4.3% based on an evaluation at a COG of 15% iron.

15.3.3 Pit Optimization Parameters

A summary of the pit optimization parameters is presented in Table 15.4 for a milling rate of 20 Mtpy based on a reference iron ore price (Platt’s 62% CFR China) of US$50/dmt concentrate and an exchange rate of 1.30 C$/US$. A price adjustment of 1$/dmt per 1% iron was applied (i.e. US$4/dmt for a 66% iron concentrate). The iron ore price assumption is deemed conservative with respect to long-term forecasts. The metallurgical recovery is estimated at 80% or 34.5% in weight recovery. The metallurgical recovery established from metallurgical testing and ultimately used in the mill production schedule is higher at 83.3%.

The total logistics cost is estimated at C$33.30/dmt and is deducted to estimate an FOB Bloom Lake concentrate price of C$36.90/dmt.

Unit reference mining costs are used for a “reference mining block” located near the pit crest or surface and are incremented with depth which corresponds to the additional cycle time and resulting incremental hauling cost. The reference mining cost was estimated at C$2.85/t with an incremental depth factor of C$0.03/t per 14 m bench.

The overall slope angles utilized in Whittle are based on the inter-ramp angles recommended from Golder Associate’s pit slope study with provisions for ramps and geotechnical berms. The overall slope angles are summarized in Table 15.3.

Table 15.4: Optimization Parameters

Optimization Parameters		**Values**
Ore tonnage	Mt/y	20.00
Mining dilution	%	4.3%
Mining recovery	%	100%
Royalty	%	0%
Weight recovery	%	34.5%
Fe recovery	%	80.0%
Revenues		
Concentrate production	Mt con.	6.90
Concentrate iron grade	% Fe	66.0%
Concentrate moisture content	%	3.5%
Reference price (Platt's 62%)	US$/dmt con.	50.00
Fe concentrate price adj.	US$/dmt con.	4.00
Concentrate adjusted price CIF China (66%)	US$/dmt con.	54.00
Exchange rate	C$/US$	1.30
Concentrate adjusted price CIF China (66%)	C$/dmt con.	70.20
Land Logistics (Mine to Sept-Iles Port)	C$/dmt con.	16.58
Ocean freight (Sept-Iles to China)	C$/dmt con.	16.72
Total concentrate logistics costs	C$/dmt con.	33.30
Concentrate adjusted price FOB Bloom Lake	C$/dmt con.	36.90
Ore Based Costs		
Processing cost	C$/dmt ore	3.41
Crushing cost	C$/dmt ore	0.56
Tailings and water mgmt. cost	C$/dmt ore	1.03
G&A costs	C$/dmt ore	2.15
Total ore based cost	C$/dmt ore	7.15
Mining Costs & Parameters		
Reference mining cost	C$/dmt mined	2.85
Incremental bench cost	US$/t/14m	0.029
Reference elevation	RL	704

15.3.4 Open Pit Optimization Results

The Whittle nested shell results are presented in Table 15.5 using only the Measured and Indicated (“M&I”) resource and in Table 15.6 with complete resource including the Inferred (“MII”). The MII optimization results are generated for resource reporting purposes. The nested shells are generated by using revenue factors to scale up and down from the base case selling price.

Table 15.5: M&I Whittle Shell Results

Pit Shell	Rev. Factor	Iron Price	Total (kt)	Ore (kt)	Fe %	Strip Ratio	Concentrate* (kt)
1	0.76	38	27	28	41.1	0.0	14
2	0.78	39	134	138	39.6	0.0	66
3	0.80	40	704	723	37.5	0.0	329
4	0.81	41	2,544	2,606	35.8	0.0	1,131
5	0.83	42	9,312	9,306	34.2	0.0	3,853
6	0.85	43	36,421	35,560	32.7	0.0	14,088
7	0.87	44	68,567	65,465	32.0	0.0	25,381
8	0.89	44	108,272	99,656	31.5	0.1	37,997
9	0.91	45	156,402	137,839	31.0	0.1	51,851
10	0.93	46	239,589	196,013	30.9	0.2	73,341
11	0.94	47	396,462	299,284	30.5	0.3	110,606
12	0.96	48	508,158	372,417	30.2	0.4	136,132
13	**0.98**	**49**	**572,116**	**410,756**	**30.0**	**0.4**	**149,417**
14	1.00	50	755,831	518,690	29.6	0.5	185,906
15	1.02	51	849,719	569,594	29.4	0.5	203,148
16	1.04	52	923,570	605,566	29.4	0.5	215,516
17	1.06	53	1,000,152	641,356	29.3	0.6	227,670
18	1.07	54	1,078,010	674,938	29.2	0.6	239,116
19	1.09	55	1,160,156	708,451	29.2	0.6	250,435
20	1.11	56	1,263,343	748,109	29.1	0.7	264,074
21	1.13	56	1,328,837	771,257	29.1	0.7	272,089
22	1.15	57	1,503,426	832,585	29.0	0.8	292,953
23	1.17	58	1,651,710	880,067	29.0	0.9	309,500
24	1.19	59	1,737,031	907,996	29.0	0.9	318,829
25	1.20	60	2,344,745	1,094,683	28.8	1.1	382,748
26	1.22	61	2,458,239	1,129,270	28.8	1.2	394,340
27	1.24	62	2,518,888	1,147,707	28.8	1.2	400,409
28	1.26	63	2,572,522	1,162,063	28.8	1.2	405,340
29	1.28	64	2,675,825	1,189,368	28.8	1.2	414,651
30	1.30	65	2,718,377	1,200,299	28.8	1.3	418,413
31	1.31	66	2,758,820	1,210,312	28.8	1.3	421,842
32	1.33	67	2,824,755	1,225,747	28.8	1.3	427,172
33	1.35	68	2,858,094	1,233,834	28.7	1.3	429,845
34	1.37	69	2,896,311	1,242,273	28.7	1.3	432,740
35	1.39	69	2,923,209	1,248,209	28.7	1.3	434,734
36	1.41	70	2,957,967	1,255,676	28.7	1.4	437,234
37	1.43	71	2,999,238	1,264,438	28.7	1.4	440,164

*Concentrate calculated at 66% Fe concentrate grade and 80% Fe metallurgical recovery

Table 15.6: MII Whittle Shell Results

Pit Shell	Rev. Factor	Iron Price	Total (kt)	Ore (kt)	Fe %	Strip Ratio	Concentrate* (kt)
1	0.76	38	27	28	41.1	0.0	14
2	0.78	39	134	138	39.6	0.0	66
3	0.80	40	704	723	37.5	0.0	329
4	0.81	41	2,552	2,613	35.8	0.0	1,131
5	0.83	42	9,404	9,400	34.1	0.0	3,853
6	0.85	43	36,461	35,612	32.7	0.0	14,088
7	0.87	44	68,759	65,676	32.0	0.0	25,381
8	0.89	44	108,621	100,014	31.5	0.1	37,997
9	0.91	45	157,019	138,468	31.0	0.1	51,851
10	0.93	46	241,007	197,325	30.9	0.2	73,341
11	0.94	47	398,450	301,487	30.5	0.3	110,606
12	0.96	48	513,142	376,856	30.1	0.4	136,132
13	0.98	49	579,526	417,306	30.0	0.4	149,417
14	1.00	50	773,764	532,662	29.5	0.5	185,906
15	1.02	51	871,701	586,165	29.3	0.5	203,148
16	1.04	52	956,244	628,116	29.2	0.5	215,516
17	1.06	53	1,034,869	666,023	29.2	0.6	227,670
18	1.07	54	1,128,308	707,904	29.1	0.6	239,116
19	1.09	55	1,234,472	752,742	29.0	0.6	250,435
20	1.11	56	1,339,074	794,489	28.9	0.7	264,074
21	1.13	56	1,521,985	870,581	28.7	0.7	272,089
22	1.15	57	1,685,547	929,264	28.6	0.8	292,953
23	1.17	58	1,865,302	989,198	28.6	0.9	309,500
24	1.19	59	1,952,945	1,020,504	28.5	0.9	318,829
25	1.20	60	2,685,675	1,259,596	28.3	1.1	382,748
26	1.22	61	2,808,385	1,297,663	28.3	1.2	394,340
27	1.24	62	2,935,756	1,334,593	28.3	1.2	400,409
28	1.26	63	3,061,056	1,371,577	28.2	1.2	405,340
29	1.28	64	3,152,230	1,398,634	28.2	1.3	414,651
30	1.30	65	3,207,736	1,413,545	28.2	1.3	418,413
31	1.31	66	3,297,106	1,436,422	28.2	1.3	421,842
32	1.33	67	3,481,959	1,480,647	28.2	1.4	427,172
33	1.35	68	3,561,287	1,501,886	28.1	1.4	429,845
34	1.37	69	3,656,997	1,526,133	28.1	1.4	432,740
35	1.39	69	3,741,537	1,546,161	28.1	1.4	434,734
36	1.41	70	3,823,303	1,565,251	28.0	1.4	437,234
37	1.43	71	3,875,185	1,576,862	28.0	1.5	440,164

*Concentrate calculated at 66% Fe concentrate grade and 80% Fe metallurgical recovery

Pit by pit results are generated with the nested shells based on three mining approaches to estimate the net present value (“NPV”) of operating cash flow discounted at 8%. A schematic of these approaches is presented in Figure 15.2.

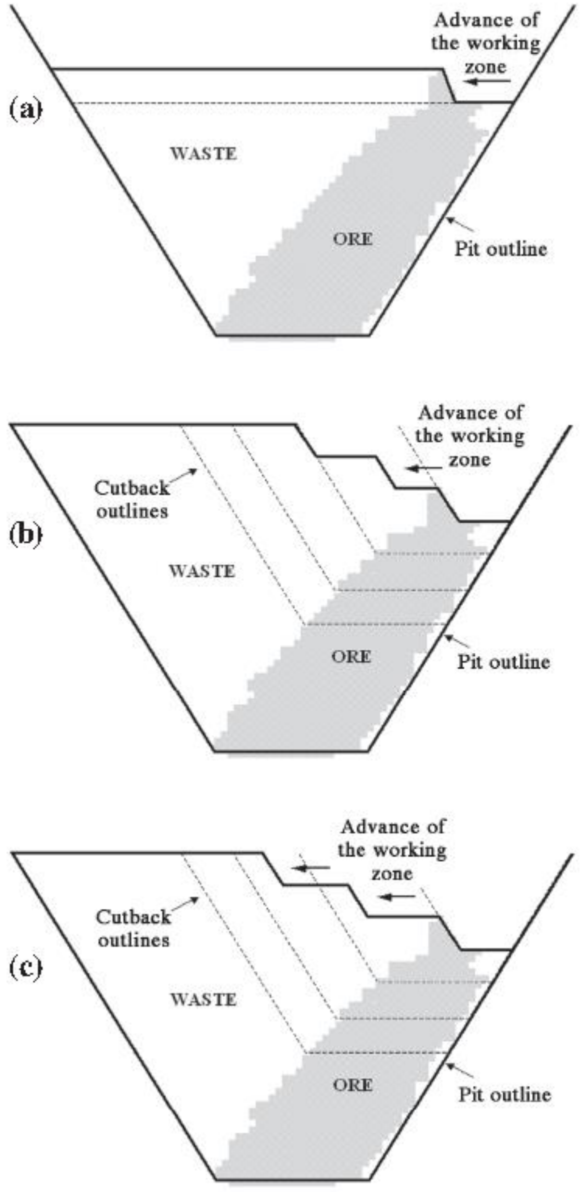
The worst case is based on mining a given pit shell bench by bench from the top down. It is referred to as the “worst case” as it produces the lowest NPV; however, it has the advantage of almost always being practical.

The best case is based on mining each nested shell one by one up to the final shell. This is referred to as the “best case” because it produces the highest NPV. It is almost never practical but provides a theoretical maximum value to aim for through practical phasing approaches. The difference with the worst case gives an indication of the value to be generated by phasing the pit.

The specified case is generated by imposing a more practical phasing approach and provides a more realistic target and phasing evaluation for the pit. In the present case a two phase approach was evaluated. The pushback chooser module in Whittle evaluates which combination of nested shells can produce the highest NPV.

Pit shell 13 is selected, for the M&I optimization, as the optimum final pit shell which corresponds to a US$49/t pit shell (Revenue Factor 0.98). This selection allows for a 20-year mine life without compromising the value of the project. This shell has a total tonnage of 572.1 Mt including 411 Mt of ore at an average grade of 30.0% Fe. The average strip ratio is 0.4:1.

Figure 15.2: Schematic Representation of Three Mining Schedule Configurations: (a) Worst-Case Mining Schedule; (b) Best-Case Mining Schedule; and (c) Intermediate Mining Schedule



Source: Whittle

Table 15.7: M&I Pit by Pit Results @ USD 50/t

Pit Shell	Mine Life (yrs)	Best Case Disc. @ 8% (M$)	Specified Disc. @ 8% (M$)	Worst Case Disc. @ 8% (M$)	Ore Tonnage (kt)	Ore Grade (% Fe)	Waste Tonnage (kt)	Strip Ratio (W:O)
1	0	0	0	0	28	41.1	-1	0.0
2	0	1	1	1	138	39.6	-4	0.0
3	0	5	5	5	723	37.5	-19	0.0
4	0	16	16	16	2,606	35.8	-61	0.0
5	0	47	47	47	9,306	34.2	6	0.0
6	2	145	145	145	35,560	32.7	861	0.0
7	3	232	232	230	65,465	32.0	3,102	0.0
8	5	305	303	299	99,658	31.5	8,614	0.1
9	7	364	359	349	137,845	31.0	18,557	0.1
10	10	428	415	394	196,018	30.9	43,571	0.2
11	15	485	451	404	299,302	30.5	97,160	0.3
12	19	506	449	383	372,451	30.2	135,707	0.4
13	**21**	**510**	**435**	**356**	**410,767**	**30.0**	**161,349**	**0.4**
14	26	508	375	245	518,690	29.6	237,141	0.5
15	29	506	341	188	569,572	29.4	280,147	0.5
16	31	503	315	142	605,525	29.4	318,045	0.5
17	33	500	289	93	641,302	29.3	358,850	0.6
18	35	496	259	39	674,880	29.2	403,130	0.6
19	37	491	221	-29	708,393	29.2	451,763	0.6
20	40	486	182	-92	748,033	29.1	515,310	0.7
21	41	483	156	-138	771,168	29.1	557,669	0.7
22	46	475	93	-242	832,437	29.0	670,989	0.8
23	49	470	43	-326	879,919	29.0	771,791	0.9
24	51	467	10	-381	907,807	29.0	829,224	0.9
25	66	454	-103	-565	1,094,321	28.8	1,250,425	1.1
26	68	453	-123	-597	1,128,881	28.8	1,329,358	1.2
27	70	452	-132	-614	1,147,261	28.8	1,371,627	1.2
28	71	452	-145	-635	1,161,590	28.8	1,410,932	1.2
29	73	451	-165	-668	1,188,873	28.8	1,486,952	1.3
30	74	451	-171	-677	1,199,769	28.8	1,518,607	1.3
31	75	451	-177	-687	1,209,782	28.8	1,549,037	1.3
32	76	450	-188	-706	1,225,183	28.8	1,599,572	1.3
33	77	450	-194	-715	1,233,221	28.7	1,624,873	1.3
34	78	450	-201	-726	1,241,642	28.7	1,654,670	1.3
35	78	450	-205	-732	1,247,573	28.7	1,675,636	1.3
36	79	450	-210	-741	1,255,005	28.7	1,702,962	1.4
37	80	449	-215	-749	1,263,745	28.7	1,735,493	1.4

Table 15.8: MII Pit by Pit Results @ USD 50/t

Pit Shell	Mine Life (yrs)	Best Case Disc. @ 8% (M$)	Specified Disc. @ 8% (M$)	Worst Case Disc. @ 8% (M$)	Ore Tonnage (kt)	Ore Grade (% Fe)	Waste Tonnage (kt)	Strip Ratio (W:O)
1	0	0	0	0	28	41.1	-1	0.0
2	0	1	1	1	138	39.6	-4	0.0
3	0	5	5	5	723	37.5	-19	0.0
4	0	16	16	16	2,613	35.8	-62	0.0
5	0	48	48	48	9,400	34.1	4	0.0
6	2	145	145	145	35,612	32.7	849	0.0
7	3	233	232	231	65,676	32.0	3,083	0.0
8	5	306	304	299	100,015	31.5	8,606	0.1
9	7	365	360	350	138,473	31.0	18,545	0.1
10	10	429	416	395	197,330	30.9	43,677	0.2
11	15	488	453	406	301,505	30.5	96,945	0.3
12	19	508	450	384	376,890	30.1	136,252	0.4
13	21	513	435	355	417,317	30.0	162,209	0.4
14	27	511	372	243	532,661	29.5	241,102	0.5
15	30	509	338	185	586,143	29.3	285,559	0.5
16	32	507	307	132	628,076	29.3	328,169	0.5
17	34	503	280	83	665,970	29.2	368,899	0.6
18	37	499	245	19	707,846	29.1	420,462	0.6
19	39	493	200	-61	752,671	29.0	481,801	0.6
20	42	489	163	-121	794,382	28.9	544,692	0.7
21	47	481	103	-222	870,138	28.7	651,847	0.7
22	51	476	49	-311	928,674	28.6	756,873	0.8
23	55	472	-9	-408	988,529	28.6	876,773	0.9
24	57	470	-34	-447	1,019,763	28.5	933,182	0.9
25	75	460	-143	-625	1,258,316	28.3	1,427,359	1.1
26	78	460	-162	-656	1,296,296	28.3	1,512,090	1.2
27	80	459	-192	-701	1,333,217	28.3	1,602,538	1.2
28	83	459	-211	-731	1,369,981	28.3	1,691,076	1.2
29	85	458	-226	-754	1,396,607	28.2	1,755,623	1.3
30	86	458	-231	-764	1,411,456	28.2	1,796,280	1.3
31	89	458	-247	-788	1,434,268	28.2	1,862,838	1.3
32	93	458	-279	-839	1,478,424	28.2	2,003,535	1.4
33	94	458	-297	-865	1,499,654	28.1	2,061,633	1.4
34	97	458	-306	-881	1,523,871	28.1	2,133,126	1.4
35	98	457	-315	-897	1,543,885	28.1	2,197,652	1.4
36	100	457	-320	-906	1,562,932	28.1	2,260,371	1.4
37	101	457	-325	-913	1,574,521	28.0	2,300,663	1.5

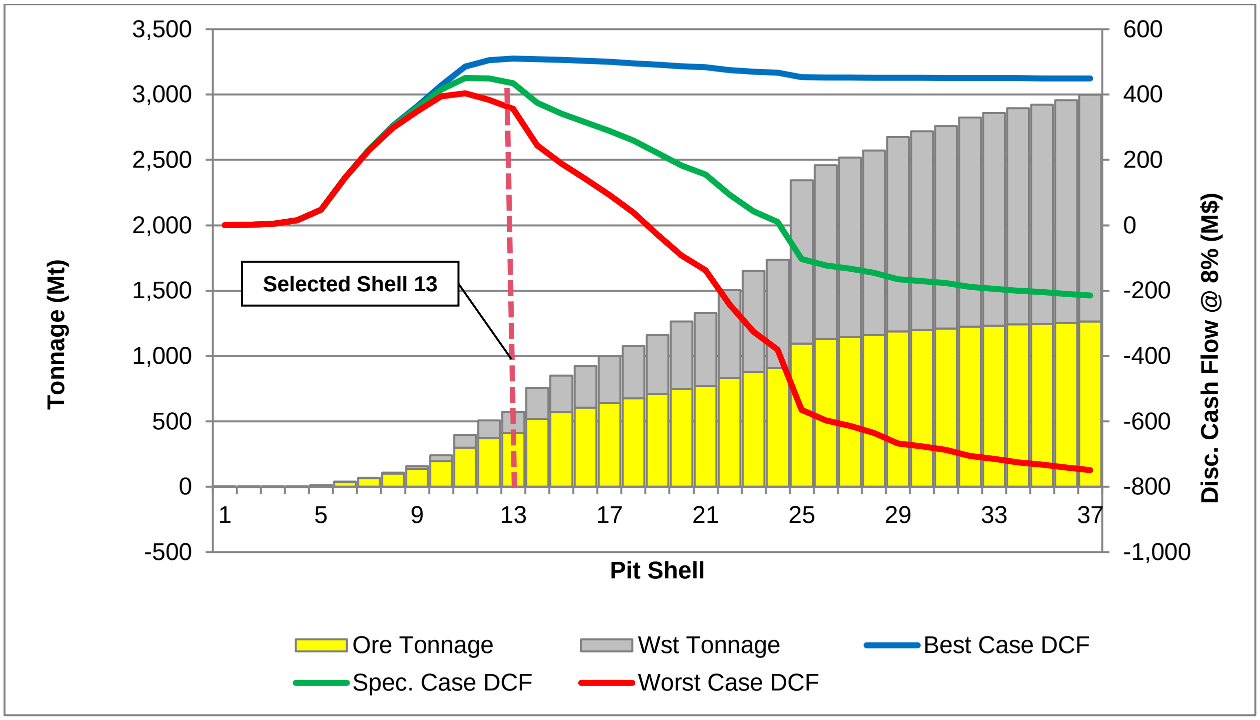


Figure 15.3: M&I Pit by Pit Graph

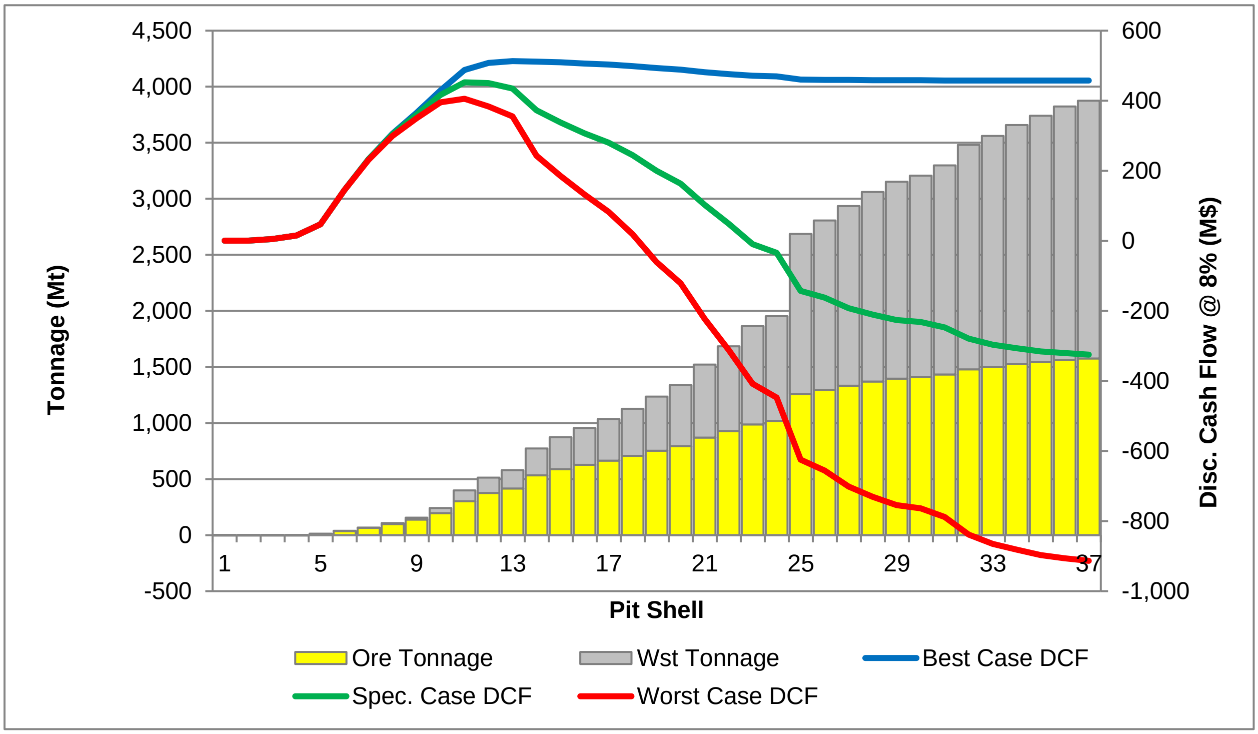


Figure 15.4: MII Pit by Pit Graph

15.4 Mine Design

15.4.1 Slope Design Criteria

The final pit was designed using a double benching configuration to a final height of 28 m. The pit slope profile is based on recommendations by Golder as presented in Section 15.3.1. The slope profile is based on recommended batter angles with catch bench width recommendations for an inter-ramp angle ranging from 48 to 52.5 degrees. A 16 m geotechnical berm is introduced every 112 m or four double-benches where ramp segments do not pass in the slope to reduce the vertical stack height.

The overburden is sloped at a 2H:1V angle. The overburden slope face should be protected with waste rock to prevent erosion. The average depth of overburden over the footprint of the pit averages less than 5 m and consists of a thin layer of top soil covering sandy till with cobbles and boulders. Most of the open pit surface has already been stripped from past operations and in certain instances a wider footprint has been proposed in this study.

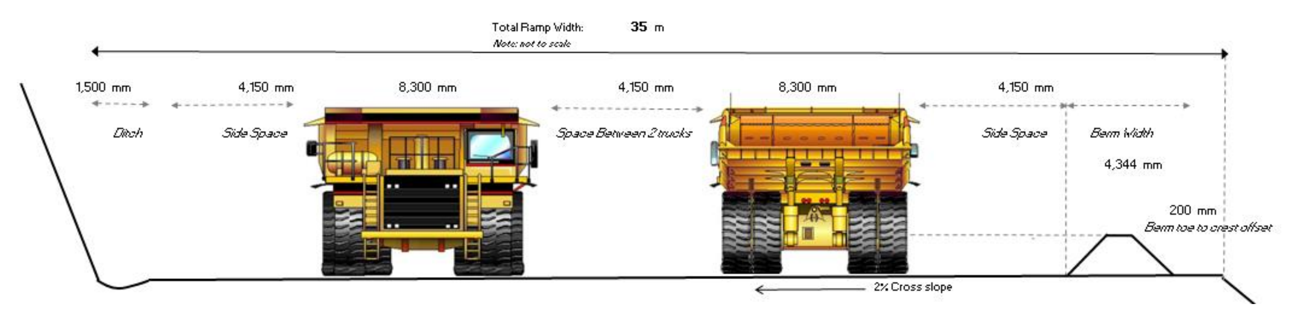
Picture 15-1: West Pit Overburden Stripping

15.4.2 Ramp Design Criteria

The ramps and haul roads are designed for the largest equipment being a 240-tonne class haul trucks (CAT 793) with a canopy width of 8.3 m. For double lane traffic, industry best-practice is to design a haul road of at least 3.5 times the width of the largest vehicle, in this case, at least 35 m. Ramp gradients are designed at 10%.

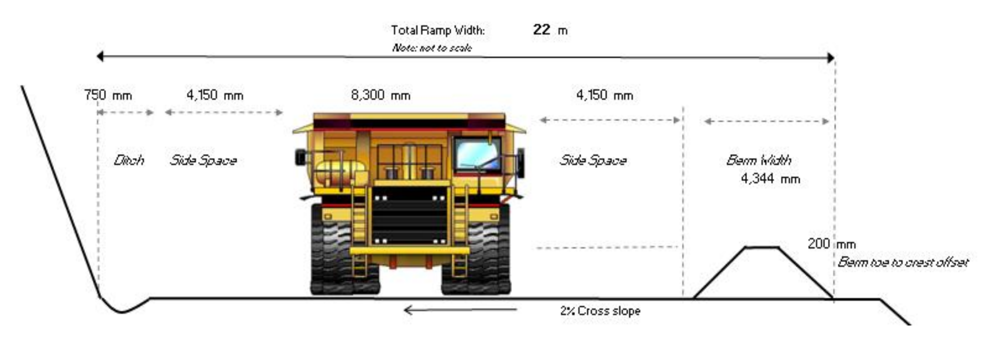
A shoulder barrier or safety berm on the outside edge will be constructed of crushed rock to a height equal to the rolling radius of the largest tire using the ramp. The rolling radius of the truck tire is 1.8 m. These shoulder barriers are required wherever a drop-off greater than 3 m exists and will be designed at 1.1H:1V. A ditch planned on the highwall will capture run-off from the pit wall surface and assure proper drainage of the running surface. The ditch will be 1.5 m wide. To facilitate drainage of the roadway a 2% cross slope on the ramp is planned.

The double lane ramp width is 35 m wide (Figure 15.5) and the single lane ramp is 22 m wide (Figure 15.6). Single lane ramps are introduced in the pit bottom when the benches start narrowing and when the mining rates will be significantly reduced.



MINING SERVICES INC. | **Double Lane Ramp Profile Design** | **Author: Etienne Bernier**
Date: December 2016

Figure 15.5: Double Lane Ramp Profile Design



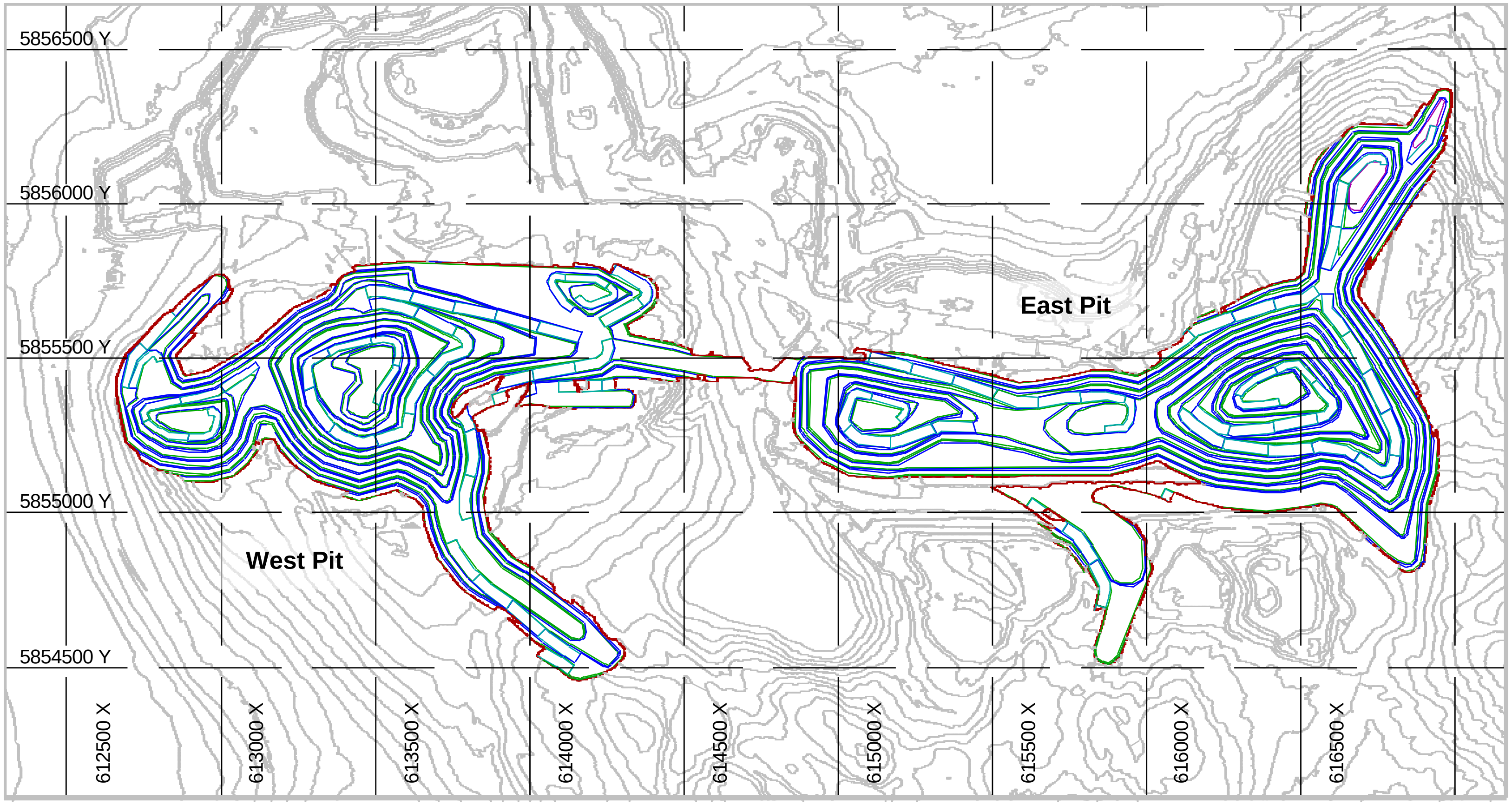
MINING SERVICES INC. | **Single Lane Ramp Profile Design** | **Author: Etienne Bernier**
Date: December 2016

Figure 15.6: Single Lane Ramp Profile Design

15.4.3 Open Pit Mine Design Results

The final pit design is presented in Figure 15.7. The final pit includes an East pit and a West pit. The final pit is 4,200 m east-west and roughly 1,800 m north-south and reaches a depth of 250 m. The final pit design was designed with the current pit position taken into consideration with respect to ramp entrances and road networks.

Both East and West final pit designs have three exits; two to the north and one to the south to provide access to the pushbacks and shorten distances to the crusher and waste dumps. The final pit design closely follows the guiding Whittle shell as presented in Figure 15.8.

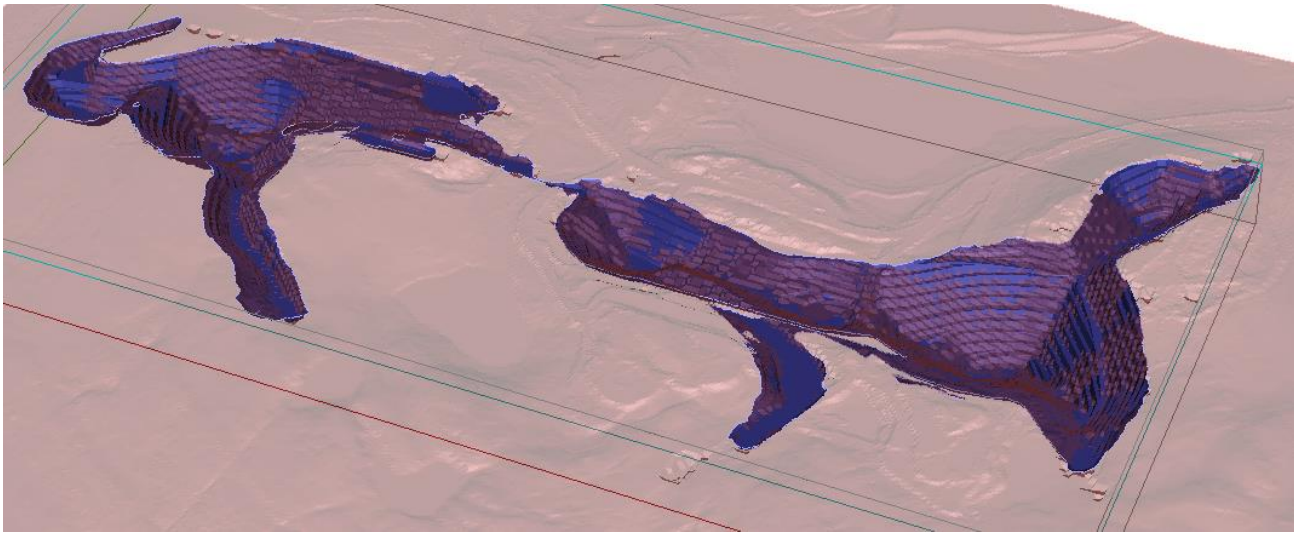


G MINING SERVICES INC.

Final Pit Design

Author: Etienne Bernier
Date: December 2016

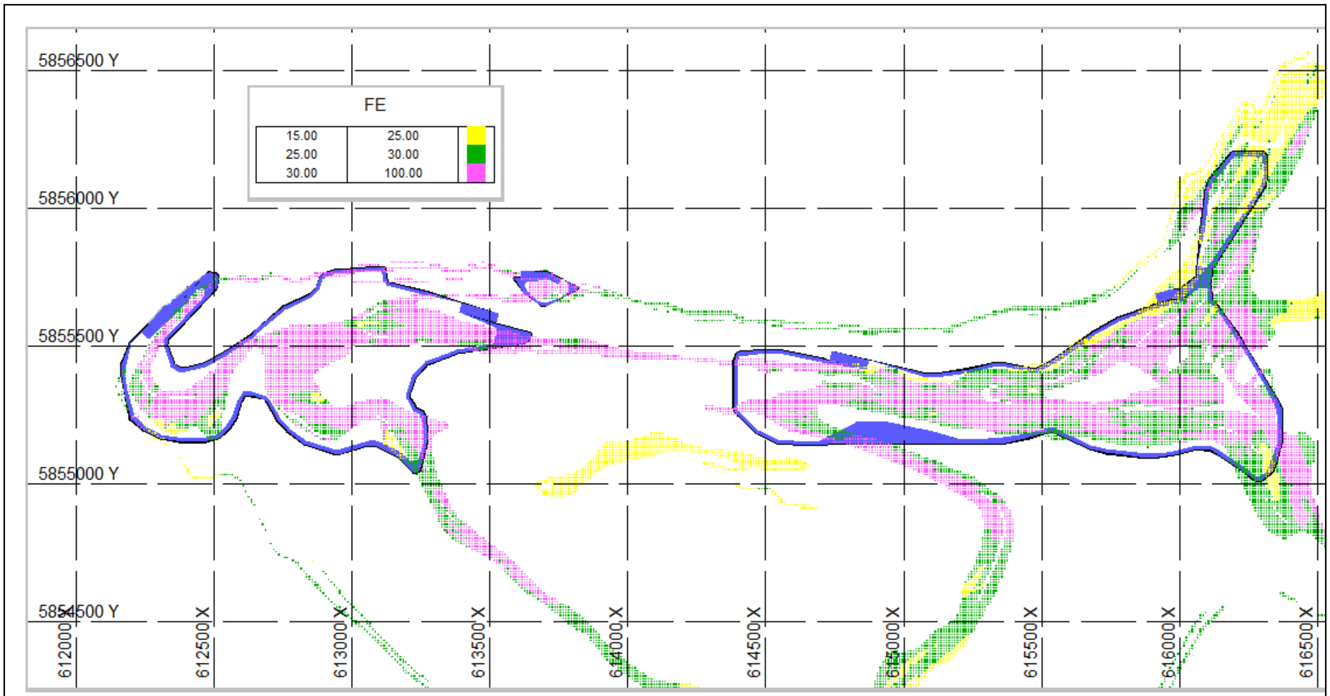
Figure 15.7: Final Pit Design



Final Pit Design vs. Whittle Shell

Author: Etienne Bernier
Date: November 2016

Figure 15.8: Final Pit Design vs. Whittle Shell



Final Pit Design vs. Iron Distribution at level 676

Author: Etienne Bernier
Date: November 2016

Figure 15.9: Final Pit Design vs. Iron Distribution (above 15% Fe) at Level 676

15.5 Mineral Reserve Statement

The Mineral Reserve and stripping estimates are based on the final pit design presented in the previous section. The Proven and Probable mineral reserves are inclusive of mining dilution and ore loss. The total ore tonnage before dilution and ore loss is estimated at 394.8 Mt at an average grade of 30.85% Fe. The dilution envelope around the remaining ore blocks (>15% Fe) results in a dilution tonnage of 17 Mt at an average grade of 10.34% Fe. The dilution tonnage represents 4.3% of the ore tonnage before dilution and the dilution grade is estimated from the block model and corresponds to the average grade of the dilution skin. Table 15.9 presents a Resource to Reserve reconciliation.

Table 15.9: Resource to Reserve Reconciliation

Resource to Reserve Reconciliation	Tonnage (kt)	Grade (Fe %)
Ore before dilution	394,759	30.85
Add: Mining dilution	16,954	10.34
P&P Mineral reserve	411,713	30.01

The Proven and Probable Mineral Reserves total 411.7 Mt at an average grade of 30.0% Fe. The total tonnage to be mined is estimated at 610.6 Mt for an average strip ratio of 0.48 which includes overburden.

Table 15.10: Final Pit Mineral Reserves and Quantities

Classification	Diluted Ore Tonnage (dry)	Fe	CaO	SAT	MgO	Al_2O_3
	kt	%	%	%	%	%
Proven	264,160	30.73	0.48	2.98	0.56	0.32
Probable	147,554	28.71	2.84	6.68	2.72	0.40
Total P&P	**411,713**	**30.01**	**1.33**	**4.30**	**1.33**	**0.35**

Notes on Mineral Reserves:

1. CIM definitions were followed for Mineral Reserves.
2. Mineral Reserves based on September 28, 2016 LIDAR survey.
3. Mineral Reserves are estimated at a cut-off grade of 15% Fe.
4. Mineral Reserves are estimated using a long-term iron price reference price (Platt's 62%) of $50/dmt and an exchange rate of 1.30 CAD/USD. An Fe concentrate price adjustment of $4.00/dmt was added.
5. Bulk density of ore is variable but averages 3.63 t/m^3.
6. The average strip ratio is 0.48:1.
7. The mining dilution factor is 4.3%.
8. Numbers may not add due to rounding.

16 MINING METHODS

16.1 Introduction

G Mining Services Inc. (“GMS”) was mandated by Quebec Iron Ore (“QIO”) to prepare a Feasibility level mining study and mineral reserve estimate for the Bloom Lake project located in Quebec.

The Bloom Lake project was previously owned by Cliffs Natural Resources and was closed and placed on care in maintenance in January 2015. It was later acquired by QIO in April 2016. The restart of the operation is based on different operating assumptions which consist of an upgrade to the Phase I plant with a mineral reserve and mining scenario updated for the current iron ore market.

The operation consists of a conventional surface mining method using an owner mining approach with electric hydraulic shovels and mine trucks. All major mine equipment required for the restart of the project is present on site as this equipment was among the assets purchased by QIO from Cliffs. The study consists of resizing the open pit based on parameters outlined in this section and producing a life-of-mine (“LOM”) plan to feed a plant at a nominal rate of 20 Mt/y.

16.2 Mine Designs

16.2.1 Open Pit Phases

Mining of the Bloom Lake project is planned with four phases with a starter phase and a final pushback in both the East and West pits. The characteristics of each mining phase are summarized in Table 16.1 and are presented in Figure 16-1 and Figure 16-2.

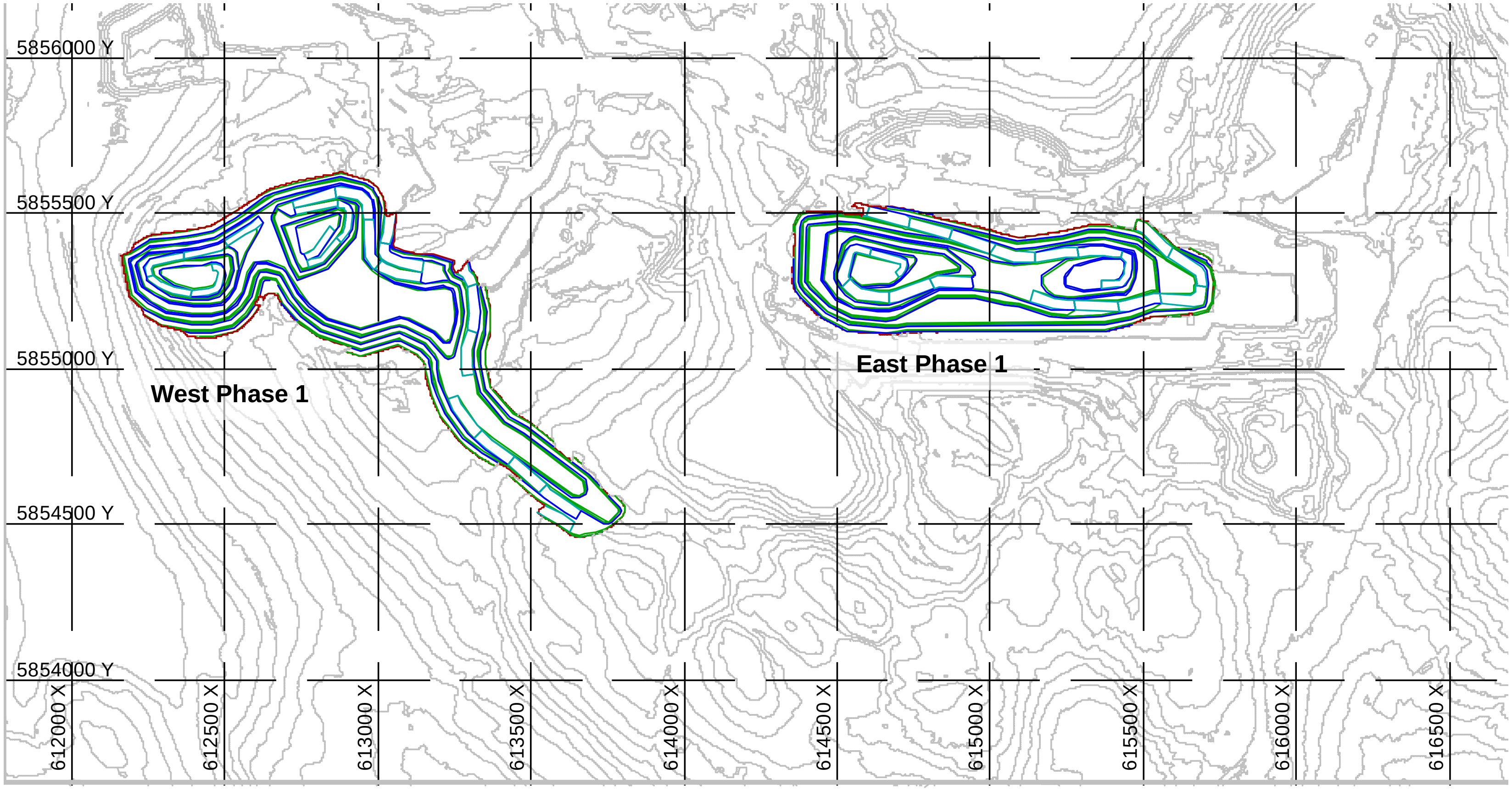
The project has two main mining zones, the East and West. The East pit is 2,000 m long by 1,850 m wide at the east end under the “Montagne du Chef”. The starting phase of the East pit is located on the western end. The West pit is 2,050 m long by 750 m wide. It has a narrow southern limb that is 1,000 m long by 200 m wide. The West pit starter phase is located to the south of the main West pit.

The East pit has two ramp exits to the north. It also has an “optional” ramp exit to the south. The southern ramp was planned for added flexibility in the mine plan and to access the southern waste storage area. The West pit has two ramp exits to the north and two to the south.

The final pit contains 411.7 Mt of ore at an average grade of 30% Fe with an average strip ratio of 0.48:1. This mineral reserve is sufficient for a 20.5-year mine life with possibilities for expansion at higher iron ore prices. The East Pit contains 59% of the ore and has higher levels of MgO and CaO than the West Pit. The strip ratio of the East Pit (0.44:1) as a whole is slightly lower than the West Pit (0.55:1).

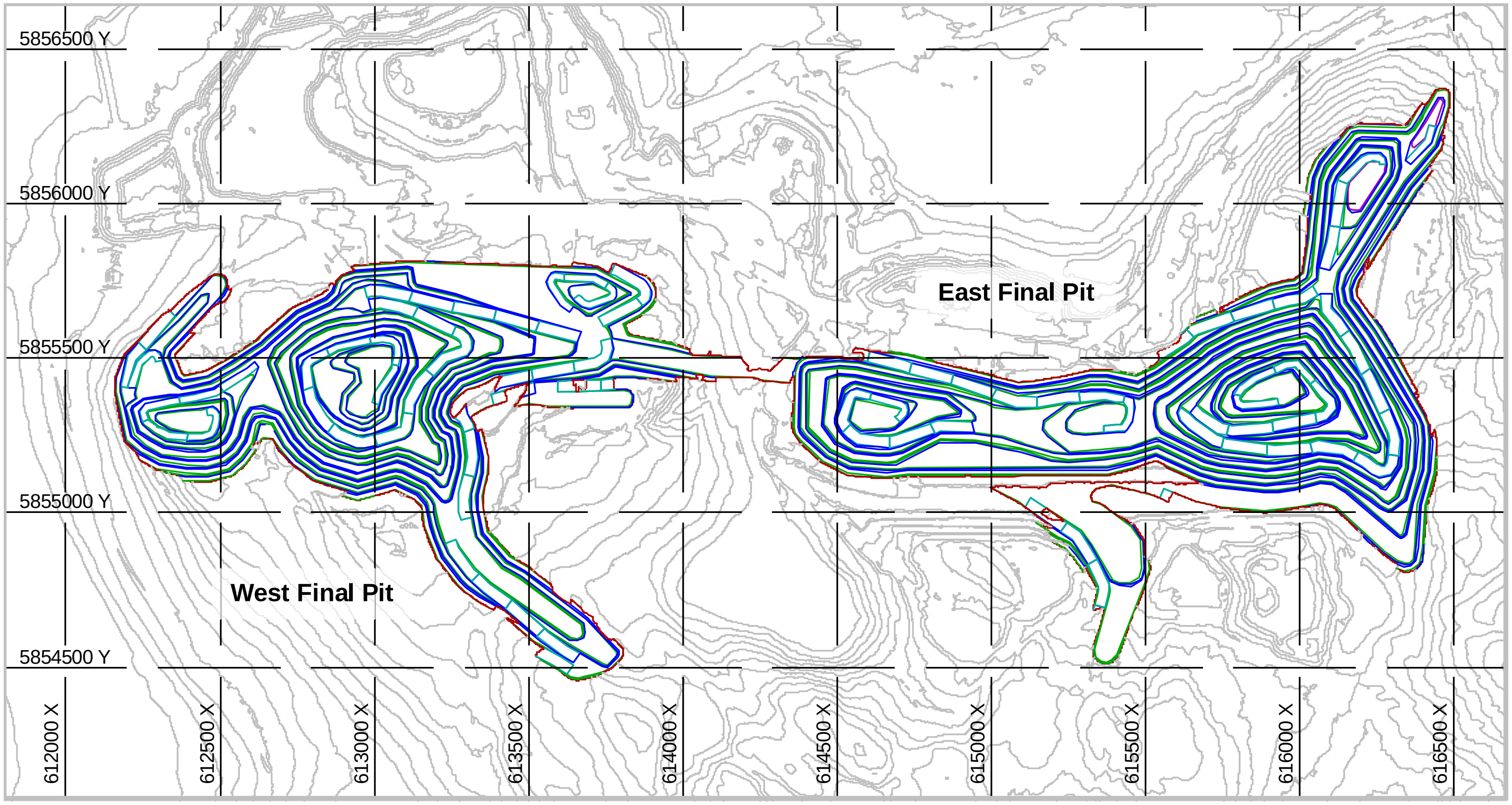
Table 16.1: Pit Phase Design Summary

		East Pit			West Pit			Grand Total
		Phase 1	Final	Total	Phase 1	Final	Total	
Total Tonnage	kt	84,544	262,666	347,210	120,349	143,048	263,397	610,607
Overburden	kt	184	1,592	1,776	4,461	1,866	6,327	8,103
Waste	kt	28,400	75,467	103,867	35,169	51,755	86,924	190,791
Strip Ratio	w:o	0.51	0.42	0.44	0.49	0.60	0.55	0.48
Ore Tonnage	kt	55,961	185,607	241,567	80,719	89,427	170,146	411,713
Fe%	%	30.16	29.02	29.28	30.63	31.41	31.04	30.01
CaO%	%	0.22	2.82	2.22	0.06	0.06	0.06	1.33
SAT%	%	2.59	7.90	6.67	0.84	1.03	0.94	4.30
MgO%	%	0.44	2.74	2.21	0.08	0.09	0.09	1.33
Al_2O_3%	%	0.25	0.37	0.34	0.37	0.35	0.36	0.35



G MINING SERVICES INC.	Starter Pit Design	Author: G Mining Date: December 2016

Figure 16-1: Starter Pit Design



MINING SERVICES INC.	**Final Pit Design**	**Author: G Mining** **Date: December 2016**

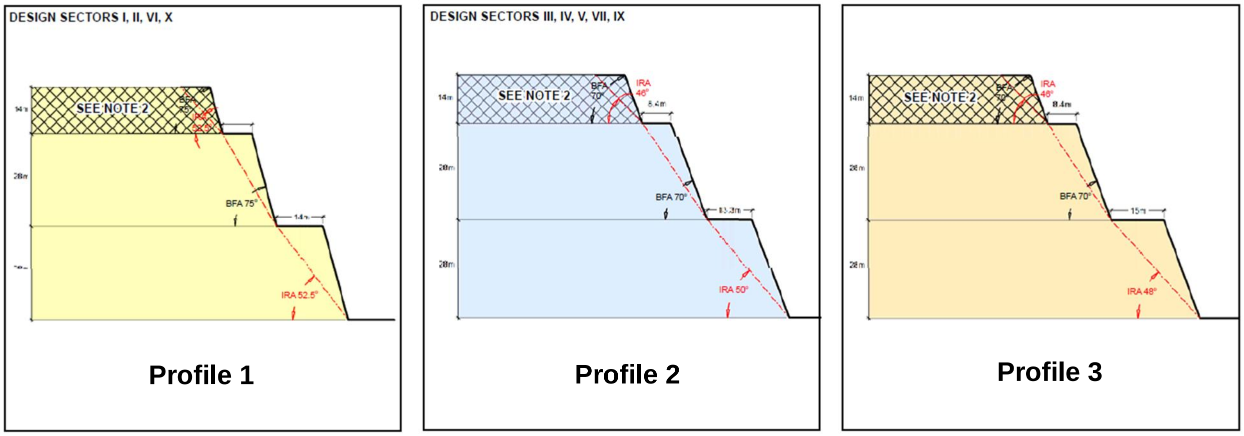
Figure 16-2: Final Pit Design

The pit design slope profiles adhere to recommendations generated by Golder Associates according to three main profiles as summarized in Table 16.2. The inter-ramp angles vary from 48 to 52.5 degrees based on a final 28m bench height.

The pit slope profile has a geotechnical catch bench every 112 m of vertical stack height. This geotechnical catch bench mitigates risks from overbank hazards on the pit wall. Overbank hazards result from muck that spills down the slope of the previous pit phase filling the catch benches. The design allows the catch bench to be accessed to remove debris.

Table 16.2: Pit Phase Design Criteria

Geotechnical Pit Design Profiles	Profile 1	Profile 2	Profile 3
Design sectors	I, II, VI, X	III, IV, V, VII, IX	XI
Vertical bench height (m)	28.0	28.0	28.0
Bench face angle (deg.)	75	70	70
Avg. Catch berm width (m)	14.0	13.3	15.0
Inter-ramp angle (deg.)	52.5	50.0	48.0
Ramp width (m)	35.0	35.0	35.0
Overall slope angle (deg.)	45.7	43.7	42.1



Profile 1

Profile 2

Profile 3

Geotechnical Bench Slope Design Recommendations

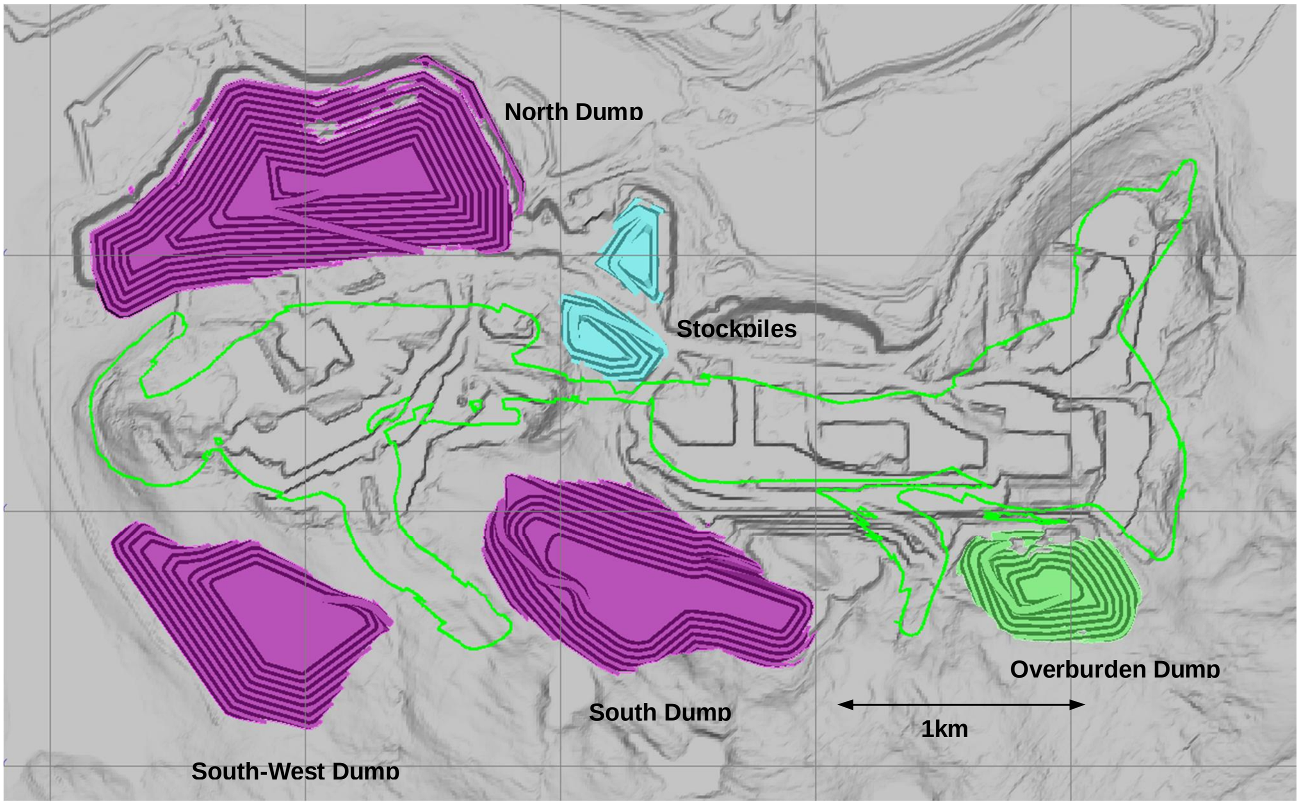
Source:
Golder Associates

Figure 16-3: Geotechnical Bench Slope Design Recommendations

16.2.2 Overburden and Waste Rock Storage

A two-step approach for storing waste rock is presented in the study. In the early years of the project, waste material will be stored outside the pit limits in designated waste storage areas. Later, as the project deepens and portions of the pit are depleted, waste material will be stored in these depleted portions allowing for lower haulage costs and a reduced environmental impact.

A total of 186 Mt of waste material is mined throughout the life-of-mine. At least half the tonnage has to be stored in waste dumps before in-pit waste dumping can commence and be committed to. The dump locations are located to the north and to the south. Both, North and South, dumps contain between 60-70 Mt of material. The north dump is an extension and raising of the existing dump and is 80 m high. The south dump is located above Lac Triangle and is 90 m high. A South-West dump was planned as a contingency storage area for the project. This dump is not used in the current plan but could contain up to 80 Mt and allow for all waste to be stored outside the pit.



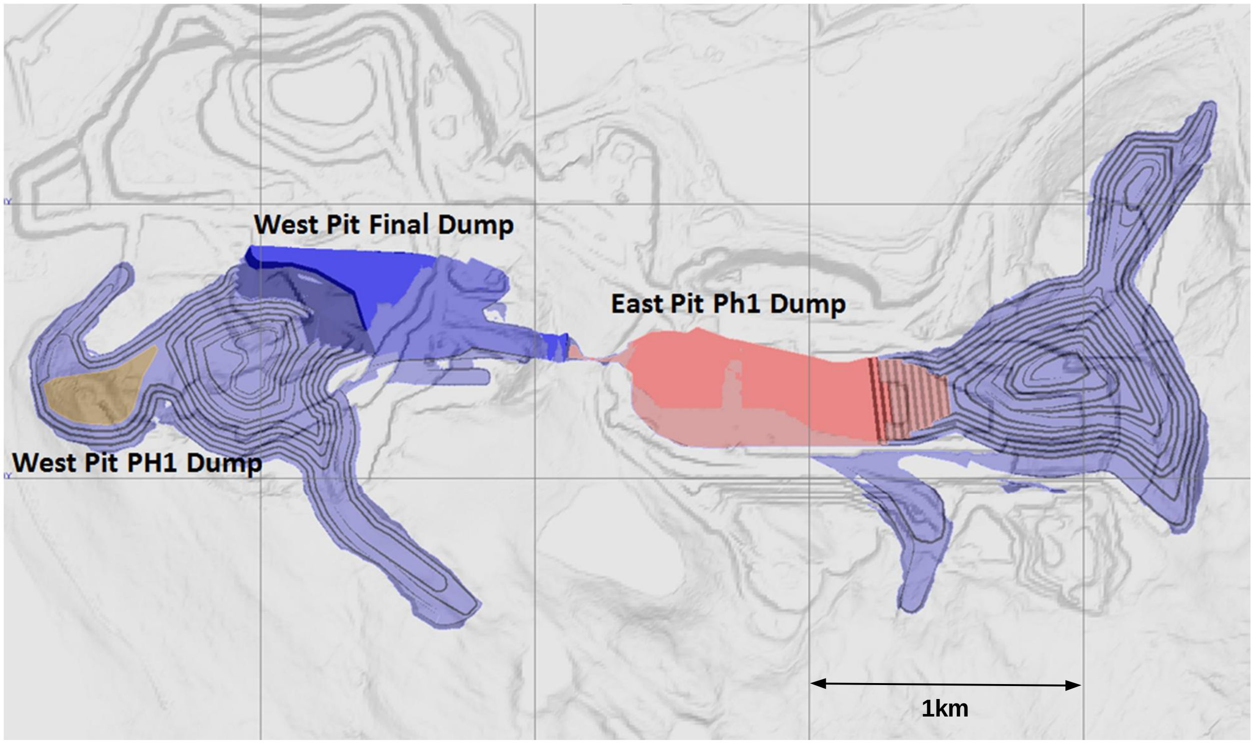
G MINING SERVICES INC. | **Waste Dump Designs** | **Author: G Mining**
Date: December 2016

Figure 16-4: Waste Storage Locations Outside the Final Pit

The overburden dump is located on the actual overburden storage location and has sufficient capacity for the remaining 8.2 Mt of overburden mined over the LOM.

Dump storage locations were kept outside the 80$ economic shell limit to allow for an expansion of the final pit. The dump storage locations were offset 50 m from this upside case pit limit for safety reasons.

During pre-production and operations, 3.8 Mt of waste rock will be required for construction needs of the Tailing Management Facility ("TMF"), mine haul roads, stockpile and crusher pad construction. All waste dump capacities are shown in Table 16.3.



G MINING SERVICES INC.	In Pit Waste Dumps Design	Author: G Mining Date: December 2016

Figure 16-5: Waste Storage Locations Inside the Final Pit

In-pit waste storage is initiated in 2022 once the East Pit Phase 1 is depleted. The West Pit Phase 1 in-pit dump will start in 2026 and will consist in filling the mined out bottom portion of the west pit.

Finally, the West Pit Final in-pit dumping is planned from year 2034 onwards. Waste rock will be pushed from the pit rim.

Table 16.3: Waste Storage Capacities

Waste Dump	Capacity (Mt)	Capacity (M m^3)	Surface Area (ha)	% Filled
North Dump	75	34.7	112	100%
South Dump	74	34	68.7	45%
Overburden Pile	8.2	5	25.5	100%
Total	**157.2**	**73.7**	**481.1**	**74%**

Table 16.4: Waste Pile Design Criteria

Waste Dump	Avg. Catch Bench Width (m)	Pile Face Angle (deg)	Overall Slope angle (H:V)	Approximate Height (m)
North Dump	15	35	4:1	80
South Dump	15	35	4:1	90
Overburden Pile	15	35	4:1	60
East Pit Phase 1	15	35	4:1	100
West Pit Final	N/A	35	1:1.43	170

16.2.3 Ore Stockpiles

Ore stockpiles are located close to crusher #2. The two stockpile locations have an approximate 7.0 Mt capacity. Stockpiling exceeds 5.0 Mt towards the end of the mine life when ore is abundant at the bottom of the east pit. Ore is then stockpiled to prevent exceeding a reasonable vertical drop-down rate and to shorten mining activities at the end of the project. Throughout the mine life, approximately 2.5Mt are preserved in stockpile which represents 6 weeks of feed.

The north stockpile pad has been designed to connect to the crusher pad, thus decreasing cycle time for ore re-handling when the stockpile is higher or at the same height as the crusher pad.

The stockpile design criteria are presented in Table 16.5. The combined stockpile capacity is estimated at 7 Mt but allows for segregation into two piles according to iron grade or other properties. The two stockpiles allow for blending operations to take place.

Table 16.5: Stockpile Design Criteria

Ore Stockpile Characteristics	Catch Bench Width (m)	Pile Face Angle (deg)	Overall Slope Angle (H:V)	Approximate Height (m)	Max Capacity (Mt)
Stockpile at max. capacity	15	35	3:1	30	7.0

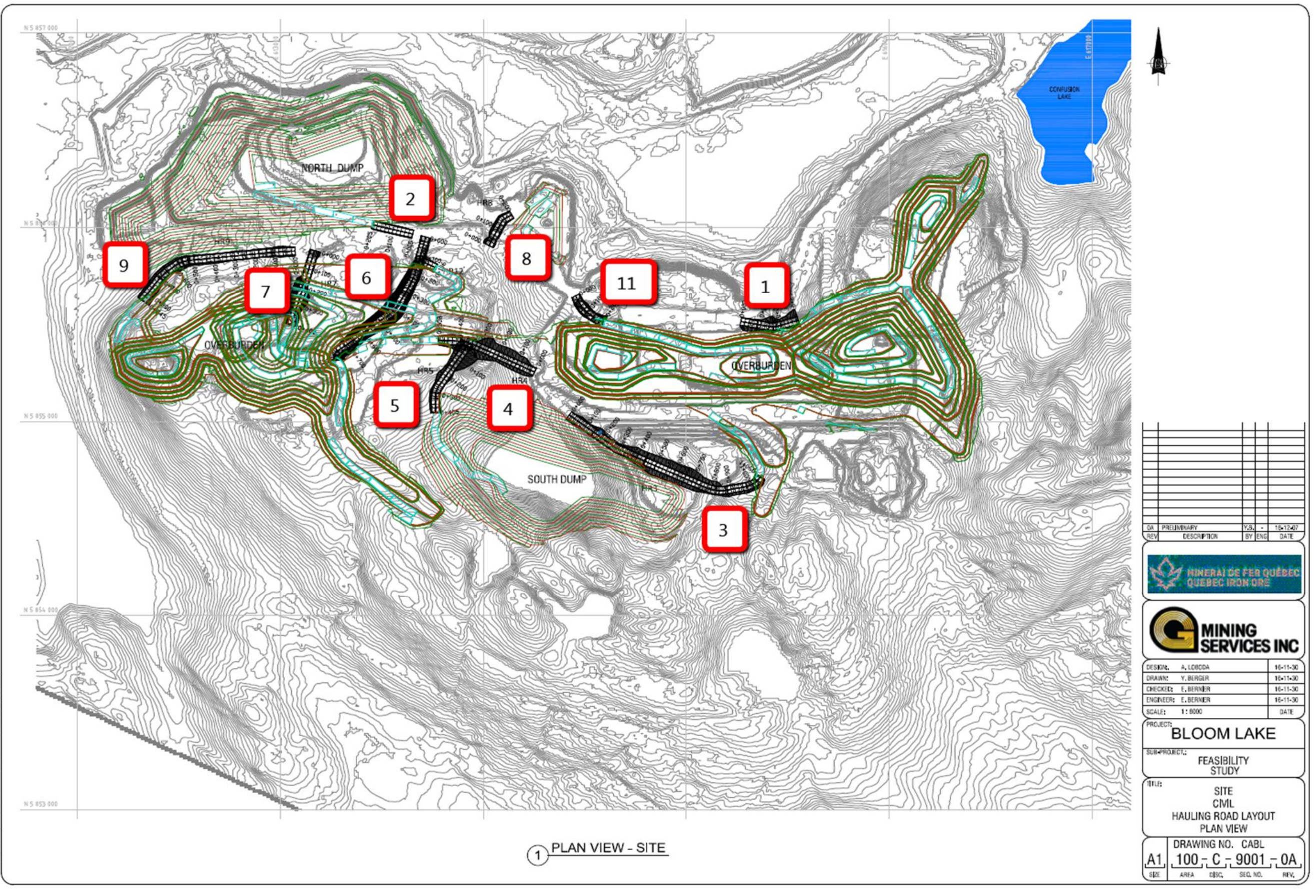
16.2.4 Mine Haul Roads

Most of the haul roads are already existing. However, adjustments and additional roads are required to access the new waste storage locations and accommodate the new pit exit locations.

The haul road leading to the crusher (road 8) and the two accesses (1 and 11) to the first mining phase are built during the pre-production phase. The other access roads to the various mining phases and waste storage locations are built later as required.

Table 16.6: Haul Road Segments

Haul Road Segment Number	Length (m)
Mine Road 1	291
Mine Road 2	205
Mine Road 3	1,075
Mine Road 4	522
Mine Road 5	405
Mine Road 6	821
Mine Road 7	410
Mine Road 8	202
Mine Road 9	848
Mine Road 11	207
Mine Road 12	107

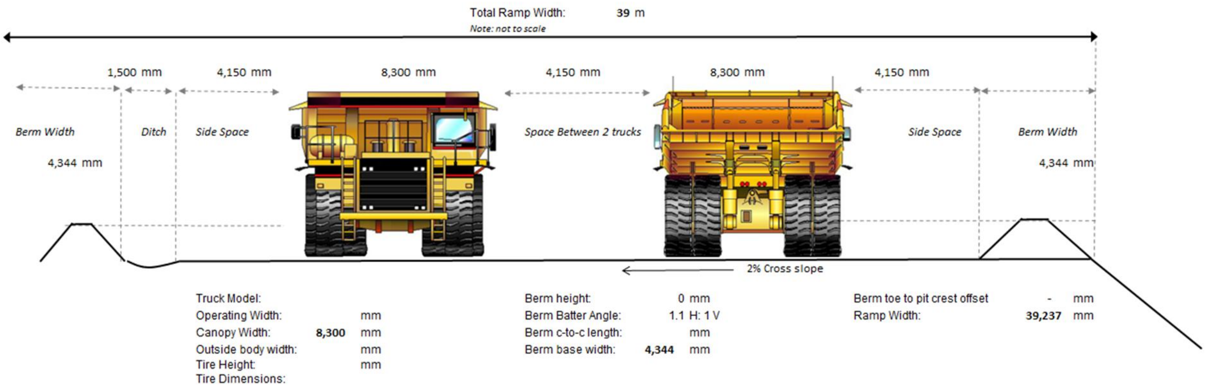


G MINING SERVICES INC.

Mine Haulage Roads

Source: G Mining
Date: December 2016

Figure 16-6: Mine Haulage Roads



MINING SERVICES INC.

Out of Pit Haul Road Profile

Source: G Mining
Date: December 2016

Figure 16-7: Out of Pit Haul Road Profile

16.3 Production Schedule

16.3.1 Production Schedule Optimization

The life-of-mine ("LOM") schedule was optimized using Minemax Scheduler software to maximize the project value according to various constraints. The optimal schedule guided the detailed schedule presented hereafter.

The Minemax Scheduler integrates the following features:

- Assess and maximize the NPV for projects and operations.
- Optimize schedules to meet mining, blending and processing constraints.
- Model multiple capital expansion scenarios.

The optimization was based on the pit phase designs and related mineral reserves. It also integrates preliminary haul cycle results to level truck requirements over the LOM. The Minemax constraints are summarized in Table 16.7.

Table 16.7 : Minemax Constraints

LOM Targets & Constraints		**LOM Target**
Mining Limits		
Total tonnage mined	Mtpy	35
Number of benches per phase per year	#/yr	5
Processing Limits & Recoveries		
Mill Feed tonnage	Mtpy	20
Fe Recovery	%	80
Contaminants Recovery		
MgO Recovery *	%	0.1637 x + 0.0779
CaO Recovery *	%	0.1356 x + 0.062
SAT (Fe_3O_4) Recovery *	%	2.0158 x - 0.6978
Al_2O_3 Recovery *	%	0.1908 x + 0.1226
Preferred Contaminants Limits in Feed		
Ore Feed – MgO *	%	≤ 2.6
Ore Feed – CaO *	%	≤ 3.2
Ore Feed - Al_2O_3 *	%	≤ 2.0

* Based on historical data provided by QIO

16.3.2 Mine Production Schedule

The mine production schedule is completed on a quarterly basis during the pre-production period and first year of commercial production and on an annual basis thereafter. The mine pre-production is initiated in July 2017 and transitions to commercial operations in the second quarter of 2018 after commissioning and achieving 80% of nameplate capacity for a period of 30 days. The mine pre-production period lasts a total of 9 months which is planned to allow for a gradual commissioning of mining equipment, hiring and training, and timely delivery of waste rock for civil work.

The objectives of the LOM plan are to maximize discounted operating cash flow of the Project subject to various constraints:

- Limit pre-production to requirements for civil works and feed of the plant once started.
- Supply best grade ore to plant and feed to a nominal capacity which ultimately reaches 20 Mt/y.
- Limit the mining rate to approximately 35 Mt/y.
- Limit the vertical drop down rate to 5 benches per phase per year.
- Limit peak truck requirements.
- Place contaminant level constraints on the mill feed.
- Minimize stockpiling.

The mining schedule pre-production tonnage is 12.1 Mt over a period of 9 months. Mining will be conducted on day shift only for a period of 3 months and on two shifts by the fourth month.

The peak mining rate of approximately 34.2 Mt is reached in 2025. The mining rate declines, starting in 2033, as sufficient ore for the mill is accessible. Stockpiling occurs during the mine life and mainly serves to control the level of contaminants in the mill feed. Stockpiling reaches 5.8 Mt in 2037. This stockpiling level is required to preserve a feasible annual sinking rate in the pit. The annual mine production and stockpile inventory are presented in Figure 16-8 and Figure 16-8: Mine Production

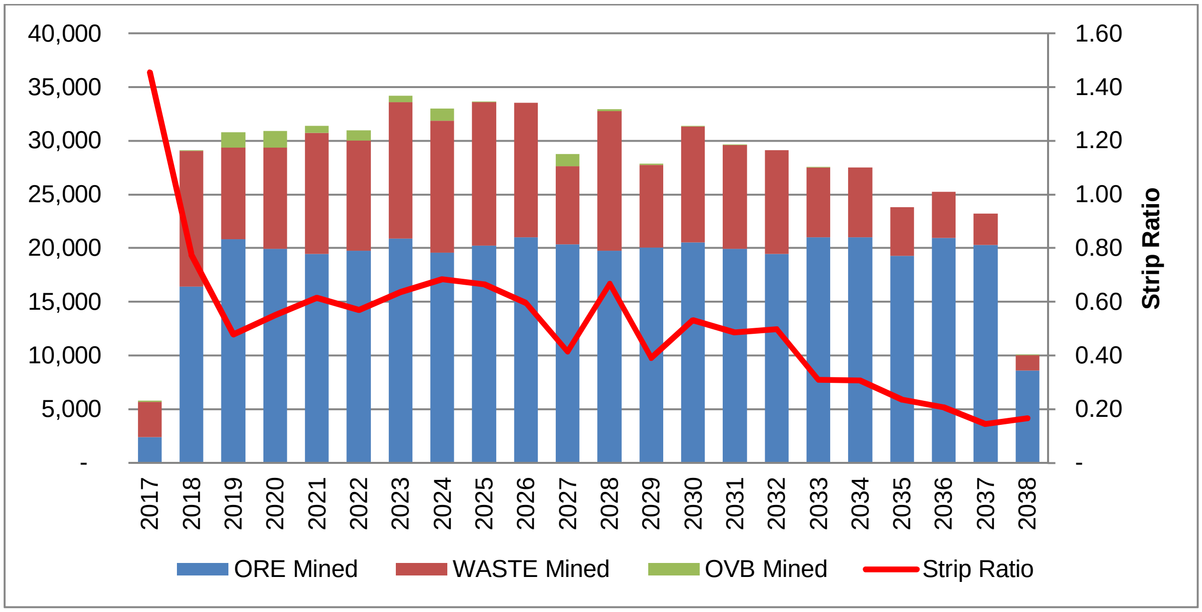


Figure 16-8: Mine Production

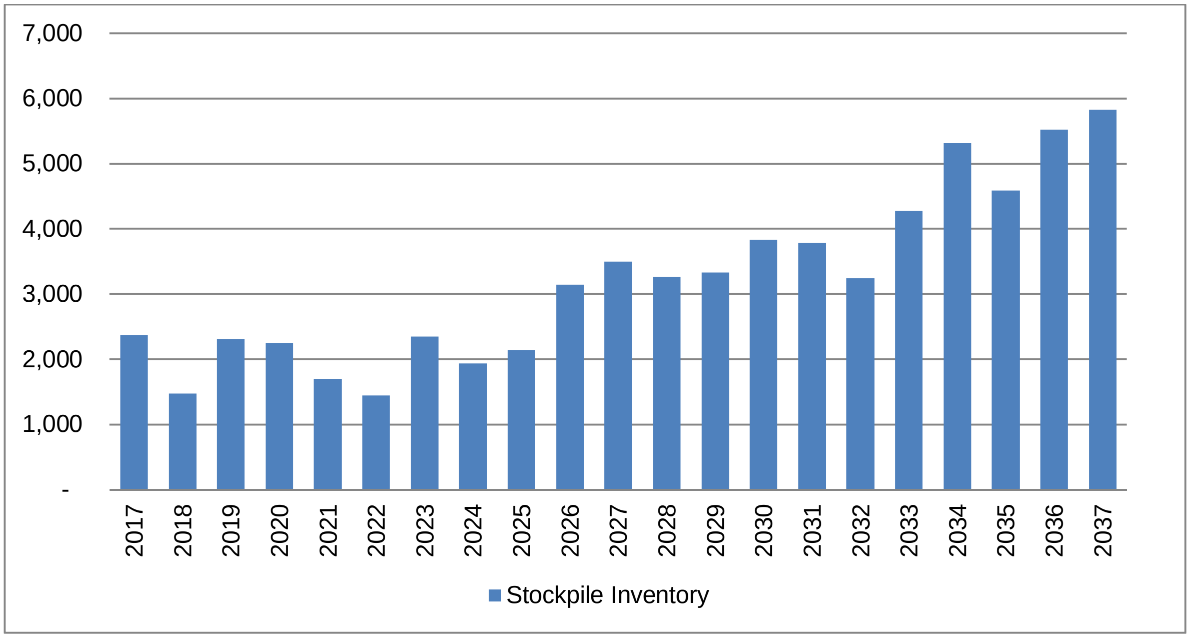


Figure 16-9: Stockpile Inventory

Table 16.8: Mine Production Schedule Detail by Period

Year	Ore (kt)	% Fe	% CaO	% MgO	% Al_2O_3	% SAT	Waste (kt)	Ovb. (kt)	Strip Ratio (W:O)	Total Tonnage (kt)
2017	2,367	29.62	0.09	0.15	0.23	1.78	3,323	119	1.45	5,808
2018	16,389	29.74	0.23	0.43	0.25	2.78	12,678	65	0.78	29,132
2019	20,834	30.33	0.21	0.40	0.24	2.12	8,537	1,423	0.48	30,794
2020	19,942	30.01	0.20	0.40	0.27	2.33	9,438	1,525	0.55	30,906
2021	19,446	29.95	0.07	0.13	0.32	1.39	11,303	634	0.61	31,383
2022	19,743	30.68	0.06	0.09	0.35	0.95	10,300	943	0.57	30,987
2023	20,908	30.80	0.06	0.09	0.35	0.88	12,679	618	0.64	34,205
2024	19,583	30.50	0.07	0.11	0.39	0.89	12,276	1,142	0.69	33,001
2025	20,213	30.96	0.08	0.12	0.42	0.80	13,383	35	0.66	33,631
2026	21,004	31.44	0.06	0.08	0.30	1.03	12,535	-	0.60	33,539
2027	20,351	30.89	0.80	0.70	0.30	2.33	7,272	1,171	0.41	28,794
2028	19,765	30.43	1.44	1.47	0.39	6.98	12,993	208	0.67	32,966
2029	20,064	29.84	1.63	1.56	0.43	6.40	7,710	113	0.39	27,887
2030	20,504	29.30	2.24	2.15	0.39	8.74	10,830	67	0.53	31,401
2031	19,954	28.24	3.19	2.91	0.38	10.07	9,658	25	0.49	29,637
2032	19,452	29.24	2.46	2.44	0.35	8.76	9,701	-	0.50	29,152
2033	21,033	29.59	2.07	1.99	0.35	6.06	6,482	7	0.31	27,522
2034	21,040	29.81	2.46	2.55	0.32	6.87	6,451	-	0.31	27,492
2035	19,276	30.10	2.36	2.41	0.28	6.43	4,553	-	0.24	23,829
2036	20,936	29.37	2.92	2.86	0.34	4.91	4,336	-	0.21	25,272
2037	20,306	29.27	2.97	2.87	0.49	5.25	2,939	-	0.14	23,244
2038	8,604	29.19	3.30	3.17	0.40	5.01	1,413	8	0.17	10,026
Total	**411,713**	**30.01**	**1.33**	**1.33**	**0.35**	**4.31**	**190,791**	**8,103**	**0.48**	**610,607**

Table 16.9: Mine Production – East Pit – Total Tonnage Mined by Bench (Mt)

Bench	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
830	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
816	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
802	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
788	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-
774	-	-	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-
760	-	-	-	-	-	-	-	-	-	-	4.7	-	-	-	-	-	-	-	-	-	-	-
746	-	-	-	-	-	-	-	-	-	-	4.9	9.5	-	-	-	-	-	-	-	-	-	-
732	0.0	-	-	-	-	-	-	-	-	-	-	12.1	12.0	-	-	-	-	-	-	-	-	-
718	1.7	-	-	-	-	-	-	-	-	-	-	-	6.9	16.6	-	-	-	-	-	-	-	-
704	4.1	4.0	-	-	-	-	-	-	-	-	-	-	-	9.5	15.7	-	-	-	-	-	-	-
690	-	15.0	-	-	-	-	-	-	-	-	-	-	-	-	12.5	9.5	-	-	-	-	-	-
676	-	10.1	5.8	-	-	-	-	-	-	-	-	-	-	-	-	18.5	2.5	-	-	-	-	-
662	-	-	12.1	-	-	-	-	-	-	-	-	-	-	-	-	-	15.5	3.1	-	-	-	-
648	-	-	9.0	2.0	-	-	-	-	-	-	-	-	-	-	-	-	1.4	16.3	-	-	-	-
634	-	-	-	7.8	-	-	-	-	-	-	-	-	-	-	-	-	0.7	8.0	6.8	-	-	-
620	-	-	-	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.1	-	-	-
606	-	-	-	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.9	8.3	-	-
592	-	-	-	0.3	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.4	-	-
578	-	-	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.6	1.7	-
564	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.6	-
550	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9	-
536	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2	-
522	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8	1.0
508	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2
494	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.3
480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8
466	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0
452	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7
438	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.8	29.1	27.0	19.1	3.6	-	-	-	-	-	9.9	21.6	18.9	26.1	28.3	28.0	20.1	27.5	23.8	25.3	23.2	10.0

Table 16.10: Mine Production – East Pit – Total Ore Tonnage Mined by Bench (Mt)

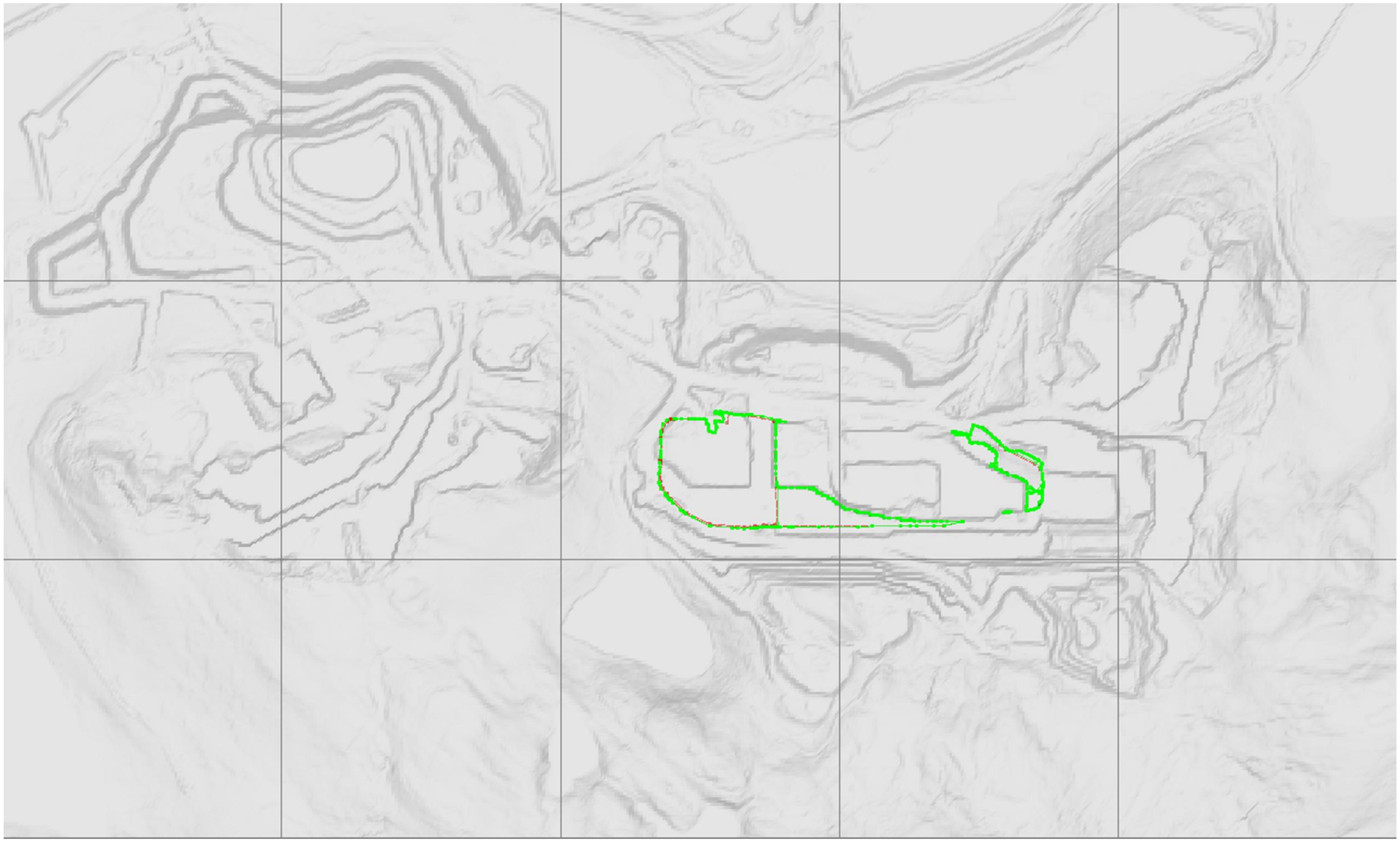
Bench	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
830	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
816	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
802	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
788	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
774	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
760	-	-	-	-	-	-	-	-	-	-	1.8	-	-	-	-	-	-	-	-	-	-	-
746	-	-	-	-	-	-	-	-	-	-	3.3	4.5	-	-	-	-	-	-	-	-	-	-
732	-	-	-	-	-	-	-	-	-	-	-	5.4	7.8	-	-	-	-	-	-	-	-	-
718	0.6	-	-	-	-	-	-	-	-	-	-	-	4.3	9.6	-	-	-	-	-	-	-	-
704	1.8	1.8	-	-	-	-	-	-	-	-	-	-	-	6.0	10.2	-	-	-	-	-	-	-
690	-	8.8	-	-	-	-	-	-	-	-	-	-	-	-	8.5	6.3	-	-	-	-	-	-
676	-	5.7	4.1	-	-	-	-	-	-	-	-	-	-	-	-	12.2	2.0	-	-	-	-	-
662	-	-	8.8	-	-	-	-	-	-	-	-	-	-	-	-	-	11.5	2.4	-	-	-	-
648	-	-	6.9	1.4	-	-	-	-	-	-	-	-	-	-	-	-	1.4	12.4	-	-	-	-
634	-	-	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	0.6	6.2	5.5	-	-	-
620	-	-	-	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.2	-	-	-
606	-	-	-	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	6.8	-	-
592	-	-	-	0.3	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6	-	-
578	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.6	1.3	-
564	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	-
550	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	-
536	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.8	-
522	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	0.8
508	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8
494	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.9
480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5
466	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9
452	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6
438	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2.4	16.4	19.7	14.5	3.0	-	-	-	-	-	5.2	9.9	12.1	15.6	18.7	18.5	15.5	21.0	19.3	20.9	20.3	8.6

Table 16.11: Mine Production – West Pit - Total Tonnage Mined by Bench (Mt)

Bench	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
830	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
816	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
802	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
788	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
774	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
760	-	-	2.4	-	-	1.1	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
746	-	-	1.4	5.4	-	-	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
732	-	-	-	6.4	4.0	-	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
718	-	-	-	-	13.3	-	5.0	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
704	-	-	-	-	10.5	7.5	-	12.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	15.4	-	2.5	8.0	-	-	-	-	-	-	-	1.0	-	-	-	-	-
676	-	-	-	-	-	6.8	7.7	-	11.5	-	-	-	-	-	-	-	0.8	-	-	-	-	-
662	-	-	-	-	-	-	11.9	-	4.3	5.6	-	-	-	-	-	-	0.4	-	-	-	-	-
648	-	-	-	-	-	-	1.2	10.0	-	9.0	-	-	-	-	-	-	-	-	-	-	-	-
634	-	-	-	-	-	-	-	5.4	-	10.4	-	-	-	-	-	-	-	-	-	-	-	-
620	-	-	-	-	-	-	-	-	4.5	7.4	2.5	-	-	-	-	-	-	-	-	-	-	-
606	-	-	-	-	-	-	-	-	3.0	-	8.6	-	-	-	-	-	-	-	-	-	-	-
592	-	-	-	-	-	-	-	-	2.4	-	8.3	-	-	-	-	-	-	-	-	-	-	-
578	-	-	-	-	-	-	-	-	-	1.2	-	7.4	-	-	-	-	-	-	-	-	-	-
564	-	-	-	-	-	-	-	-	-	-	-	4.0	2.8	-	-	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-	-	-	-	-	-	5.2	-	-	-	-	-	-	-	-	-
536	-	-	-	-	-	-	-	-	-	-	-	-	1.1	3.7	-	-	-	-	-	-	-	-
522	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	1.4	0.5	-	-	-	-	-	-
508	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	2.4	-	-	-	-	-
494	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	-	-	-	-	-
480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-
466	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
452	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
438	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	3.8	11.8	27.8	31.0	34.2	33.0	33.6	33.5	19.4	11.4	9.0	5.3	1.4	1.2	7.4	-	-	-	-	-

Table 16.12: Mine Production – West Pit – Total Ore Tonnage Mined by Bench (Mt)

Bench	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
830	`	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
816	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
802	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
788	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
774	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
760	-	-	0.3	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
746	-	-	0.8	2.4	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
732	-	-	-	3.1	2.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
718	-	-	-	-	7.8	-	2.3	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
704	-	-	-	-	6.5	4.4	-	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
690	-	-	-	-	-	10.1	-	0.4	3.8	-	-	-	-	-	-	-	0.8	-	-	-	-	-
676	-	-	-	-	-	4.8	5.2	-	5.0	-	-	-	-	-	-	-	0.7	-	-	-	-	-
662	-	-	-	-	-	-	9.0	-	2.1	2.9	-	-	-	-	-	-	0.3	-	-	-	-	-
648	-	-	-	-	-	-	1.1	7.7	-	4.7	-	-	-	-	-	-	-	-	-	-	-	-
634	-	-	-	-	-	-	-	4.9	-	7.1	-	-	-	-	-	-	-	-	-	-	-	-
620	-	-	-	-	-	-	-	-	4.1	5.2	1.9	-	-	-	-	-	-	-	-	-	-	-
606	-	-	-	-	-	-	-	-	2.9	-	7.0	-	-	-	-	-	-	-	-	-	-	-
592	-	-	-	-	-	-	-	-	2.3	0.0	6.8	-	-	-	-	-	-	-	-	-	-	-
578	-	-	-	-	-	-	-	-	-	1.2	-	6.3	-	-	-	-	-	-	-	-	-	-
564	-	-	-	-	-	-	-	-	-	-	-	3.6	2.1	-	-	-	-	-	-	-	-	-
550	-	-	-	-	-	-	-	-	-	-	-	-	4.9	-	-	-	-	-	-	-	-	-
536	-	-	-	-	-	-	-	-	-	-	-	-	1.0	3.3	-	-	-	-	-	-	-	-
522	-	-	-	-	-	-	-	-	-	-	-	-	-	1.6	1.3	0.3	-	-	-	-	-	-
508	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	1.7	-	-	-	-	-
494	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3	-	-	-	-	-
480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	-	-	-	-
466	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
452	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
438	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	1.1	5.4	16.5	19.7	20.9	19.6	20.2	21.0	15.6	9.9	8.0	4.9	1.3	1.0	5.5	-	-	-	-	-

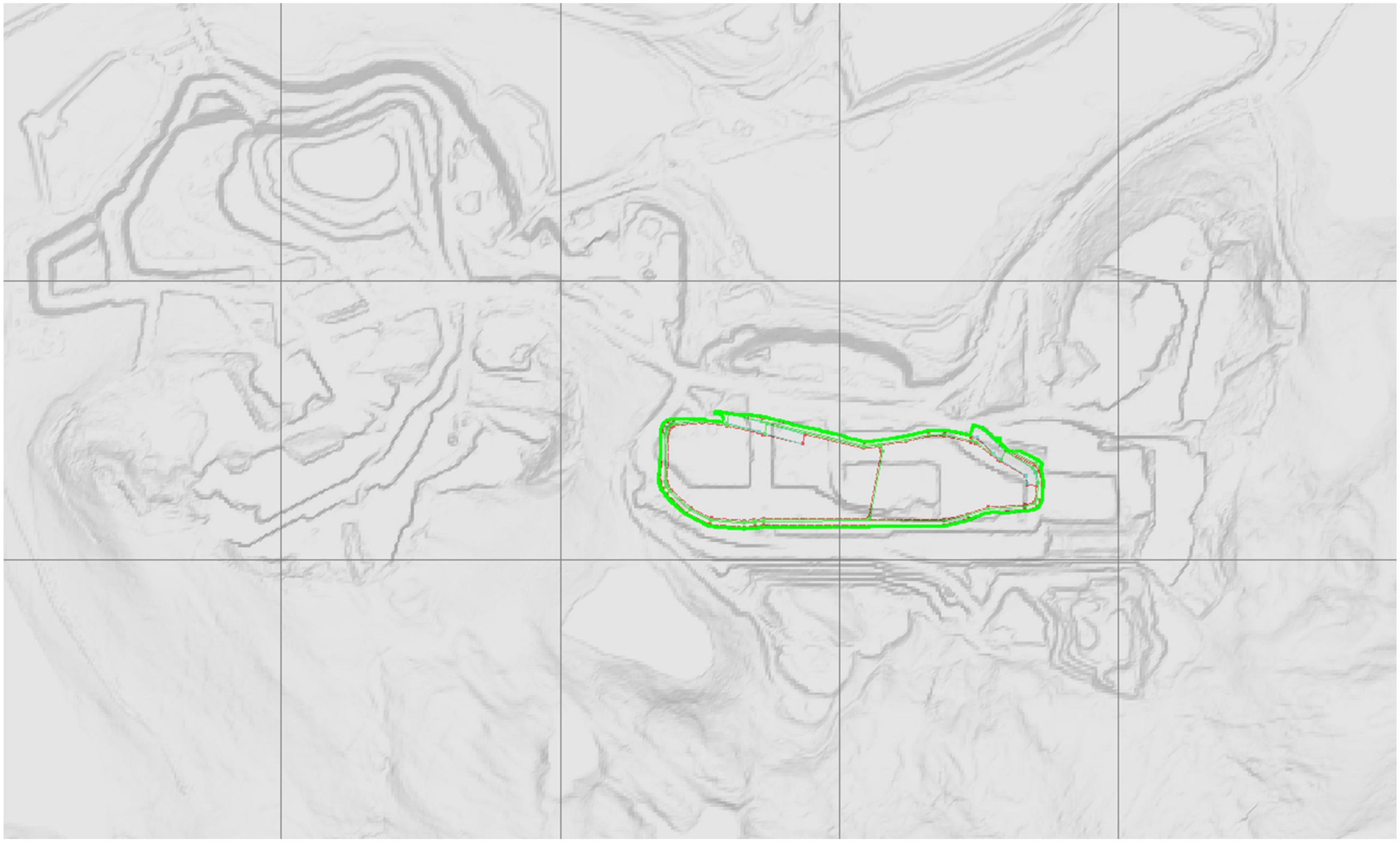


MINING SERVICES INC.

Pit Schedule – Q4-2017

Source: G Mining
Date: November 2016

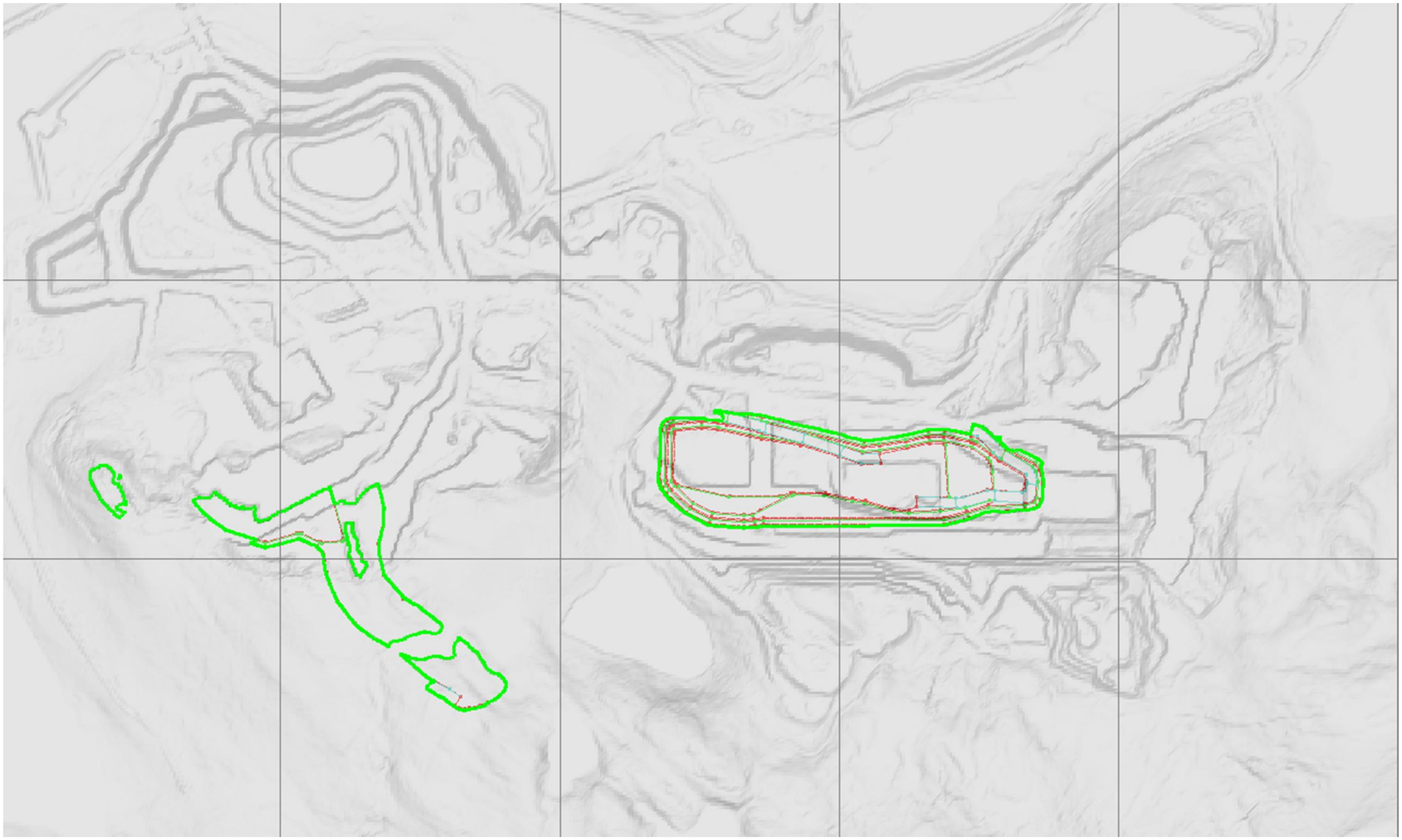
Figure 16-10: Production Schedule – 2017



Pit Schedule – Q4-2018

Source: G Mining
Date: November 2016

Figure 16-11: Production Schedule – 2018

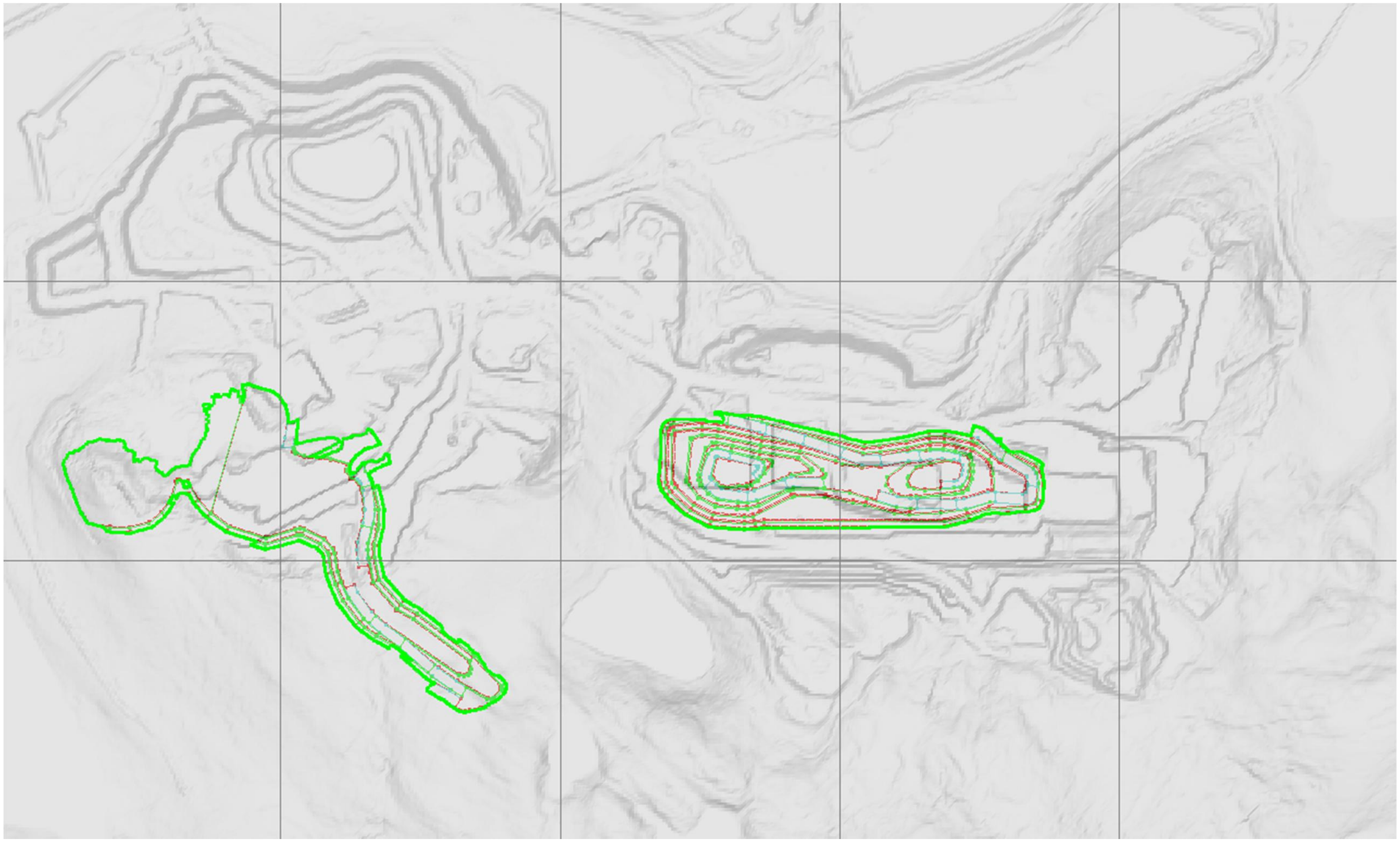


MINING SERVICES INC.

Pit Schedule – 2019

Source: G Mining
Date: November 2016

Figure 16-12: Production Schedule – 2019

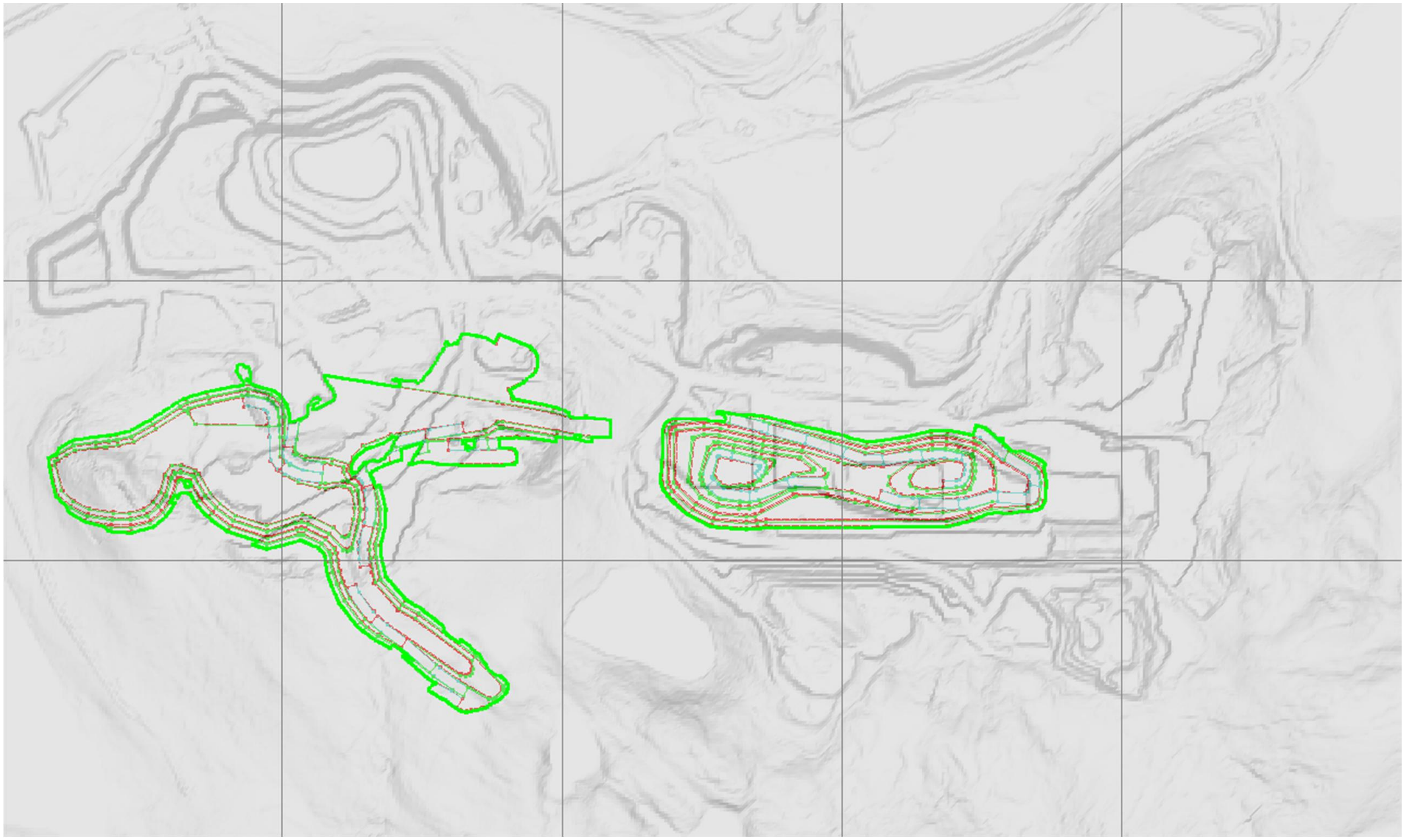


MINING SERVICES INC.

Pit Schedule – 2021

Source: G Mining
Date: November 2016

Figure 16-13: Production Schedule – 2021

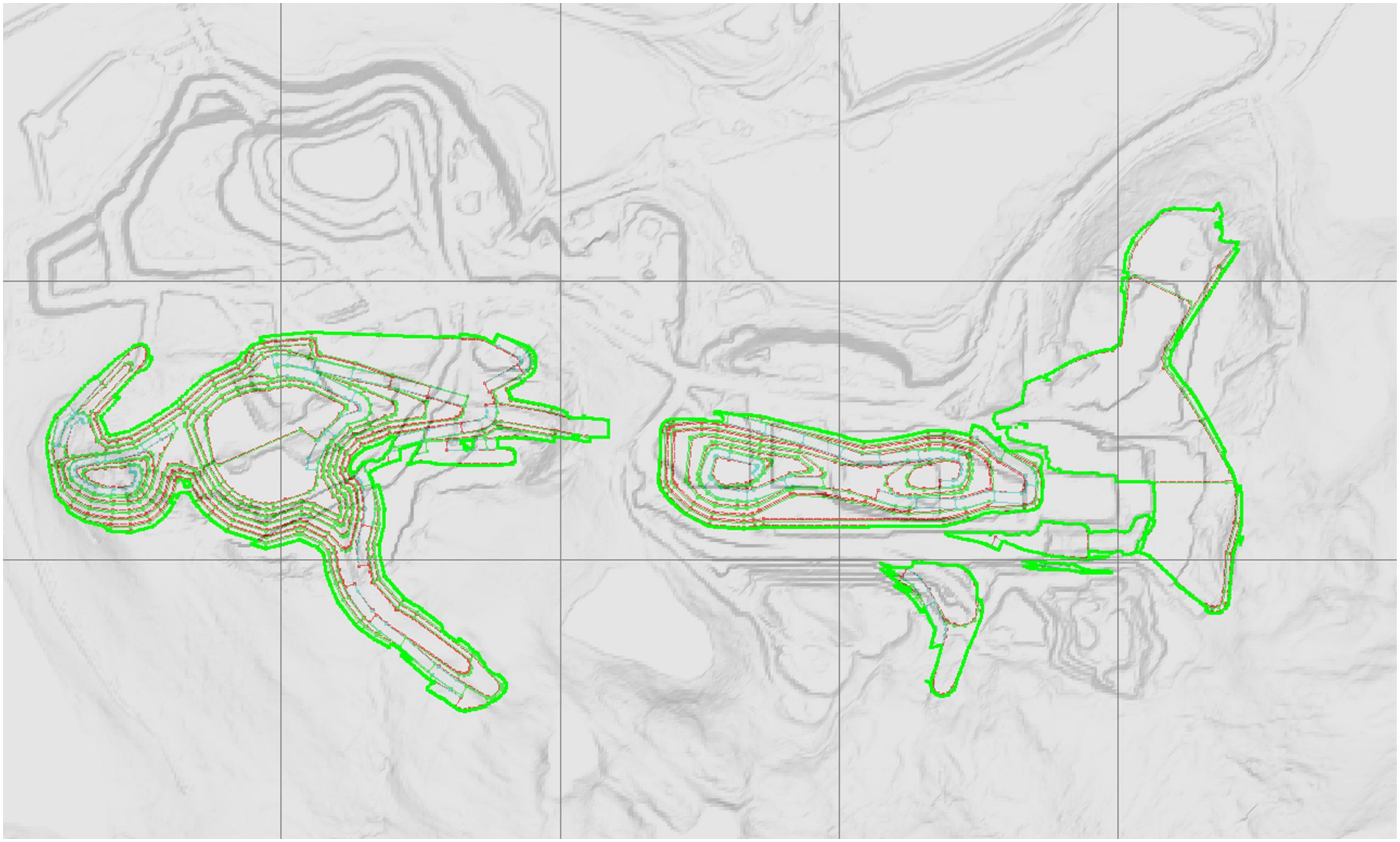


MINING SERVICES INC.

Pit Schedule – 2023

Source: G Mining
Date: November 2016

Figure 16-14: Production Schedule – 2023

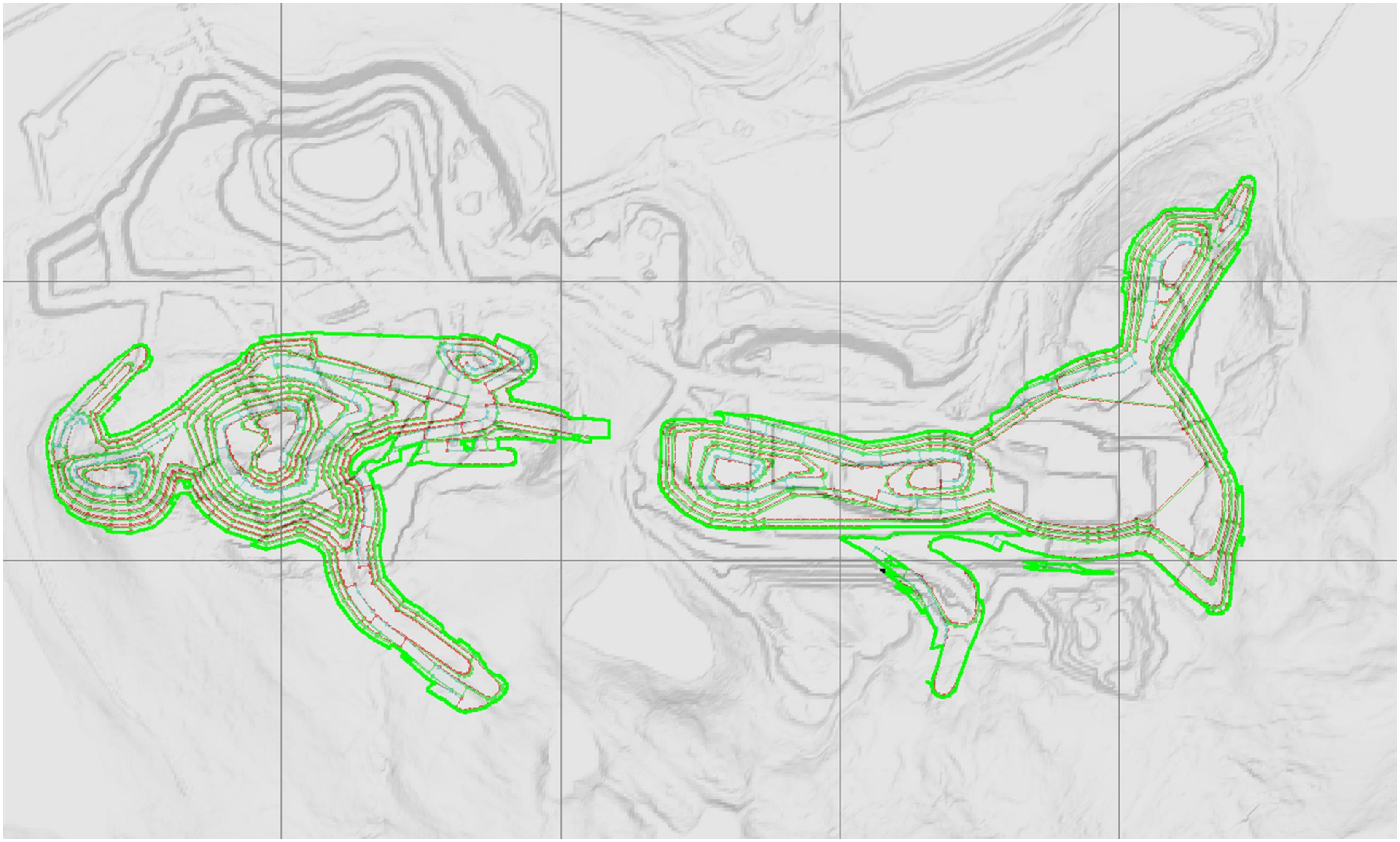


MINING SERVICES INC.

Pit Schedule – 2028

Source: G Mining
Date: November 2016

Figure 16-15: Production Schedule – 2028

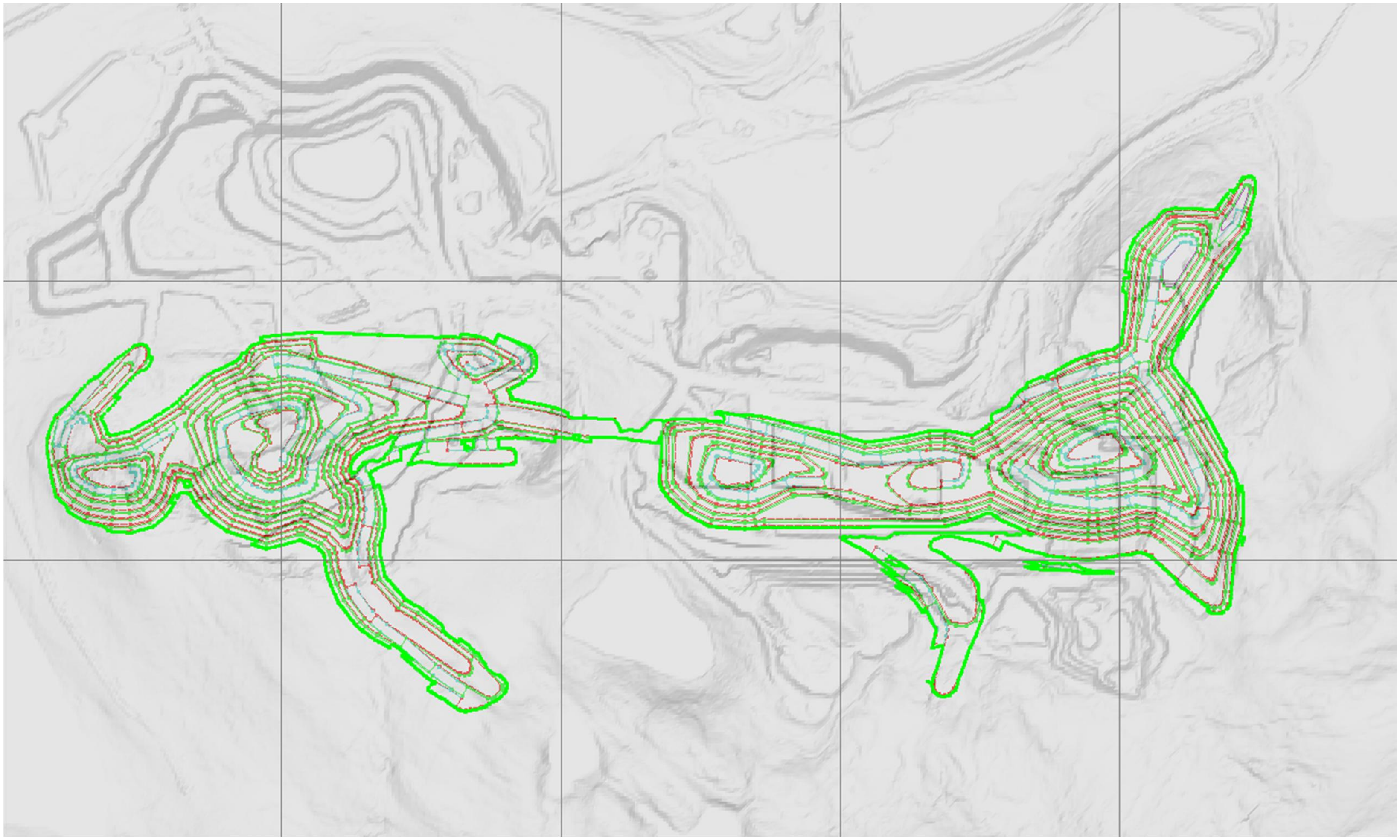


G MINING SERVICES INC.

Pit Schedule – 2033

Source: G Mining
Date: November 2016

Figure 16-16: Production Schedule – 2033



Pit Schedule – 2038

Source: G Mining
Date: November 2016

Figure 16-17: Production Schedule – 2038

16.3.3 Mill Production Schedule

The mill production schedule is presented in Table 16.14. The ramp-up and commissioning period is three months from January 2018 to March 2018 (Table 16.13). A total tonnage of 18.0 Mt is planned for 2018. From the second quarter of 2018 onwards the mill throughput is planned at 100% of nameplate which is equivalent to 20 Mt/y.

The metallurgical recovery during the ramp up and commissioning period has been adjusted downwards from normal steady-state operating performance expectations. Concentrate production averages 7.4 Mtpy over the 20.5 year LOM. The concentrate, at 66.2% iron, is obtained with a metallurgical recovery that averages 83.3% over the same period.

Table 16.13: Mill Ramp-Up

Mill Ramp-Up Schedule	Tonnage (% of Nameplate)	Fe Recovery (%)
Month 1	40	70
Month 2	60	77
Month 3	80	80
Month 4	100 (Full)	Fe % * 0.01 + 0.533 (Full)

Table 16.14: Mill Production Schedule Detail by Period

Year	Ore Milled (kt)	% Fe	% CaO	% MgO	% Al_2O_3	% SAT	% Fe Recovery
2018	18,027	29.7	0.22	0.41	0.25	2.71	0.00
2019	20,000	30.3	0.21	0.40	0.24	2.07	82.10
2020	20,000	30.0	0.20	0.39	0.27	2.35	83.64
2021	20,000	30.0	0.07	0.13	0.32	1.40	83.30
2022	20,000	30.7	0.06	0.09	0.35	0.96	83.26
2023	20,000	30.8	0.06	0.09	0.35	0.88	83.97
2024	20,000	30.5	0.07	0.11	0.39	0.89	84.10
2025	20,000	31.0	0.08	0.12	0.42	0.80	83.80
2026	20,000	31.4	0.06	0.08	0.30	1.03	84.26
2027	20,000	30.9	0.82	0.71	0.30	2.35	84.74
2028	20,000	30.4	1.42	1.45	0.39	6.91	84.18
2029	20,000	29.8	1.64	1.58	0.43	6.45	83.74
2030	20,000	29.2	2.29	2.20	0.39	8.90	83.12
2031	20,000	28.7	2.80	2.59	0.37	9.59	82.54
2032	20,000	29.0	2.68	2.60	0.36	8.81	81.95
2033	20,000	29.5	2.20	2.10	0.35	6.26	82.25
2034	20,000	29.8	2.47	2.56	0.32	6.71	82.76
2035	20,000	30.1	2.31	2.37	0.29	6.33	83.09
2036	20,000	29.7	2.61	2.62	0.34	4.82	83.42
2037	20,000	29.3	2.98	2.86	0.49	5.24	82.99
2038	13,686	29.2	3.00	2.86	0.36	5.03	82.60
Total	**411,713**	**30.0**	**1.33**	**1.33**	**0.35**	**4.31**	**83.29**

Table 16.15: Concentrate Production Detail by Period

Year	Concentrate (kt)	%Fe	%CaO	%MgO	%Al_2O_3	%SAT
2018	6,646	66.2	0.09	0.14	0.17	4.76
2019	7,667	66.2	0.09	0.14	0.17	3.47
2020	7,549	66.2	0.09	0.14	0.17	4.05
2021	7,535	66.2	0.07	0.10	0.18	2.12
2022	7,780	66.2	0.07	0.09	0.19	1.24
2023	7,826	66.2	0.07	0.09	0.19	1.08
2024	7,723	66.2	0.07	0.10	0.20	1.10
2025	7,881	66.2	0.07	0.10	0.20	0.92
2026	8,049	66.2	0.07	0.09	0.18	1.37
2027	7,852	66.2	0.17	0.19	0.18	4.04
2028	7,700	66.2	0.25	0.32	0.20	13.22
2029	7,489	66.2	0.28	0.34	0.20	12.31
2030	7,292	66.2	0.37	0.44	0.20	17.25
2031	7,093	66.2	0.44	0.50	0.19	18.64
2032	7,194	66.2	0.43	0.50	0.19	17.07
2033	7,367	66.2	0.36	0.42	0.19	11.91
2034	7,479	66.2	0.40	0.50	0.18	12.82
2035	7,590	66.2	0.38	0.47	0.18	12.05
2036	7,444	66.2	0.42	0.51	0.19	9.01
2037	7,311	66.2	0.47	0.55	0.22	9.87
2038	4,977	66.2	0.47	0.55	0.19	9.44
Total	**155,446**	**66.2**	**0.24**	**0.29**	**0.19**	**7.83**

16.3.4 Waste Requirements for Civil Work

Waste material will be required for construction and various usages in the mine. The total waste rock required is 1.6 Mt mainly for the TMF (50%), followed by road maintenance (40%) with minor quantities for stemming material for blasting (10%).

16.4 Mine Operations and Equipment Selection

16.4.1 Mine Operations Approach

Mining is to be carried out using conventional open pit techniques with electric hydraulic shovels and mining trucks in a bulk mining approach with 14 m benches. An owner mining open pit operation is planned with the outsourcing of certain support activities such as explosives manufacturing and blasthole loading.

16.4.2 Production Drilling and Blasting

Drill and blast specifications are established to effectively single pass drill and blast a 14 m bench. For this bench height a 311 mm blast hole size is proposed with a 6.25 m burden by 7.25 m spacing with 1.5 m of sub-drill. These drill parameters combined with a high energy bulk emulsion with a density of 1.2 kg/m^3 result in a powder factor of 0.40 kg/t. Blast holes are initiated with electronic detonators and primed with 450 g boosters. The bulk emulsion product is a gas sensitized pumped emulsion blend specifically designed for use in wet blasting applications.

Several rock types are present in the pit including hematite, gneiss, schist, quartzite and amphibolite. The average rock properties based on testing show a range in hardness between 52 and 119 MPa (Table 16.16).

Table 16.16: Rock Properties

Rock Properties		Hematite Iron Formation	Gneiss	Schist	Quartzite	Amphibolite
UCS	MPa	119	67	52	113	80
Young's Modulus	GPa	43.95	20.15	11.25	n/a	29.84
Poisson’s Ratio	%	0.19	0.27	n/a	n/a	0.22
Specific Gravity	t/m^3	3.41	2.74	2.77	2.68	3.04

The drilling parameters used in the study are based on data collected from the previous operation at Bloom Lake. The average drill productivity for the production rigs is estimated at 43 m/h instantaneous with an overall penetration rate of 19.4 m/h. The overall drilling factor represents time lost in the cycle when the rig is not drilling such as move time between holes, moves between patterns, drill bit changes, etc. The average drilling productivity for each of the two available drills is estimated at 2,620 t/h including the 6% re-drill factor.

The blast hole rig available for production drilling has a hole size range of 244 mm to 406 mm with a single pass drill depth of 21.3 m with a 21.4 m tower configuration. The drill model is the Bucyrus 49HR electric drive, which is now equivelant to Caterpillar MD6640.

Blasting activities will be outsourced to an explosives provider who will be responsible for supplying and delivering bulk explosives in the hole. The mine engineering department will be responsible for designing blast patterns and relaying hole information to the drills via the wireless network.

Blast hole loading and firing activities will be performed on day shift only. During full production, the blasting team will consist of 5 individuals. One of them will be operating the explosive truck (contractor), there will be one blaster and two helpers, one stemming truck operator as well as one drill and blast supervisor. All accessories and blasting consumables will be purchased through the bulk explosive supplier.

Budgeting of explosives products and services is based on proposals received from suppliers, although no final agreement has been made. The cost for blast movement monitoring has been included in the blasting cost.

In the current Feasibility Study, a mobile manufacturing unit (“MMU”) was chosen. The approach reduces infrastructure construction. The emulsion truck is a miniature emulsion factory that mixes ANSOL and fuel to form emulsion at the blast hole location. Thus, the provider is not storing an amount of emulsion on-site, but stores required ingredients (ANSOL, fuel, gasser and water) in separate tanks which are not considered as explosives. For this reason, the explosives plant or depot can be located closer to the mining operations.

Table 16.17: Drill & Blast Parameters

Drill and Blast Parameters		Ore	Gneiss	Schist	Quartzite	Amph.
Drill Pattern						
Explosive Density	g/cm^3	1.2	1.2	1.2	1.2	1.2
Hole Diameter	in	12.25	12.25	12.25	12.25	12.25
Diameter (D)	m	0.311	0.311	0.311	0.311	0.311
Burden (B)	m	6.25	7.50	7.50	7.50	7.00
Spacing (S)	m	7.25	8.50	8.50	8.50	8.00
Subdrill (J)	m	1.50	1.50	1.50	1.50	1.50
Stemming (T)	m	6.00	6.00	6.00	6.00	6.00
Bench Height (H)	m	14.00	14.00	14.00	14.00	14.00
Blasthole Length (L)	m	15.50	15.50	15.50	15.50	15.50
Pattern Yield						
Rock Density	t/bcm	3.41	2.74	2.77	2.68	3.04
BCM/hole	bcm/hole	634	893	893	893	784
Yield per Hole	t/hole	2,164	2,445	2,472	2,392	2,381
Yield per Meter Drilled	t/m drilled	140	158	159	154	154
Powder Factor	kg/t	0.40	0.35	0.35	0.36	0.36
Weight of Expl. per Hole	kg/hole	867	867	867	867	867
Drill Productivity						
Re-drills	%	6%	6%	6%	6%	6%
Pure Penetration Rate	m/h	43.0	43.0	43.0	43.0	43.0
Overall Drilling Factor (%)	%	45%	45%	45%	45%	45%
Overall Penetration Rate	m/h	19.4	19.4	19.4	19.4	19.4
Drilling Productivity	t/h	2,701	3,053	3,086	2,986	2,972
Drilling Efficiency	holes/h	1.25	1.25	1.25	1.25	1.25

16.4.3 Ore Control

The ore control program will consist of establishing dig limits for ore and waste in the field to guide loading unit operators. A high precision system combined with an arm geometry system will allow shovels to target small dig blocks and perform selective mining. The system will give operators real-time view of dig blocks, ore boundaries, and other positioning information. Physical flagging in the field will also be implemented.

The ore control boundaries will be established by the technical services department based on grade control information obtained through blast hole sampling with post-blast boundaries adjusted for blast movement measurements made using a BMM® system. A blast movement monitoring system has been included in the blasting cost for 20% of the blasts. The blast hole cuttings will be analyzed for half (50%) of the blastholes. An XRF technology will also be utilized for waste ore contact confirmation.

16.4.4 Pre-Split

Pre-split drill and blast is planned to maximize stable bench faces and to maximize inter-ramp angles along pit walls as prescribed by the geotechnical pit slope study. The pre-split consists of a row of closely-spaced holes along the design excavation limit of interim and final walls. The holes are loaded with a light charge and detonated simultaneously or in groups separated by short delays. Firing the pre-split row creates a crack that forms the excavation limit and helps to prevent wall rock damage by venting explosive gases and reflecting shock waves. As a starter best-practice, it is recommended that operations restrict production blasts to within 50 m of an unblasted pre-shear line. Once the pre-split is shot, production blasts will be taken to within 10 m of the pre-shear and then a trim shot used to clean the face. Double bench pre-split holes spaced 1.8 m apart will be 36.2 m in length and drilled with a smaller diameter of 165 mm (6.5 in.).

Blasting of the pre-split holes will use a special packaged pre-split explosive internally traced with detonating cord that ensures fast and complete detonation of the decoupled charge. For our specific application, a 40 mm diameter cartridge, 28 m long will be used. This load factor of 2.37 kg/m allows for a targeted charge weight of 1.02 kg/m^2 of face.

Table 16.18: Pre-Split Parameters

Pre-Split Parameters		Pre-Split single	Pre-Split double
Drill Pattern			
Hole Diameter	in	5	6.5
Diameter (D)	m	0.127	0.165
Spacing (S)	m	1.8	1.8
Bench Height (H)	m	14	28
Pre-Split Hole Length (L)	m	18.1	36.2
Face Area	m^2	32.58	65.16
Explosives Charge	kg	33	66.36
Charge Factor	kg/m^2 face	1.02	1.02
Cartridge Charge			
Nb Cartridges	qty	35	70
Cartridge Length	m	0.40	0.40
Cartridge Loading Factor	kg/m	2.37	2.37
Decoupled Charge Length	m	14	28
Decoupled Charge	kg	33	66
Drill Productivity			
Pure Penetration Rate	m/h	46.2	41
Overall Drilling Factor (%)	%	83%	84
Overall Penetration Rate	m/h	38.2	34.4
Drilling Efficiency	holes/h	2.1	1.0
Meters of Drilling per m Crest	m/m of crest	10.06	20.11

The drill selected for this application is a more flexible type of rig capable of drilling down-the hole angled holes. The hole size range of this rig is between 110 mm and 203 mm with a maximum hole depth of 55 m. Suitable models for this application are the Atlas Copco SmartRoc D65 or the Sandvik DR560. This drill is not presently available and will be purchased.

16.4.5 Loading

The majority of the loading in the pit will be done by two electric drive hydraulic face shovels equipped with a 23 m^3 bucket. The shovels are matched with a fleet of 218 t payload capacity mine trucks. The project already owns three Caterpillar 6060 electric drive hydraulic front shovels. The hydraulic shovels will be complemented by one production front-end wheel loader (“FEL”) with a 12 m^3 bucket. Two Komatsu WA1200-6 units are available on site.

Although interchangeable, the hydraulic shovels will primarily be operating in ore and waste while the wheel loaders will primarily be used for re-handling operations. For the last eight years of the mine life a significant portion of the the production will be shifted to the loader to avoid the purchase of a replacement front shovel. The loading productivity assumptions for both types of loading tools in ore, waste and overburden are presented in Table 16.19.

The 23 m^3 shovel is expected to achieve a productivity of 3,381 t/h based on a 4 pass match with the mine trucks and an average load time of 2.9 minutes. The productivity in waste will decrease at 3,160 t/h due to the lower density of material.

The wheel loader is expected to achieve a productivity of 2,067 t/h based on a 7 pass match and an average load time of 4.6 minutes in ore. The productivity in waste is estimated at 1,881 t/h.

Table 16.19: Loading Specifications

Loading Unit		**Shovel (23 m^3)**	**Shovel (23 m^3)**	**FEL (12 m^3)**	**FEL (12 m^3)**
Haulage Unit		**Truck (218 t)**	**Truck (218 t)**	**Truck (218 t)**	**Truck (218 t)**
Material		**Ore**	**Wst/Ovb**	**Ore**	**Wst/Ovb**
Rated Payload	t	217	217	217	217
Heaped Volume	m^3	149	149	149	149
Bucket Capacity	m^3	23	23	12	12
Bucket Fill Factor	%	90%	92%	90%	92%
In-Situ Dry Density	t/bcm	3.60	3.20	3.60	3.20
Moisture	%	3%	5%	3%	5%
Swell	%	33%	33%	33%	33%
Wet Loose Density	t/lcm	2.79	2.53	2.79	2.53
Actual Load Per Bucket	t	57.71	53.46	31.09	28.80
Passes (Decimal)	#	3.76	4.06	6.98	7.54
Passes (Whole)	#	4.00	4.00	7.00	8.00
Actual Truck Wet Payload	t	231	214	218	230
Actual Truck Dry Payload	t	224	204	211	219
Actual Heaped Volume	m^3	83	85	78	91
Payload Capacity		106%	99%	100%	106%
Heaped Capacity		56%	57%	52%	61%
Cycle Time					
Truck Exchange	min	0.70	0.70	0.60	0.60
First Bucket Dump	min	0.10	0.10	0.10	0.10
Average Cycle Time	min	0.70	0.70	0.65	0.65
Load Time	min	2.90	2.90	4.60	5.25
Cycle Efficiency	%	75%	75%	75%	75%
Number of Trucks Loaded per h	#	15.52	15.52	9.78	8.57
Production / Productivity					
Avg. Prod. dry tonnes /h	t/h	3,478	3,160	2,067	1,881

16.4.6 Hauling

Haulage will be performed with 218 tonne class mine trucks. The existing truck fleets consist of seven Caterpillar 793D and three Caterpillar 793F mechanical drive trucks.

The truck fleet productivity was estimated using Talpac software. Cycle times have been digitized and estimated for each period for each dumping location depending on the type of material.

The assumptions and input factors for the Talpac simulations are presented in Table 16.20, Table 16.21 and Table 16.23.

A speed limit of 50 km/h was applied except for the bottom of the pit until the truck reaches the ramp where a speed limitation of 30 km/h was imposed to reflect the lack of proper road and less favorable rolling conditions on the pit floor.

Table 16.20: Speed Limits

Site Location	Speed Limit (km/h)
Pit on working bench, near dump face	30
Downhill Ramp < -5%	30
Mine Road and Ramps	50

Table 16.21: Rolling Resistance

Road Type	Rolling Resistance (%)
Main Road	2.50
Ramp	3.00
Pit floor and near dump face	3.50

Table 16.22: Cycle Time Components

Cycle Time Component	Duration (min)
Truck Average Load Queue Time [1]	2.50
Truck Average spot Time at Loader	0.85
Truck Average Loading Time	2.90
Truck Average Dump Queue Time	0.00
Truck Average Spot Time at Dump	0.85
Truck Average Dumping Time	0.74

Note 1: Average Load Queue Time for a fleet of 10 trucks maximum

The fuel consumptions were also estimated with Talpac which generates a specific engine load factor depending on the proportion of the travel on ramp grades and on flatter gradients. Generally, the fuel burn rate increases with depth as a longer period of time is spent on grade.

The following tables present the results for the haulage study. When cycle times decrease going forward in the schedule it is due to the mining of benches higher in the pit when new mining phases are initiated.

The total haul hours required by period determines the number of trucks required throughout the LOM. The truck fleet reaches a maximum of 10 units in 2025 and remains at this level until 2028 before it starts decreasing as a result of a drop in mining rate.

Table 16.23: Ore Haulage Results

Phase	Distance (m)	Hauling Hours (h)	Average Cycle Time (min)	Average Travel Velocity (km/h)	Fuel Consumption (L/NOH)*
2017	2,306	2,119	12.0	28	96
2018	3,088	15,162	12.2	34	127
2019	4,250	25,179	16.3	29	153
2020	5,616	27,346	18.4	31	170
2021	5,646	25,403	17.6	33	166
2022	6,070	26,244	17.9	35	172
2023	5,632	27,573	17.7	33	159
2024	5,346	26,967	18.5	29	163
2025	5,652	29,386	19.6	28	175
2026	5,723	32,352	20.7	26	183
2027	6,059	29,437	19.5	30	178
2028	6,130	28,998	19.7	30	164
2029	5,718	26,063	17.5	34	168
2030	5,348	25,482	16.7	34	155
2031	5,489	25,945	17.5	33	166
2032	5,568	25,786	17.8	32	174
2033	6,005	31,029	19.8	29	173
2034	6,510	32,610	20.8	29	184
2035	6,918	31,604	22.0	28	194
2036	6,323	34,333	22.1	26	179
2037	7,122	36,202	24.0	26	191
2038	8,931	20,435	31.9	22	212
TOTAL	**5,921**	**585,655**	**19.6**	**30**	**173**

* NOH : Net Operating Hour (Defined in Figure 16.20)

Table 16.24: Waste Haulage Results

Phase	Distance (km)	Hauling Hours (h)	Average Cycle Time (min)	Average Travel Velocity (km/h)	Fuel Consumption (L/NOH)*
2017	4,964	4,283	17.3	29	144
2018	5,519	17,535	18.6	29	155
2019	6,133	28,091	22.1	25	162
2020	6,882	33,993	24.2	25	167
2021	5,507	33,305	19.8	27	162
2022	6,712	34,334	22.4	27	162
2023	6,020	39,894	21.2	26	154
2024	5,772	38,554	21.1	25	163
2025	5,774	46,993	23.6	21	158
2026	6,019	43,241	23.2	23	172
2027	6,572	27,854	25.8	21	172
2028	7,617	50,440	26.1	24	186
2029	7,859	30,812	26.9	24	190
2030	6,413	40,278	25.0	22	176
2031	7,020	36,774	25.6	23	187
2032	6,354	34,086	23.6	23	173
2033	6,593	23,303	24.2	24	183
2034	7,261	23,618	24.6	25	187
2035	7,657	18,719	27.6	23	182
2036	7,006	16,740	26.0	23	176
2037	7,795	12,193	27.9	23	187
2038	9,661	7,448	35.4	21	212
TOTAL	**6,580**	**642,488**	**23.9**	**24**	**172**

* NOH : Net Operating Hour (Defined in Figure 16.20)

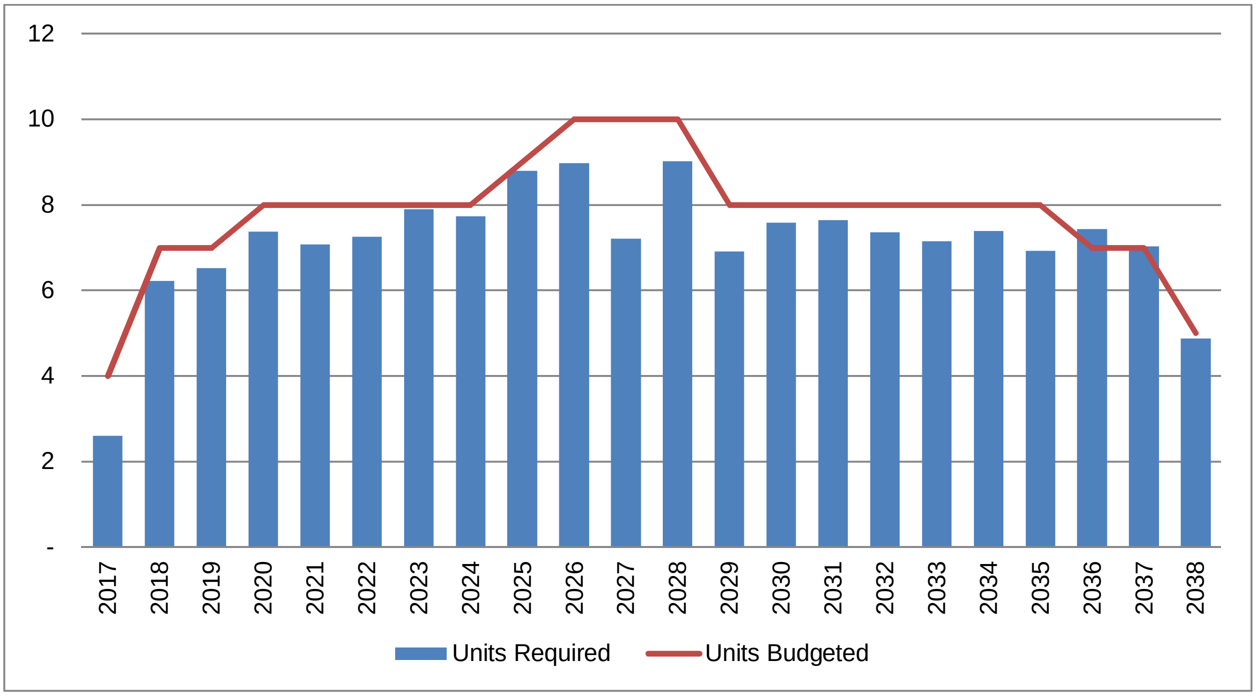


Figure 16-18: Truck Requirement – Required vs. Budgeted

16.4.7 Dewatering

The pumping system is designed to handle a 1 in 10 yr event. The data was provided by WSP with respect to the ultimate pit design. A maximum of 1,550 m^3/h from the West Pit and 1,050 m^3/h from the East Pit are considered necessary when a 1:10 yr event occurs. With these pumping rates, a period of 10 days would be required to remove water from the pit. The pumped water will be sent to sedimentation ponds. It is also assumed that only one pit at a time will be dewatered. Underground inflows were also estimated in the latest geotechnical Golder report. They were only considered for the East Pit as the inflows are estimated from the Confusion and Mazare Lakes.

Table 16.25: 1:10 yr Pumping Requirement

West Pit				
Event	**Snow m^3**	**Rainfall m^3**	**UG Inflow**	**Total m^3**
1:10yr	194,360	65,419	-	259,779
			HourlyPumpingRate	1,082
East Pit				
Event	**Snow m^3**	**Rainfall m^3**	**UG Inflow**	**Total m^3**
1:10 yr	164,262	55,289	155,000	374,551
			HourlyPumpingRate	1,561

For the study, the dewatering was based on annual precipitation which averages 0.84 m. The pumps used are the Tsurumi LH875. Two pumps are required for typical dewatering operations of the pit. To manage an extreme event (1 in 10 yr event) two additional pumps are required on standby.

16.4.8 Road and Dump Maintenance

Waste and ore storage areas will be maintained by a fleet of one 899 HP and two 630 HP track-type dozers. Also, a 904 HP wheel dozer is available on site (later replaced by a 687 HP wheel dozer) and will be dedicated to the maintenance of the mine roads and the loading areas.

Mine roads will be maintained by two 16 ft blade motor graders. A water/sand truck will be used to spray roads to suppress dust or spread road aggregate during winter months. Two small water trucks are also available (1 x water truck and 1 x sand truck). They will be used for areas inaccessible to the larger truck.

For snow removal activities, a 230 HP IT loader (toolcarrier) will be used either with a snow blade or with a snow blower for cleaning around buildings and in critical areas. If needed, a second IT loader from the maintenance department can give additional support.

16.4.9 Support Equipment

All miscellaneous construction related work, such as berm construction and water ditch cleaning will be done by one 49 t excavator. This unit will be equipped with a hydraulic hammer for boulders clearing after blasts.

For open pit service, two mechanic service trucks are planned, one fuel truck, one lube truck and one low-boy. Four light towers are required to illuminate critical workplaces such as at the loading face, stockpile area, and waste dump points. In other places, the electrical network of the pit could be used for lighting.

Several other pieces of equipment are planned to support the mining activities: one boom truck (28 t crane), one 230 HP utility wheel loader, one small 5 t forklift for the maintenance facility. A 785D tractor and low-boy trailer is also available for moving tracked equipment around the property. A backhoe loader as well as a vibratory compactor are available for road construction.

16.4.10 Mine Maintenance

The Bloom Lake project does not intend to sign for a maintenance and repair contract (“MARC”) for its mobile equipment fleet. Consequently, the maintenance department has been structured to fully manage this function, performing maintenance planning and training of employees. However, reliance on dealer and manufacturer support for major components is planned through component exchange programs. A provision for an external contract was budgeted as a yearly contractor fee for all major equipment.

Tire services such as tire pressure and wear monitoring, scheduled tire rotation, tire replacement and repairs will be outsourced and has been budgeted as part of the maintenance budget.

The maintenance department will require specialized tools for the specific equipment models on site such as diagnostic tools, pin pullers, hydraulic torque wrenches and general shop tools such as presses, nitrogen charging kits, air tools, lift stands and kidney looping machines. The cost for the replacement and repair of shop tools and specific equipment maintenance tools required has been included in the operating expenditures throughout the mine life.

A Computerized Maintenance Management System (CMMS) will be used to manage maintenance and repair operations. This system will keep up to date status, service history and maintenance needs of each machine. The specific software package is yet to be selected as this package will require an interface or integration to large external systems such as ERP’s, accounting, dispatch and condition monitoring system.

As most of the fleet was purchased used (between 12,000 to 33,000 hours), a provision of 3.48 M$ has been made in the pre-production CAPEX for a thorough mechanical inspection and for the replacement of certain major components that are due to be replaced based on equipment maintenance history. This amount also includes the labor costs for the tire repairs and the inspection of the fire suppression systems on all the units. Since the closure of the Bloom Lake project by Cliffs, the equipment has been inspected on occasion in 2015 and 2016 as part of the care and maintenance plan by equipment vendors.

16.4.11 Mine Management and Technical Services

The mine is headed by a mine manager who is responsible for the overall management of the mine. Superintendent positions in operations and maintenance report directly to the mine manager. Both the Chief Geologist and Chief Engineer will also report to the Mine Manager.

The operations department is composed of one foreman per crew (4 in total). A mine dispatcher is planned on each shift. To increase operator level performance and organize structured training programs two mine trainers are planned on day shift only. The operations department includes 15 staff employees at peak level.

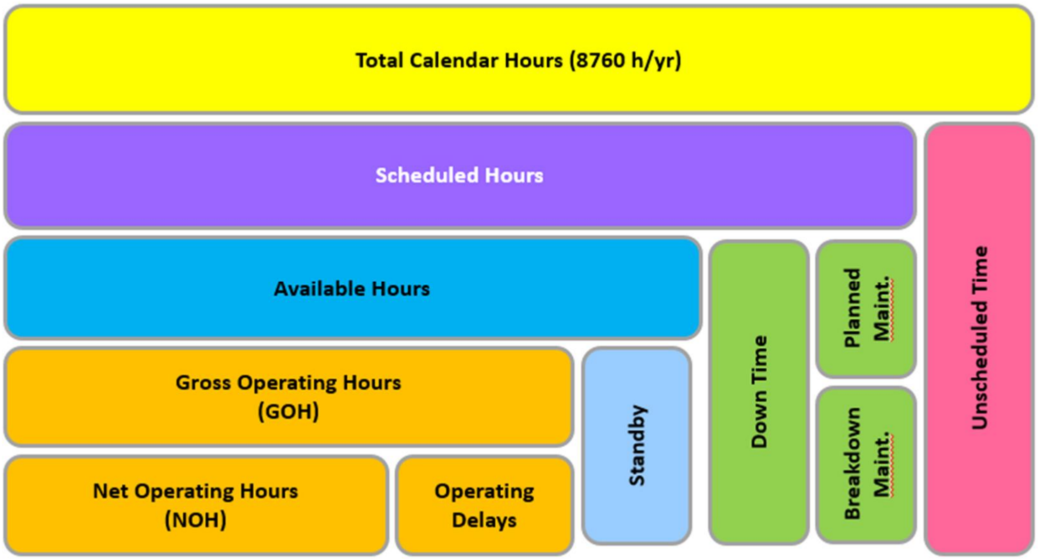
The engineering and geology team will provide support to the operations team by providing short-term and long-term planning, grade control, surveying, mining reserves estimation and all other technical functions. Operating costs for this group includes salaries, office supplies, software fees, survey and grade control supplies, etc. The engineering and geology team includes 36 employees.

16.4.12 Roster Schedules

While some of the workforce is to be sourced locally from neighboring communities such as Fermont (Qc), Labrador City (NL) or Wabush (NL) the rest of the workforce will be hired on a Fly-in Fly-out basis. Except for some certain administrative positions which would be on a standard 8 hour shift 5 days on/2 days off, the rest of the crews will be working 12-hour shifts with a 15 on / 13 off rotating schedule. Four crews are required to operate on a continuous basis 24-hours per day 365 days per year. This schedule for rotational employees results in 2,184 scheduled hours of work per year.

16.4.13 Equipment Usage Model Assumptions

The equipment hour usage model utilized to plan equipment requirements and productivity is illustrated in Figure 16-19 The typical equipment usage model assumptions are established by equipment groupings as presented in Table 16.26. The annual net operating hours (“NOH”) varies approximately between 5,000 and 6,000 hours per year.



The definitions are as follows:

- Calendar hours – defined as 8,760 hours/year
- Unscheduled hours – scheduled outages including statutory holidays, planned shutdowns and scheduled down shifts
- Scheduled hours – total calendar hours less unscheduled hours
- Down hours – time unit is mechanically inoperable due to preventive maintenance or unscheduled breakdowns
- Available hours – is scheduled hours less down time
- Standby hours – time the equipment is available but not manned or used
- Gross operating hours (GOH) – available hours less idle or standby
- Operating delay hours - time the unit is available, manned, but not producing or efFective
- Net operating hours (NOH) – the difFerence between GOH and operating delays

KPI calculations:

- NOH = Net Operating Hours
- GOH = NOH + Delay
- Total Hours = NOH + Delay + Standby + Down
- Availability = (NOH + Delay + Standby) / (NOH + Delay + Standby + Down)
- Use of Availability = (NOH + Delay) / (NOH + Delay + Standby)
- Net Utilization = (NOH + Delay) / (NOH + Delay + Standby + Down)
- EfFectiveness = NOH / (NOH + Delay) = NOH / GOH
- Overall Equipment Efficiency (OEE) = NOH / Total Hours

G MINING SERVICES INC.	**Equipment Hour Usage Model**	**Source: G Mining** **Date: Aug. 2016**

Figure 16-20: Equipment Hour Usage Model

Table 16.26: Equipment Usage Model Assumptions

Equipment Usage Assumptions		Shovels	Loaders	Trucks	Drills	Ancillary
Days in period	days	365	365	365	365	365
Availability	%	85.0	82.0	82.0	85.0	85.0
Use of Availability	%	90.0	90.0	92.0	85.0	85.0
Utilization	%	76.5	73.8	75.4	72.25	72.25
Effectiveness	%	85.0	85.0	87.0	85.0	80.0
OEE	%	65.0	62.7	65.6	61.4	57.8
Total Hours	h	8,760	8,760	8,760	8,760	8,760
Down Hours	h	1,314	1,577	1,577	1,314	1,314
Delay Hours	h	1,005	970	859	949	1,266
Standby Hours	h	745	718	575	1,117	1,117
Gross Operating Hours (GOH)	h	6,701	6,465	6,609	6,329	5,957
Net Operating Hours (NOH)	h	5,696	5,495	5,749	5,380	5,063

16.4.14 Fleet Management

A fleet management system including hardware and software is already implemented to manage in real-time the operation, monitor machine health, and track key performance indicators (“KPIs”). The system will be managed by a dispatcher on each crew who will control the system which will send operators onscreen instructions to work at peak efficiency. A system administrator will be required to assure proper functioning of system hardware and software with ongoing annual vendor support.

The fleet management system on site is by Modular Mining. A provision has been included in the pre-production CAPEX to perform an audit of the system and startup.

The shovels are equipped with the Modular ProVision system, which is a high precision global positioning system (GPS). This system improves the productivity and bench grade control, and can be integrated with the mine planning software.

The production drills are also equipped with the high precision ProVision system. This system helps to guide rigs into position and assure holes are drilled to the correct depth and location.

16.4.15 Pit Slope Monitoring

Slope movement monitoring is planned for the open pit to gather measurements and confirm assumptions in order to assure safe working conditions. Initial slope movement monitoring would consist of using prisms reading using manual or automated surveys with at least two permanent total stations established in climate controlled enclosures, to ensure full coverage of the open pit. The initial prism monitoring will provide movement response data to verify visual observations and confirm if the slope is performing adequately.

A permanent, fully-automated monitoring system using Lidar or radar could be considered for the long term if warranted based on review of prism monitoring results from the first year or two of slope performance.

The slope movement monitoring data will be important for the calibration of numerical models required for detailed design updates during the mine life. The pit phasing approach will allow for adjustments to the final design based on observations and knowledge gained with the interim pit phases.

16.4.16 Electric Cable Handling

An evaluation of capital and operating cost was made for mining cable management and electrification of the pit since the mine will operate two electric front shovels and two electric drills.

The operation of a 550 HP wheel loader with a removable cable reel attachment has been budgeted to handle the electric cables required for the various production units. As the pit circumference was already partly electrified by aerial lines, an estimate of the required additional equipment and infrastructure was completed. To maintain and expand the infrastructure, a team of electricians and helpers, along with the costs to operate a lineman's truck and a flatbed truck were budgeted in the OPEX. The sustaining capital was incremented with additional sub-stations and electric lines throughout the life of the mine.

The cable handling team will support the mine operations crew when moving the electric driven machines in the pit.

16.4.17 Aggregate Plant

The project has multiple needs for crushed rock of different granulometry. An external contractor will be hired to supply and operate the aggregate plant, and those costs have been imbedded in the cost per tonne of crushed rock that is produced.

The main usage of crushed rock is for road maintenance (67% of total), which will be used during winter to help with traction on snowy haulroads and ramps and to maintain all the roads to an acceptable standard throughout the year. The second usage of importance is for stemming material for all blast holes (21% of total). Finally, the remainder of crushed rock (12% of total) will be for the Tailing Storage Facility.

The additional haulage cost of waste rock from the pit to the aggregate plant has been accounted for as well as the use of a wheel loader (7 m^3) to feed the plant and load the trucks that will haul the final crushed material.

16.5 Mine Equipment Requirements

The main mining equipment fleet was purchased with the project by QIO. However, the fleet size was evaluated to validate requirements in accordance with the LOM plan. The current fleet hours were taken into consideration to plan replacement units. The equipment requirements are presented in Table 16.27.

Table 16.27: Equipment Requirements

Equipment Purchase Schedule	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Major Equipment																						
Mining Truck (240 t)	4	7	7	8	8	8	8	8	9	10	10	10	8	8	8	8	8	8	7	7	7	5
Mining Truck (100 t)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Electric Hydraulic Shovel (34 m³)	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
Wheel Loader (20 m³)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Electric Prod Drill	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1
Track Dozer (899 HP)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Track Dozer (630 HP)	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
Motor Grader (16 ft)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Wheel Dozer (904 HP)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Water/Sand Truck (76 kL tank)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pre-split drill (6.5")	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Support Equipment																						
Excavator (49t)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wheel Loader (7 m³)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Small Water Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Small Sand Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stemming Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Boom Truck 28t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
IT Loader (Toolcarrier)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Tracked Skid Steer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mechanic Service Truck	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Fuel Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lube Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lowboy & Tractor (150t)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pick-up Truck	20	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	20	20	20	15	15	15
Mobile Air Compressor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mobile Welding Machine	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Light Tower	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mobile Genset	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Forklift 5t payload	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lineman Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Service Truck (Platform)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dispatch system	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dewatering Pump 10in	4	7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Equipment Simulator	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Slope Monitoring System	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hydraulic Hammers for Excavator 49t	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Spare Box for Haul Trucks	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Spare Bucket for Shovels	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Snow Blower	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Snow Plow (Blade) for IT Loader	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Transportable Sub-station 7.5MVA 34.5kV/7.2kV	-	-	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Isolated Electric Line 34.5kV (185m)	-	-	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mining Cable extension (7.2kV SHD-GC, 1/0 AWG (300m)	-	-	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6	6	6
Pumping Container	-	-	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
GEMS - SQL	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Whittle	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Talpac	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Autocad	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

16.6 Mine Manpower Requirements

Figure 16-20 presents the mine manpower requirements over the LOM with a reduction occurring when the tonnage decreases in 2028. The first and last year, 2017 and 2038, are fractional years and explain the reduction in number of employees. The total mine department workforce is 182 the first year of operation and reaches a peak of 274 individuals by the tenth year.

The total mine staff is relatively constant over the mine life with 63 people required. Only 4 contractors are planned for blasting activities.

The mine maintenance group will have a maximum of 81 employees of which 12 employees are staff members. The mine geology team reaches a maximum of 14 employees. The mine engineering group will have a total of 22 employees.

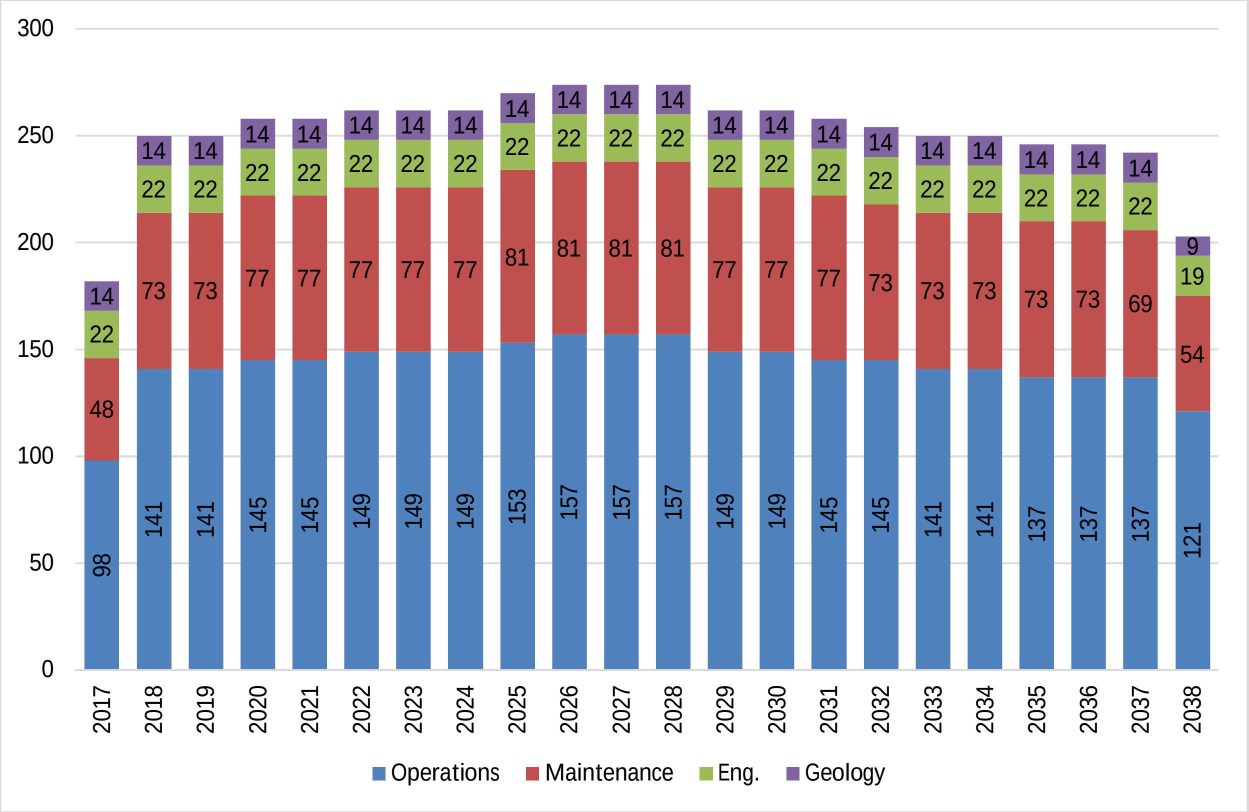


Figure 16-21: Mine Manpower Requirements

17 Recovery Methods

17.1 Introduction

Quebec Iron Ore (QIO) intends to use the crushing and storage facilities of the Phase II operation along with the mill and the rail load-out facilities from the Phase I operation to produce 7.4 Mtpa of concentrate, with a recovery of 83.3% from the ore mined from the main pit.

The phase I and phase II facilities currently exist; however, prior to the start-up planned for the end of 2017, refurbishments and improvements as described below will be made to improve the iron ore recovery, operational reliability, and fugitive dust control.

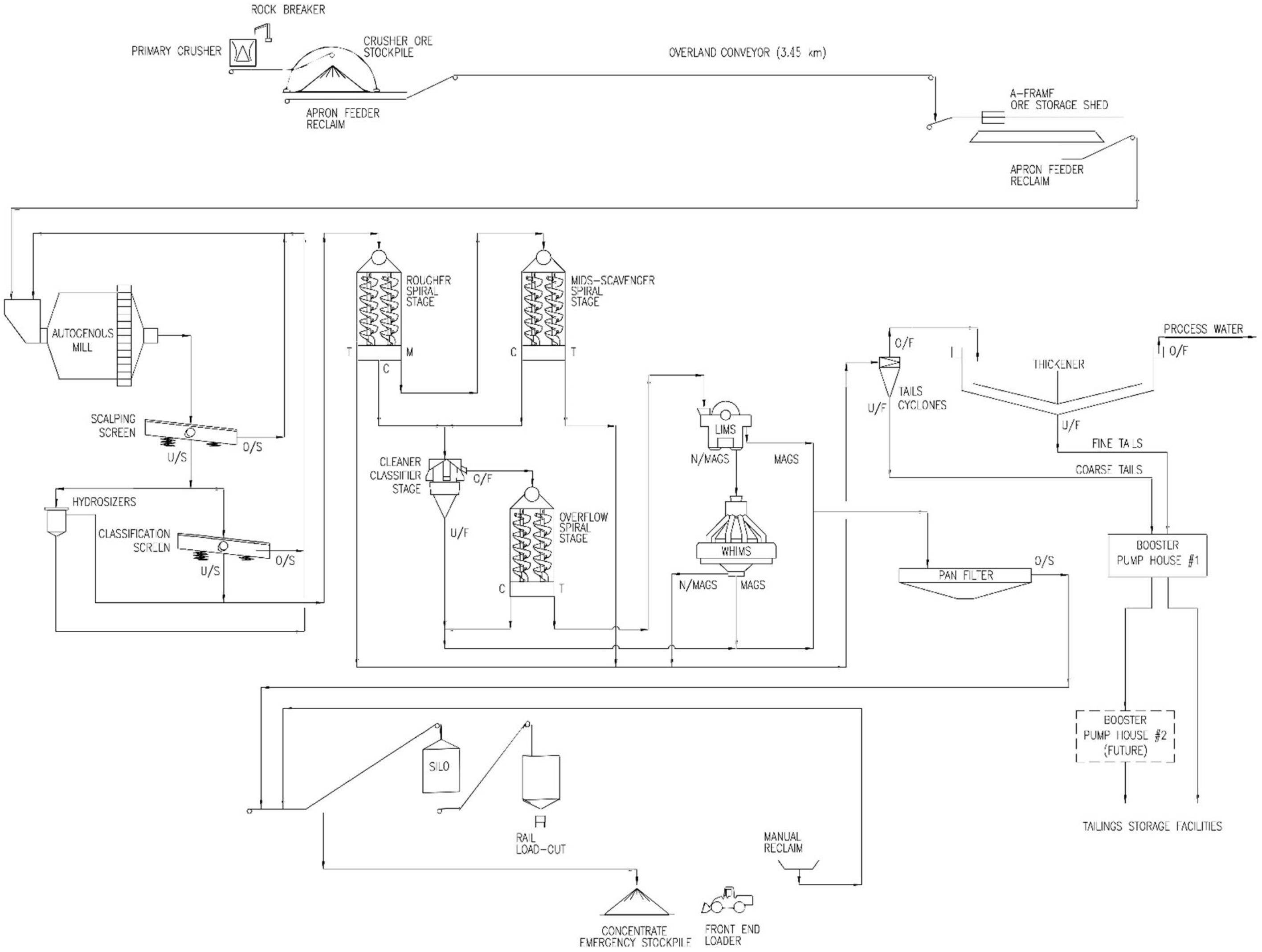
The following Table 17-1 is the list of major equipment that will be used for QIO operations and from which operational phase it comes from:

Table 17-1 – List of Major Processing Facilities

Major Processing Facilities	Source Phase
Primary Crusher (near pit)	Phase II
Crushed ore stock pile (local to the crusher)	Phase II
Overland conveyor (3.46 km)	Phase II
A-Frame crushed ore stockpile shed	Phase II
Reclaim apron feeders (within the A-Frame)	Phase I
AG Mill	Phase I
Screens	Phase I
Spirals	Phase II & New
Hydrosizer	New
Magnetic separators	New
Pan filter & thickener	Phase I
Concentrate storage and rail load-out	Phase I

The following Figure 17-1 shows the block flow diagram of the plant process from the primary crusher to the rail load-out.

Figure 17-1 Block Flow Diagram



17.2 Primary Crusher and Crushed Ore Stockpile

Ore from the mine will be delivered by 240-tonne trucks to the phase II near pit gyratory crusher which has two loading points. A hydraulic hammer (rock breaker) has been installed adjacent to the crusher to manipulate lumps in the feed pocket and to break up lumps too large to enter the crusher. The rock breaker will be operated from a control station in the crusher's operator's room. A 75 t capacity crane has been located over the dump pocket and will be used for handling the crusher's main shaft and concaves during maintenance periods. An auxiliary 10-tonne capacity hoist has been installed over the hoist well in the crusher building to handle parts for the crusher drive, apron feeder, and crushed ore conveyor ancillary equipment. The crusher building has been enclosed and provided with a Venturi-type dust collector and an air make-up unit. Scrubber effluent, floor wash-down water and drainage will be collected in a sump and pumped to the reclaim tunnel sump.

Ore crushed to less than 200 mm by the primary crusher will be fed by a belt feeder with a design capacity of 6 600 tonnes per hour onto a local 5 800 t stockpile which will be covered by a dome to contain the dust (refer to the primary crusher stockpile dome section below). The stockpile is then reclaimed by two apron feeders to load a 3.45 km overland belt conveyor. The overland conveyor feeds into a belt tripper (shuttle) within the A-Frame crushed ore stockpile shed, to produce a longitudinal stockpile. This will allow the crusher to be taken out of service for normal maintenance while maintaining feed to the mill. The total pile capacity in the A-Frame shed is 437,000 t, which is sufficient to maintain an uninterrupted feed to the grinding circuit for much more than 72 hours to allow for major repairs to be undertaken on the crusher. Ore will be reclaimed from the dead storage area of the ore stockpile by loaders or excavators.

The Phase II crusher and overland conveyor have been designed to provide a sufficient quantity of feed to the plant. Should there be any unexpected failures in this system, the phase I crusher is redundant, and can be put back into service by hauling the run-of-mine ore from the mine to the crusher located at the plant.

17.3 Primary Crusher Stockpile Dome

The stockpile shed is designed to hold approximately 5,800 t of crushed ore and to shelter the stockpile from the wind. The dome will be installed at the end of conveyor #2410-5251-001 and will have a width of 34 m, a length of 34 m, and an inside free height of 14 m. This dome will be completely enclosed with a wall at each end. There will be a large door at one end to allow access by a front-end loader. The dome foundation consists of 92 concrete blocks piled two high and resting on crushed rock. The concrete blocks are the large type with the dimensions 4' X 4' X 8'.

17.4 Overland Conveyor

The overland conveyor was built during the Bloom Lake Phase II project. It consists of a 1,600 mm wide belt conveyor, 3.45 km long and running at 4.6 m/s. The conveyor is used for transferring the crushed ore from the primary crushing station to the A-frame crushed ore stockpile. Its original design capacity of 6,000 t/h is amply sufficient for the newly considered average throughput of 2,500 t/h. It generally follows the profile of the terrain with few elevated sections to cross ditches, lakes and depressions.

A site visit was organized during the week of January 9th, 2017 to visually inspect the conveyor. The observations made during the visit resulted in the following recommendations for the improvement of the maintenance and of the operation of the conveyor:

- Access to elevated sections of the conveyors:

  Presently, elevated sections of the conveyor are accessed by five (5) towers, each equipped with a caged ladder. For safety reasons, the maintenance personnel must not carry any tools or parts when climbing these ladders. Installing staircases with lifting hoists near the most convenient support towers would facilitate the maintenance operations.

- Shelter for the maintenance of the elevated sections:

  Considering the high cross winds, it would be preferable to procure and install lighted enclosures which ride on the conveyor structure. These movable shelters are envisaged to shelter maintenance personnel at strategic elevated locations when they perform maintenance tasks.

- Reinforcement of the walkways along sides of the conveyor:

  It was observed that, at few places, the walkways were disengaged from the supports, probably due to the thermal and settling movements. Also, the grating under the conveyor has mesh which is too large to prevent tools from falling to the ground. It is recommended to install a lifeline on the elevated length of the conveyor on both sides and temporarily use carpeting over the grating when servicing of the return belt is performed.

- Belt vulcanizing equipment:

  The conveyor is not equipped with a belt vulcanizing station or equipment. A covered, insulated and heated area is required to vulcanize the spliced belt. A place is also required for installing the winding and unwinding rolls and a bend pulley to guide a new section of belt into place.

- Covering of the conveyor drives:

  The components of the conveyor drives are currently installed in an open building. Snow and ice often covers the drive equipment in the winter. It is recommended to completely enclose the drive equipment.

17.5 A-Frame Crushed Ore Stockpile Building

The A-Frame building was built during the Bloom Lake Phase II project. The building was designed to cover the existing phase 1 plant stockpile fed by crusher 1 as well as the new phase 2 plant fed by crusher 2 using the overland conveyor. The building is equipped with a shuttle conveyor system that allows the material coming from crusher 2 to unload over the phase 1 plant apron feeders as well as phase 2 plant apron feeders. Because of physical constraints, the phase 1 plant apron feeders are not aligned and centered with the shuttle conveyor, therefore when using crusher 2 to feed phase 1 plant, the pile generated has a slight offset resulting in an uneven loading of the two phase 1 apron feeders.

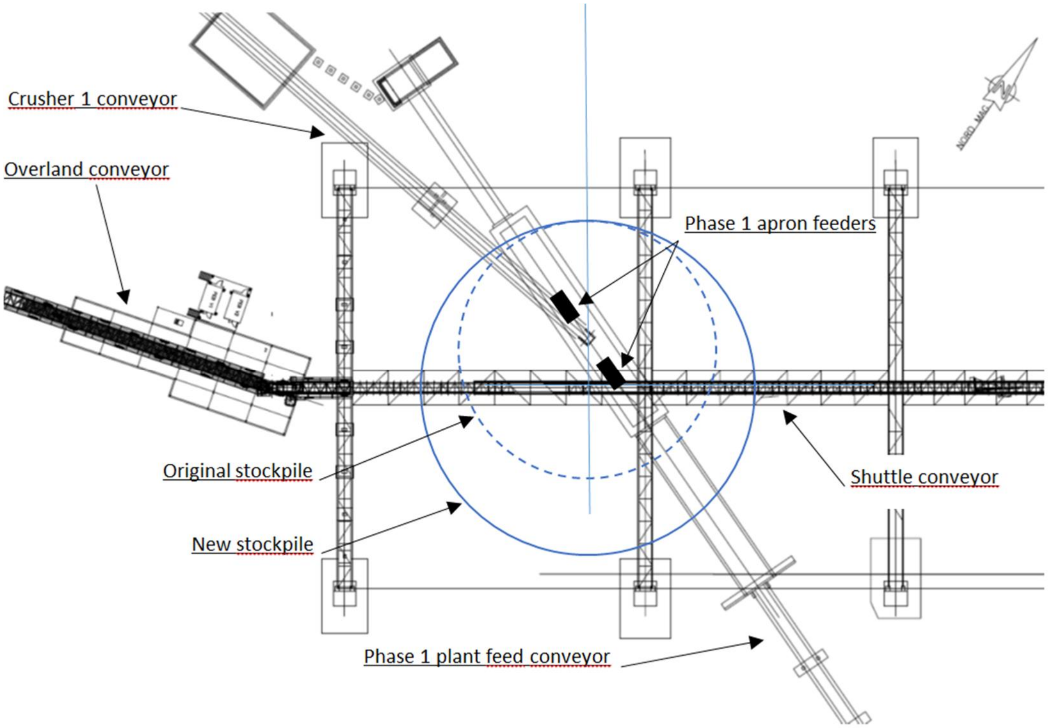


Figure 17-2: Plant Feed Conveyors

Since the objective of QIO is to restart the phase 1 plant using the primary crusher 2 and the overland conveyor, a trade-off analysis was performed to evaluate the impact of an uneven apron feeder loading on the operation. Different modifications were proposed to center the stockpile with the phase 1 apron feeders, among them:

- Install a new diverting chute at the shuttle conveyor discharge
- Install a new conveyor underneath the shuttle conveyor
- Install a third apron feeder

After analysis and discussion among the engineering team and QIO, it was decided that the optimal solution was to leave the system as it is because it involves no cost and despite the fact that the stockpile will not be centered with the apron feeders, the live load volume is 40% higher than the configuration using the crusher 1 system.

Below is the result of this analysis for the original phase 1 operation vs the projected situation using crusher 2 and the overland conveyor to feed the phase 1 plant.

Crushed Ore Stockpile

Capacity	Original Stockpile	New Stockpile
Total Volume (m^3)	35,146	60,634
Live Volume (m^3)	8,831	12,330
Dead Volume (m^3)	26,315	48,304

The reason why the new stockpile live load is higher than the original stockpile is because the shuttle conveyor unloading the crusher 2 is 5 m higher than the crusher 1 conveyor which results in a significant stockpile volume increase.

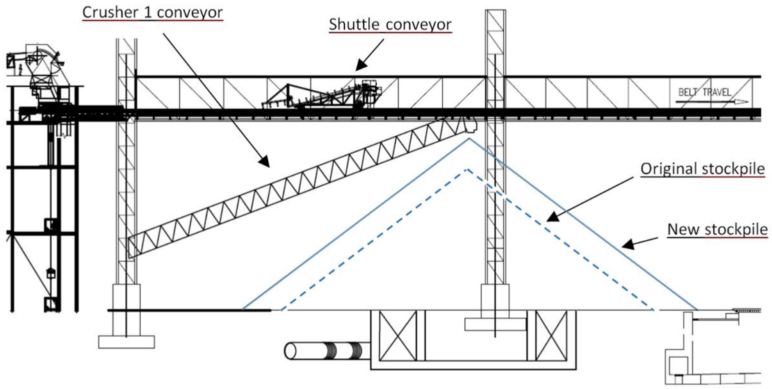


Figure 17-3: Crushed Ore Stockpile

17.6 A-frame Crushed Ore Storage Dust Suppression

To control the dust inside the A-frame storage building, additional metal siding, supported by structural steel at the end of the joists, will be installed. This structure will be installed on only half of the length on one side of the A-frame building. Additional metal siding, complete with structural steel, will be installed at one end of the building from the existing wall to the bottom of the columns.

A pile of crushed ore will be placed between the joists and the ground on one side and between the new metal siding and the ground at the end of the building. The amount of crushed ore material needed to make these two piles is about 12,000 tonnes.

17.7 AG Mill Grinding Study and Simulation Modelling

QIO has planned to refurbish the autonomous grinding mill prior to the operations start-up. One of the main components of this work will be to replace the girth gear (QIO have two in stock as spares). The existing girth gear is slightly worn and by replacing this gear, the mill will be able to handle its full power potential of 17,000 HP and with maximum reliability.

As part of the feasibility study, Ausenco Canada Inc. (Ausenco) simulated the Bloom Lake AG mill circuit to ensure that the mill has enough capacity to maintain the required throughput of 2,482 t/h, when processing the ores from a new area of the pit called West Mine in order to maintain an average annual throughput of 20,000,000 tonnes at the process plant with 92% plant availability. This study, was performed by reviewing the comminution circuit survey report by SGS, compiling ore breakage characteristics provided by Champion and finally, analysing the comminution circuit performance and determining ore characteristics and operational strategies to achieve 2,482 t/h throughput rate.

The following conclusions were reported:

- The comminution surveys indicated that:
  - Relatively higher throughput rates are achieved for higher iron grade ores, with lower SPI and higher Axb values.
  - The power drawn by the mill is lower than the calculated power draw, based on mill design and operating conditions due to slurry pooling, excessive accumulation of slurry in the mill and liner packing.
  - The Bloom Lake AG mill is running very inefficiently, according to a number of specific energy calculation methods, due to both slurry pooling and the absence of grinding media in the mill charge.
  - The Ausgrind[1] and Morrell[2] methods resulted in similar average energy utilization for the survey data.
- The breakage characterization results show that:
  - Bloom Lake ores are of low competency and soft.
  - The database of SPI values for both the main pit and west pit ores suggest low ore variability and absence of competent and hard ores.
- With a competent rock media load and no slurry pooling, the circuit throughput would reach rates close to 2,500 t/h when processing ores with the average breakage characteristics of the survey feeds. Based on the average ore characteristics from the surveys, Ausenco has calculated optimized throughput rates of 2,342 t/h (Morrell's model) and 2,488 t/h (Ausgrind model).

In order to achieve the desired throughput of 2,482 t/h, the following recommendations were subsequently made:

- Blends composed of harder main pit material can be included in the mine plan, to be mixed with the west pit material when required.
- If a consistent feed containing adequate lump media cannot be sustained, the recommended alternatives are the use steel media (2-5%) or barren competent rocks (5-10%).
- These measures to reach higher throughputs may increase circulating loads. However, this is not expected to be an issue for Bloom Lake, as the circuit was designed to reach up to 60% circulating loads.

The key to successful autogenous milling is correct feed preparation. It is critically important to preserve a consistent feed blend containing adequate competent lump media to form a stable rock media load in the mill. Without this, steady state operation becomes difficult to achieve.

17.8 Ore Concentration Process

17.8.1 Existing Phase 1 Circuit Overview

The existing Phase 1 concentrator recovery circuit is a traditional 3-stage spiral separator circuit with rougher, cleaner and re-cleaner spiral stages. The three stages of spiral separators are arranged vertically, such that the products from one stage flow to the next via gravity. A basic flowsheet is shown in Figure 17-4 below. Rougher concentrate reports to the subsequent cleaner and re-cleaner upgrade stages by gravity. Rougher tailings are rejected and pumped to the tailings retention facility, while cleaner tails and re-cleaner tails (with their relatively high content of iron) are re-circulated to the front-end of the circuit.

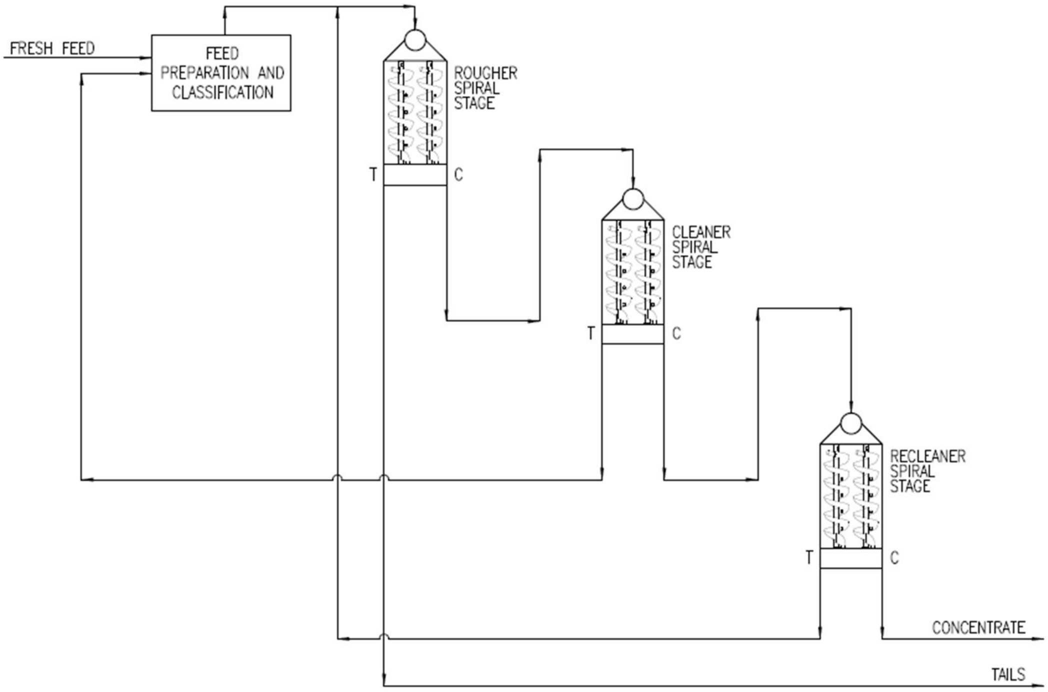


Figure 17-4: Simplified Phase 1 Three Stage Spiral Recovery Circuit Flowsheet

The long-term recovery of iron ore prior to the shutdown averaged around 72%, significantly below expectation as a result of the following factors:

1. Final spiral selection was sub-optimal and incorporated five turn instead of seven turn spirals throughout the circuit resulting in excessive loss of iron in the rougher stage tailings.
2. The feed grade shifted between start-up and the final years of operation, while the final concentrate grade requirement of the previous owner shifted from 5.5% to 4.5% SiO2, significantly impacting circuit recovery.
3. Poor quality of spiral and ancillary parts manufacture led to premature wear necessitating repair or replacement of equipment. The issues caused deficiencies in separation performance and in some cases would cause contamination of the concentrate.
4. General issues with controlling spiral feed densities and consistent delivery of effective wash water volumes for optimum separation performance.

17.8.2 Phase 2 Circuit Overview

An alternative gravity concentration flowsheet was developed for implementation in the Phase 2 concentrator to assist with overcoming shortcomings with the Phase 1 recovery circuit flowsheet design. The Phase 2 flowsheet was comprised of rougher spirals followed by a cleaning stage employing UCCs (up-current classifiers) producing final concentrate to the underflow. The UCC overflow stream is scavenged with a spiral separator stage to recover misplaced fine iron. This complementary use of the two types of gravity separation technology works well to maximize iron recovery in a robust manner across a broad range of particle sizes. A simplified diagram of the Phase 2 recovery circuit flowsheet is shown in Figure 17-5 below.

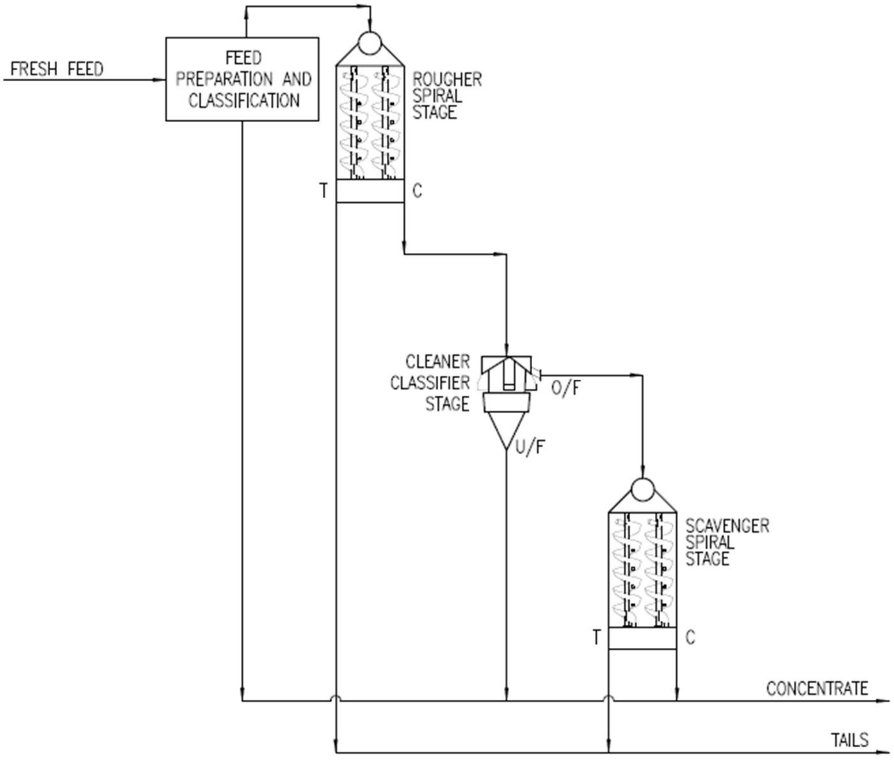


Figure 17-5: Simplified Phase 2 Spiral and UCC Recovery Circuit Flowsheet

The seven-turn twin-start WW6+ spiral was selected for both the rougher and UCC overflow spiral stages in the Phase 2 flowsheet. The selection was made based on test work that compared the performance of the HC33 and WW6 spiral models from Mineral Technologies, the SX20 spiral model from Multotec and the H9000W from Outotec. The WW6 spiral separator has been used successfully for many years for iron ore processing with thousands of spiral starts placed in various operations around the world, with a high concentration of units in service in the Labrador Trough. This spiral is particularly developed for high recoveries of high density materials like hematite and utilizes wash water addition to achieve improved levels of silica rejection.

17.8.3 Proposed Phase 1 Upgrade Recovery Circuit

Although the flowsheet developed for the Phase 2 plant was robust and an effective solution for the Bloom Lake ore, QIO decided to look for avenues to further improve iron recovery.

The upgraded flowsheet development effort was initially based on a review of available data from several sources including historical site Phase 1 performance, test and pilot data and associated reports from development of the Bloom Lake Phase 2 flowsheet, and MT internal information regarding spiral performances on typical ores in the Labrador trough. This information was used to derive preliminary separation models for each of the gravity concentration unit operations, while estimated recovery models were assumed initially for LIMS (low intensity magnetic separators), and WHIMS (wet high intensity magnetic separators) magnetic separation. A dynamic process flowsheet model was then developed with the MT proprietary mass and water balance modelling package which allows comparison of different flowsheet concepts. The model output was first checked and calibrated against historical plant data before being used for the comparative work.

Based on the results of the process modelling, Mineral Technologies proposed the upgraded flowsheet depicted in Figure 17-6 to replace the existing Phase 1 flowsheet.

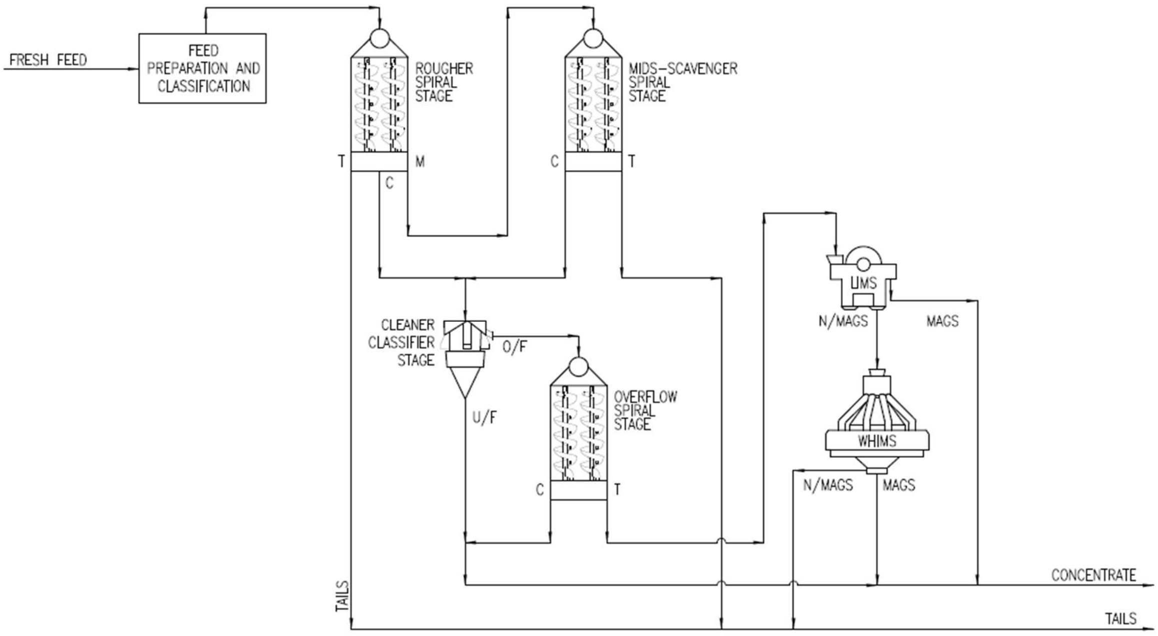


Figure 17-6: Upgraded Phase 1 Recovery Circuit Flowsheet

The gravimetric portion of the recommended flowsheet developed uses a multi-stage circuit comprised of spirals and UCCs to achieve the desired 80%+ Fe recovery, with a key difference between the recommended case and the Phase 2 flowsheet concept being the inclusion of a “mids” stage. This separation stage uses an incremental number of spirals to treat a key portion of the rougher spiral stage middlings, which assists the overall circuit performance by ensuring misplaced Fe in the rougher stage has an opportunity to be recovered and advanced to the classifier stage. In addition, the treatment of a portion of the gravity circuit tailings with LIMS and WHIMS magnetic separators was included to further maximize plant iron recovery by targeting losses of fine iron.

The upgraded Phase 1 recovery circuit flowsheet depicts the replacement of the existing 3-stage spiral circuit with a new gravity circuit comprised of:

- Rougher WW6+ spirals used for primary concentration duty with rougher stage concentrate proceeding directly to the cleaner UCC. This is as per the Phase 2 flowsheet with the exception of:

  - The Rougher spirals will have three products (as opposed to two) and the new middlings stream from the Roughers will be routed by gravity to the mids scavenger spiral stage.
  - The quantity of spirals in the Rougher stage has been increased (20 per bank instead of 16) to cater for and to minimise the effect of any variation in feed conditions.
- Mids-Scavenger WW6+ spirals used to scavenge iron mineral remaining in the rougher spiral middlings. This spiral stage allows the treatment of material that might otherwise be re-circulated to the rougher spirals over their own dedicated spirals. This frees the rougher spiral capacity for treatment of virgin feed only, removes the possible adverse impacts of retreatment of middlings on the rougher spirals, and increases the opportunity for higher overall circuit iron recoveries by moving more mass forward towards the cleaner stage.
- Cleaner UCC's are used to upgrade the combined Rougher and mids spiral concentrate products to final concentrate. Note that the unique MT classifier arrangement allows the UCC to be fitted between the UCC overflow spirals on the same plant level, permitting the UCC overflow launder to be used as the Overflow spirals feed distributor (see Figure 17-7).
- Overflow (O/F) WW6+ spirals used to scavenge fine iron minerals that were misplaced to overflow of the UCC. Unlike most spiral stages which are sized primarily by solids loading, this spiral stage is sized primarily by volumetric loading to ensure that the UCC overflow stream (lower percent solids than typical spiral feeds) can be handled appropriately.

A benefit of the upgraded circuit over the original Phase 1 gravity circuit is limiting the recirculating process streams. In the Phase 1 flowsheet, Cleaner and Re-cleaner spiral tails were directed back to Rougher spiral feed, as these streams contained significant quantities of valuable mineral that could be recovered.

In the proposed Upgrade circuit, the UCC cleaner tailings (the overflow stream) are retreated over the dedicated overflow spirals, after which the tailings stream is discarded. This arrangement reduces the opportunity for losses of iron to the rougher stage tailings due to the recirculating loads, as the probability of losing valuable mineral particles increases each time a particle is recirculated.

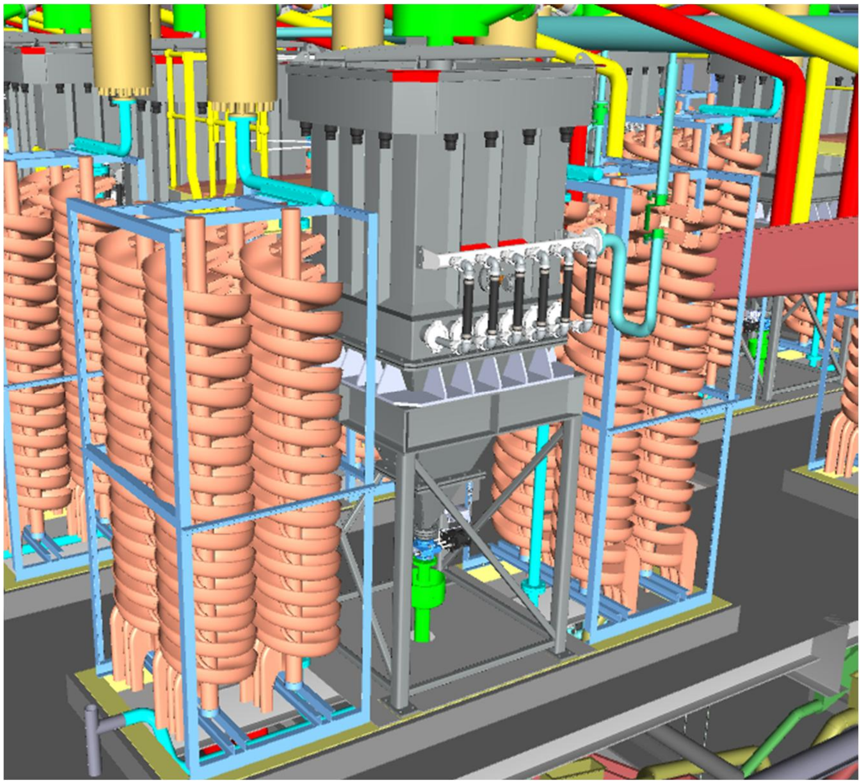


Figure 17-7: MT UCC and Overflow Spiral Arrangement

In addition to the gravity circuit upgrade, the recovery of additional iron minerals (that would otherwise be lost to the gravity circuit tailings) will be achieved by a magnetic scavenging circuit. The UCC overflow spiral middlings will be treated by a combination of Low Intensity Magnetic Separators (LIMS) and Wet High Intensity Magnetic Separators (WHIMS) to recover additional misplaced fine iron to further enhance overall circuit recovery.

The magnetic recovery circuit is a multi-stage circuit of WHIMS separators (in a Rougher – Cleaner configuration) that scavenges and upgrades iron ore to produce a concentrate of sufficient quality that it can be blended in with the gravity circuit concentrate. Prior to the WHIMS circuit a stage of LIMS will be used to remove any highly magnetically susceptible particles such that they do not interfere with the subsequent WHIMS stages.

17.8.4 Overall Circuit Metallurgical Balance and Performance Simulation

As the metallurgical testing program advanced, the results were used to progressively upgrade the process model with updated separation performance information for the spiral, UCC and magnetic separation stages. The model was then optimized for iron recovery and updated with all relevant process conditions to form the mass and water balance used to populate the process flow diagrams for the project. Table 17-2 below shows the predicted iron recovery of the overall recovery circuit (gravity and magnetic circuits) at varying feed grades. Note the following for clarity:

- Table 17-2 does not represent the actual recoveries obtained during the metallurgical testwork (refer section 13 of this document) but instead represents the predicted recoveries developed through the optimisation of the recovery circuit process model.

- Table 17-2 references both ‘optimum case’ recoveries and ‘expected plant performance’ recoveries. The optimum case recoveries represent the modelled maximum recovery attainable from the flowsheet and these optimal recoveries are downgraded to represent the expected plant performance during operation. The downgrade for expected plant performance is due to normal operational conditions in a large scale process where factors such as component wear, minor differences in operational settings and fluctuations in feed conditions impact on the recovery of concentrate. In this case, the optimal recoveries have been downgraded by 2% and this figure is determined based on Mineral technologies experience in flowsheet development and consideration of the specific nature of the processing operation.

Table 17-2: Modelled Performance of the Upgraded Phase 1 Circuit

Plant Performance

Performance Scenario	29% Feed Fe		30% Feed Fe		31% Feed Fe	
	Fe Recovery %	Mass Recovery %	Fe Recovery %	Mass Recovery %	Fe Recovery %	Mass Recovery %
Optimum Case	84.3	37.3	85.3	39.0	86.3	40.8
Expected Plant Performance	82.3	36.6	83.3	38.2	84.3	39.9

17.8.5 Plant Design

The Phase 1 upgrade circuit will be housed in the existing Phase 1 concentrator building. As such the processing operation will utilise existing services and infrastructure such as:

- The concentrator and associated buildings
- Process, potable and services water supply and systems
- Electrical supply and reticulation
- Plant instrumentation and control systems
- Feed preparation equipment
- Tailings and product handling equipment.

The layout and design of the equipment for the Phase 1 upgrade will be tailored to suit the existing building configuration such that any modification required is limited.

17.8.6 Mineral Separation Equipment

17.8.6.1 Spirals

A spiral assembly consists of one or more polyurethane troughs winding down around a central column. As the feed pulp flows down each trough, the action of water washing across the mineral washes light material to the outside of the trough, while denser mineral particles crowd towards the inside of the trough, where they are removed by adjustable splitters.

A single WW6+ spiral is shown in Figure 17-8 below and one of the adjustable splitters are shown in Figure 17-8.

At the bottom of the spiral trough is a product box, containing 2 more adjustable splitters, allowing the separation into 3 distinct products. This is shown in Figure 17-10; the dark band of iron ore mineral grains can be clearly seen.

The WW6+ spiral also features the addition of wash water via a wash-water gallery along the inside of the trough. The metered addition of wash-water aids in the rejection of gangue material, and allows an improvement in iron recovery. Unlike the spirals currently installed in the Phase 1 concentrator, the wash-water system on the WW6+ spiral is open and readily accessible for cleaning if blockage occurs, reducing the time spent by plant personnel maintaining optimum spiral operating conditions.

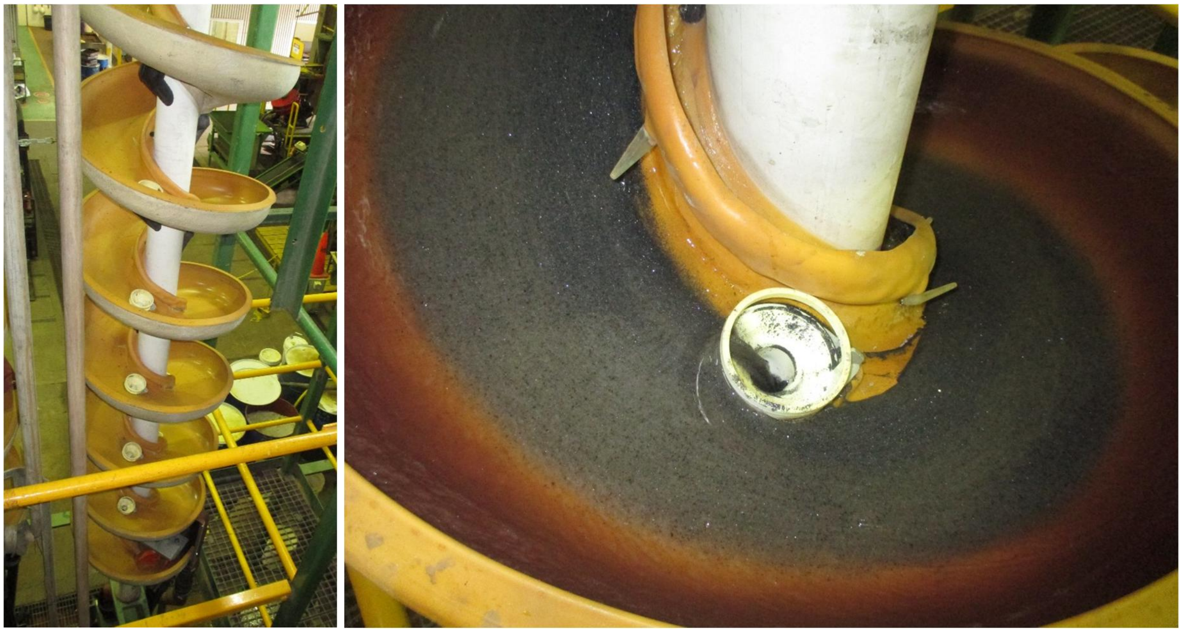


Figure 17-8 and Figure 17-9: WW6+ spiral in testing rig and Iron ore pulp on WW6+ spiral at the entry to a splitter

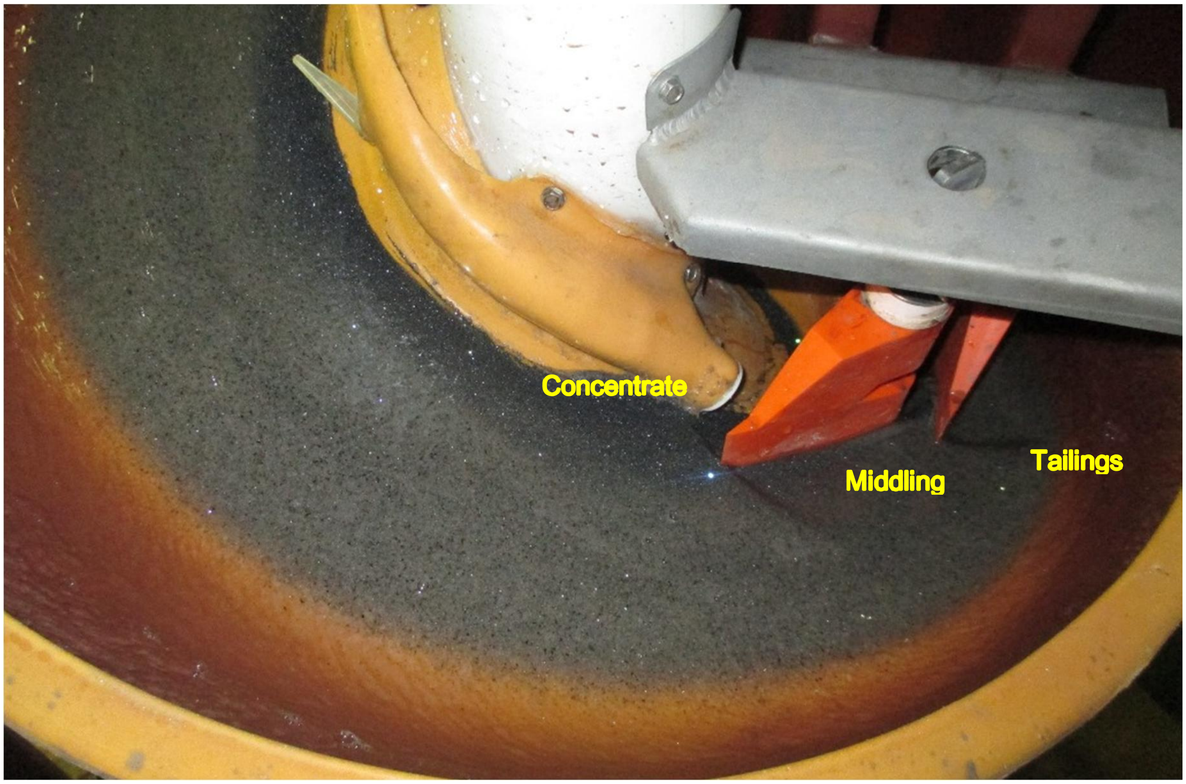


Figure 17-10 : WW6+ Product Box

17.8.6.2 Up-Current Classifiers

Up-current classifiers act on the differences in size and density of mineral particles when entrained in a hindered bed. Water is injected through a perforated manifold, providing a rising current of water. Mineral feed entering the top section of the classifier meets the rising current of water. The interaction of the rising current and the settling solids creates a fluidised bed of particles that causes fine and low density mineral grains to rise over the overflow weir together with the process water, while coarser and higher density grains pass through the fluidised bed to the lower tapered dewatering section. The resulting underflow (bottom) product is therefore comprised of mostly high density and coarse particles, while the overflow (top) product is comprised of low density and fine mineral grains (see Figure 17-11).

In this iron ore application, the concentrate reports to the underflow while the impurity minerals report to the overflow. A small but significant proportion of fine iron ore particles also report to the overflow; this stream is subsequently processed over the O/F spirals to recover this otherwise lost valuable mineral.

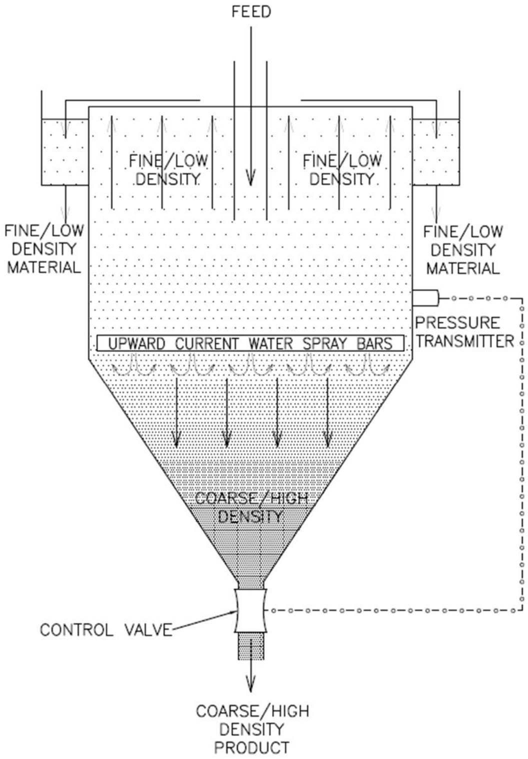


Figure 17-11: Up-current Classifier (UCC) Operational Schematic

17.8.6.3 Low Intensity Magnetic Separators (LIMS)

The primary role of the LIMS is to remove highly magnetically susceptible particles from the feed to the WHIMS separators. If these particles remain in the WHIMS feed, their residual magnetism would cause them to remain within the matrix of the WHIMS separation rotor, causing the separation zone to become blocked.

The LIMS consists of a sealed drum with a stationary magnetic array within the drum. The drum casing rotates within a bath of slurry. Highly magnetically susceptible particles are attracted to the drum, sticking to the drum surface so that they are carried out of the slurry bath. Once out of the influence of the magnetic field, the magnetic product is washed off the surface of the drum. The non-magnetic slurry overflows a weir (which provides bath level control) and exits the separator.

17.8.6.4 Wet High Intensity Magnetic Separators (WHIMS)

It is known that there are losses of fine iron in the gravity circuit as separation performances drops off at the finer size ranges. As hematite is a paramagnetic mineral, readily recovered by high intensity magnetic separation, WHIMS present an alternative separation technology to address the shortcomings of the gravity circuit on certain recoverable iron particles. The inclusion of a WHIMS magnetic separation circuit treating a portion of the spiral tailings streams is specifically targeted at the recovery of fine iron ore particles that have failed to report to the gravity concentrate.

Each of the WHIMS machines consists of a separation matrix (arranged in a ring of radial plates) that rotates within a series of high intensity electromagnets. The arrangement of the magnets is such that the separation matrix passes through alternating magnetic zones and non-magnetic (or null) zones. The magnetic field intensity can be adjusted to increase or decrease the field strength and attraction of the magnetic particles to the separation matrix.

The feed is distributed evenly via a central feed distributor to 8 specific feed points around the separation matrix. The feed points coincide with the point of ascending magnetic intensity between opposing polarity poles. Adjacent to each of these feed points, a controlled volume of water is provided to ensure the non-magnetic particles fall freely through the separation matrix as it rotates past the feed points. At this point the magnetic particles contained in the feed are magnetically bound within the separation matrix and so do not pass through the matrix.

As the matrix rotates, the retained particles are transported through the changing magnetic field to a 'null' zone of the magnetic field, where they are subsequently washed free from the matrix by additional water sprays. The magnetic concentrate and the non-magnetic tail are collected separately and discharged from the machine.

It should be noted that the capability of the WHIMS units to operate at very reduced magnetic field intensities allows them to be utilised as LIMS if necessary to cater for higher magnetite levels in the ore.

Figure 17-12 and Figure 17-13 show the WHIMS testing arrangement and a simplified explanatory diagram of the separation process in the WHIMS rotor.

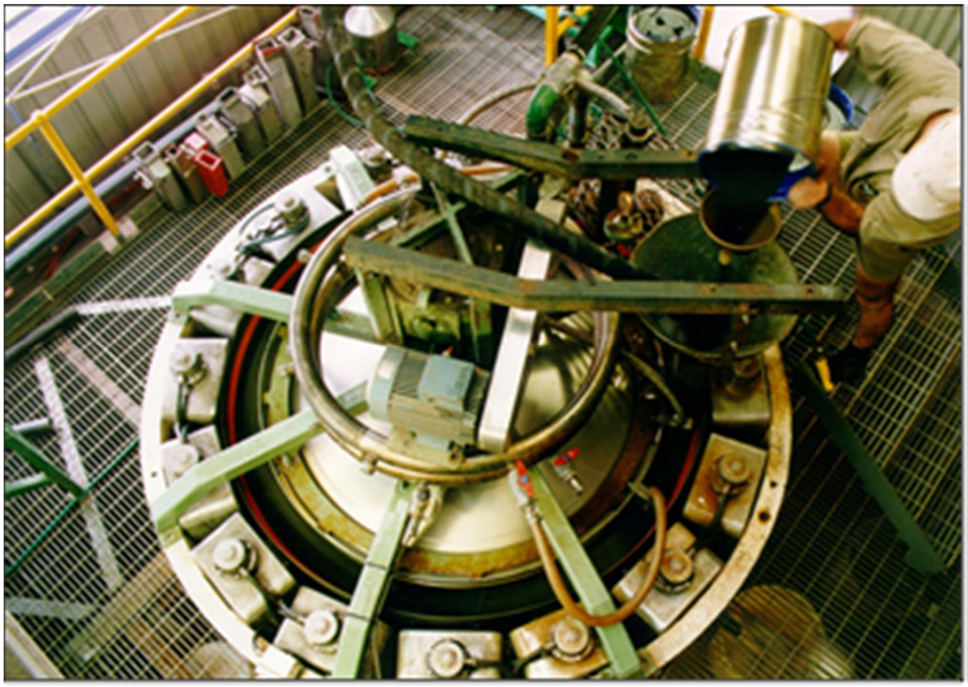


Figure 17-12: MT WHIMS Test Installation

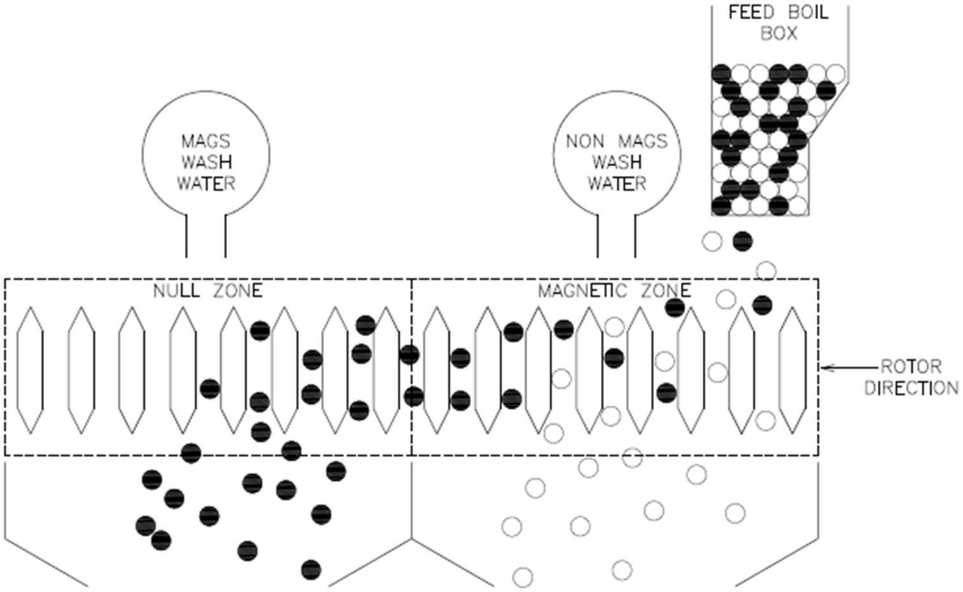


Figure 17-13: WHIMS Conceptual Diagram

17.8.7 Other Processing Equipment

17.8.7.1 Fine and Coarse Tailings Equipment

The tailings material is discharged from the concentrator in two separate streams to allow the coarse and fine tailings to be disposed of and stored efficiently. This is as per the existing Phase 1 operation.

The parameters for the flow conditions and the split in particle size between the coarse and fine tailings were developed between Mineral Technologies and WSP Canada to accommodate both the recovery circuit process parameters and the tailings dam storage requirements. A specific change to the existing operation for the upgrade is to increase the cut point between the coarse and fine tailings streams (from nominally 45µm to 106µm), this reduces the amount of fines in the coarse stream allowing it to drain more freely and stack more efficiently.

Hydrocyclones (or cyclones) are currently used in the Phase 1 process for the separation of the tailings into coarse and fine streams. These same cyclones will be utilised in the upgrade flowsheet with some modification to replaceable parts (such as the discharge spigots) to allow an increase in the cut point at which they operate.

In the flowsheet, the combined tailings stream is pumped to two clusters of cyclones, with the coarse particles reporting to the underflow of the cyclones and the fine particles reporting to the overflow. The major portion of the water in the slurry stream reports to the overflow with the fine particles making this a very dilute slurry.

The coarse tailings are discharged from the cyclone underflow and are subsequently pumped to the coarse tailings storage facility, whereas the dilute nature of the fine tails streams dictates that it is a very large volumetric flow that needs to be further processed prior to disposal.

The use of thickeners is wide-spread in mineral processing plants. This equipment serves to increase the density of a feed stream (thicken it) and in this way, the entrained water in a tailings stream can be recovered for re-use within the processing plant, rather than being discarded to the tailings retention facility. As well as reducing the water use, this assists in reducing the volume and land area that would otherwise be required to hold the tailings stream.

Figure 17-14 shows a simplified diagram of the operation of a thickener. Essentially, a thickener works by allowing the solids in the feed stream enough time to settle out of the slurry such that clear water can be recovered and the solids can accumulate and be collected. Flocculant and/or coagulant is commonly added (and is in this case) to the feed slurry to assist in the agglomeration of the solid particles to increase the rate of settling. Key components of the thickener are as follows:

- The thickener tank (a large tank with a sloping floor) – the tank diameter is a key parameter and is selected based on the settling rate of the particles in the feed slurry.
- A feed well to control the inflow of slurry to the tank. The design of the feed well is critical to the thickener operation such that the feed to the tank is not so turbulent as to disrupt the settling of the solids but that it is turbulent enough to thoroughly mix any flocculent or coagulant added to the feed.
- A set of radial rakes that rotate at the base of the tank. These rakes collect settled solids from the floor of the thickener tank and direct it towards the underflow cone at the centre of the tank.
- An underflow cone at the centre of the base of the tank where the collected and thickened solids are discharged from the thickener
- An overflow weir at the top of the tank around its perimeter to facilitate the collection of the recovered process water

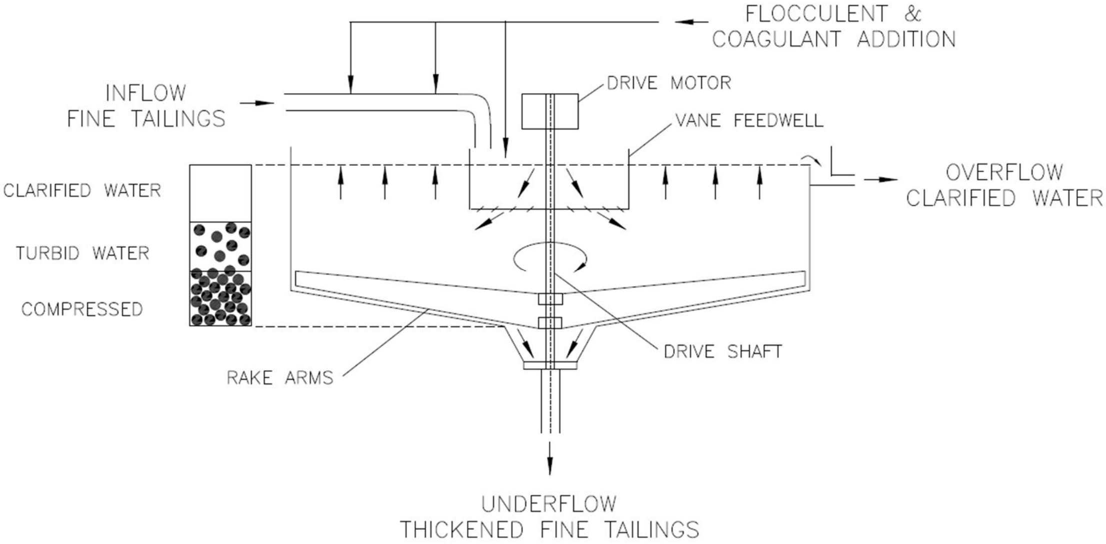


Figure 17-14: Thickener Conceptual Diagram

The thickener in the Phase 1 concentrator is a 31 meter diameter Outotec High-Rate thickener. Following some initial troubleshooting and fine-tuning immediately after Phase 1 commissioning, the thickener proved capable of recovering water from the fine tailings stream. Remedies undertaken during the initial stages of operation of the Phase 1 plant to improve the thickener performance included improved systems and controls of coagulant and flocculant addition.

Given the increased use of water in the proposed flowsheet, it was necessary to verify the suitability of this thickener for the increased volumetric loading. Outotec have performed dynamic testing of a representative sample of fine tailings material from the metallurgical testwork program associated with the upgraded Phase 1 concentrator flowsheet. This testwork confirmed the recommendation for the inclusion of a simple vane feedwell retrofit to the existing thickener to ensure that the increased volumetric load and up to 375 t/h of solids can be handled successfully, avoiding the need for more substantial modifications to the tailing area to accommodate the upgraded flowsheet.

17.8.7.2 Pan Filters

The final concentrate is combined and directed to one of four pan filters for removal of entrained water prior to storage. This technology is widely used in similar iron ore processing operations in the Labrador Trough area and is proven to deliver cost efficient filtering solutions for hematite concentrates. This water (filtrate) is reused in the process water system. It is important that concentrate moisture levels be managed during winter to prevent concentrate from freezing in a rail car during transport, as this can create operational problems with unloading operations.

The pan filters are comprised of a round pan that rotates around a vertical axis (refer Figure 17-15 for a conceptual diagram). Concentrate feeds to the filter and is evenly dispersed across the surface. As the pan rotates, the filter cake passes over a section of vacuum (applied underneath the pan), that draws the filtrate out of the filter cake. The use of a steam hood is common in winter to drive additional moisture out of the filter cake. Once the pan rotates past the steam hood, a rotating auger scrapes the solids off the filter and into a chute, taking concentrate to the concentrate storage bin.

Filterability testing of a concentrate sample has been undertaken to confirm the suitability of the existing pan filters for the slightly changed duty in the upgrade flowsheet. The change in duty is due to an increase in total concentrate produced and a shift in concentrate particle size distribution due to increased recovery of coarse and fine iron particles. The filterability testing has shown that the filter performance will be similar to that of the previous operation and as such will be suitable for the new duty. Additionally, the filters where initially sized to process 8 M tonnes of concentrate per year and this is aligned with the new flowsheet conditions.

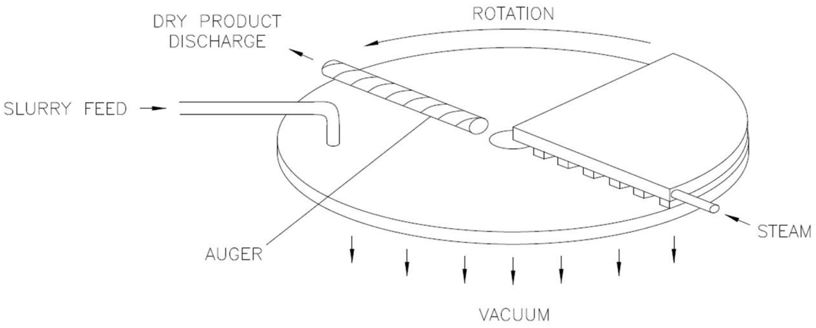


Figure 17-15: Pan Filter Conceptual Diagram

17.9 Concentrate Storage

Concentrate is discharged from the pan filters to a 1,067 mm (42”) wide belt conveyor and transported to a 24,000 t capacity silo located at the train load-out station. At a rate of approximately 920 t/h of concentrate, the silo will be able to hold approximately 26 hours of production.

If the silo is full, concentrate will be discharged to an 80,000 t capacity emergency stockpile located next to the plant. Concentrate will be reclaimed by a front-end loader and returned to the conveyor feeding the silo.

18 Project Infrastructure

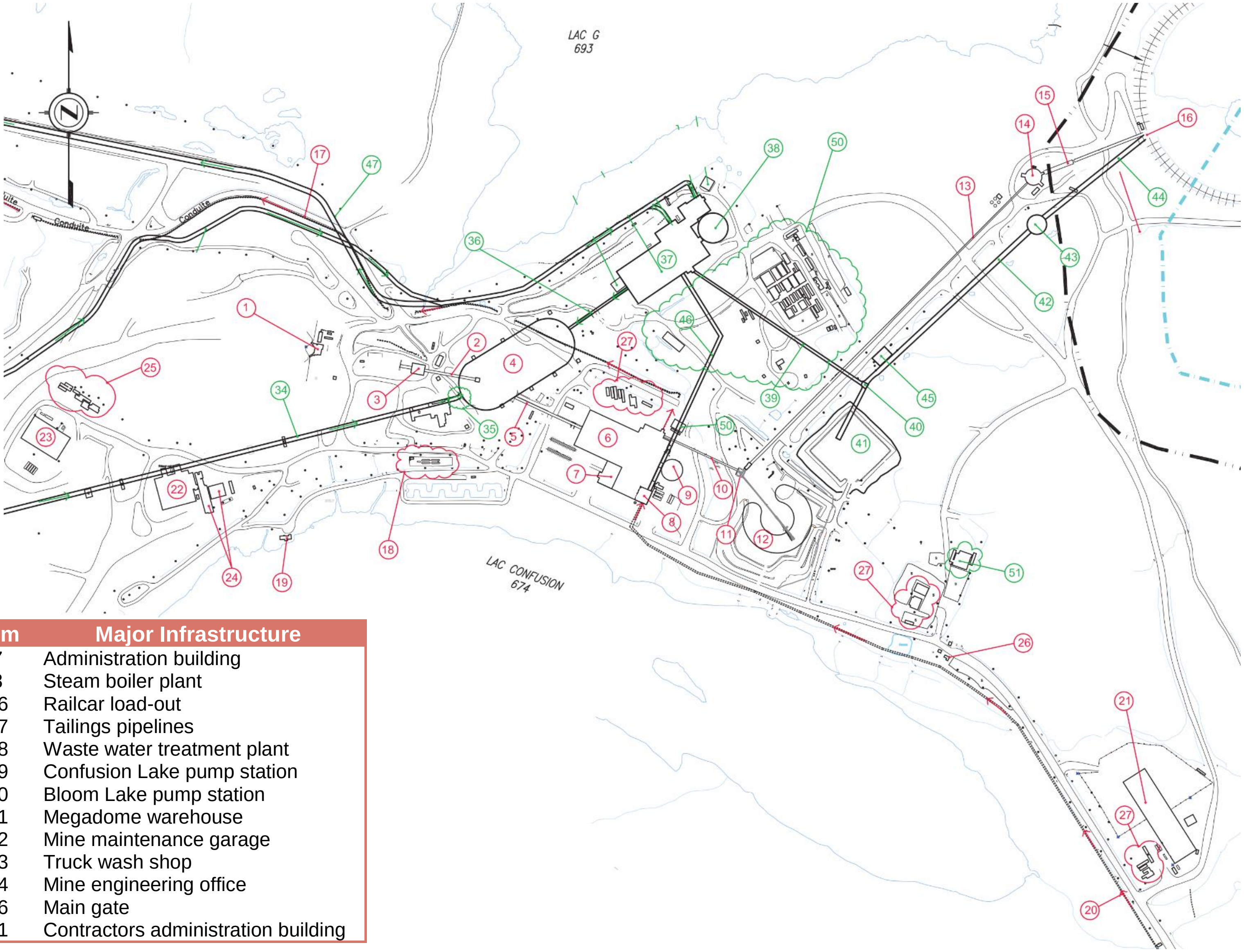
18.1 Mine Infrastructure

The entire mine infrastructure which was being used by Cliffs is available for the mining operations. This includes the following facilities:

- Mine maintenance shop (with 4 bays)
- Mine equipment secondary garage capable of servicing 320 t trucks (35 m x 50 m, with 2 bays)
- Mine equipment wash bay (38 m x 60 m)
- Fuel storage and distribution system
- Electrical infrastructure for the mine, including a 34.5 kV sub-station
- A cafeteria at Bloom West Mine (to minimize the lost time for truck driver breaks)
- Spare parts containers located around the mine to store drilling equipment, surveyor equipment and environmental equipment.
- Mobile shovel bucket repair shop
- Dispatch system, complete with trailers, offices and a cafeteria

18.2 Infrastructure Located at the Processing Plants

All the infrastructure which was being used by Cliffs is available for the Quebec Iron Ore operations. Figure 18-1, on the following page, shows the location of the major infrastructure located at the phase I and phase II plants.



Item	Major Infrastructure
7	Administration building
8	Steam boiler plant
16	Railcar load-out
17	Tailings pipelines
18	Waste water treatment plant
19	Confusion Lake pump station
20	Bloom Lake pump station
21	Megadome warehouse
22	Mine maintenance garage
23	Truck wash shop
24	Mine engineering office
26	Main gate
51	Contractors administration building

Figure 18-1 – Major Infrastructure Located at the Processing Plants

18.3 Tailings and Surface Water Management

18.3.1 Surface Water Management

18.3.1.1 Design Criteria

The design criteria for surface water management is based on *Directive 019* for the mining industry – March 2012 and the referred laws.

18.3.1.2 Existing Infrastructures

The present drainage system and most of the water management equipment and infrastructure are appropriate and operational.

The main basins have been designed prior to 2014 by AMEC Foster Wheeler. Their design respects the regulation. The existing treatment plant meets the operating criteria in terms of capacity. Contact waters from the site, if not returned to the mill as process water, are treated and released by the treatment plant. Some upgrades to the pumping and drainage networks will have to be implemented to satisfy the design criteria and improve the robustness of the system. These upgrades are included in CAPEX and Sustaining CAPEX.

18.3.1.3 Modifications to the Existing Water Management System

Some modifications will have to be incorporated to the water management system in order to meet the design criteria and improve robustness from an operational point of view. The investments mainly relate to the management of surface runoff water and are not part of the process and tailings water. Modifications are minor compared to the site-wide management system.

Investments will have to be made at various pumping stations. They go from the modification of some supply lines to adding pumping capacity to pumping stations. Considering the size of the site and the number of pumping points, the integration of a monitoring and automation system shall be part of the upgrade work to improve the water management system and to secure the operation. The majority of the pumping network is electrified; further completion of the electrification will be performed progressively for operational performance purposes.

18.3.2 Tailings Storage Facility

18.3.2.1 Concept

The Bloom Lake tailings management strategy is developed around hydraulic deposition of coarse and fine tailings. Coarse tailings account for approximately 83% of tailings feed, while fine tailings account for 17% of total tailings feed.

In total, the mill expects to produce an average of 12.36 Mt of tailings annually over 21 years of operation.

The Bloom Lake Tailings storage facility (TSF) is partially developed in its current layout as some starter dykes are not completed. A fine tailings storage facility (Basin A) is developed with impervious dykes and filtering dykes. A coarse tailings storage facility (HPA-South and HPA-West) is developed with filtering dykes to hold the tailings and with water-retaining dykes to hold the process water.

The fine tailings management strategy is based on storage in Basin A all year long. The coarse tailings management strategy is based on containment during winter in a specific location where process water can return to the process water pond with minimal ice build-up (PRG-2 and PRG-3) and in summer in HPA-South. Once HPA-South storage area is filled, tailings will be hydraulically deposited in a year-round storage area named HPA-West.

To achieve this deposition strategy, additional tailings pumping capacity is required for fine tailings and coarse tailings.

Figure 18.2 presents the layout of the TSF at the end of mine life.

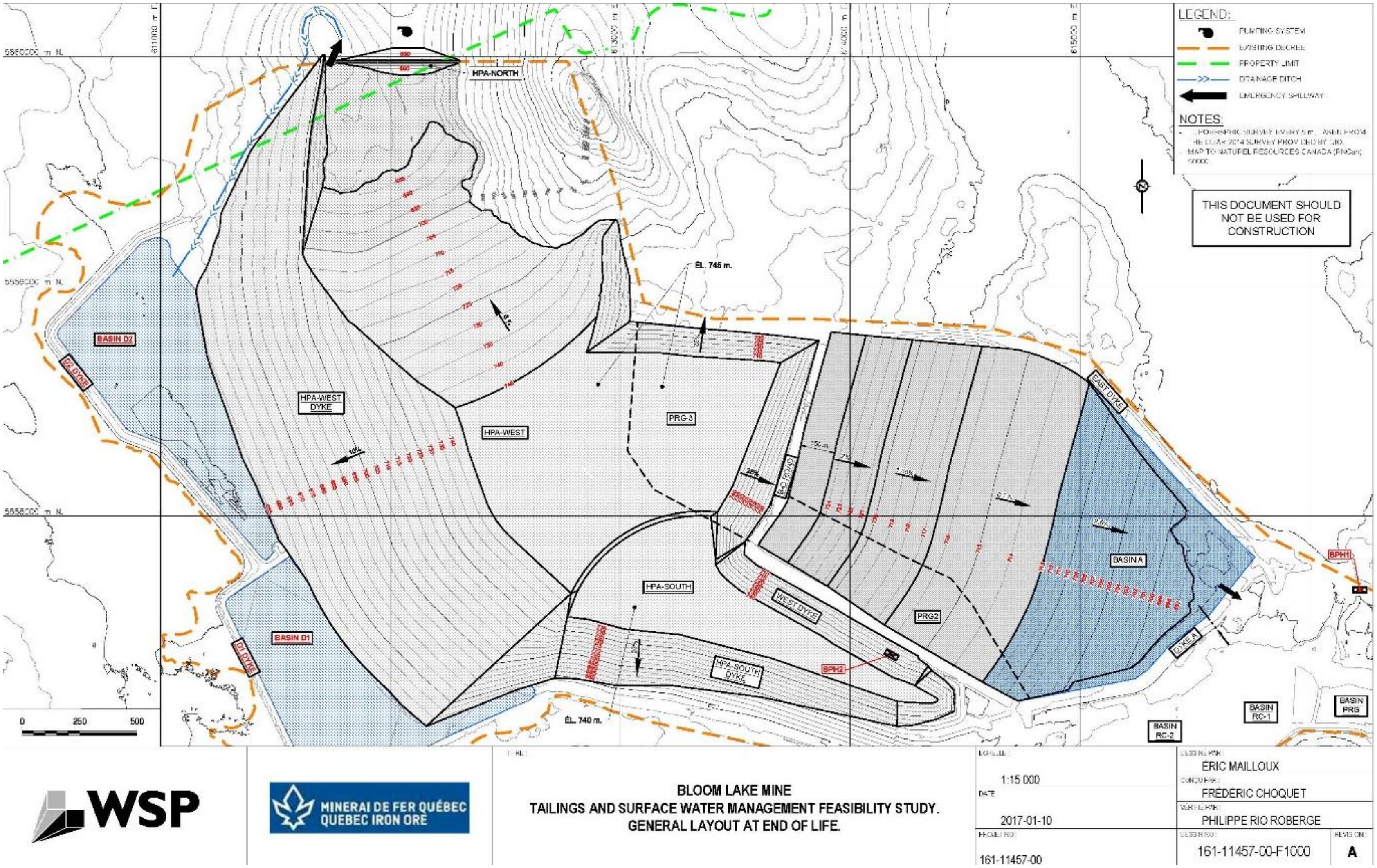


Figure 18-2 – Tailings Storage Facility Layout at End of Mine Life

18.3.2.2 Design Criteria

The containment of coarse and fine tailings is done in the existing permitted area of the Bloom Lake property. The design of the TSF ensures a safe management of tailings, and is based on conservative design assumptions.

The design of the TSF and the containment structures is done in accordance with industry standards (Canadian Dam Association, Mining Association of Canada, etc.) and in compliance with current provincial regulations.

18.3.2.3 Infrastructure and Operation

The fines tailings basin will require dyke raising during the mine operation due to tailings deposition. Also, some infrastructure will have to be built, completed or rehabilitated. Completion of west dyke in PRG-3 is required and rehabilitation of PRG-2 dyke is also required. The HPA-West storage facility requires a starter dyke at mine start-up to contain tailings. Towards the end of mine life, a new containment dyke (HPA-North) will be built to manage tailings until mine closure.

Upstream dyke raising is selected for the raising of HPA-South and HPA-West filtering dykes. HPA-South raising will be made by dozing the coarse tailings materials from the storage facility. HPA-West is planned to be raised by hydraulic beach deposition and dozer mechanical raising. Some trucking of coarse tailings materials is planned for HPA-West raising where beach deposition is not achievable. These operations are planned to be executed by QIO mine and water management operators and their equipment.

18.3.3 Tailings Slurry Pumping (Boosting)

Assessment of the present coarse and fine tailings pumping capacity with the new slurry parameters (fine tailings 261 t/h at 360 m^3/h and coarse tailings 1264 t/h at 1645 m^3/h) revealed that the present coarse tailings pumping system has reached the maximum pumping distance and elevation achievable in the deposition area and that the fine tailings pumping system is under capacity to achieve the proposed tailings management strategy. Therefore, the proposed pumping strategy integrates an upgrade to the fine and coarse tailings pumping system in the existing booster pump house (BPH#1) to allow hydraulic deposition of fine tailings until end of mine life as well as hydraulic deposition of coarse tailings for approximately 3 years. Following that period, a second booster pumping station (BPH#2) is required to allow for coarse tailings hydraulic deposition until end of mine life. Available and compatible parts from Phase 2 plant inventory are reused for the modifications on BPH#1 and the construction of BPH#2. These parts were purchased and are presently on site, either installed in the Phase 2 mill or still in crates.

18.4 Train Loading Station

Concentrate produced in the plant is discharged to a series of conveyors and transported to one 24,000 t silo at the train load-out station. The train loading station will fill one 240-railcar (100 t capacity railcars) train.

A dedicated calcium chloride system is in place to store and dose the addition of the freeze protection solution on the top layer of each railcar. This prevents freezing of the concentrate in the railcar and unloading difficulties in case of an unplanned delay of the rail transport during the winter.

In this study, no modifications have been planned for the existing train loading facilities.

18.5 Rail Infrastructure

The rail network consists of three separate segments to transport iron ore concentrate from the mine site to port. The first segment is the rail spur on-site consisting of a 31.9-km long segment that is operational and connects to the Quebec North Shore and Labrador (QNS&L) railway at the Wabush Mines facilities in Wabush, Labrador. The second segment uses the QNS&L railway from Wabush to Arnaud junction in Sept-Îles, the third section is from Arnaud junction to Pointe-Noire (Sept-Îles), which is the property of SFP Pointe-Noire (SFPPN).

No major capital investment is expected for the rail spur located at the Bloom Lake mine.

There are 735 insulated ore cars dedicated to move Bloom Lake concentrate as part of the rail fleet consisting of three trains.

18.6 Port Infrastructure

The concentrate is unloaded from railcars at Pointe Noire, which is owned by SFP Pointe-Noire (SFPPN) which is controlled by the Government of Quebec and can be either loaded directly onto a vessel or stockpiled to be reclaimed and loaded at a later date. The former Cliffs / Bloom Lake concentrate stockpiling and shipping system is comprised of a rotary car dumper, dump hopper, stockpiling and reclaiming conveyors, a stacker-reclaimer, and ship loaders. Storage capacity is currently 670,000 t of concentrate in the stockpile yard.

There are two marine terminals at Pointe Noire consisting of Dock 30 and Dock 31. Both docks are owned by the Port of Sept-Iles and were leased and operated in the past by Cliffs. Iron ore concentrate can be shipped via Dock #31 using a 6,000 t/h stationary shiploader. Dock 30, which is part of the Wabush Mine facilities, has two 3,500 t/h traveling shiploaders and the associated conveyor systems. The two marine terminals are now tied together via a cross conveyor that allows concentrate that is stored or unloaded on the Dock 31 side to be loaded into vessels at Dock 30.

The water draft at Dock 31 is limited and cannot be significantly increased. Vessel size is limited and vessel loading operations are hindered by the stationary shiploader. Several improvements have been made to the structure at Dock 30 and dredging has been completed to fully load Cape-size vessels independent of tidal conditions. A new shiploader is planned for Dock 30 that will significantly increase the loading rates of concentrate.

A new Multi-User Dock, owned by the Port of Sept-Iles, was built at Pointe-Noire. The dock has a capacity of 50 Mtpa via two 10,000 t/h travelling ship loaders. The dock was designed to receive 400,000 DWT Chinamax vessels. This dock is not currently linked to the Pointe-Noire conveyor systems, however engineering is in progress to make this possible. Once completed, this will be the dock most likely used by QIO.

QIO does not own any off-site assets so there is no Capex associated with the port infrastructure.

18.7 Electrical Substation and Site Power Distribution

The electrical power for the project is supplied by Hydro Quebec from the Normand sub-station which is located 12 km from the mine. QIO owns the 315 kV main station (Substation W), located near Route 389 including 2 x 80 MVA transformers. The Hydro-Quebec power line terminates inside the main station and is fed through SF-6 gas-insulated type 315 kV indoor switchgear to the two 80 MVA oil-filled transformers. The commercial power metering is made after the incoming 315 kV breaker. The main switchgear and stepdown transformers are used to connect various 34.5 kV power lines.

Three 17-km power lines A, B and C were constructed by Hydro-Quebec (HQ). The first section of 11.5 km has been installed from the HQ Normand station along Route 389 to the mine power metering station at the junction of Route 389 and the plant access road. The second section of 6.5 km has been installed along the mine access.

The peak power demand should not exceed 30 MW and the average should be approximately 22 MW. A total of 22.5 km of 34.5 kV aerial lines were built to supply power to various plant and mine loads such as: guard house, crusher building, fresh water pumping station, reclaim pumping station, fire pumping station, loadout station, explosive storage, maintenance buildings and process plants. The mine site is supplied at 7.2 kV via two portable substations 34.5 kV to 7.2 kV, 7.5 MVA located at each end of the pit.

QIO’s current production plans and tailings pumping to tailings storage facilities which are slightly further away will use only a small fraction of the surplus electrical power availability (68 MW total available power). The existing electrical infrastructure is more than adequate to accommodate the new loads.

One of the small improvement projects to be completed is the new 25 MW electrical steam boiler. The installation of this new boiler will increase power demand, but can be easily supplied from the existing phase II high voltage power lines.

18.8 Non-Process Buildings

The 2,485 m^2 (35 m x 71 m) service building attached to the concentrator building provides the following services:

- Maintenance shops
- Unloading and warehousing completely stocked with parts and supplies
- Electrical/instrument repair shop
- Boiler plant to provide steam for heating and filter cake drying. The boiler plant also hosts the boiler water treatment system
- Offices for administration, purchasing, human resources, technical services (engineering and geology), training and plant operating personnel
- Laboratory equipped for metallurgical testwork, wet and dry assaying
- Lunchroom, men's and women's change rooms, sanitary and locker facilities
- Communications room
- Compressor room to provide service air and instrument air to the concentrator
- a blower room to supply low pressure air to the concentrate filters

- Fresh water storage tank and water treatment facilities
- Electrical room

Other non-process buildings:

- 8 various utility domes used as warehouse of shops for contractors

In this study, $420,000 in funds were allocated to recommission non-process buildings.

18.9 Shop and Warehouse

The service building warehouse floor area covers an area of 630 m^2 (21 m by 30 m) and is 9.5 m high. Trucks to be unloaded will descend a ramp to bring the truck bed level with the loading dock and floor inside the warehouse. Another warehouse is located at the entrance of the mine site. The dome type building covers an area of 5,600 m^2. Half the building is insulated and organized to host large parts. The remaining half of the building is not insulated and is used for cold storage. A fenced outdoor warehouse yard surrounds the dome building and has an area of 20,000 m^2 which is used to stock bulk and large materials.

18.10 Utilities Area

The 820 m^2 utilities area includes the boiler room, fresh water storage tank and water treatment, blower and compressor rooms and the emergency MCC room. The emergency generator has been located outside the Service Building

Two 50 MBTU/h water tube boilers supply high pressure steam to the concentrate filters and to the hot water heat exchangers for building heating. At peak load, both boilers are in operation. Light fuel oil #2 has been used as fuel. A project will be realised to install an electric electrode steam boiler to offset a major portion of the steam produced with #2 oil.

18.11 Emergency Vehicle Station

The emergency vehicle station is sized for an ambulance and one fire truck. The first-aid station has also been located in this area.

18.12 Offices, Change Rooms and Lunch Room

An office space of 1,379 m^2 for administration, human resources, accounting, purchasing, engineering, plant operating and maintenance personnel has been provided on the second floor of the service building. Washrooms and a fully equipped first aid room is also located on this floor.

Offices along the outer walls have been provided with windows. There is also direct access from the offices to the concentrator operating floor. Change rooms, showers and toilets for men has been located on the ground floor and on the first floor for women. A lunch room has been provided on the first floor.

18.13 Laboratory

The laboratory located on the ground floor has 266 m^2 of floor space for the preparation and analysis of samples by wet methods and XRF. The preparation area has been equipped for splitting, drying, crushing, grinding, screening and filtering of samples from both the mine and the concentrator. A dust collection system has been provided in the preparation area. Fume hoods have been installed in the wet assay room. A storage room and shelving has been provided for samples and supplies. There is also direct access from the laboratory to the concentrator.

18.14 Heating, Ventilation and Air Conditioning

Systems have been designed for outdoor temperatures of -40°C in winter and 17°C in summer and inside temperatures of 19-21°C. Fresh air changes vary from 1 in the offices to 10 in change rooms.

The shops, warehouse and concentrator are heated with hot water from the boiler plant by a central system for each sector, which includes supply fan, return/exhaust fan, heating coil, filter and air/air energy recovery system.

The office, laboratory and lunch room has been air conditioned by a variable volume central unit with a 700 kW steam heating coil and 40 ton roof-mounted cooling unit. Heating of cold perimeter areas has been supplemented by using electrical baseboard heaters.

A steam aerotherm heater has been installed near each garage door in the service building and concentrator to compensate for the heat loss through air infiltration in winter.

18.15 Water Distribution and Drainage Network

Hot and cold water has been distributed to all sanitary facilities in the concentrator building. Cold water has also been distributed to the mine offices.

Emergency showers and eye-washes have been installed in the laboratory, shops, and at the flocculant preparation area in the concentrator.

Water used for the wash bay operations is recirculated through settling basins with oil skimmers and reused until it allows for good washing operations. Oil and grease are recovered and disposed off-site on a regular basis by an authorized contractor as it is the case for the non-recyclable oily waters.

Drainage from shop repair bays is collected in a gutter and pumped on a regular basis to be disposed off-site by an authorized contractor.

18.16 Access and Site Roads

The sole access road to the Bloom Lake deposit is from Highway 389. This 5 km access road has been provided with a barrier gate to control access. The security station and the main first-aid station are located at the barrier gate. Other roads have been constructed from the concentrator to the mine, the crusher, along the route of the tailings line and to the freshwater collection point at Bloom Lake.

18.17 Fresh Water Supply

Fresh water is required for make-up to the boilers and for domestic consumption. Fresh water is supplied to the fresh water tank at the concentrator by gravity flow from Bloom Lake through a 1.5 km long, 152 mm diameter HDPE pipe.

18.18 Reclaim Water Supply

Reclaim water is pumped from the decanted water in the RC-2 basin. There are three 700 hp pumps mounted on separate barges. Each pump is capable to meet the demand of the phase 1 concentrator; therefore 2 pumps will be on stand-by. This system was designed to provide water for both phase 1 and phase 2 concentrators.

The pipeline has been constructed of 610 mm diameter HDPE pipe (approximately 4.5 km long) and has been buried. The reclaim water pipeline will terminate at the process water reservoir outside the phase I concentrator.

Reclaim water is also supplied to the booster pump house 1 (BPH1) for gland seal and tailings lines flush water. Water for the BPH1 can also be sourced from the phase 1 plant or from the phase 2 plant through the tailings pipelines.

18.19 Fire Protection

The fire protection system includes fire water pumps, a fire water distribution network, fire water hose stations and water sprinkler systems.

A water sprinkler system has been installed over covered conveyor belts and over the lubrication and hydraulic systems in the process areas.

Fire water pumps have been located in a pump house and source water from Confusion lake. There are three pumps, two main pumps and one jockey pump to maintain the pressure in the fire water pipe network. One of the main pumps is driven by an electric motor and the other by a diesel engine, complete with controls for automatic starting.

Alarm signals are automatically transmitted to the security station in the service building.

18.20 Fuel Storage

Number 2 light fuel oil and gasoline is delivered to the site by road tanker and delivered to one of the nineteen fuel storage tanks.

A gasoline fuel station for pick-up trucks and other vehicles has been located close to the storage tank area.

18.21 Effluent Water Treatment

A water treatment plant is in place and is designed to comply with all regulatory and permitting standards. The treatment plant can treat effluent water from various sources and can handle of contact water coming from any basins present on the site as well as any type of runoff waters collected and pumped into tailings facility basins. All recirculated water not required for the concentrator process can be discharged to nature by the water treatment plant at a capacity of 75,000 m^3 / day which is more than adequate to accommodate the needs on a yearly basis. A dome covers the water treatment equipment.

18.22 Sanitary Treatment and Waste Disposal

The sewage disposal system is designed to accommodate the concentrator and service building and the truck shop. The sewage treatment system includes collecting and pumping stations, a septic tank and aerobic treatment stages. The treated water meets the mandatory discharge parameters before it is released to nature by ground infiltration.

There are over 20 portable toilet stations all over the site and the effluent collected in these toilets is pumped out periodically and properly disposed off-site in the city of Baie-Comeau.

Solid waste materials which cannot be recycled and domestic waste will be sent to municipal dump located in the Baie-Comeau area.

Used oil and lubricants and all other hazardous wastes, will be managed by a recognized waste disposal company.

18.23 Accommodations

Lodging for construction workers and permanent workers will be accommodated within the town of Fermont. QIO owns the following facilities:

- 4 houses located on *rue des Melèzes* (with 5 rooms each)
- 22 houses, fully furnished, located on *rue des Bâtisseurs* (12 with 8 rooms each, 6 with 7 rooms each and 4 with 5 rooms each)
- Two blocks of 99 rooms of lodging located on *rue du Fer*

These accommodations listed above are fully equipped with furniture, linen and wiring for communications and entertainment.

Temporary and permanent workers will be fed at the QIO cafeteria facility located in Fermont. The QIO cafeteria is a fully equipped industrial kitchen with walk-in freezers and fridges. It has a warehouse and delivery dock. The cafeteria has a seating capacity of 150+ persons. This new building completed in 2014, has a complete gym, work offices, as well as a playroom with pool tables, golf simulators and other recreational games.

19 Market Studies

Ausenco engaged Metalytics to provide an iron ore market study for use in the Bloom Lake Feasibility Study NI 43-101 Technical Report for its client Quebec Iron Ore (QIO), a subsidiary of Champion Iron Limited (Champion). In 2016, Champion acquired the Bloom Lake Mine and related assets through QIO and plans to restart operations.

The Scope of Work for the Market Report was agreed upon (including revisions decided in January 2017) as follows:

1. Executive Summary
2. Outline of the iron ore market:
    a. Iron ore market overview including the main ore types (hematite and magnetite) and traded iron ore products (fines, lumps, concentrates, and pellets) and their positions in the international market
    b. The major markets and sources of internationally traded iron ore
    c. Iron ore pricing and evolution
3. Iron ore supply and demand – summary discussion and statistics (year-by-year to 2022, then single years 2025, 2030 and 2035) for the following items:
    a. Steel demand, crude steel and iron production history and base case forecast by key countries/regions
    b. Iron ore demand history and base case by key countries/regions
    c. Iron ore production history and base case forecast by key countries/regions
    d. Global iron ore imports/exports and seaborne trade history and base case forecast by key countries/regions
4. Bloom Lake market positioning considering location and product specifications (chemical and physical product specifications and planned production levels provided by Ausenco)
5. Iron ore prices – statistics and summary discussion of the following items:
    a. Price drivers and the basis of determining forecasts
    b. Reference iron ore price (62% Fe fines) history and Base Case forecasts to 2035 (CFR China basis)
    c. Price premiums for high-grade concentrates and alternative high-grade reference prices
    d. Bloom Lake Concentrate Base Case CFR China price forecasts
    e. Alternative High and Low Case reference price scenarios to 2035 with outline descriptions

This report is based on Metalytics' iron ore industry knowledge, experience, analysis, and on information available to us from company, industry, trade, government, and other sources that may be limited or inaccurate. Metalytics has produced analysis, estimates and projections based upon this information and upon assumptions that are subject to significant degrees of economic, commercial, market, industrial and other uncertainties. Although we have exercised care in preparing this material, Metalytics makes no warranty of any kind regarding its contents, and shall not be liable in respect of any matter arising from its use without limitation.

19.1 Outline of the Iron Ore Market

19.1.1 Major Iron Ore Markets

The world iron ore industry is normally seen as having two geographical markets – the Atlantic and the Asia-Pacific. The major trade in the Atlantic market is Brazilian supply to Europe, with Vale being the overwhelmingly dominant supplier. South Africa’s Kumba (Anglo American), Mauritania’s SNIM and Sweden’s LKAB are the other major suppliers, with additional tonnage coming from Canada, Ukraine and Russia. Vale’s dominance made it the price setter in Europe under the benchmark pricing system (which ceased in 2010), and Vale’s European prices also flowed on to world price settlements in some years.

In the Asia-Pacific, the major markets are in East Asia – China, Japan, South Korea, and Taiwan – and Australia is the chief source of ore. Australia-Japan trade dominated in this region until about 2004. Prices were traditionally set between either Rio Tinto or BHP Billiton and the Japanese Steel Mills (JSM) – usually led by Nippon Steel. Vale was a smaller, but important player in this market.

The rising global importance of the China market meant that Vale turned to Asia to expand its sales, as its traditional European markets were flat and contracted in the wake of the Global Financial Crisis (GFC). Vale’s shipments to China, which now account for well over half its iron ore sales volume, made it a major player in the Asia-Pacific.

India emerged as a major supplier into Asian iron ore trade in the early-to-mid-2000s, exporting about half of the country’s production and becoming the second or third-largest source of imports into China, with myriad small producers and traders selling into the spot market. In fact, this Indian trade effectively established the spot market as the driver of world prices and facilitated the development of published iron ore price indices. From 2011, India’s export trade contracted severely, as a result of government policies to stamp out illegal mining and exports, and to preserve resources for the country’s own steel industry.

A major dynamic affecting the Asia-Pacific market is China’s domestic iron ore industry. However, it is very fragmented and statistical data are problematic. There was rapid growth in total Chinese raw iron ore production from the mid-2000s, but its impact in terms of availability of saleable ore was offset by declining grades and recoveries. Despite the domestic supply expansion, China has become at least 80% dependent on imports on a saleable ore basis.

Nevertheless, China’s domestic market adds to overall price dynamics. China’s production is higher-cost than mainstream imports, which tends to put upward pressure on domestic prices, which then interact with import prices.

Following a wave of iron ore industry consolidation in the early 2000s, world production and seaborne trade became dominated by three producers – Vale, Rio Tinto, and BHP Billiton. Fortescue Metals Group (FMG) entered the market in 2008 and has risen to become a fourth major market participant. These ‘Big Four’ account for about three quarters of global seaborne exports. On the demand side, China accounts for around 70% of world seaborne imports (seaborne imports make up 95% of international trade), and 60% of global iron ore demand, and overall Asia (excluding the Middle East) accounts for 88% of seaborne trade. This compares with around 8% for Europe.

19.1.2 Iron Ore Types and Products

Saleable iron ore products normally contain iron-bearing minerals such as hematite, goethite/limonite, or magnetite and are sold in these main physical forms:

- Lumps – sized from about 6 mm up to 30-35 mm
- Fines – sized from ~0.150 mm to 6.3 mm (sometimes up to 10 mm)
- Concentrates – intensively processed ore with particles less than 1 mm
- Pellet feed – fine concentrates with most particles less than 0.050 mm
- Pellets – 6 mm to 18 mm balls made by the agglomeration of pellet feed

Fines and lumps are generated from the crushing and screening of mined iron ore. Concentrates are the result of further and more intensive beneficiation processes to remove contaminants from low-grade ores. Lumps and pellets are referred to as “direct charge” products as they are suitable for directly charging into a blast furnace, whereas fines and concentrates first must be agglomerated into a lumpy material, either by sintering to form a clinker-like material or pelletising to form pellets. Fines make up more than an estimated 60% of world seaborne trade, while lumps account for about 15%, with concentrates (and pellet feed) having a similar share to lumps. Pellets make up the rest at less than 10%.

The main iron ore products used in steelmaking contain one or more of the iron (Fe) oxide minerals:

- Hematite (ferric oxide) – Fe_2O_3
- Magnetite (ferrous-ferric oxide) – Fe_3O_4
- Hydrous iron oxides – $FeO.OH.nH_2O$ – such as goethite and limonite, generally formed by the weathering of hematite

World seaborne trade in iron ore is dominated by so-called Direct Shipping Ores (DSO) in which the principal iron mineral is hematite. DSOs generally require simple processing of the raw mined ore, such as crushing and screening to separate lumps from fines, and/or minor upgrading to slightly increase the iron grade of the saleable products. The term “DSO” has become a relative term and may be applied to ore produced by beneficiation (beneficiated DSO) through which 80-90% of the raw ore is recovered as higher specification saleable product.

Hematite-based ore and its derivatives currently account for 97% of Australia’s iron ore production, as well as the bulk of output from Brazil, South Africa and India. Much of Brazil’s iron ore production comes from itabirite hematite deposits with in-situ grades typically in the 40-56% Fe range. These can be beneficiated or concentrated to high-grade fines and concentrates (and sometimes lump) in the 60-66% Fe range, but with mass recoveries as low as 45%, although 75-85% is common.

Magnetite ore deposits are generally of low iron grade (20-40% Fe) and require high levels of processing to concentrate the mined material into saleable products, which commonly grade above 63% iron. Processing usually involves crushing and grinding the ore to a very fine particle size and then using magnetic separation techniques to extract the magnetite from the unwanted minerals. China’s steel industry was built on the use of magnetite concentrates, but as steel industry expansion outstripped domestic iron ore supply, imported ores came to dominate.

The value of high-grade concentrates – whether hematite or magnetite – in improving the average grade of blast furnace feed blends is recognised by the market. Traditionally, ultrafine products such as pellet feed were priced at a discount to sinter feed fines. Concentrates and pellet feed are now priced against the same indices as similar-grade fines.

The term “concentrate” is often used loosely to refer to any beneficiated ultrafine iron ore product – i.e. ore that has been intensively processed and upgraded. Another related term is “pellet feed” – i.e. ultrafine material that is used to produce pellets. Concentrates also can overlap with fines in terms of sizing. When these terms are used more precisely, pellet feed refers to the finest material (75-90% less than about 50 µm), while concentrates refer to the coarser material (approximately 100µm to 1mm), which overlaps the normal fines sizing (150 µm to 8 mm).

Iron ore deposits of Canada’s Labrador Trough, where Bloom Lake is located, contain hematite-magnetite iron formations, which although low grade, can be beneficiated to high-grade concentrates.

19.2 Iron Ore Pricing and Evolution

Until 2010, iron ore term contract prices were set annually under a convention known as the benchmark pricing system. Prices or percentage price movements were agreed between the large iron ore suppliers and their major steel mill customers and these were then used as references or “benchmarks” to set prices throughout the industry.

Prices for individual iron ore products referenced against benchmark prices could be adjusted for quality with structural discounts or by the application of price penalties when chemical or physical properties fell outside agreed specifications.

In the Asian market, Rio Tinto Hamersley or BHP Billiton Newman prices were commonly used as the reference price for fines and lump, while Vale prices were used for pellets and concentrates. Benchmark prices were usually quoted in US cents per mtu (metric tonne unit), i.e. per 1% Fe per tonne.

By 2008, the system had begun to break down with companies exploring alternatives. Also during that year, industry publications such as Platts and Metal Bulletin developed iron ore price indices, based on China’s spot iron ore import market, with prices ‘normalised’ to standardised ore specifications with price adjustments for quality variations within defined ranges. The spot market provides for sales of individual shipments without a term contract. It had grown from supplying supplementary tonnage in the early 2000s to being a major part of the Chinese iron ore market and was seen by major producers as an indicator of the market clearing price.

BHP Billiton and Rio Tinto began introducing new pricing mechanisms to be more responsive to changing market conditions and 2009 marked the last contract year for the benchmark pricing system. From April 2010, the major producers, led by BHP Billiton, moved customers to index-based pricing. The index price of 62% Fe fines was adopted as the reference for contract pricing with Platts “IODEX” the most commonly used index.

Major differences that emerged with Index-based pricing included:

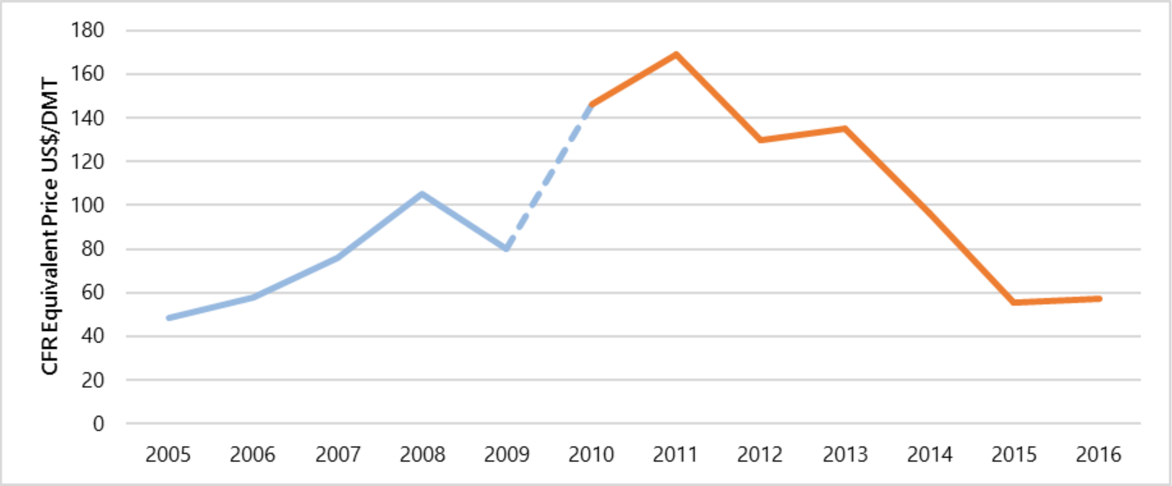
- The reference price (Index) is on a CFR China and US$/dry tonne basis.
- A quality premium or price differential per 1% Fe could be applied in pricing formulas to adjust for grade.

- FOB prices are calculated using freight netbacks from the CFR China price – a significant benefit for Australian producers in the Asian market because of their lower freight costs compared with more distant competitors.
- Structural discounts for concentrates and pellet feed disappeared.
- Various indices became available from different providers for use in pricing formulas covering a range of grades and products.

A history of prices spanning the transition from benchmark to index pricing is depicted in Figure 19-1. The annual benchmark prices prior to 2010 which were set on US$/dmtu FOB basis have been converted to a US$/dry tonne CFR basis using nominal iron grades, market freight rates from Australia to Japan/China, and moisture content assumptions; prices from 2010 have been derived from annual average index prices. Index-based prices for long-term contracts became standard from April 2010. Initially, they were calculated on a lagged-quarterly basis, before shorter quotation periods were progressively introduced. The annual average index prices therefore are not the same as contract prices. Moreover, leading brands such as Rio Tinto's Pilbara Blend can command a premium over the index price.

Thus, the resulting chart is for illustrative purposes only. Nonetheless, it shows the rise of annually negotiated prices leading up to the market crash in 2008 and the subsequent slide in 2009. Market recovery, largely powered by China's economic stimulus measures, then saw prices surge, before correction and then the general downward trend as supply began to catch and overtake demand. In 2016, the market found a new lower equilibrium, albeit with a surge back up to around the US$80/tonne level towards the end of the year.

Simplified representation – Prices do not necessarily represent contract or realised prices



Prices 2005-2009: based on Hamersley/Pilbara Blend benchmark prices and market freight rates converted to US$/dry tonne

Prices 2010-2016: based on Platts 62% Fe index CFR China (2016 partially estimated)

Source: Metalytics analysis

Figure 19-1 **Iron Ore Price Evolution: Australian Reference – Index Reference Fines**

19.3 Iron Ore Supply and Demand

This section outlines base case assumptions and the resulting future scenario for steel demand and supply, iron ore demand and supply, and iron ore trade. In developing our assumptions, we consider among other things current and future global economic growth and intensity of steel usage on a country or regional basis. We also take account of planned and potential iron ore supply, with the level of detail dependant on the time horizon. Such assumptions carry considerable uncertainty, especially in the longer term.

19.3.1 Steel Demand and Production

The global steel and iron ore industry is now in the post-boom era and Metalytics' Base Case assumption is that there will be continued slowing of steel consumption growth over the time horizon covered by this Report. We have assumed that growth in other emerging economies and any recovery in advanced economies will not make up for the maturing and eventual decline of China's steel usage. Between 2005 and 2010, global apparent finished steel consumption expanded at a compound annual growth rate (CAGR) of 4.6%, while China's steel consumption grew at 11.1%. Our projections assume that world CAGR will decline to below 1.5% p.a. as China's demand contracts in the mid-2020s.

Table 19-1 Finished Steel Consumption Growth (5-year CAGRs)

Period	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035
World	4.6%	2.7%	2.0%	1.5%	1.2%	0.9%
China	11.1%	2.7%	0.9%	0.0%	-1.5%	-2.0%

Source: Metalytics December 2016

Nevertheless, future global growth is building off a high base, so that global steel consumption would increase from around 1.5 billion tonnes in 2016 to almost 2 billion tonnes by 2035 under this scenario. That increment is approximately equivalent to China's steel consumption in 2008 at the peak of the iron ore boom.

Further, more than half of the growth in steel demand (net of China's decline) would come from Asia outside of China, with 27% attributable to India. As Table 19-2 shows, India's steel consumption per capita would still only be at relatively modest levels for a developing economy, while China's would be tracking along a declining path.

Table 19-2 Projected Steel Demand
Based on the assumed growth rates shown in Table 19-1

Finished Steel Consumption	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
World (Mt)	**1,535**	**1,545**	**1,500**	**1,506**	**1,532**	**1,572**	**1,615**	**1,659**	**1,691**	**1,719**	**1,762**	**1,872**	**1,967**
Europe	180	187	195	199	202	208	212	216	218	220	223	231	235
C.I.S.	59	56	50	50	51	52	53	55	56	57	61	68	62
North America	131	146	134	134	138	141	144	147	150	153	166	177	186
South America	51	49	46	41	43	45	47	49	51	53	56	69	80
Africa/Middle East	88	91	92	96	101	106	111	116	122	127	144	183	213
Asia & Oceania	1,026	1,017	983	988	998	1,021	1,048	1,077	1,094	1,109	1,134	1,162	1,203
China	735	711	672	666	666	676	689	703	706	706	703	652	589
India	74	76	80	86	91	98	105	113	121	130	144	184	234
World (kg per capita)	*224*	*224*	*215*	*212*	*214*	*217*	*221*	*225*	*229*	*231*	*232*	*238*	*242*
China (kg/capita)	*540*	*519*	*489*	*482*	*479*	*485*	*493*	*501*	*502*	*501*	*497*	*460*	*418*
India (kg/capita)	*58*	*59*	*61*	*65*	*68*	*72*	*76*	*81*	*86*	*92*	*98*	*120*	*148*

Note: Projections based on assumptions as described

Source: Metalytics December 2016

The associated response in steel production is summarised in Table 19-3. It shows China's crude steel output plateauing by the mid-2020s. We expect that the challenges and hurdles faced in developing countries – especially in India – to build new steel plants will mean that as China's own steel requirements decline, its massive installed capacity, even allowing for current rationalisation, will contribute to meeting supply deficits in other markets and help balance out world demand. With well-established industrial and raw materials supply infrastructure, China will be able to play a role in global and especially Asian steel markets like the one Japan has played over many decades.

Table 19-3 Steel Production

Crude Steel Production (Mt)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
World	**1,650**	**1,670**	**1,621**	**1,630**	**1,660**	**1,696**	**1,747**	**1,797**	**1,831**	**1,863**	**1,922**	**2,035**	**2,132**
Europe	205	208	202	199	206	213	220	224	227	230	228	232	234
C.I.S.	108	106	102	102	106	110	113	114	114	114	116	118	118
North America	118	120	110	110	114	119	125	131	134	137	138	140	143
South America	47	46	45	41	46	48	51	55	58	62	68	84	98
Africa/Middle East	43	45	43	43	50	56	62	66	72	79	101	132	146
Asia & Oceania	1,129	1,145	1,119	1,134	1,139	1,149	1,177	1,207	1,225	1,240	1,271	1,329	1,394
China	822	823	804	805	801	802	815	831	835	835	838	838	838
India	81	87	89	98	102	109	117	126	135	145	155	198	252

Source: Metalytics December 2016

19.3.2 Pig Iron and DRI production

Another important long-term assumption is that the usage of steel scrap as a source of iron feed units will increase, as steel production growth moderates, allowing the rate of scrap generation to better pace steel production. This, along with growth in direct reduced iron (DRI) output, means blast furnace (pig iron) production would grow at lower rates than those for steel production as shown in Table 19-4.

Table 19-4 Steel and Pig Iron Production Growth (5-year CAGRs)

Period	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035
Steel						
World	4.5%	2.5%	2.1%	1.7%	1.1%	0.9%
China	12.4%	4.7%	0.7%	0.2%	0.0%	0.0%
Pig Iron						
World	5.3%	2.3%	1.6%	0.7%	0.5%	0.2%
China	11.6%	3.0%	0.7%	-0.1%	-0.4%	-1.5%

Source: Metalytics December 2016

Table 19-5 Blast Furnace Iron Production

Projections Corresponding to Growth and Other Assumptions

Pig Iron Production (Mt)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
World	1,208	1,190	1,159	1,162	1,178	1,196	1,224	1,252	1,266	1,277	1,298	1,331	1,341
Europe	103	106	105	104	107	111	115	116	116	117	114	116	117
C.I.S.	82	79	78	79	83	85	87	87	87	87	86	86	86
North America	41	41	36	33	36	38	39	41	42	43	46	46	47
South America	30	31	31	29	32	32	33	36	38	40	44	49	56
Africa/Middle East	8	8	8	8	8	9	9	10	11	13	23	31	34
Asia & Oceania	944	925	901	909	912	921	940	962	973	977	985	1,003	1,001
China	748	716	691	693	689	690	701	715	718	714	713	700	649
India	51	55	58	64	67	71	76	82	88	95	101	128	164

Source: Metalytics December 2016

While increased DRI and scrap supply would see reduced growth for pig iron production, annual output from blast furnaces (and alternatives such as Finex and Corex), and hence consumption of iron ore, would still increase. Assuming that most of this growth occurs in the Asian region – notwithstanding a decline in China's output – and allowing for varying degrees of growth elsewhere, the increase in global production by 2035 would be similar to the current combined production of Europe, the Americas, Africa and the Middle East.

19.3.3 Iron Ore Supply and Demand

Our projections for future iron ore consumption are driven by the steel and iron production projections derived above. As a result, the growth rates shown in Table 19-6 follow a similar pattern to those for steel and iron, with China's demand falling in the 2020s and global growth rates moderating.

Table 19-6 Iron Ore Consumption Growth (5-year CAGRs)

Period	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035
World	6.1%	3.4%	1.7%	1.1%	0.9%	0.4%
China	14.7%	5.4%	0.2%	-0.1%	-0.4%	-1.5%

Source: Metalytics December 2016

Overall, these assumptions result in annual world consumption increasing by 10% over the remainder of the decade and then a further 12% over the next 15 years to 2035. This requires an increase of almost 200 Mt over the four years to 2020 – more than twice the planned output of Vale’s Carajás S11D project due to start commercial production in 2017. Over the following 15 years, annual demand would grow by around a further 275Mt – in other words, by the end of that period, additional supply equivalent to BHP Billiton’s current output from its Western Australian operations would be required. From a global perspective, this appears to be a modest target spread over that time frame; however, it will not be without challenges owing to competition for land and water use, infrastructure and investment requirements, regulatory and financing hurdles, and sovereign risk considerations.

Over the long term, we have assumed that developing countries outside of China will drive iron ore demand as China’s consumption begins to decline in the 2020s. Further, India should display strong growth rates, but will not be ‘another China’. Rather, by 2035, India’s iron ore demand would be just below the level China reached in 2004. It should be noted that demand in other growth regions – including the Middle East, Africa, and South America – carries the risk of political instability, which may see it fall short of the projections shown in Table 19-7.

Our global iron ore balances are built up from country and regional analyses, with production based on producer and mine-by-mine estimates considering project plans and considerations of market effects on output levels.

In the short term, supply has overtaken demand, leading to a structural surplus. However, producers are now focused on cost control and sustaining production and quality levels rather than expansion. We have assumed that the high-cost end of marginal production, particularly in China, will be progressively displaced by lower-cost supply to the seaborne market – especially from Australia and Brazil. Nevertheless, we also have assumed that a substantial tonnage of moderate-cost Chinese domestic production will remain over the forecast timeframe.

Table 19-7 Iron Ore Consumption and Production

Projections Corresponding to Steel and Iron Assumptions

Iron Ore Consumption (Mt)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
World	**2,016**	**2,113**	**2,061**	**2,046**	**2,072**	**2,120**	**2,180**	**2,243**	**2,277**	**2,301**	**2,370**	**2,476**	**2,521**
Europe	160	165	159	158	163	169	175	177	176	178	175	178	179
C.I.S.	144	135	127	130	137	141	144	145	146	147	159	158	158
North America	72	77	73	62	69	73	76	81	84	86	89	88	90
South America	61	62	61	51	63	64	67	71	75	79	98	120	140
Africa/Middle East	54	60	57	59	67	78	84	90	94	100	142	180	196
Asia & Oceania	1,526	1,615	1,586	1,584	1,573	1,595	1,634	1,679	1,702	1,710	1,706	1,753	1,758
China	1,174	1,237	1,207	1,206	1,173	1,176	1,195	1,219	1,225	1,218	1,211	1,190	1,104
India	119	132	134	129	140	153	167	183	196	207	211	269	333
Total Demand	**2,047**	**2,138**	**2,057**	**2,066**	**2,069**	**2,138**	**2,195**	**2,254**	**2,282**	**2,275**	**2,376**	**2,481**	**2,523**
Iron Ore Production (Mt)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**
World	**2,112**	**2,183**	**2,124**	**2,124**	**2,161**	**2,200**	**2,248**	**2,313**	**2,343**	**2,352**	**2,387**	**2,490**	**2,539**
Europe	43	42	39	35	36	38	38	38	38	38	41	46	41
C.I.S.	206	200	195	194	195	195	197	197	198	198	190	180	170
Africa/Middle East	155	166	127	119	125	136	146	154	161	161	184	213	243
North America	113	119	107	98	102	107	109	117	120	122	121	125	120
South America	419	431	450	455	470	495	532	565	579	591	578	614	640
Brazil	387	399	414	420	434	459	494	526	539	551	530	550	565
Asia & Oceania	1,175	1,225	1,205	1,222	1,234	1,229	1,227	1,241	1,248	1,242	1,273	1,313	1,325
China	364	313	249	225	179	146	123	119	117	117	110	100	93
India	136	135	137	131	138	144	153	161	164	165	168	190	195
Australia	622	750	805	852	901	920	932	941	946	940	965	985	1,000
Net Balance	65	45	67	57	92	62	53	59	61	77	11	9	16
as % of Demand	*3.2%*	*2.1%*	*3.2%*	*2.8%*	*4.4%*	*2.9%*	*2.4%*	*2.6%*	*2.7%*	*3.4%*	*0.5%*	*0.4%*	*0.6%*

Notes:
“Total Demand” accounts for stock in transit. This requirement increases or reduces as imports rise or fall, which can amplify the effect of changes in consumption.
China’s iron ore production is estimated on a saleable product basis. Official statistics are reported on a raw ore or ROM basis.

Source: Metalytics December 2016

It is almost inevitable that there will be short-term imbalances, which will see suppliers enter and leave the market over time. Ultimately, it is the projects with suitably competitive attributes in advantageous development environments that underpin long-term supply.

19.3.4 Seaborne Iron Ore Trade

Seaborne trade accounts for around 95% of current world iron ore trade and its share should rise further as the major exporting nations – Australia, Brazil, and (in a distant third place) South Africa – are separated by the world’s oceans from the major iron ore markets in Asia and Europe. Some localised trade occurs around the CIS and Eastern Europe, there is cross-border trade in North America, and there is some land-based trade between China and neighbouring countries. Even so, those trade flows are influenced by the seaborne market from which they take their lead on pricing.

Table 19-8 Seaborne Imports and Exports
Projections Corresponding to Assumptions for Iron Ore Supply and Consumption in Steelmaking

Seaborne Imports (Mt)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
Europe	120	121	115	117	124	129	135	137	136	137	135	137	139
Nth & Sth America	13	16	17	11	13	13	14	17	17	18	28	43	48
Africa & Middle East	28	34	32	35	39	48	52	56	59	63	89	126	132
Asia & Oceania	1,026	1,171	1,196	1,233	1,233	1,297	1,351	1,389	1,409	1,415	1,406	1,434	1,441
China*	799	917	931	977	963	1,019	1,063	1,091	1,097	1,090	1,090	1,079	1,000
Total Seaborne Imports	**1,187**	**1,342**	**1,361**	**1,395**	**1,409**	**1,487**	**1,552**	**1,598**	**1,620**	**1,634**	**1,659**	**1,740**	**1,764**
Total Seaborne Demand**	**1,200**	**1,354**	**1,362**	**1,397**	**1,413**	**1,495**	**1,559**	**1,603**	**1,623**	**1,635**	**1,666**	**1,745**	**1,768**
Seaborne Exports (Mt)	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2025**	**2030**	**2035**
Australia	610	757	811	843	889	910	920	934	935	934	959	982	1,000
Brazil	330	344	366	381	384	409	443	470	487	496	467	485	493
S. Africa	63	65	65	54	55	54	53	53	52	51	54	58	58
India	15	10	4	14	17	17	17	13	13	12	17	18	17
Canada	36	37	35	39	40	43	43	49	48	48	45	56	50
C.I.S.	31	29	28	24	15	8	5	3	3	3	3	2	1
Other Sth America	27	29	32	33	28	28	28	28	27	27	29	32	36
Other Africa	18	20	18	17	18	20	23	26	32	33	48	59	74
ROW	127	85	69	54	48	50	55	60	59	59	55	66	71
Seaborne Exports	**1,256**	**1,376**	**1,427**	**1,458**	**1,495**	**1,539**	**1,587**	**1,635**	**1,657**	**1,663**	**1,676**	**1,760**	**1,800**
Seaborne Trade Balance	56	22	64	62	82	44	28	32	34	27	10	15	32
as % of trade	*4.7%*	*1.6%*	*4.7%*	*4.4%*	*5.8%*	*2.9%*	*1.8%*	*2.0%*	*2.1%*	*1.7%*	*0.6%*	*0.9%*	*1.8%*

Notes: *China excludes land-based imports from neighbouring countries
**Total Seaborne Demand includes allowance for stock in transit

Source: Metalytics December 2016

Seaborne export projections reflect the trends in production. An exception is India, where we have assumed that production increases will mainly be directed to the domestic market, as demand outgrows local supply and the country follows China in becoming dependent on imports, owing to constraints on iron ore mining development as well as to ore quality issues. The overall projected balance for seaborne trade reflects global supply and demand differences. Surpluses below about 5% generally indicate a closely balanced market, at risk of short-term tightness if supply disruptions or surges in demand occur. Our assumptions yield a scenario (as shown in Table 19-8) which projects that the current surplus will be absorbed and the market then starts to come into balance by 2018, after which it remains at a balanced-to-tight level.

Longer-term, we have assumed that the legacy of cautious post-boom investment, declining reserves, and constraints on new mining development should keep the market broadly in balance (on average), although it is unlikely that supply and demand will always be synchronised – short-term disequilibriums are to be expected.

Our supply growth assumptions suggest that Australia will remain the predominant seaborne supplier, adding more than 150 Mt to annual seaborne exports by 2035, compared with over 110 Mt for Brazil. Further, that Brazil's exports would be limited by constraints on mining and infrastructure development, as well as more feed being required by the domestic steel industry over that timeframe.

While the previously touted new iron ore frontier of West Africa has failed to live up to projections, over the next 20 years there may be time for some projects to gain traction. Shipping distances from West Africa to Asia are similar to those from Brazil to Asia and, in that sense, West African projects directly compete with Brazilian supply in terms of delivered costs to Asia.

19.3.5 Iron Ore Trade

The iron ore trade figures given in Table 19-9 include the non-seaborne components of world imports and exports. These are the outcome of the assumptions outlined previously, including the amount of cross-border trade that may occur in North America, CIS and Eastern Europe, and China over the given timeframe.

As noted previously, it is seaborne trade that drives global iron ore markets and where reference prices are determined. The main impact that the non-seaborne portion may have is that surpluses from cross-border trade may be redirected to the seaborne market. Changes in these local balances can therefore affect seaborne trade to an extent.

Table 19-9 World Iron Ore Imports and Exports
Projections Based on Assumed Iron Ore Supply, Consumption and Trade Flows

Iron Ore Imports (Mt)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
Europe	143	145	141	147	150	156	162	164	163	165	162	165	166
North America	11	16	13	12	12	13	14	16	16	17	35	53	60
Central & Sth America	11	12	13	7	9	9	10	10	11	12	16	24	29
Africa & Middle East	28	34	32	35	39	48	52	56	59	63	89	126	132
C.I.S.	17	14	10	17	17	20	24	25	25	25	14	13	18
Asia & Oceania	1,047	1,186	1,218	1,252	1,251	1,312	1,364	1,400	1,420	1,426	1,417	1,445	1,451
China	820	933	953	996	981	1,034	1,076	1,102	1,108	1,101	1,101	1,090	1,010
Total Iron Ore Imports	**1,256**	**1,406**	**1,427**	**1,469**	**1,477**	**1,558**	**1,626**	**1,671**	**1,694**	**1,709**	**1,733**	**1,825**	**1,856**
Iron Ore Exports (Mt)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2025	2030	2035
Australia	610	757	811	843	889	910	920	934	935	934	959	982	1,000
Brazil	330	344	366	381	384	409	443	470	487	496	467	485	493
South Africa	63	65	65	54	55	54	53	53	52	51	54	58	58
North America	59	55	45	47	45	47	47	53	53	52	67	90	90
C.I.S.	79	78	75	81	74	74	76	77	76	76	45	35	30
Europe	30	32	25	24	23	24	25	25	25	26	27	26	25
Other Sth America	27	29	32	33	28	28	28	28	27	27	29	32	36
Asia (excl. Middle East)	65	36	28	27	29	27	27	24	24	24	22	19	18
Other Africa	18	20	18	17	18	20	23	26	32	33	48	59	74
Rest of the World	37	36	27	25	25	29	34	39	38	37	30	43	49
Total Iron Ore Exports	**1,317**	**1,452**	**1,491**	**1,532**	**1,571**	**1,622**	**1,677**	**1,727**	**1,749**	**1,755**	**1,748**	**1,831**	**1,872**
Balance	61	46	64	63	93	64	51	56	55	47	15	5	16
as % of imports	*4.9%*	*3.3%*	*4.5%*	*4.3%*	*6.3%*	*4.1%*	*3.2%*	*3.4%*	*3.3%*	*2.7%*	*0.9%*	*0.3%*	*0.9%*

Source: Metalytics December 2016

19.4 Bloom Lake Market Positioning

We were supplied with product specifications for Bloom Lake iron ore concentrate (Table 19-10) compiled during the QIO Bloom Lake Feasibility Study and based on test work undertaken from September 2016 to January 2017. These specifications are described as "typical". Iron ore producers commonly quote "typical" or "expected" specifications for their products; guaranteed or minimum/maximum levels of various components are also separately specified in sales contracts.

Table 19-10 Bloom Lake Concentrate Typical Specifications

Chemical Composition & Particle Size Distribution from QIO Bloom Lake Feasibility Study (Based on metallurgical test work September 2016 to January 2017)

Typical Chemical Composition

Content	Fe	Silica	Alumina	Phos.	Sulphur	MnO	CaO	MgO	Na_2O	K_2O	TiO_2	LOI
%	66.2	4.44	0.27	0.014	<0.01	0.08	0.10	0.10	0.02	0.01	0.16	0.18

Typical Particle Size Distribution

Size (microns)	850	600	425	300	212	150	106	75	45	-45
% Retained	1.35	8.76	13.6	17.7	18.0	17.5	10.6	7.25	3.96	1.31

Source: Mineral Technologies via Ausenco

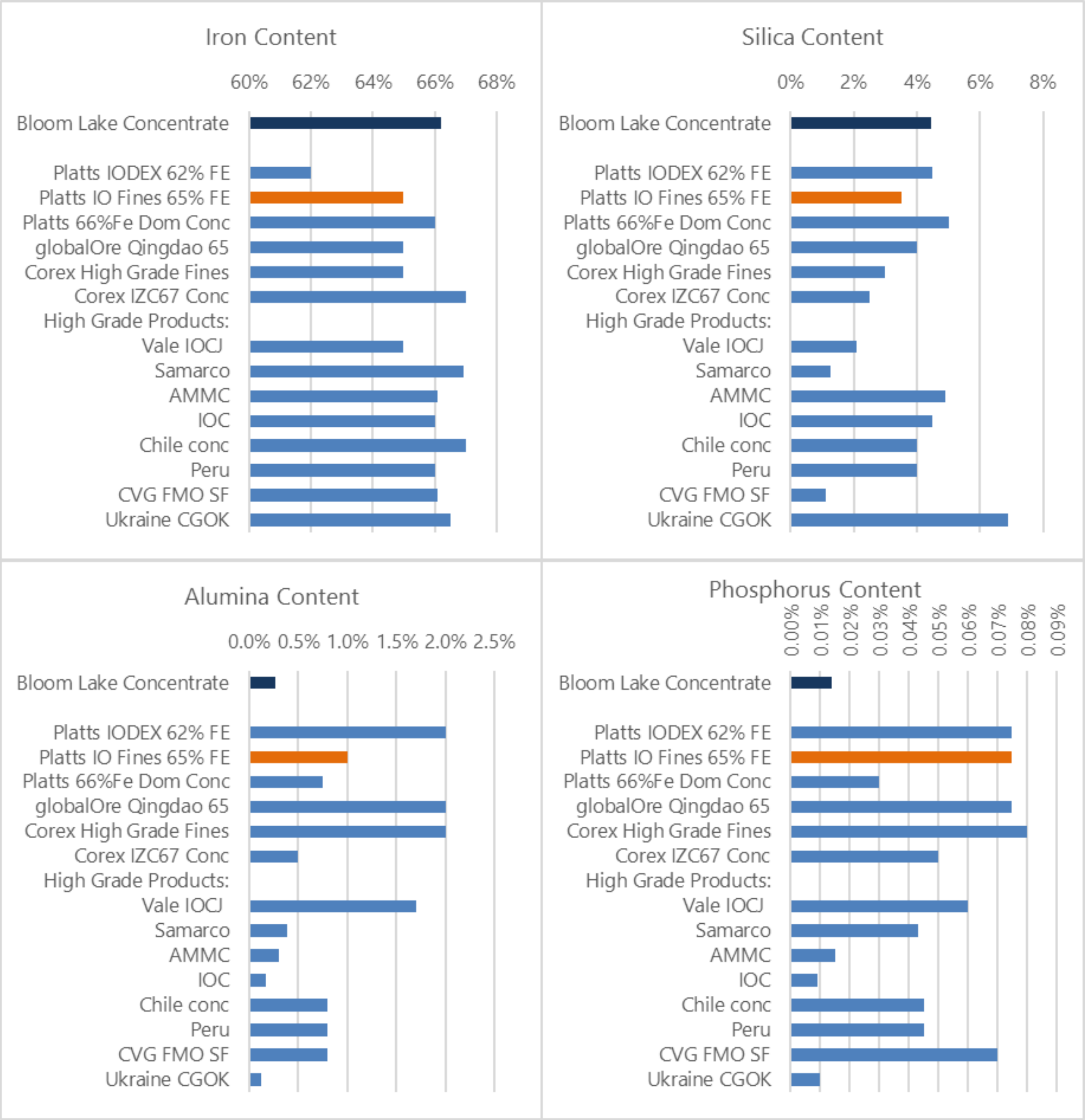
Moisture content specifications were not supplied, but the historical moisture figure of 3.2% is considered a reasonable assumption and would be consistent with other Labrador Trough concentrates.

The particle size distribution positions the Bloom Lake product as coarse-grained concentrate suitable for use as a sinter feed product and falls within the general sizing range of Canadian concentrates. Although we have not been provided with information on sintering performance, Bloom Lake concentrate previously was successfully sold into global markets for several years with sales exceeding 6 million tonnes in 2014.

Figure 19-2 compares the Bloom Lake concentrate analysis with the chemistries of some reference index and trading platform specifications, along with those of some potentially competing high-grade products. Note that this is only a generalised comparison as some product specifications may have been superseded and, if current, may change. Moreover, companies often offer variations on product specifications at different times as operational and market circumstances change. Within those limitations, it is clear that the Bloom Lake product's iron content is competitive in the high-grade fines market.

Figure 19-2 Bloom Lake Chemistry Comparison

These charts are only suitable for generalised comparison and should not be relied upon



Note: Product chemistries are charted for indicative comparison purposes and may not be current.
The specifications of actual products traded may differ materially from those shown above
Index, trading platform, and company product specifications are subject to change at any time

Source: Ausenco (Bloom Lake concentrate), Platts, The Tex Report, COREX, globalORE, companies, Metalytics

At 4.44%, the silica level is similar to other Canadian (Labrador Trough) concentrates, higher than Brazilian and other South American products, but lower than competing products from CIS sources. It also sits below the Platts index base specification for Chinese domestic concentrate. The decline in China's iron ore production – which is generally characterised by higher silica levels – has to some extent required a rebalancing of silica in sinter feed blends, but this is generally the role of low to medium grade products.

Bloom Lake concentrate has a very low alumina level, also characteristic of traditional Canadian concentrates. It could therefore be used in a blend to correct for high alumina in lower-priced ores. Phosphorus and sulphur, which are generally deleterious contaminants, are also present at very low levels – this can be quite beneficial in reducing the total load of those elements in a blast furnace raw material mix.

Geographically, Eastern Canada is at a logistical disadvantage to Brazil, the main source of high-grade products into Asian markets. On the other hand, it is well-placed to supply Europe and other Atlantic markets. Prior to Bloom Lake's shutdown in 2014, it mainly supplied China and so has a previously-established position in that market. The typically low Canadian concentrate moisture level in the Bloom Lake product is a benefit in reducing effective transport costs, when considered on a dry basis.

19.5 Iron Ore Prices

This section contains our Base Case price scenario for financial modelling and two alternative cases provided for sensitivity analysis. The Base Case has been developed using the same assumptions of future steel and iron ore supply/demand as outlined in previous sections, along with assumptions about Bloom Lake product in the global iron ore market.

19.5.1 Price Drivers

Our iron ore price forecasts consider factors such as projected global supply and demand balances, especially for seaborne trade, current and projected iron ore operating costs and value to steel mills. All of these are influenced by many underlying factors and assumptions, which contain many uncertainties and complicating factors.

Our Base Case is therefore a price *scenario* that reflects these assumptions.

Prices may be driven by supply and demand in the market in general, but also within market segments. Government policies can change at any time and can have a dramatic effect. The prices of metallurgical coal and coke affect the value equation for different iron ore grades and product types. Industry cost structure in combination with market demand theoretically establishes pricing at the margin, although this is far from static and can be complicated by other factors. For example, it has been common for Chinese iron ore mines to operate at a loss. Further, as prices declined in recent years, producers globally have significantly reduced costs enabling profits and economic returns to be made at lower price levels than previously was the case.

19.5.2 Reference 62% Fe Fines Iron Ore Price

The primary reference for pricing internationally-traded iron ore is the price of 62% Fe fines delivered to China. There are several industry publications that track spot prices for this and other products and compile price iron ore indices. The most commonly referenced is Platts' IODEX 62% Fe CFR China index. CFR indicates cost and freight. Platts assesses trading transactions, bids and offers for iron ore fines grading between 60% Fe and 63.5% Fe, and then adjusts (or normalises) the price information to align it to a base standard specification. Platts has set the quality specification for the IODEX 62% Fe index as follows:

- 62% Fe, 4.5% silica, 2% alumina, 0.075% phosphorus, 0.02% sulphur, and 8% moisture.

Our price forecasts are based around this index price and are given in Table 19-11, along with corresponding inflation assumptions. We take account of market developments in pricing, and our iron ore supply and demand projections, paying special attention to the forward picture for seaborne trade.

Table 19-11 Base Case Price Forecast for 62% Fe Fines CFR China Forecast at December 2016 (Prices in US$/dmt)

Calendar Year	62% Fe Fines CFR China	
	NOMINAL TERMS	REAL (2016) TERMS
2011	$169	
2012	$130	
2013	$135	
2014	$96	
2015	$56	
2016		$57
2017		$55
2018		$56
2019		$65
2020		$68
2021		$68
2022		$70
2023		$70
2024		$70
2025		$71
2026		$74
2027		$78
2028		$80
2029		$80
2030		$77
2031		$74
2032		$70
2033		$63
2034		$65
2035		$70

Source: Platts, Metalytics December 2016 forecasts

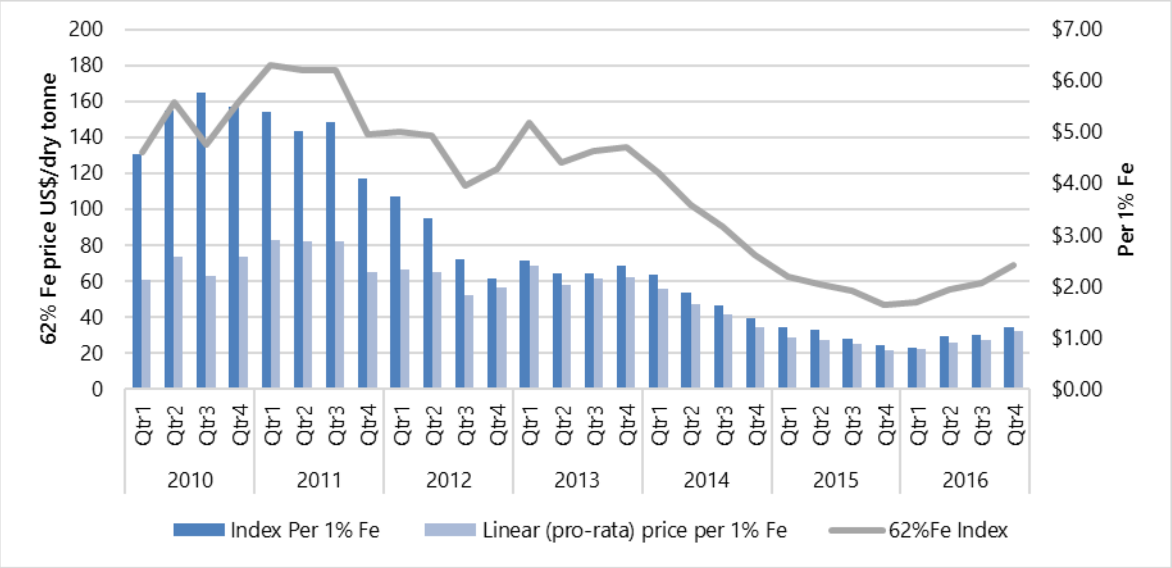
We have assumed that the reference 62% Fe index will range sideways over the next two years, suppressed by excess supply, before lifting towards a higher equilibrium level in 2019 and the following years. While prices rose to around the US$80/dmt mark in late 2016, our projected forward market balances indicate a surplus emerging in 2017. Much will depend on the extent to which new supply is offset by the market exit of existing production – particularly from China's domestic iron ore sector. It is a reasonable assumption that there will be ongoing displacement of domestic concentrate by imported ore. The rate at which this occurs will play a key role in balancing the market over the next five years.

The long-term (2021-2035) average price is set slightly higher, based on the assumption that the period should be characterised by reasonably close market balances, with annual prices moving in a band between US$66/dmt and US$80/dmt in real-terms. We have assumed that the post-boom iron ore industry caution and investment conservatism will long pervade the sector. Consequently, new capacity developments should mainly be driven by the need to replace depleted mines, manage product quality, and by cautiously pacing demand. Hurdles to project development including regulatory requirements in mainstream production jurisdictions and sovereign risk in other regions should also act to dampen global capacity growth.

19.6 Price Premiums

19.6.1 Mid-Range Grades

Price premiums or quality adjustment indices vary with market conditions. They are influenced by many factors including the steel market and mill margins, coal and coke prices, scrap prices, supply and demand of different grades of iron ore, and whether iron ore prices are rising or falling, as well as the absolute price level.



Notes: Per 1% Fe is equivalent to per metric ton unit (mtu)

"Linear (*pro-rata*) price per 1% Fe" is the 62% Fe price expressed as US$ per mtu (or per 1% Fe)

Reference: Platts, Metalytics analysis

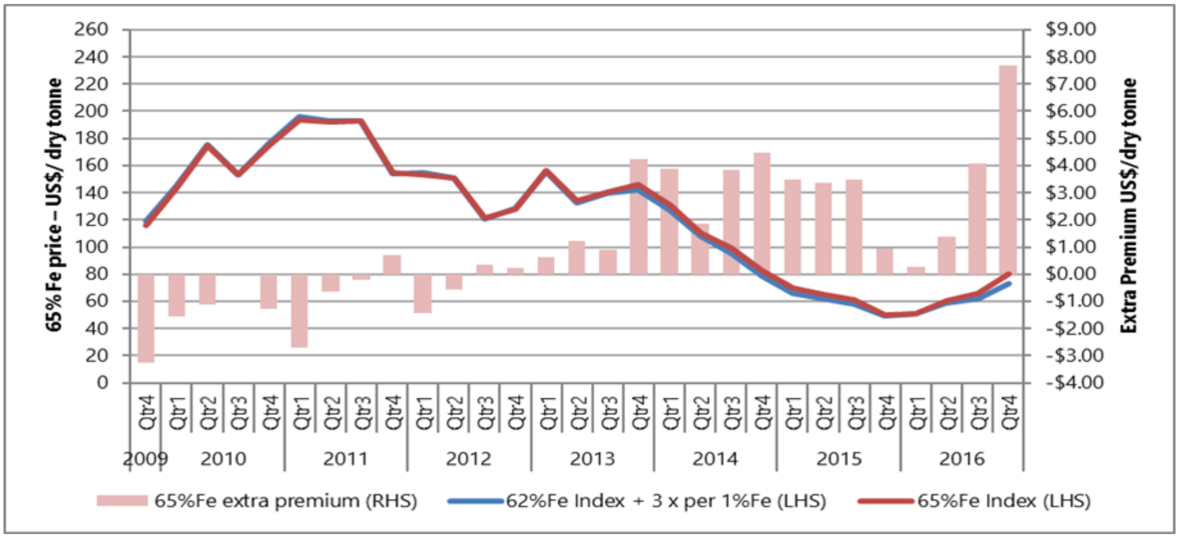
Figure 19-3 Standard Price Differentials

Premiums are variously referred to as a "Per 1% Fe differential" (Platts and TSI) or "Dollar Fe Value-in-Use" (Metal Bulletin) and are quoted by price index providers as applying over specified grade ranges. Such assessments allow prices for a wide range of products and grades to be referenced to a 62% Fe index by adding or subtracting a multiple of the differential/VIU index. From the inception of index-based pricing, they have been applied beyond the grade range over which they were assessed to calculate prices for high-grade products. For the first two-to-three years of index-based pricing, this assessed market value of each 1% Fe change in grade was significantly higher than a straight linear *pro-rata* price adjustment, as illustrated by . Since then, however, the price differential has tracked much more closely to the linear rate, ranging from equalling it to being about 40% higher.

19.6.2 High-Grade Products

Until late 2013, the index price for 65% Fe fines was generally within ±1% of the formula price calculated by adding three times the per 1% Fe differential to the 62% Fe index price. Vale, the largest supplier of high-grade ore to the seaborne market, traditionally used the latter method for its long-term contract sales, but, in spot sales, the company was able to achieve significantly higher premiums. High-grade products reduce blast furnace fuel rates and increase furnace productivity. In the fourth quarter of 2013, Vale introduced an additional premium for contract sales for its Carajás fines. A significant extra premium (beyond the ±1% range) for high-grade fines then was seen in the 65% Fe Index price.

Figure 19-4 65% Fe Price Comparison



Note: 2016 Q4 data is up to 15 December 2016

References: Platts, Metalytics

Figure 19-4 compares 65% Fe index prices with formula prices calculated from the 62% Fe index and quality differential. The difference between the two represents an extra premium being realised by high-grade product. The lower silica and alumina contents in the base specification for the 65% Fe index contribute towards the extra premium.

During the period of low prices that prevailed in late 2015 and early 2016, high-grade producers reaped very little extra value beyond the standard grade adjustment. That changed in the third quarter, as coking coal prices began to rise and steel prices shot up after China's National Holiday period. The extra premium then jumped further in late November amid coal price induced panic, before subsiding to still-high levels.

This demonstrates that, despite the conceptual extra value-in-use of high-grade iron ore for blast furnace operations, the actual realised value is very dependent on market conditions – particularly prevailing coal prices, steel prices, and blast furnace productivity drivers. At times of steel over-supply and low prices, blast furnace operators are less concerned about output than they are about costs and they look for cheaper raw materials and are unwilling to pay a premium for higher-grade iron ore. The opposite applies when coal prices are high and fuel rates become a concern or when steel demand is strong and prices are attractive.

In the case of Bloom Lake concentrate at 66.2% Fe, a 65% Fe index is a convenient and appropriate reference to use for price forecasting as it incorporates assumptions about future high-grade premiums. Actual contract pricing may be on another basis, such as a formula price with a negotiated premium.

19.6.3 Bloom Lake Base Case Price Estimate – CFR China Basis

Iron ore is commonly sold on a Cost and Freight (CFR) or Fee on Board (FOB) basis. Under a CFR sale, the product changes hands as it is unloaded at the arrival port and the pricing includes shipping costs. In recent years, there has been a strong trend to CFR sales, as this gives sellers control over shipping. An FOB sale is for iron ore delivered on board a vessel at the loading port, and the price is usually determined by netting back the cost of ocean freight (to China) from the CFR China price.

We understand that shipping costs for Bloom Lake are the subject of a separately commissioned study. As this information is necessary for analysing FOB netback prices, the scope of this report is confined to pricing on a CFR (China) basis – China being where global reference prices are set.

The following represents our base case price forecasts as at December 2016 for the period to 2035 for medium grade (62% Fe) and high-grade (65% Fe) iron ore fines on a CFR China basis and corresponding estimates for 66.2% Fe Bloom Lake concentrate, also on a CFR China basis. All prices are in real 2016 terms. The inflators we have assumed (based on World Bank projections) are shown with the prices in Table 19-12.

Table 19-12 Bloom Lake Concentrate Base Case Price Estimates
Prices in USD/dry metric ton and in Real 2016 Terms

Year	62%Fe Index CFR China	Mid-Range Premium Per 1%Fe	65%Fe Index CFR China	65%Fe Index Additional High-Grade Premium	Bloom Lake Concentrate 66.2% Fe CFR China	Total Premium over Reference 62% Fe CFR China
2016	57.47	1.01	64.15	3.65	65.34	7.87
2017	55.47	0.97	62.24	3.85	63.38	7.91
2018	56.17	0.99	62.72	3.59	63.88	7.71
2019	64.81	1.15	71.13	2.87	72.44	7.63
2020	68.05	1.32	74.82	2.81	76.20	8.15
2021	68.39	1.38	75.25	2.72	76.64	8.24
2022	69.76	1.46	76.76	2.61	78.18	8.42
2023	69.76	1.46	76.78	2.63	78.20	8.44
2024	69.76	1.46	76.82	2.67	78.24	8.47
2025	70.81	1.48	77.94	2.68	79.38	8.58
2026	74.35	1.56	81.71	2.68	83.21	8.87
2027	78.06	1.64	85.65	2.68	87.24	9.17
2028	80.41	1.69	88.15	2.69	89.78	9.37
2029	80.30	1.68	88.06	2.71	89.68	9.38
2030	76.90	1.61	84.49	2.75	86.05	9.15
2031	73.83	1.55	81.26	2.79	82.76	8.93
2032	70.14	1.47	77.38	2.83	78.81	8.67
2033	63.12	1.32	69.99	2.89	71.28	8.16
2034	64.71	1.36	71.69	2.91	73.01	8.30
2035	70.30	1.47	77.62	2.90	79.05	8.75

Source: Metalytics December 2016 (Index price forecasts); Metalytics January 2017 (Bloom Lake 66.2% Fe Concentrate prices)

Note: USD/dry metric ton Per 1% Fe is an equivalent unit to USD per dry metric ton unit (US$/dmtu)

We have derived the Bloom Lake concentrate prices by escalating our projected 65% Fe CFR Index prices to 66.2% Fe on a linear or *pro-rata* basis to arrive at a CFR China price. Technically, we could also consider alternative pricing adjustments using price differentials to account for the difference in silica levels (4.44% in the Bloom Lake concentrate as against 3.5% in the Platts 65% Index specification), alumina levels (0.27% for Bloom Lake concentrate versus 1.0% for the Platts 65% Index), and phosphorus (Bloom Lake at 0.014% versus Platts 65% Fe at 0.075%). Platts publishes differential price indices for all of these, however they are assessed at higher content levels than contained in the specifications for Bloom Lake concentrate and the Platts 65% Fe index. Similarly, the per 1% Fe differential could be used to adjust the index price for iron grade rather than by *pro-rata* escalation. Both methods are used in international trade.

In the case of Bloom Lake concentrate at the given specification, Metalytics concludes that there would be only small differences between adjusting the 65% Fe index using differentials and using the simple *pro-rata* method shown in Table 19-12. The results on average differed by 0.3% over the period (given assumptions about future differentials levels), which does not justify the extra complication and hypotheses required for the differential adjustment method. It mainly is reflective of the higher silica of Bloom Lake concentrate being significantly offset by lower alumina and phosphorus. In practice, there are many pricing parameters that are far more significant, including actual delivered grade variation and precision of the forecast. Projecting future chemistry differentials is especially problematic as they influenced by many factors that are difficult to predict.

While silica and alumina play important roles in the sintering process and the removal of phosphorus and sulphur add to steel plant operating costs, iron content is clearly the primary driver of value as iron is the principal ingredient required to make steel. The *pro-rata* adjustment is identical to the long-practiced industry method of adjusting sales prices on a US$/dmtu (dry metric ton unit) basis. A dmtu is 1% Fe per dry tonne.

19.6.4 Alternative Price Scenarios

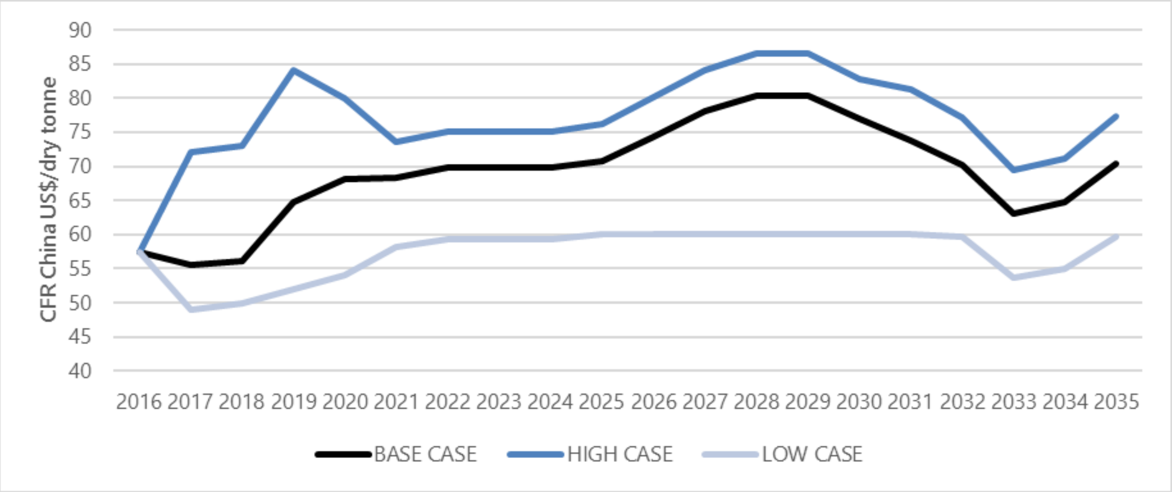
We have constructed two alternative price scenarios around the base case for sensitivity modelling purposes. These are not upper and lower bounds for future prices; actual prices could be outside the ranges given. Reference 62% Fe fines CFR China prices for the three cases are depicted in Figure 19-5.

The high case is an optimistic scenario from a supplier's perspective. It assumes that iron ore balances turn out to be much tighter over the medium term than assumed for the base case and that corrections resulting from future supply responses to higher price levels do not cause prices to revert to base case levels.

The low case is a more conservative scenario. It assumes more persistent market surpluses from soft or flat demand with limited adjustment in supply so that the industry stays in a long period of low prices.

Details of the two alternative cases follow.

Figure 19-5 **Reference CFR China 62% Fe Fines Real Terms Price Scenarios**



Prices in Real 2016 Terms

Source: Metalytics December 2016

19.6.5 High Price Case

The high case is a scenario in which the projected market surplus in 2017 does not emerge to the extent assumed for the base case, owing to delays in bringing new supply to the market, or alternatively that Chinese demand holds up rather than contracts and demand is stronger elsewhere, or a combination of these.

Table 19-13 High Price Case

Prices in USD/dry metric ton and in Real 2016 Terms

Year	62%Fe Index CFR China	Mid-Range Premium Per 1%Fe	65%Fe Index CFR China	65%Fe Index Additional High-Grade Premium	Bloom Lake Concentrate 66.2% Fe CFR China	Total Premium over Reference 62% Fe CFR China
2016	57.47	1.01	64.15	3.65	65.34	7.87
2017	72.00	1.34	79.82	3.81	81.29	9.29
2018	73.00	1.35	80.60	3.54	82.09	9.09
2019	84.00	1.56	91.48	2.81	93.17	9.17
2020	80.00	1.48	87.45	2.99	89.06	9.06
2021	73.66	1.43	80.83	2.89	82.32	8.66
2022	75.13	1.51	82.46	2.78	83.98	8.85
2023	75.13	1.58	82.53	2.68	84.06	8.92
2024	75.13	1.58	82.57	2.71	84.10	8.96
2025	76.26	1.60	83.78	2.73	85.33	9.07
2026	80.07	1.68	87.83	2.72	89.45	9.38
2027	84.08	1.76	92.08	2.72	93.78	9.71
2028	86.60	1.82	94.77	2.73	96.52	9.92
2029	86.48	1.81	94.67	2.75	96.41	9.93
2030	82.83	1.74	90.83	2.79	92.50	9.68
2031	81.21	1.70	89.14	2.82	90.79	9.57
2032	77.15	1.62	84.87	2.87	86.44	9.29
2033	69.44	1.46	76.74	2.93	78.15	8.72
2034	71.18	1.49	78.60	2.95	80.05	8.87
2035	77.33	1.62	85.13	2.93	86.70	9.37

Source: Metalytics December 2016 (Index price forecasts); Metalytics January 2017 (Bloom Lake 66.2% Fe Concentrate prices)

For the remainder of the decade, the High Case assumes that the pattern of new supply more slowly coming on stream continues and the market is closely balanced. Various other factors that might contribute include Chinese authorities cracking down on non-performing and non-compliant domestic iron ore mines, stronger global recovery in steel and higher steel prices potentially by increasing protectionism around the world.

This scenario then assumes that by the 2020s a supply response to the higher price levels begins to relieve market tightness, but the response is muted by the lingering caution of the post-boom era. That risk aversion then leads to supply, again lagging demand, until the imbalance encourages another period of mining investment followed by another market correction and then rebalancing around the end of the period.

19.6.6 Low Price Case

The low case assumes that there are greater market surpluses, and therefore lower prices than in the base case.

Table 19-14 Low Price Case

Prices in USD/dry metric ton and in Real 2016 Terms

Year	62%Fe Index CFR China	Mid-Range Premium Per 1%Fe	65%Fe Index CFR China	65%Fe Index Additional High-Grade Premium	Bloom Lake Concentrate 66.2% Fe CFR China	Total Premium over Reference 62% Fe CFR China
2016	57.47	1.01	64.15	3.65	65.34	7.87
2017	49.00	0.87	55.08	3.47	56.10	7.10
2018	50.00	0.97	55.99	3.09	57.02	7.02
2019	52.00	0.96	57.47	2.60	58.53	6.53
2020	54.00	0.99	59.72	2.75	60.83	6.83
2021	58.13	1.04	64.08	2.82	65.26	7.13
2022	59.30	1.06	65.32	2.84	66.53	7.23
2023	59.30	1.06	65.34	2.86	66.55	7.25
2024	59.30	1.06	65.38	2.89	66.58	7.29
2025	60.00	1.07	66.14	2.92	67.36	7.36
2026	60.00	1.07	66.16	2.94	67.38	7.38
2027	60.00	1.07	66.18	2.96	67.40	7.40
2028	60.00	1.07	66.20	2.98	67.42	7.42
2029	60.00	1.07	66.22	3.00	67.44	7.44
2030	60.00	1.07	66.24	3.02	67.46	7.46
2031	60.00	1.07	66.26	3.04	67.48	7.48
2032	59.62	1.07	65.88	3.06	67.09	7.48
2033	53.65	0.96	59.62	3.08	60.72	7.06
2034	55.00	0.98	61.06	3.10	62.19	7.18
2035	59.76	1.07	66.09	3.13	67.31	7.56

Source: Metalytics December 2016 (Index price forecasts); Metalytics January 2017 (Bloom Lake 66.2% Fe Concentrate prices)

These could be driven either by supply-side or demand-side factors (or a combination of both). For example:

- The assumed improvement in steel consumption in advanced economies, and especially Europe, does not materialise
- China’s steel production declines as domestic consumption falls, and the export market cannot compensate due to lower global steel demand
- China’s iron ore production turns out to be “stickier” than assumed in the base case and despite loss-making and market over-supply is slow to contract
- The large producers and some other low-cost suppliers provide ample supply to keep prices subdued, while others continue to operate at marginal or breakeven levels

The low case also assumes that late in the period, supply moves further ahead of the slow growth or flat demand to give a matching pattern to the other cases.

20 Environmental Studies, Permitting and Social or Community Impact

20.1 Related Information

There is no related information. The following information was summarized in the NI 43-101 compliant Technical Report prepared for Cliffs and issued on January 31, 2013 (SRK, 2013), and has been updated with more recent information developed since that time, as relevant and appropriate.

20.2 Environmental Studies

In 2006, Consolidated Thompson Iron Mines Ltd. conducted an environmental impact study for the mine development project (GENIVAR, 2006). Since then, several other studies were conducted due to project changes and these studies were intended to support the modification of the provincial authorization. The other studies conducted were required as per provincial and federal authorizations. The main studies used and summarized below are:

- The environmental and social impact statement (GENIVAR, 2006 and WSP 2014)
- The request for modification of the project, the mine expansion (GENIVAR, 2011a)
- Previous Technical Reports prepared by the former owners of the mine (Consolidated Thompson Iron Mines Ltd. and BBA Inc., 2008; CIMA, 2010; SRK, 2011 and 2013)

20.2.1 Air

Potential non-point sources of dust include the tailings impoundment, the waste rock piles and the ore and concentrate stockpile areas. The mine has dust mitigation measures for fine particle emissions, such as dust collectors, at some of the crushing and transportation facilities. The laboratory has a dust collection system in the preparation area and fume hoods in the wet assay room. Current efforts at the mine include the construction of an A-Frame enclosure over the primary ore crusher and stockpile, which will allow to reduce overall particulate emissions substantially. In addition, the mine proceeds to watering of the roads to reduce dust emission. In the tailings impoundment as well as the waste rock stockpiles, areas that become inactive are gradually revegetated to avoid wind erosion and dust dispersion. Note that some waste rock piles have already been revegetated on the site.

20.2.2 Upland Habitat

Considering the mine does exist, and that there is no expansion projected, no additional impacts are anticipated on plants and wildlife. No plants designated with a protection status are known in the area. Bird habitat loss has already occurred with the past construction and mining operations and the availability of similar habitats nearby is believed to provide suitable replacement habitat according the environmental and social impact statements.

20.2.3 Aquatic Habitat

Impacts to local lakes and water courses were identified in the initial environmental impact study. No additional serious harm to fish or fish habitat loss is anticipated to operate the mine, as no expansion is projected.

However, the mine is subject to the Metal Mining Effluent Regulations (MMER). The MMER was registered on June 6, 2002 and is under the Fisheries Act. It applies to all Canadian metal mines (except placer mines) that exceed an effluent flow rate of 50 cubic metres per day and deposit effluent into fisheries waters at any time after the regulations were registered. The MMER also considers any seepage and surface drainage water discharged from the site as being effluents. Each mining effluent must be discharged from an identifiable final discharge point. The MMER prescribes limits for arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids (TSS), radium-226, and pH in mine effluent. Mines subject to the MMER are also required to conduct Environmental Effects Monitoring (EEM) programs in accordance with prescribed criteria. The objective of EEM is to determine the effects of mining effluent on the receiving aquatic environment, specifically with regard to effects on fish, fish habitat, and the use of fisheries resources. The owner or operator must thus monitor effluent quality and flow at least once a week. The regulations also include provisions for reducing metal sampling frequency to once per quarter on certain conditions. Sampling will go back to being once a week if these conditions are no longer met. Monthly acute lethality tests must be conducted on each discharged effluent, using the standardized 96-hour testing method on rainbow trout and conducting monitoring tests on *Daphnia magna*. Moreover, the MMER also includes a requirement that effluent be non-acutely lethal to rainbow trout. However, there is no requirement that the effluent be non-acutely lethal to *Daphnia magna*.

Currently QIO is preparing the study design for the 3rd cycle of the EEM study. The biological monitoring field work will be carried out in September 2017. Despite the fact the mine is in care and maintenance, the EEM program has not stopped.

The MMER includes provisions (regulatory amendment) allowing the use of a natural water body frequented by fish for mine waste disposal. Thus, to be able to list the water body on Schedule 2 of the MMER, the proponent must conduct an assessment of alternatives for mine waste disposal in order to demonstrate that the selected mine waste disposal site (MWDS) is the most environmentally, technologically and socio-economically sensible solution. The proponent must also develop a compensation plan to compensate fish habitat loss stemming from the use of the water body. The effluents discharged from the MWDS must meet the regulation discharge limits and other requirements.

QIO does not intend to expand the current mine footprint; hence, there is no need to list any waterbody on Schedule 2 on the MMER; neither is there a need to conduct any alternative study. Nonetheless, the effluent monitoring as well as the EEM program must be continued as it is currently being carried out.

20.2.4 Cultural and Historic Resources

According to the Environmental Impact Statement prepared in 2006, no archaeological or historic resources are known within the mine site. Moreover, during the past operation years, no archaeological or historic resources were found on the site. Given that the proposed project does not include excavation on new areas, there is very little chance of finding any artefacts.

20.2.5 Water

The Bloom Lake Mine has an authorization to withdraw water from Bloom Lake for domestic (potable) use and for boiler make-up water. There is no restriction regarding the volume extracted. *De la Confusion* Lake water may be used during outage of the reuse water circuit, which recycles tailings water back to the plant for reuse as process water. It may be used for the fire suppression system.

Potential sources of impacts to water quality are the tailings impoundment and sedimentation basins, the pit and waste rock dumps. Iron ore and iron concentrate stored at the stockpiles, plus fine particles in the tailings, can be windblown to surface water bodies, or infiltration from the facilities could reach groundwater. Specific potential impacts are increased metals concentrations, especially iron and aluminum as well as increased total suspended solids, nitrate and nitrite concentrations.

Surface water and decant water from the tailings are collected in a settling pond. The settling pond water level is maintained by pumpback to the process water reservoir at the concentrator or by intermittent pumping to a clarification pond. The water in the clarification pond is treated to flocculate fine solids before discharge to the environment. Solids from the bottom of the clarification pond are pumped back to the tailings impoundment.

In regards to water quality, QIO must comply with the requirements from Directive 019 and the MMER. The depollution attestation should be effective in 2017. This attestation, renewable every five years, establishes the environmental conditions under which the industrial establishment can operate. The attestation will include several conditions which were already included in previous certificates of authorization delivered to the mine. There are no new conditions expected within the attestation.

20.2.6 Hazardous Materials Management

Hazardous material at Bloom Lake include used oil, used antifreeze, oil filters, oil canisters, hydraulic hoses, aerosols, absorbents and soiled clothes. This material is collected in wheeled carts, barrels or various containers identified and dated. Used oil tanks are also present on site in several locations. Hazardous material stored in carts, barrels or tanks are disposed of by a specialized company on a regular basis.

The hazardous material management must be carried out accordingly with the regulation respecting hazardous material (L.R.Q., c. Q-2, r. 32). In addition, hazardous material transportation must comply with the Transportation of Dangerous Substances Regulation (L.R.Q., c. C-24.2, r. 43).

Fuel oil tanks have integral holding sections to retain leakage and prevent contamination to the ground. Used oil and lubricants and oil skimmed from ponds are disposed of off-site by a contractor. Petroleum products must be stored and disposed of in compliance with the provincial *Petroleum Products Regulation* (L.R.Q., c. P-30.01, r. 1).

20.2.7 Tailings and Waste Rock

A geochemical study was performed on waste rocks and tailings (Golder, 2013). According to this study, the waste rocks and tailings from Bloom Lake does not shed any leachate and have no acid mine drainage potential (sulphur below 0.3%) based on the Directive 019 criteria.

20.3 Environmental Issues

There are no known significant issues that are believed to materially impact the mine’s ability to operate.

20.4 Operation Monitoring Requirements

Environmental monitoring during operations includes water and air quality.

The site monitors mine effluent, domestic effluent and groundwater. Effluent is continuously monitored (visually) with more specific analyses required on routine basis that ranges from three times a week to annually per federal (MMER) and provincial requirements (Directive 019). As per the MMER a biological monitoring (EEM) is also conducted on a 36-month cycle basis. There are 59 groundwater monitoring points that are sampled twice a year for arsenic, calcium, copper, iron, potassium, magnesium, sodium, nickel, lead, zinc, petroleum hydrocarbons, bicarbonate, sulphate, pH and electrical conductivity.

There are seven dust collectors and the boilers stacks that must be monitored and must be maintained in good operating condition. No other air emission requirements are in place.

20.5 Required Permits and Status

Federal

The mine has already been authorized for operation under the federal environmental authority including Fisheries and Oceans Canada (DFO), Transport Canada, Natural Resources Canada and Environment Canada.

There is only one pending process with the federal government associated with the 2008 authorization for destruction of fish habitats. There is still work to be completed regarding fish habitat compensation for 1,600 m^2. The compensatory plan is under preparation and the authorization from DFO to proceed with the compensation project should be issued in 2017. This process does not prevent QIO from operating the mine.

Provincial

Construction of an 8 Mt/y for the Bloom Lake Iron Mine project was started in 2008 and commenced operation in March 2010. The project was subject to an environmental impact assessment and review process under Section 31 of the Environment Quality Act, which led to the first decree (137-2008) issued by the Quebec government in 2008 (Table 1). The increase in production (Phase II) was proposed (CIMA, 2010) and approved by the Ministry of the Environment in a decree modification in August 2011, which approved the project. In addition, two decrees (608-2012 and 764-2012) modifying decree 137-2008, were issued in 2012 to expand the pit(s), and the tailings management facilities.

In 2011, an environmental impact statement was prepared to build a 315 kV-34.5 kV electrical power station to provide the power to the mine. The project was authorized by decree in 2012.

Certificates of authorization, in compliance with Sections 22 and 32 of the Environmental Quality Act, were approved for the construction of various infrastructure during Phase I. The certificate of authorization for the mine exploitation, ore treatment, waste rock and tailings disposition was granted in March 2010.

Certificates of authorization for construction of new infrastructure associated with Phase II were also granted in 2011. The authorization to proceed with operation of Phase II was obtained on September 4, 2013. The mine has also received operational permits for the mine, dust collection systems, railroad and the wastewater treatment systems (Table 1). Overall, a total of 38 certificates of authorization have been issued to the Bloom Lake iron mine in the past and the most relevant are listed in Table 1. Note that infrastructure such as the pit, waste rock piles, tailing management facilities, water management structure as well as the treatment plant have all been authorized. A few of these authorizations will require modifications to consider the new mine plan.

Among these, are an update of the current authorized infrastructures and the operational certificate of authorization. A very small area of the future tailing pond (33 hectares) will be outside the mining lease limit so a lease for occupation of crown land will be required when usage of this portion of land will be needed (after 13 years of mining operations). This lease is obtained by filling and submitting a request form to the provincial ministry.

Table 20-1 Environmental Permits

Permit Name and Description	Agency	Date Authorized
Obtained in the past		
Certificate of authorization for Bloom Lake iron mine	Government of Quebec	20/02/2008
Certificate of authorization for operation of the Bloom Lake iron mine	MDDELCC (Quebec)	02/03/2010
Certificate of authorization for the construction and operation of two wastewater treatment systems related to the plant	MDDELCC (Quebec)	24/01/2011
Certificate of authorization for the railway	MDDELCC (Quebec)	20/04/2010
Certificate of authorization to operate six dust collectors	MDDELCC (Quebec)	20/09/2010
Certificate of authorization to modifying Bloom Lake mine operation, Phase II	MDDELCC (Quebec)	15/09/2011
Certificate of authorization to build new structures	MDDELCC (Quebec)	15/09/2011
Decrees 608-2012 and 764-2012 modifying decree 137-2008 issued on February 20th, 2008 to expand the pit(s), and the tailings management facilities	MDDELCC (Quebec)	06/2012 & 07/2012
Certificate of authorization to install and build a boiler, a water-glycol heater, conveyors and transfer tower, a storage silo and a new water treatment plant	MDDELCC (Quebec)	21/11/2012 18/06/2013
Certificate of authorization to operate phase II – production increase	MDDELCC (Quebec)	04/09/2013
Certificate of authorization to modifying the tailing pond	MDDELCC (Quebec)	26/02/2014
Certificate of authorization to create a new borrow pit	MDDELCC (Quebec)	04/07/2014
Authorization of work or activity that results in serious harm to fish	DFO	20/07/2016
Authorization from DFO to proceed with the remaining compensation work	DFO	To be received at the beginning of 2017
Required for Future Activities		
An update of the current authorized infrastructures and the operational certificate of authorization	MDDELCC (Quebec)	---
Certificate of authorization for new infrastructures (to be discussed with MDDELCC)	MDDELCC (Quebec)	---

20.6 Social and Community

The Bloom Lake property is located in the north-eastern part of the province of Quebec, adjacent to the Labrador/Newfoundland border, in Normanville Township, Kaniapiskau County. The property is centred at approximately latitude 52° 50’ north and longitude 67° 16’ west. The National Topographic System (NTS) map coverage is 23 B14. The Bloom Lake property is located 13 km west of the town of Fermont and 30 km southwest of the municipalities of Wabush and Labrador City.

According to the most recent environmental impact statement (WSP, 2014), the population in the RCM of Caniapiscau included 4,215 inhabitants in 2011, of which 2,874 were from Fermont. Fermont counted 2,633 inhabitants in 2006 and 2,918 inhabitants in 2001. First Nations Uashat mak Mani-Utenam is 2,801 inhabitants according to the 2011 Canadian census data (GENIVAR 2011b). Population fluctuations are highly correlated to mining activities in that region.

The Bloom Lake property is located in the Labrador Trough area, which straddles the border between Quebec and Labrador. There are several iron ore mines in the area including Mont-Wright owned by ArcelorMittal and Carol Lake owned by Iron Ore Company of Canada (IOC). Wabush Mines, located in Labrador and once owned by Cliffs Natural Resources (Cliffs), ended its activities in 2014.

The surrounding area is used for limited holiday and recreational activities. The mine operator has made agreements with different users in order to compensate for impacts on community use of the lands within the mining lease. An agreement was signed between Consolidated Thompson and Innu Takuaikan Uashatmak Mani-Utenam representing the aboriginal people. Because these are non-public agreements, there is no detailed information available regarding this agreement.

A noise study was conducted to assess impacts on the nearby areas. Noise levels at nearby Daigle Lake (nearest habitations) and Fermont are lower than the 40 dBA threshold allowed.

20.7 Mine Closure

A conceptual closure plan was prepared for the Phase 1 of the Bloom Lake mine in 2009. In 2013, the closure plan was reviewed (AMEC, 2013) to include Phase 2 which resulted in increasing the plant production capacity. The comprehensive closure plan details closure objectives, baseline conditions, project description, closure actions, progressive rehabilitation, closure and post-closure monitoring. MERN approved the revised closure plan at a cost of CAD $ 41.7 million which was covering five years of mining operations, starting in 2012. QIO must provide a financial guarantee covering this five years closure plan cost to the provincial government in accordance with Section 111 of the Regulation Respecting Mineral Substances other than Petroleum, Natural Gas and Brine (Chapter M-13.1, r. 2).

According to the second paragraph of Section 232.6 of Quebec’s Mining Act (L.R.Q., c. M 13.1), QIO shall submit a revised plan to the Minister for approval every 5 year. Based on the previous owner’s mining operation plan, the next closure plan revision was scheduled for late 2017 but the mining operation stopped three years before (December 2014).

In order to estimate a mine closure and restoration costs for the entire life of the new Bloom Lake mining project, WSP used a conservative approach in line with the concepts of the MERN’s guide on mine closure and restoration (MRNF, 1997). The mine closure and restoration costs for the entire life of the new Bloom Lake mining project is estimated at CAD $ 76,435,740, assuming no salvage value for the equipment and that a third party will complete the closure and restoration work. This cost includes the direct and indirect costs of site restoration as well as post-operation and post-closure monitoring.

The goal of mine site restoration is to return the site to an acceptable condition, ensuring that the environment as a whole will eventually be able to take back its course. The closure plan focuses on the rehabilitation of land and areas affected by mining activities (i.e. roads, pads, buildings, water ponds, tailing management facility, waste rock piles, etc.). The reclamation program includes the following activities:

- The pumping will stop and the open pit mines will be naturally flooded.
- All buildings and structures no longer required for post-restoration monitoring will be dismantled. The salvageable material and equipment will be transported to recycling facilities. Waste material resulting from the dismantling operations will be transported to authorized sites for elimination.
- All surface area of the affected industrial site will be covered with the soil set aside during construction, and then seeded.
- The tailings management facility (TMF) and the waste rock piles will be progressively vegetated with native species as certain sections will be ready for closure.
- The overburden pile, as well as the waste rock piles, will be reshaped for drainage before being vegetated.
- During the restoration period, once the water quality has been demonstrated, the TMF's polishing ponds will be converted into a wetland.
- During the restoration period, once all surface has been restored, the retention ponds will no longer need to collect the mine's runoff water. Thus, the ponds will be breached and vegetated. Prior to the pond's breaching, water in the pond will be pumped and treated if required.
- The access roads located on the property will be scarified. Access to the TMF and to the open pit will be block off with boulders, and warning signage will be installed. The Mazaré bridge will be dismantled, as only one access will be needed for post-restoration monitoring.
- Contaminated soil will be treated on site or disposed off-site, with respect to regulations.

21 Capital and Operating Costs

21.1 Capital Cost Estimate

The current section outlines the methodology used for the development of the capital cost estimate (CAPEX) by defining the sources of data, the assumptions and the exclusions.

21.1.1 Objective

The objective of the Capex estimate is to establish the cost baseline for QIO's Bloom Lake re-start project by performing engineering to increase the project definition to a Feasibility Study (FS) level, i.e., between 10% and 40%, and hence support the FS estimate.

21.1.2 Type of Estimate and Accuracy

This Capex estimate qualifies as Class III – Feasibility Study Estimate – per AACE recommended practice R.P.18R-97.

The accuracy of this Capex estimate has been assessed at ±15%.

21.1.3 Scope of the Feasibility Study Capex Estimate

The Capex estimate includes all the direct and indirect project costs, complete with the associated contingency. Since the Project is planned to be executed in 2017, escalation is excluded. Pre-mitigation risk money has been included as a ratio of all project costs, based on benchmarks; no provision is included in the Capex estimate for mitigation plans.

The Capex will cover all costs to be spent during the period planned to start at the second quarter of 2017 and ending at the start of commercial production.

It should be noted that any further studies beyond this FS, including but not limited to FEED, as well as analysis of various business cases, options and/or scenarios, are explicitly excluded. The operating costs (OPEX) are also excluded from this Capex estimate as well as any sustaining capital costs.

21.1.4 Mandate and Division of Responsibility

Ausenco is responsible for developing the estimate for the scope of work under its responsibility and for compiling the estimates developed by QIO and other project collaborators, as obtained.

A division of responsibility matrix is presented in Table 21-1 below.

Table 21-1: WBS List and Division of Responsibility

Area	Responsibility		
	Engineering	**MTO Development**	**Capex Estimate**
1000 – MINE	G-Mining	G-Mining	G-Mining
2000 – PROCESS			
2100 – GENERAL	-	-	-
2400 – CRUSHING	-	-	-
2500 – STOCKPILE AND RECLAIM	Ausenco	Ausenco	Ausenco
2600 – CONCENTRATOR			
2610 – Grinding	-	-	-
2615 – Gravity Separation	Mineral Technologies	Mineral Technologies	Mineral Technologies
2650 – Dewatering	Mineral Technologies	Mineral Technologies	Mineral Technologies
2660 – Loadout	-	-	-
2680 – Common Services	-	-	-
2690 – Common Services (continued)	-	-	-
2700 – TAILINGS DISPOSAL			
2710 – Tailings Pipeline	WSP	WSP	WSP
2740 – Reclaim water pumps and pump-houses	QIO	QIO	QIO
2750 – Reclaim water pipeline	QIO	QIO	QIO
2770 – Dams	WSP	WSP	WSP
2780 – Tailings Booster Pump-house #1 (BPH #1)	WSP	WSP	WSP
2800 – FACILITIES	-	-	-
2840 – Pump-house	-	-	-
3000 – ON-SITE INFRASTRUCTURES	-	-	-
4000 – OFF-SITE INFRASTRUCTURES			
4100 – RAIL	QIO	QIO	QIO
4200 – PORT	QIO	QIO	QIO
9000 – INDIRECTS			
9100 – PM, E, P and CM services	QIO / Ausenco / MT / WSP	QIO / Ausenco / MT / WSP	QIO / Ausenco / MT / WSP
9200 – Construction Field Indirects	QIO / Ausenco / MT / WSP	QIO / Ausenco / MT / WSP	QIO / Ausenco / MT / WSP
9800 – Owner’s Costs	QIO	QIO	QIO
9900 – Contingency, escalation, risk and management reserve	OIQ / Ausenco	OIQ / Ausenco	OIQ / Ausenco

21.1.5 Project Description

The high-level scope of work for the project consists of the following elements:

- A new mining plan for Bloom Lake, which will include additional support mobile equipment.
- A dome to cover the crushed ore storage pile.
- Process flowsheet upgrade within the existing Phase 1 concentrator. The flowsheet upgrade focus is to improve the recovery of iron by the concentrator, with specific attention given to improving recoveries of the coarser (+425 microns) and fine (-106 microns) iron minerals, while having no adverse effect on the recovery of other size fractions.
- Revised tailings management plan and storage facilities.
- Revised water management plan.
- Small restoration and improvement work.

21.1.6 Terminology

Terms used throughout the estimate development are as listed in Table 21-2.

Table 21-2: Terminology

Term	Definition
Theoretical Material Take-Offs (MTO's):	These are neat quantities directly taken off 3D models or 2D drawings; theoretical quantities don't account for construction losses, wastage, overlap, compaction factor, cut factors, etc. The estimating department is responsible for developing these additions, on the basis of historical data.
Engineering conditioning:	Based on the selected proposal obtained, Engineering is responsible for identifying any deviation from the RFQ/RFP documents; engineering conditioning includes, without limitation, variations to materials of construction, scope of work, battery limits, technical exceptions, etc.
Procurement conditioning:	Based on the selected proposal obtained, Procurement is responsible for identifying any deviation from the RFQ/RFP documents; Procurement conditioning includes, without limitation, variations to terms and conditions, shipping terms, duties, vendor documents, warranties, spare parts, vendor representatives, commercial exceptions, etc.
Estimating conditioning:	Based on the selected proposal obtained, Estimating is responsible for quantifying and costing any deviation from the RFQ/RFP documents; estimating conditioning includes, without limitation, the assessment of inclusions and exclusions pertaining to each proposal.
Engineering / design development:	Design development is described as the evolution of engineering during the execution phases of a Project; changes may include variation in the materials of construction, tighter tolerances, plant layout modifications, etc.
Allowances:	Allowances are necessary to ensure that the scope of work is covered in its entirety; it is the estimator's responsibility to validate quantities obtained by Engineering and allow for quantities that cannot be expressly defined, that are missing or, ultimately, when it is not economical to perform a detailed take-off; examples of allowance are: access stairs and platforms/walkways around equipment, connections for structural steel (as design is usually sub-contracted), insulation and paint, embedded metals, bolts, nuts and gaskets, cable tray drops, etc.
Construction add-ons:	Construction add-ons, as identified by the estimating group, may consist of over excavation, fill and backfill compaction factor, concrete over pour, cut factor (for rebar, small bore piping, cables, etc.), overlapping (siding and roofing), loss / theft, damaged and unrecoverable materials, etc..
Carry over:	Carry over work is defined as work originally expected to be completed at vendor's premises but which is transferred to work site, usually as a result of delays in fabrication and/or assembly of skid equipment, prefabricated assemblies, modules, etc.

Term	Definition
Work over:	Work over can be best described as work necessary for a system to be functional in the absence of key element due to, namely, scope reduction or delay in delivery
Punch list:	A punch list is a list of incomplete work identified during construction walk downs or resulting from a QA/QC inspection either at vendors' premises or at site. These lists are usually developed for construction stage gates such as mechanical completion, commissioning and transfer to Operations;
Deficiency:	Work that was performed incorrectly either in fabrication or installation, which requires correction before turnover of project to operations
Level of Confidence:	For the purposes of evaluating the accuracy and, ultimately, the contingency (as defined below), an objective assessment of the level of confidence will be made. Typically, this assessment is made on a per-package basis. The intent is to identify the engineering progress for each package at the end of this FS, and make an assessment of the possible variations from the estimated costs during the execution phases.
Contingency:	Contingency is an integral part of the estimate and can best be described as an allowance for undefined items or cost elements that will be incurred, within the defined project scope, but that cannot be explicitly foreseen due to a lack of detailed or accurate information. It should not be considered as a compensation for estimating inaccuracy nor is it intended to cover any costs due to potential scope changes, "Acts of God", labour strikes, labour disruptions outside the control of the project manager, fluctuations in currency or cost escalation beyond the predicted rates.
Project Management Reserve:	The project reserve is a provision that might be added to cover uncertainties outside the ones taken into account in the estimate.
Accuracy:	Per AACE, estimate accuracy is an indication of the degree to which the final cost outcome of a project may vary from the estimated cost. It is traditionally expressed as a +/- percentage range around the estimated cost.
Escalation:	Escalation is an amount added to an estimate to cover for the future value of an element of cost due to inflation.
Risk during the implementation phase, including construction:	A project risk can be defined as a future event or uncertainty, whose exact outcome is unknown and which may impact cost and/or schedule.

21.1.7 Organisation and Coding Structure

21.1.7.1 Estimating

For the purposes of this FS, the estimate will be managed by Ausenco and it will be Ausenco's lead estimator's responsibility to manage the estimate and coordinate with QIO and other project collaborators (G Mining, Mineral Technologies, WSP and QIO).

21.1.7.2 Estimate Coding

Estimate coding assists with the estimate interaction with scheduling, cost control, construction as well as commissioning and operations. The following sub-sections list the various codes used for each element of cost.

21.1.7.3 Work Breakdown Structure

The project is divided into main areas using the first digit of a 4-digit coding system. Areas are further developed into sub-areas using the second digit. The third and fourth digits enable the definition of the facility. The four-digit number is also known as the WBS number. Refer to Table 21.1 for the WBS list.

21.1.7.4 Commodity and Resource Coding Structure (CRC codes)

All work activities, be they supply and/or installation of permanent equipment, materials or services, have been assigned a standard Ausenco commodity code developed on the basis of Ausenco's standard discipline list.

21.1.7.5 Crew Codes

Crews will be developed to define the requirements in terms of trade workers necessary to perform work activities.

21.1.7.6 Currency Codes and Currency Exchange Rates

All costs are expressed in their native currency; currency exchange rates have been sourced from Oanda as of December 22, 2016. Since it is expected that the project will be constructed in 2017, no allowance has been made for the fluctuation in exchange rates over time.

It is to be noted that the base currency will be the Canadian Dollar (CAD).

21.1.7.7 Units of Measurement

The units of measurements will be based on the International System of Units.

21.1.8 Estimating Software

The capital cost estimate has been developed on an MS Excel spreadsheet.

21.1.9 Estimate Presentation

The Capex estimate is presented to QIO as an Open Book Estimate (OBE).

21.1.10 Labour Costs

Base unit man-hours along with productivity factors were developed internally. All-inclusive labour crew mix wage rates were developed based on the Labour decree in effect in the province of Québec.

21.1.11 Workweek and Rotations

The workweek for construction will be six days at ten hours per day, for a total of 60 hours weekly. The rotation schedule for construction will be three weeks in followed by one week of R&R.

21.1.12 Equipment and Material Costs

Costs for equipment and materials, were provided by the following:

Table 21.1 – Equipment and Material Costs Summary

Entity	Pricing Type	Elements of Scope	Costs (CAD)
Ausenco Elec. For MT	MTO[1]	Electrical bulk materials	$480,672
Ausenco Elec. For WSP	MTO[1]	Electrical bulk materials	$84,320
G-Mining	Budgetary	Mining mobile equipment	$4,827,820
MT	Budgetary	Process equipment & piping	$20,564,000
QIO Ellipse	Budgetary	Software & licencing	$856,606
Weir	Budgetary	Pumps	$712,000
Total			$27,525,417

Note 1: Material take-off estimate

21.1.13 Mine Capital Expenditures (G Mining)

The mining capital expenditures ("CAPEX") includes pre-production mining prior to commercial production and equipment purchases and replacements. Most of the major mining fleet is present on site and owned by QIO resulting in a low initial CAPEX and most of the CAPEX requirements consist of equipment replacements over the 20 year mine life.

During pre-production and ramp-up a total of 12.1Mt is mined over a period of 9 months for a total cost of C$ 41.5 M for an average cost of C$ 3.44/t (Table 21-3). This cost includes operational readiness costs related to the mine operation which explains the higher unit cost.

Table 21-3: Pre-Production Mining CAPEX

Activity	Pre-Prod Capex (k C$)
Mine Operations	2,536
Mine Geology	1,522
Mine Maintenance Admin.	3,957
Mine Engineering	3,334
Drilling	2,193
Pre-Split Drilling and Blasting	337
Blasting	5,957
Loading	5,246
Hauling	7,586
Dewatering	354
Dump Maintenance	2,873
Road Maintenance	2,236
Grade Control	225
Support Equipment	1,270
Electrical Cable Handling	640
Topo Drilling Contract	98
Overburden Mining Contract	546
Aggregate Plant	343

Activity	Pre-Prod Capex (k C$)
Sub-Total In-situ Mining	41,250
Rehandling	274
Total Mining Cost	41,524

Initial CAPEX for equipment purchases is estimated at C$4.8 M which is primarily for support equipment (C$3.5 M). The sustaining CAPEX for mine equipment is estimated at C$111.9 M with the details presented in Table 21-6, Table 21-7 and Table 21-8.

Table 21-4: Major Equipment CAPEX

Major Equipment CAPEX (k C$)	Pre-Prod CAPEX	Sustaining CAPEX	Total CAPEX
Mining Truck (240t)	-	44,457	44,457
Mining Truck (100t)	-	2,056	2,056
Electric Hydraulic Shovel (34 m³)	-	-	-
Wheel Loader (20 m³)	-	-	-
Electric Prod Drill	-	16,860	16,860
Track Dozer (899 HP)	-	6,906	6,906
Track Dozer (630 HP)	-	4,702	4,702
Motor Grader (16ft)	-	4,179	4,179
Wheel Dozer (700HP)	-	1,572	1,572
Water/Sand Truck (76kL tank)	-	2,056	2,056
Pre-split drill (6.5")	1,306	1,306	2,612
Sub-Total Major Equip.	**1,306**	**84,094**	**85,399**

Table 21-5: Support Equipment CAPEX

Support Equipment CAPEX (k C$)	Pre-Prod CAPEX	Sustaining CAPEX	Total CAPEX
Excavator (49t)	649	2,596	3,246
Track Dozer (474 HP)	-	-	-
Wheel Loader (7 m³)	-	-	-
Small Water Truck	-	750	750
Small Sand Truck	-	1,000	1,000
Stemming Truck	340	-	340
Vibratory Compactor - (130HP)	-	-	-
Backhoe Loader 115HP	-	-	-
Emulsion Truck	-	-	-
Boom Truck 28t	-	388	388
IT Loader (Toolcarrier)	-	3,200	3,200
Tracked Skid Steer	-	-	-
Mechanic Service Truck	-	2,283	2,283
Fuel Truck	-	1,281	1,281

Support Equipment CAPEX (k C$)	**Pre-Prod CAPEX**	**Sustaining CAPEX**	**Total CAPEX**
Lube Truck	-	854	854
Lowboy & Tractor (150t)	-	3,655	3,655
Pick-up Truck	655	3,554	4,209
Pit Buses	-	-	-
Mobile Air Compressor	41	83	124
Mobile Welding Machine	-	74	74
Light Tower	-	257	257
Mobile Genset	27	-	27
Forklift 5 t payload	60	60	120
Tire Service Truck (or Tire Manipulator)	-	-	-
Lineman Truck	-	388	388
Service Truck (Platform)	-	164	164
Dispatch system	30	-	30
10" Pipe – 145 psi	2	-	2
10" Pipe – 232 psi	-	11	11
Dewatering Pump 10in	-	2,989	2,989
Equipment Simulator	-	-	-
Slope Monitoring System	-	500	500
Hydraulic Hammers for Excavator 49t	-	480	480
Spare Box for Haul Trucks	-	500	500
Spare Bucket for Shovels	500	-	500
Snow Blower	200	200	400
Snow Plow (Blade) for IT Loader	57	-	57
Transportable Sub-station 7.5MVA 34.5kV/7.2kV	-	1,832	1,832
Isolated Electric Line 34.5kV (185 m)	-	240	240
Mining Cable extension (7.2kV SHD-GC, 1/0 AWG (300 m)	-	224	224
Pumping Container	-	210	210
GEMS - SQL	861	-	861
Whittle	85	-	85
Talpac	15	-	15
Autocad	-	-	-
Sub-Total Support Equip.	**3,522**	**27,772**	**31,294**

Table 21-6: Major Equipment Purchase Schedule

Equipment Purchase Schedule	**Total**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
Major Equipment																							
Mining Truck (240t)	7	-	-	-	-	-	-	-	-	5	1	1	-	-	-	-	-	-	-	-	-	-	-
Mining Truck (100t)	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Electric Hydraulic Shovel (34 m³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheel Loader (20 m³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Electric Prod Drill	3	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Track Dozer (899 HP)	2	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Track Dozer (630 HP)	2	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Motor Grader (16ft)	3	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
Wheel Dozer (904HP)	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Water/Sand Truck (76kL tank)	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pre-split drill (6.5")	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Total	**22**	**1**	**-**	**-**	**-**	**1**	**1**	**4**	**1**	**6**	**2**	**2**	**-**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Table 21-7: Support Equipment Purchase Schedule

Equipment Purchase Schedule	**Total**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
Support Equipment																							
Excavator (49 t)	5	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-
Track Dozer (474 HP)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wheel Loader (7 m³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Small Water Truck	3	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
Small Sand Truck	4	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-
Stemming Truck	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vibratory Compactor – (130 HP)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Backhoe Loader 115 HP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Emulsion Truck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boom Truck 28t	2	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
IT Loader (Toolcarrier)	6	-	1	1	-	-	-	-	-	1	1	-	-	-	-	-	-	2	-	-	-	-	-
Tracked Skid Steer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mechanic Service Truck	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Fuel Truck	3	-	1	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Lube Truck	2	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Lowboy & Tractor (150 t)	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pick-up Truck	90	14	11	-	-	-	14	11	-	-	-	14	11	-	-	-	9	-	-	6	-	-	-
Pit Buses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mobile Air Compressor	6	2	-	-	-	-	-	-	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Mobile Welding Machine	4	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Light Tower	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Mobile Genset	24	-	-	-	4	-	-	4	-	-	4	-	-	4	-	-	4	-	-	4	-	-	-
Forklift 5t payload	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tire Service Truck (or Tire Manipulator)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lineman Truck	2	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Service Truck (Platform)	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dispatch system	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dewatering Pump 10 in	16	-	-	-	-	4	-	-	-	-	4	-	-	-	-	4	-	-	-	-	4	-	-
Equipment Simulator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Slope Monitoring System	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydraulic Hammers for Excavator 49 t	4	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	1	-	-
Spare Box for Haul Trucks	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spare Bucket for Shovels	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Snow Blower	2	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Snow Plow (Blade) for IT Loader	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportable Sub-station 7.5 MVA 34.5 kV/7.2 kV	2	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isolated Electric Line 34.5kV (185 m)	4	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mining Cable extension (7.2 kV SHD-GC, 1/0 AWG (300 m)	6	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-	-	-
Pumping Container	2	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Total	**205**	**27**	**16**	**8**	**4**	**7**	**16**	**19**	**11**	**5**	**10**	**15**	**12**	**7**	**3**	**9**	**16**	**3**	**1**	**11**	**5**	**-**	**-**

Table 21-8: Equipment Capital Expenditure Schedule

Equipment CAPEX Schedule (C$ k)	**Total**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
Major Equipment																							
Major Equipment	**85,399**	1,306	-	-	-	550	1,393	16,015	8,155	34,106	7,657	8,407	-	1,572	4,846	1,393	-	-	-	-	-	-	-
Support Equipment	**31,294**	3,521	2,652	2,462	43	1,710	886	5,604	1,743	1,670	1,444	1,082	764	835	447	1,586	1,643	1,318	649	362	868	2	2
Total Equipment CAPEX	**116,693**	4,827	2,652	2,462	43	2,260	2,279	21,619	9,898	35,776	9,101	9,489	764	2,406	5,293	2,979	1,643	1,318	649	362	868	2	2
Initial CAPEX	**4,828**	4,827	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sustaining CAPEX	**111,865**	-	2,652	2,462	43	2,260	2,279	21,619	9,898	35,776	9,101	9,489	764	2,406	5,293	2,979	1,643	1,318	649	362	868	2	2

21.1.14 Concentrator Iron Upgrade plant

21.1.14.1 Scope of Estimate

MT’s scope for the capex estimate includes the iron upgrade circuit from the discharge of the existing autogenous (ag) mill up to the discharge of the existing concentrate pan filters, including:

- Modification of the existing gravity separation circuit (referred to as the gravity circuit)
- Addition of a new magnetic separation circuit (referred to as the mags circuit)
- Upgrades to other process equipment as necessary to suit the new process flow parameters of the plant

MT’s scope of work is depicted at a high level in the Process Flow Diagrams (PFD’s) and other documentation developed as part of the study for the plant upgrade. Further detail of this documentation is provided below in the Basis of Estimate section.

The battery limits and exclusions from MT’s scope for this estimate are as follows:

- The ag-mill discharge point prior to entering the discharge chute is the feed battery limit. The mill is not in MT’s scope however the chute that splits the flow to the scalping screening stage is.
- The recirculation of oversize feed material back to the mill is not part of the scope of work and the battery limits are the oversize discharge points from the vibrating screens.
- Modification or upgrade to the slurry tailings pumping systems (both coarse and fine) is not included in the scope of this capex estimate and the battery limit is the suction flange on the first stage pumps for both of these systems. It should be noted that the pump calculations for the first stage of pumping (i.e. the pumps within the concentrator building) is included in MT's scope.
- The final concentrate handling system is not part of the scope and the battery limit is the discharge outlet of the concentrate pan filters.
- Supply of services to and within the building is not a part of the estimate scope. The exception to this is the reticulation of the plant process water (PW) to the various users within the plant, the battery limit for this portion of the scope is the inlet to the existing PW pump suctions.
- The scope does not include any addition or modification to the existing building structure, civil works or infrastructure type items. This includes steelwork, cladding and other items relating to the civil building and architectural disciplines that don’t support process equipment.
- The full scope of electrical, instrumentation and control for the plant area, including any handling, storage and installation of radioactive sources for instrumentation such as density gauges. The exception to this is the provision of the operating and control philosophy and functional specification for the changes to the iron upgrade circuit.

Specific items to note for clarity on the scope of work are listed below:

- The existing classification screens will not be modified as part of the upgrade work.

During the previous operation of the plant they did not perform at a very high efficiency and there are some options for improvement by modifying screen performance parameters (such as screen deck type and vibration amplitude). It has been determined that to undertake those modifications it is more beneficial that the plant be running at the same time such that the work can be done on an iterative basis and changes assessed to measure improvement.

Instead of changes to the screens themselves there will be work done to replace the static screen supplying feed onto one of the four screens. The intention is to achieve better dewatering prior to feeding onto the screen and also to slow down and reduce the energy of the feed stream to the screen.

- There is no change to the existing UCC and screen arrangement that was installed during operation to reduce the load to the existing classification screens.
- The existing pumps that will be upgraded as part of this scope are listed below:
    - The spiral tails dewatering cyclone feed pumps (equipment numbers 615-5661-001 to 004)
    - The classification screen undersize pumps (equipment numbers 610-5661-005 to 008)
    - The pan filter filtrate pumps will have a pulley change so they run at a higher speed
    - The three PW pumps will be controlled by variable speed drives instead of fixed speed motor starters (this electrical change is out of MT’s scope)
- The mags circuit will be comprised of two low intensity magnetic separators (LIMS) to prepare the feed for the subsequent seven wet high intensity magnetic separators (WHIMS) for the upgrade of the ore. The WHIMS units will be 16 pole machines in an extra wide rotor configuration.
- There has been no allowance for change to the existing main floor sump pump operation or configuration.
- There is no allowance for modification or change to the existing pump boxes or other tanks or sumps within the plant as these are deemed to have been suitable for the operation.
- There is no allowance for the upgrade of the existing pan filters for dewatering the concentrate. Historical information provided as well as testwork by the manufacturer indicate that the capacity of the existing filters will be sufficient for the increased iron recoveries in the upgraded plant and filtration testwork has determined that the filter performance will be similar for this feed material.
- The thickener will be upgraded by installing a larger feedwell with a different internal configuration as recommended by Outotec (suppliers of the existing thickener on the site).

21.1.14.2 Basis of the Estimate

The capex estimate has been developed based on the work MT has undertaken as part of a study for the plant upgrade undertaken for QIO. The study revolved around a metallurgical testing campaign conducted at the MT Carrara laboratories using a bulk sample of the Bloom Lake ore. In parallel with this metallurgical testing campaign, the new plant process design was developed and plant layouts and mechanical design work was undertaken.

The process design, plant layouts and mechanical design work were completed to a feasibility study level that is suitable for the 43-101 requirements.

It is important to note that the estimate has been established on the basis that the existing equipment supporting the operation of the gravity and mags upgrade equipment is functional and in good condition and will not be modified unless required due to changed process conditions.

Documentation

The key supporting documentation developed for the study is listed below. Reference should be made to the latest revision of the documents with respect to the capex estimate.

- Basis of Design for the process upgrade (496-MS0001)
- Design Criteria for the process upgrade (496-PM0002)
- Project Description, Site Data and Climatic Conditions (496-PM1001)
- Metallurgical testwork outcomes detailed in Section 13 (Mineral Processing and Metallurgical Testing) of the 43-101 document for the Phase 1 upgrade
- PFDs for the upgrade (00000-49D-001-201 and 202)
- Equipment list for upgraded and new equipment (496-MS1001)
- Electrical load list for upgraded and new equipment (496-ES0803)
- Field instrument list for upgraded and new equipment (496-ES0901.02)
- Piping and Instrumentation Diagrams (P&IDs) for the upgrade (00600-49D-002-200 to 502)
- 3D model of the revised plant layout
- 2D general arrangements of the revised plant layout (00600-45D-001-300 to 319)
- 2D equipment layouts (00600-45D-002-100 to 103)
- 2D details of plant components (00600-45D-004-300 to 309)

Development of the Estimate:

The PFD's for the upgraded plant process have been developed using the metallurgical testing campaign as a basis for the processing performance and flow parameters for each of the stages of the iron upgrade process.

The PFD's then formed the basis of all engineering and design work for the plant upgrades and they dictate the type and processing capacity of each item of processing equipment used in the plant. This information feeds into the design of the plant layout and the engineering design calculations. It also defines the requirements of the peripheral equipment to support the process equipment required for upgrading the feed ore.

Following the selection of the required equipment, each item was assessed to be either:

- Sourced from the existing Phase 2 building
- Existing Phase 1 equipment that required upgrade/modification
- New equipment to be sourced from vendors

The major equipment that will be sourced from the Phase 2 building are the existing WW6plus spirals and the associated frames, launders, distributors, hoses and other components. There are various other items that will also be sourced from the Phase 2 building including pumps, valves and instruments. New equipment pricing and equipment modification pricing has been obtained from vendors with the key items and vendors as follows:

- Upgrades and modifications to existing pumps on site by Weir Minerals (the existing pumps were supplied and maintained by Weir)
- Modification to the existing thickener to install a new, higher capacity feed well by Outotec (the original supplier for the thickener)

The new iron upgrade equipment required for the project will be supplied by MT and includes additional WW6plus spirals, up-current classifiers (UCC's) in a special slim configuration to allow integration with the WW6plus spirals, low intensity magnetic separators (LIMS) and wet high intensity magnetic separators (WHIMS).

21.1.14.3 Estimate Details

The capex estimate is summarised in the following table. It should be noted that there are duties and VAT payable on the imported equipment for the project and this value has been presented separately in Table 21-9 below.

Table 21-9: Estimate Summary

Vendor equipment costs	CAD	14,911,000.00
Packing and transport costs for vendor equipment	CAD	1,260,000.00
Material costs for fabricated items	CAD	4,393,000.00
Site installation labour	CAD	10,197,000.00
Site indirects (construction equipment, facilities, travel, management and site staff, administration, safety)	CAD	3,408,000.00
Other project indirects (project management, engineering and drafting, procurement, insurance	CAD	1,771,000.00
Commissioning and ramp up support	CAD	250,000.00
Process support following commissioning	CAD	240,000.00
Total (CAD)	**CAD**	**36,430,000.00**

Duties and VAT on imported equipment	CAD	772,000.00

Note that in addition to using a Canadian dollar (CAD) basis for establishing the capex estimate, portions of the estimate have been developed using Australian (AUD) and United States (USD) currencies as a basis and are subject to exchange rate fluctuations. The rates of exchange utilised and the estimate values associated with those foreign currencies are as follows:

- Canadian dollar basis portion of the estimate – CAD18,860,000.00

- Australian dollar basis portion of the estimate – AUD 17,667,000.00. This has been established on the basis of AUD 1 = CAD 0.97062. Note that this value includes the duties tabled in the estimate summary (CAD 772,000.00).
- United States dollar basis portion of the estimate – USD 675,000.00. This has been established on the basis of USD 1 = CAD 1.33774.

21.1.15 Tailings and Surface Water Management (WSP)

The capex includes the construction cost associated with the initial investments required prior to restart of the mining operations as well as the cost to build starter dykes and pumping infrastructures. A summary table of capex for the tailings and surface water management and operation is presented at the end of the section (Table 21-10).

21.1.15.1 Water Management

This section includes improvements to the existing surface water management system. Before the start-up of the mining operations, investments are necessary for water management in order to meet the design criteria and improve robustness from an operational point of view.

Costs include the construction of a total of three exfiltration ditches along the downstream side of certain dykes surrounding tailings storage areas. Those are recommended in order to improve the exfiltration recovery infrastructures currently in place and to prevent associated potential legal non-compliance. Exfiltration water will be collected and pumped back into the water management system. The required exfiltration ditches are the following:

- 2,000 m of exfiltration ditch downstream of Dyke D-1
- 2,150 m of exfiltration ditch downstream of Dyke D-2
- 2,500 m of exfiltration ditch downstream of East Dyke

A total of twelve water pumping stations will also need to be upgraded in order for the site to comply with laws and regulations design criteria. Costs associated with the needed improvements include those related to replacement of pumps, pipes and/or associated infrastructures before start-up. Two emergency spillways located at basins BS-1 and BM-12 will also be required to meet regulation standards. The cost includes excavation, membrane installation and rock protection.

21.1.15.2 Fine Tailings Management

This section includes construction costs for fine tailings management prior to start the mining operations. Those are essentially associated to work required on fine tailings dykes in order to ensure straight forward operations resuming.

- East Dyke: Costs include a clay liner installed on East Dyke to impound Basin A, a protection cushion covering the liner and an access road made of rock wrapped in geotextile at the upstream toe of East Dyke in order to provide adequate access to the work area.
- Dyke A: Costs include a transition between the impervious liner of the East Dyke and the impervious core of Dyke A in order to ensure the continuity of the impervious components.
- West Dyke: Costs include a 2 meter raise of the liner installed on the West Dyke required for the site start-up in order to meet the new tailings filling plan. The liner will be installed on the existing upstream face of the dyke built in 2014.

- Dyke B: Cost includes the rehabilitation earthwork of Dyke B in order to make it operational again (Dyke B is not operational according to the statutory dykes inspection performed by Amec Foster Wheeler in 2016). Work consists of stabilizing the current Dyke B with riprap on both upstream and downstream slopes. The design of these earthworks shall be finalized at the detailed engineering stage.

Earthwork described will be done by a contractor. The G&A costs are estimated at 8.5% of the earthwork value and the profit made by the contractor is estimated at 10% of the earthwork value.

21.1.15.3 Coarse Tailings Readiness Work

This section includes investments required at year zero as well as earthwork for the staged completion of starter dykes required to ensure straightforward operations resuming for the coarse tailings management.

The following earthworks will be done by a contractor. The G&A costs are estimated at 8.5% of the earthwork value and the profit made by the contractor is estimated at 10% of the earthwork value.

- A starting dyke will be built around the deposition area in HPA-South to contain tailings at start-up. The associated capex includes the placing and compaction of tailings borrowed from the stored tailings area. Another starting dyke will be built two hundred meters upstream of the rock toe of HPA-West. This starting dyke will prevent the finest portion of deposited tailings from clogging the rock toe. Once the starting dyke is built, the space between the rock toe and the starting dyke will be backfilled with tailings transported from PRG-2. The tailings will be placed and compacted at a 10% downstream slope. The backfill operation is split between years 1 and 2.
- As the toe of HPA-West will ultimately be submerged by the D2 basin, no intervention will be possible in case of erosion due to exfiltration. A rock toe with a layer of filter material and geotextile will thus be required. This rock toe will also be used as an access road to the toe of HPA-W for inspections.

At year 0, tailings will need to be borrowed from PRG-2 to construct HPA-West dyke. Dozers, excavators, loaders and trucks owned by QIO will be used for this operation.

A dozer, available at the site, and a rental compactor will also need to be used to create available volume for hydraulic deposition in the tailings impoundment area for start-up operations.

A field laboratory will be installed on site. This laboratory will allow the materials used in the earthworks to be controlled on the TSF. This laboratory will include standard geotechnical and civil testing equipment such as a nucleodensimeter storage room, particle size distribution sieves and equipment, as well as concrete testing equipment.

21.1.15.4 Tailings Pumping

Existing Booster Pump House

Several modifications must be brought to the available booster pump house (BHP #1) so that the pumping system accommodates the expected production of the fine and coarse tailings, as well as the distance and elevations of the tailings deposition plan.

The required investments associated with pumping of fine tailings at year zero are related to the modification of the current pumping capacity in order to be able to pump the required 360 m3/h of fine tailings slurry (261 dry tons/h) at a distance of 2,750 m at an elevation of 715 m in Basin A area as required by the new tailings filling plan (starting at year 1). In order to accommodates these operational requirements, the pumping arrangement will change from the two existing 150 HP pumps in series to four 150 HP pumps per pumping set. An arrangement of an operating pump set with a stand-by set is planned. The two extra pumps are already available in Phase 2 inventory. The existing 8-inch pipeline lengths already connected to the BPH#1 will need to be extended with the addition of an extra 1,050 m of pipeline. This will also come from the available pipeline on site. Modifications to the existing pumping capacity will require flange changes in order to accommodate a new maximum pressure of 600 psi. Costs associated to the additions of the pumps and the extension of pipeline at year zero include engineering, electrical and mechanical work and equipment as well as instrumentation.

As the fine tailings plan will require the discharge of tailings at a distance of 3,850 m at an elevation of 717 m at year 4, the addition of a fifth 150 HP high pressure pump for each of the two pumping sets will be required. Costs at year 4 include engineering, electrical, mechanical work and equipment as well as instrumentation.

The required investments associated with pumping coarse tailings at year zero are related to the increase to the pumping pressure in the tailings line in order to be able to pump the required 1,645 m3/h of coarse tailings slurry (1,264 dry tons/h) to be discharged at a distance of 2,650 m at an elevation of 740 m in HPA-South area and in PRG-2, as required by the new tailings filling plan from year 1 to year 3. These operating criteria will require the addition of a fifth pump on each of the two coarse tailing pumping lines of BPH#1. Two new pumps with high pressure casings (600 psi) will be purchased and two 1,000 HP motors available from phase 2 will be reused at BPH#1. A total of 2,600 m of 14-inch diameter pipes will need to be added on each of the existing pipelines (addition of 700 m/line for each of the two lines for PRG-2 area and 600 m/line for each of the two lines for HPA-S area). Those are available on site in phase 2 inventory. New flanges will be purchased to accommodate 600 psi pressure. Finally, the existing pipelines flanges in the TSF will be replaced to 600 psi flanges. Costs associated to the additions of the pumps and the extension of pipeline at year zero include engineering, structural work, electrical work, mechanical work and equipment as well as instrumentation.

Gate valves must be changed as their operation and performance were unsatisfactory during the previous operation of the site. All existing Delta-type BPH#1 valves will be replaced by Clarkson pneumatic knife gate valves. The valves upstream of the pumps will be of the standard KGF type and those downstream of the pumps will be of the high-pressure type (KGF-HP) to support the high pressure at the discharge. Four 8-inch standard valves and eight 8-inch high pressure valves will be required for fine tailings pumping lines and ten 14-inch standard valves and eighteen 14-inch high pressure valves will be required for coarse tailings pumping lines. Costs include purchase and installation.

Other costs included in tailings pumping CAPEX for BPH#1 include pre-operation inspection and maintenance made by the manufacturer.

Second Booster Pump House

The installation of a second booster pump house (BPH#2) is required to accommodate pumping at greater distances as defined by the new tailings filling plan for coarse tailings hydraulic deposition in PRG-3 area as well as in HPA-South and West deposition areas (starting at year 3). BPH#2 will be located in the southwest portion of the TSF, which represents the most direct way of pumping coarse tailings (fine tailings pumping plan will be accommodated by the modified BPH#1 for the entire operation life).

In order to have an additional booster pump house operational at year 3, construction of BHP#2 will need to be completed by year 2. The configuration of the coarse tailings pumps in BPH#2 will be identical to that of BPH#1 and will include two pumping lines comprised of four pumps each. Each pump will consist of a 14-inch suction and a 12-inch discharge, a 1000 HP motor and a 14-inch discharge hose. A fifth pump will need to be added to each pumping line in year 6. This will allow to differ BPH#2 costs while meeting increasing needs of pumping coarse tailings at a further distance to the west and north portions of the tailings storage area.

Costs associated to the additions of the BPH#2 include engineering, building construction and structural work, electrical and mechanical work and equipment as well as instrumentation.

21.1.15.5 Engineering and Project Management

Engineering and project management costs include the following:

- Site supervision required to ensure quality control for the earthwork, provide technical support throughout the construction season with a field team and issue construction reports.
- Annual recurring engineering for tailings and surface water management required to ensure proper evolution of the tailings storage facility. These include planning, design and inspection activities.
- Additional engineering costs required to restart the site as starter dykes, rehabilitation and completion of existing earthworks are required, and operation procedures need to be developed.

21.1.15.6 Dust Emissions Mitigation, Progressive Restoration and Instrumentation

Progressive restoration of the complete Bloom Lake mine site is planned, starting with the revegetation of the downstream slope of D2 Dyke at year 0. Costs include the revegetation of this slope which will allow current observable dust emissions to be prevented.

As part of the dust emission mitigation plan, initial investments on dust monitoring are also required in year 0. The cost included the installation and the equipment for dust monitoring.

An instrumentation program is required to monitor the performance of the tailings and water earthworks. Investments include the installation of soil pressure probes with a geotechnical drill at year zero to ensure proper monitoring and to meet the certificate of authorization requirements.

Table 21-10: Tailings and Surface Water Management CAPEX (in CAD, without Contingency)

Activity \ Years	Total	0	1	2	3	4	5	6
	CAPEX (k $)							
Water management – construction	**6,147**	6,147	-	-	-	-	-	-
Fine tailings – construction	**3,095**	3,095	-	-	-	-	-	-
Coarse tailings – construction	**6,739**	2,109	4,302	328	-	-	-	-
Coarse tailings – readiness work	**3,045**	3,045	-	-	-	-	-	-
Tailings pumping – construction	**30,439**	6,906	-	20,869	-	206	-	2,457
Engineering and project management	**2,594**	2,594	-	-	-	-	-	-
Progressive restoration	**378**	378	-	-	-	-	-	-
Dust monitoring	**190**	190	-	-	-	-	-	-
Instrumentation	**117**	117	-	-	-	-	-	-
Total Costs	**52,744**	**24,582**	**4,302**	**21,198**	**0**	**206**	**0**	**2,457**

21.1.16 Tailings and Surface Water Management Sustaining CAPEX

The "Sustaining Capex" includes the upgrade of the existing infrastructure. Each upgrade is scheduled to be built at least one and a half years ahead of its commissioning, to allow a safety margin and seasonal construction. A summary table of sustaining CAPEX costs for the tailings and water management and operation is presented at the end of the section (Table 21-11).

21.1.16.1 Water Management

This section includes costs associated to upgrades needed to the improved surface water management system as well as instrumentation-automation.

A junction between two mining basins is required at year 1 in order to simplify the surface water management system. The cost includes ditching work between the two.

Between year 2 and year 12, pumping stations must be upgraded or added in order for the existing installations to remain efficient and environmentally safe. Those include pumps, pipes and infrastructure. Costs represent upgrade investments for one pumping site at year 2 (BM6), for six sites at year 4 (BM14, BU02, BU05, BU06, Pignac West Lake and BU07) and for one pumping site at former Triangle Lake at year 12.

Instrumentation and automation costs include the following:

- Instrumentation: Costs include the instrumentation for all the surface water pumping points on site. The instrumentation includes probes for water levels, flow meters and probes for start-up and shutdown. Those probes are installed at years 1, 2 and 4 at the same time as the upgrades on the pumping stations. They will be used as part of an automation process.
- Automation: The cost is related to the automation of the water management infrastructures on site, to be put in service at year 4, once all instrumentation will be in place. The automation will be controlled from the water treatment plant. The objective is to decrease environmental risks by reducing human intervention.

21.1.16.2 Fine Tailings Management

This section includes the costs associated to the raising of fine tailings dykes based on the new filling plan. Each required raise is spread over a few years in order to facilitate construction. Further, the construction sequence between individual dyke raises is coordinated to spread work.

Dyke A

Dyke A confines water in the fine tailings storage facility. Its elevation depends on the elevation of water as defined by the fine tailings filling plan. As fine tailings are settled at the bottom of the basin, dike A must be raised to maintain the water storage capacity and allow to continuously meet regulatory requirements.

Costs associated with Dyke A raises include the work and material for the following:

- Raising the impervious till core and its backfilling with tailings sand
- Installation of a rock cover on the upstream slope of the dyke in order to prevent erosion caused by waves
- Installation of a frost protection on the crest to ensure the efficiency of the core throughout the winter

Investment for raising the dyke is spread over two years, where possible, to split the construction costs. This corresponds to a feasible construction method.

East Dyke

The East Dyke is used to confine both tailings and water basin. Therefore, it has to be impervious where it retains water and it is made of tailings sands where it confines only fine tailings. The elevation of East Dyke is defined by the filling plan and the elevation of the water basin.

Costs associated with East Dyke raises include the work and material for the following:

- Application of a liner to ensure the required imperviousness
- Installation of a protecting cushion made of sand to avoid liner damages
- Installation of a rock cover on the upstream slope of the dyke to prevent erosion or the exposure of the liner

Investment is planned according to Dyke A and West Dyke construction requirements, for the same elevation raise.

West Dyke

The West Dyke is used to confine both tailings and water basin. This dyke has to be impervious where it retains water and it is made of tailings sands where it confines only fine tailings. The elevation of the West Dyke is defined by the fill plans and the elevation of the basin.

Costs associated with West Dyke raises include the work and material for the following:

- Application of a liner to ensure the required imperviousness

- Installation of a protecting cushion made of sand to avoid liner damages such as punctures
- Installation of a rock cover to prevent the erosion of the dyke or the exposure of the liner

Investment is planned according to Dyke A and East Dyke construction requirements, for the same elevation raise.

Decant Structure

A decant structure allows the process water to flow from basin A to basin RC-1 and then to basin RC-2. From RC-2, water will be recirculated in the concentrator. The decant structure will be raised according to the existing design. By doing this, it will ensure the continuity and the integrity of the infrastructure. Costs associated with decant structure raises include the work and material for 2 m raise increments.

The raising schedule of the structure is dictated by the raising of the basin A-level and must precede the raising schedule of Dyke A.

Emergency Spillway

An emergency spillway is mandatory to allow the adequate evacuation of the project flood. For Basin A, the spillway is built at one extremity of Dyke A. Its raising schedule matches the raising schedule of Dyke A. Incremental emergency spillway elevations can be built between two dyke raises. Costs associated with emergency spillway raises include the work and material for a 1.5 m raise. In year 5, the water level is expected to be raised by 2.5 m in basin A. The cost of the raise in year 4 has thus been proportionally increased.

All earthwork described in section 21.1.24 will be done by a contractor. The G&A costs are estimated at 8.5% of the earthwork value and the profit made by the contractor is estimated at 10% of the earthwork value.

21.1.16.3 Coarse Tailings Management

This section includes the costs associated to the raising of HPA-West and HPA-South dykes, based on the new filling plan.

HPA-West

The HPA-West dyke is raised by the upstream method. It is built with a gentle downstream slope of 10%. The dyke is only composed of tailings. Considering the final level of water, impounded by the dam and its cross section, no impervious element is needed in HPA-West dyke.

Tailings will be required for the downstream slope of HPA-West in D1 basin and to proceed with upstream raises on HPA-West in D2 basin after year 4, where pumping capacity is not sufficient to perform tailings beaching. The sustaining CAPEX include the construction costs which are define by the dozer and compactor used to spread and compact the transported tailings by QIO equipment and labour.

BPH#2 Pad

The second booster pump house will be built on a pad made of controlled backfill at an elevation allowing for TSF development overtime. The backfill will consist in coarse tailings from PRG-2. The tailings haulage costs are included in the OPEX while the Sustaining CAPEX includes costs for its placement and compaction.

Erosion Control Spurs

In order to control the deposition of the fine fraction of the coarse tailings, spurs made of dumped rock will be built in the tailings storage facility, during its last 6 years of operation. These spurs are intended to help control the deposition of tailings and optimize the available space to impound coarse tailings.

The costs include the transportation of blasted rock from a stockpile fed by the mining operations, the dumping and the shaping of the spurs in the TSF. The unit cost is calculated assuming the contractor will use appropriate sized equipment such as articulated 30T trucks and small dozers to accomplish this task.

PRG-3 development

Starting on year 3, coarse tailings will be impounded in PRG-3 in winter. The water must drain in the fine tailings basin through a spillway. Therefore, West Dyke must be completed by year 3. Later, West, East and North dykes must minimally be raised at the expected elevation of Basin A year 10 in order for Basin A to be contained by impervious dykes.

The Sustaining CAPEX include the construction cost of the dykes, and the construction and raise of the operation spillway. Costs associated with this task include the work and materials for the following:

- Construction of a liner anchoring key in the natural ground
- Tailings placement and compaction to create the embankment
- Application of a liner to ensure the required imperviousness
- Installation of a protecting cushion made of sand to avoid liner damage
- Installation of a rock cover on the upstream slope of the dyke to prevent the erosion or the exposure of the liner
- Installation of geotextile and rock protection on the spillway

North Closure Dyke

A dyke is needed at the northern edge of the TSF for coarse tailings management. That dyke will be required during the last years of operation. Its construction is spread over two years. Its cross section will be similar to Dyke A. Costs associated with North closure dyke include the work and materials for the following:

- Stripping and impervious core keying
- Raising the impervious till core and its backfilling with tailings sand
- Installation of a rock cover on the upstream slope of the dyke in order to prevent erosion caused by waves
- Installation of a frost protection on the crest to ensure the efficiency of the core throughout the winter

Rock Toe – HPA-W

The HPA-W rock toe, started at year 1, must be extended to serve as a starting dyke for HPA-W upstream raise. Construction is required to start at year 4 and must be completed by year 13. The investment has been postponed as much as possible in this study. Costs associated with this task include the work and material for the following:

- Placement of rockfill
- Placement of filters between the rockfill and the tailings sand

The earthwork described in section 21.1.25 will be done by a contractor. The G&A costs are estimated at 8.5% of the earthwork value. The profit made by the contractor is estimated at 10% of the earthwork value.

21.1.16.4 Tailings Pumping

Recurring investment is required to maintain the pumping system during the operation of the TSF. Fine and coarse pipeline lengths will be increased to accommodate the deposition plan. Unused lines available at the site will be reused. More field valves will also be needed to maintain the versatility of the pumping system as the Booster Pump House # 2 comes into service.

Since the fine tailings plan will require the discharge of tailings at a distance of 3,750m at an elevation of 717 m at year 4, a pipeline extension of 1,100 m will be required. 550m of 8-inch pipeline available on site will be used and 550m of pipeline will be purchased.

Following the construction of BPH#2, a total length of 3,200 m and 5,000 m of 14-inch pipelines will be required to reach HPA-West Dyke and PRG-3 areas respectively. The remaining available pipelines from phase 2 inventory will be used as well as 1,400m reused from PRG-2, bringing the total new pipeline length required at year 3 to 6,200 m. A pipeline length of 135 m will also be required each year of operation in order to reach a further distance for the coarse tailings discharge point within the coarse tailings storage area. Specifications of the piping and flanges will accommodate a maximum pressure of 600 psi.

21.1.16.5 Instrumentation

Instrumentation installation used to monitor tailings and water earthworks performance will be done every 5 years. As the tailings storage facility fills up and the dykes are raised, extra instrumentation will be required to monitor the performance.

21.1.16.6 Engineering and Project Management

Engineering and project management cost include a site supervision to ensure a quality control for the earthwork, provide technical support throughout the construction season with a field team and issue construction reports.

Table 21-11: Tailings and Surface Water Management Sustaining CAPEX (in CAD, without Contingency)

	Sustaining CAPEX (k$)								
Activity / Years	Total	1	2	3	4	5	6 to 10	11 to 15	16 to 21
Water management	**2,345**	339	155	-	1,485	-	-	365	-
Fine tailings - construction	**15,369**	-	810	1,385	1,604	889	3,487	3,114	4,080
Coarse tailings - construction	**34,410**	631	5,311	4,934	4,568	6,740	679	2,166	9,381
Tailings pumping - construction	**7,674**	-	-	5,351	586	109	543	543	543
Engineering and project management	**11,215**	2,895	1,080	1,080	1,080	1,080	1,250	1,250	1,500
Instrumentation	**150**	-	-	-	-	50	50	50	-
Total Sustaining CAPEX costs	**71,163**	**3,865**	**7,356**	**12,750**	**9,324**	**8,867**	**6,009**	**7,488**	**15,504**

21.1.17 PM, E, P and CM Services

The cost estimate for project management, engineering, procurement and construction management are based on a manpower forecast and consists, without limitation, of the following:

- Salaries, fringes, uplifts, recruitment, overhead, etc.
- Expenses (i.e. business and rotational travelling, including in-transit costs, etc.)
- IT services
- Home office support and expenses (communications, IT services, IT equipment, courier, printing, office space, furniture, consumables, stationery, etc.)

21.1.18 Site Indirect Costs

Site indirect costs are included and consist, without limitation, of the following:

- Power distribution through tie-ins to the existing reticulation
- Room and board, in the existing facilities owned by QIO; a budgetary proposal obtained by a local service provider serves as the basis for costs along with the manpower forecast. The proposal includes catering, operations and maintenance
- Existing offices on site will serve for PM, E, P and CM; an allowance for field office supply (IT equipment, i.e. computers and monitors, courier, printing, furniture, consumables, etc.) is included.
- IT, including hardware and software, stationaries, etc. is included.
- Communications are included and they include monthly fees. An allowance for cellular phones and short wave radios is included as well.
- The existing tank farm will be used for all requirements by the QIO PM team under the self-execution strategy and distributed as free issue consumables to sub-contractors.
- Existing infrastructures for the management of sewerage, construction waste (dry, wet, hazardous and non-hazardous) and garbage, including collection, treatment and disposal is included and is based on historical data obtained by QIO.

- Maintenance of existing roads and walkways are included and costs are based on historical data obtained by QIO.
- Field office supply (IT equipment, courier, printing, office space, furniture, consumables, etc.).
- Access control and monitoring will be managed through existing installations.
- Existing lay down and storage areas, as well as warehousing, complete with, but not limited to, materials management and materials handling equipment, fencing, signage and lighting will be used for the construction phase. Costs for related labour are included.
- Site security will be ensured by QIO’s staff and is included through the manpower plan.
- Existing light vehicles are included and an allowance for maintenance and operations is included.
- Existing first aid and medical installations will be used; medical services, doctors and nurses, are added through the manpower forecast plan.
- Site surveying is included in the manpower forecast plan.
- Non-destructive testing and QA/QC testing, including laboratory services, are included in the manpower forecast plan.
- An allowance for general and final clean-up is added.

21.1.19 Owner’s Costs

Owner’s costs have been developed by QIO and have been incorporated in the overall estimate as obtained from QIO.

21.1.20 Other Costs

The following assumptions form the basis for the calculations of other direct costs:

- It is assumed that there will be no requirements for heavy lifts
- Vendor representatives are included and are based on proposals
- Spare parts are included and are based on proposals
- First/initial fills are included through an allowance
- Testing (hydro, pneumatic, leak) is deemed included with the proposals
- Logistics and freight are deemed included with the proposals
- POV and commissioning are included with the operational readiness

21.1.21 Contingency

The project contingency was evaluated using a deterministic approach; a deterministic approach is an objective assessment of possible ranges of the accuracy for major elements of scope as a function of their definition, i.e. engineering progress.

21.1.22 Escalation

All costs will be spent during the year 2017 and the first quarter of 2018 and therefore, no allowance for escalation is included in the estimate.

21.1.23 Risk

The Ausenco, G Mining, Mineral Technologies, WSP and QIO project team members assisted in a risk workshop session to identify potential capital and health and safety risks (both threats and opportunities) which was captured in a risk register. Each risk was assigned a level of consequence and probability for which a probable consequence value was derived. Mitigation plans were developed, but the risks were not re-evaluated post-mitigation.

The project risk allowance was evaluated using a deterministic approach; a deterministic approach is an objective assessment of possible ranges of the risk allowance for major elements of scope as a function of their definition.

21.1.24 Estimate Qualifications

Estimates are developed within a framework of reference which is defined by assumptions and exclusions grouped under estimate qualifications.

21.1.25 Assumptions

The following is a list of assumptions that enabled the development of the estimate:

- The workweek is based on 6 days at 10 hours per day.
- Rotations are based on 3 weeks in followed by 1 weeks R&R.
- Construction, POV and commissioning will be performed in 2017.
- Estimate assumes logical sequences in work activities and that sequence in work activities will not be altered.
- The PM, E, P and CM team will be in sufficient quantity so as not to delay the execution.
- The PM, E, P and CM team will have construction expertise so as not to delay the execution.
- The estimate assumes engineering will be sufficiently developed to support construction and to avoid rework.
- Direct craft labour will all be sourced from the province of Québec.
- Direct craft labour will all be journeymen, i.e. no allowance for apprentices.
- Labour decree will remain effective throughout the construction period.
- Accommodations in Fermont will be sufficient in quality and quantity in order to avoid labour disruption.
- Access to site will be allowed 7 days per week and 24 hours per day.
- The estimate assumes a smooth transition between phases.
- The estimate assumes that the source, quantity and quality for power, fuel, water will be suitable for the construction phase.

- Overburden disposal will be within plant limits.
- The estimate assumes that the source, quantity and quality of engineered fill and backfill material will be suitable.
- The estimate assumes no variation to the baseline project schedule.
- No interruption in job continuity
- Normal distribution of workforce over the period of construction.

21.1.26 Exclusions

Following are items specifically excluded from the baseline estimate:

- Any and all taxes
- Currency fluctuation
- Escalation
- Work stoppage resulting from a labour dispute
- Work stoppage resulting from community relations dispute
- Work stoppage resulting from environmental issues
- Allowance for turnovers
- Scope change
- Allowance for carry-over work
- All costs beyond the start of commercial operation
- Allowance for rework as a result of failed QA/QC inspection
- Costs associated with the remediation of deficiencies
- Change to the labour decree
- Allowance for underground obstructions
- Financing charges
- Delays, including those caused by community relation, permitting issues, project financing, etc.

21.1.27 Capital Cost Estimate Summary

The following is the summary tables for the capital cost estimate (CAPEX).

Table 21-12 – Capital Cost Estimate Summary by Area

WBS	Area	Cost
0000	General	$13,318,225
1000	Mine	$46,725,919
2000	Process	$64,851,532
3000	On-site Infrastructure	$0
4000	Off-site Infrastructure	$0
9000	Indirect Costs	$32,291,825
Total		$157,187,501

Table 21-13 – Capital Cost Estimate Summary by Discipline

Type	Discipline	Cost
A	Site Work	$0
B	Earthworks	$14,345,950
C	Concrete	$0
E	Structural Steel	$0
F	Architectural and Unit Building	$0
G	Port/Marine	$0
H	Rail	$0
J	Mining	$41,898,100
K	Pipeline	$0
L	Mechanical Plate-work and Tanks	$0
M	Mechanical Equipment	$64,342,069
P	Piping	$0
Q	Electrical Equipment	$549,500
R	Conduit and Cable Tray	$164,437
S	Wire and Cable	$2,309,515
T	Instrumentation	$1,286,106
U	Construction Indirects	$6,182,126
V	Other Indirect	$0
W	EPCM	$7,834,291
X	Contingency	$8,106,485
Y	Owner Cost, including Risk	$10,168,924
Z	Open	$0
Total		$157,187,501

21.2 Operating Costs

21.2.1 Basis of Estimate

The operating cost for the Bloom Lake mine has been estimated at a feasibility study level with an accuracy of ±15%.

The following basic data pertains to the estimate:

- The estimate base date is first quarter of 2017.
- The estimate is expressed in Canadian dollars (CAD$).
- No allowance has been made in the estimate for escalation from the base date, growth or changes in currency exchange rates.
- All import duties and taxes are excluded from the estimate (and are not expected to apply as all consumable and reagent pricing is FOB).
- No estimate contingency has been considered.

21.2.2 Exchange Rates

Table 21-14 shows the long-term exchange rates used to develop the operating cost estimate.

Table 21-14 – Exchange Rates

CAD	Exchange Rate
CAD 1	AUD 0.971
CAD 1	USD 1.338
CAD 1	EUR 1.393
CAD 1	CAD 1.000
CAD 1	RAND 0.096

21.2.3 Operating Costs Summary

Project operating costs have been divided into six major cost centres:

- Mining operating costs were estimated by G Mining.
- Crushing plant operating costs were estimated by Ausenco.
- Processing plant operating costs were estimated by Ausenco and Mineral Technologies.
- Concentrate land logistics costs were estimated by QIO.
- Water and tailings management and operations costs were estimated by WSP.
- Site support (G&A) costs were estimated by Ausenco.

A summary of the average operating cost over the life of mine is show in Table 21-15.

Table 21-15 – Summary of Average Production Period Operating Costs

Description	Production Period Average		
	$/t Ore	$/t Dry Concentrate	% of Costs
Mining	3.95	10.45	24.35%
Crushing plant	0.37	0.98	2.29%
Process plant	2.81	7.44	17.32%
Concentrate land logistics	6.37	16.88	39.32%
Water & tailings operations	0.83	2.20	5.13%
General and administration	1.88	4.98	11.59%
Total Cost	16.21	42.93	100.00%

Operating costs vary with time according to total material mined, concentrator throughput and concentrate output, which are provided in the production schedules in Section 16. A summary of the variation in operating cost per tonne of concentrate produced during the project life is shown in

Figure 21-1. Costs are generally stable over the life of the project, as the production schedule also presents little variation. Operating costs in the first and, particularly, in the last, operating years are higher as the plant throughput is reduced during those years and fixed costs are attributed to fewer tonnes of concentrate.

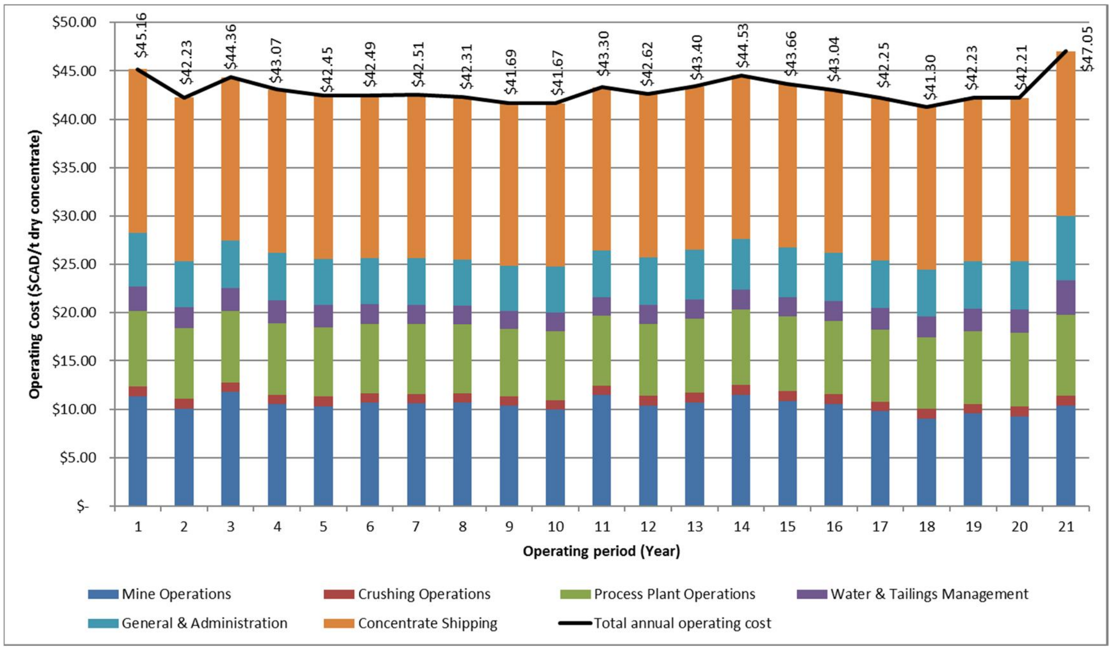
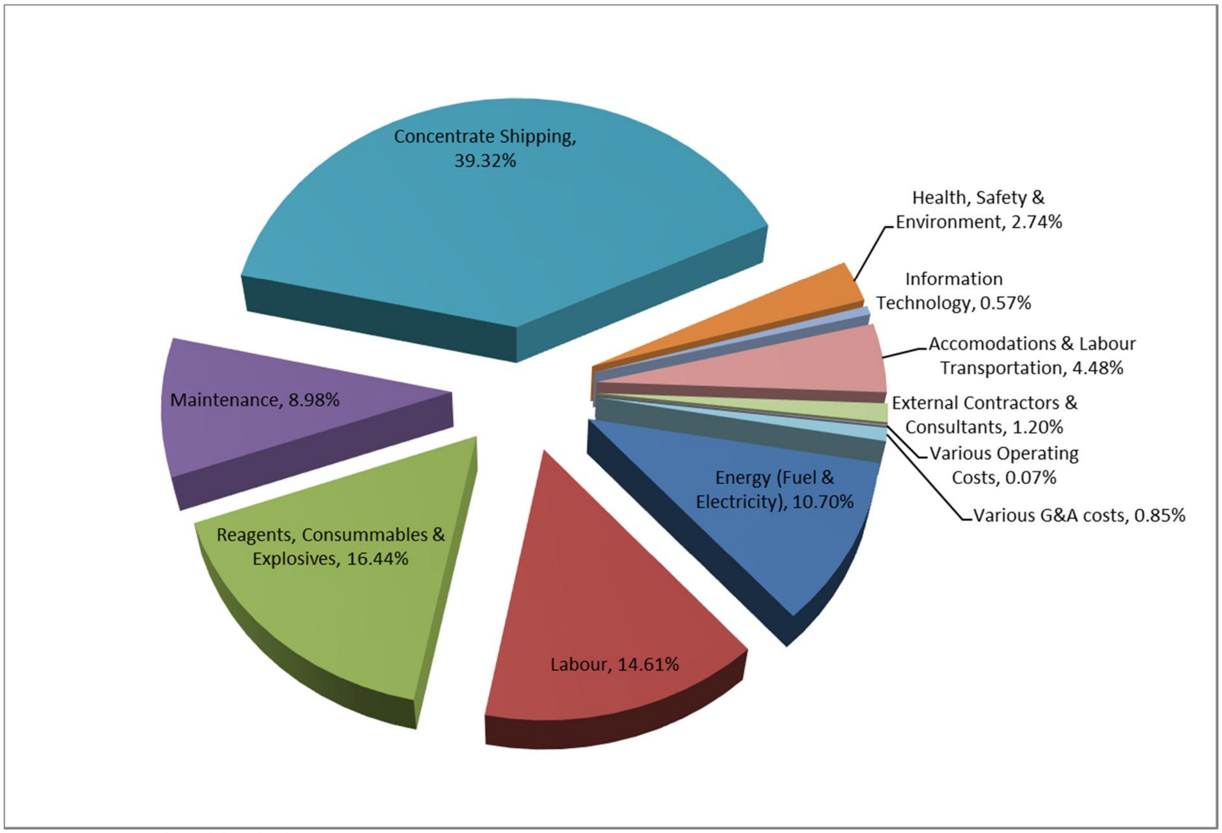


Figure 21-1: Operating Costs over the Project Life

Average operating costs have been separated into various cost components. Figure 21-2 presents the relative weight of each cost component. It can be observed that there are four major cost components for this project:

- Maintenance costs, at 9.01%
- Energy costs, including fuel and electricity, at 10.70%
- Labour costs, at 14.61%
- Reagents, consumables including wear parts and explosives, at 16.44%



Concentrate land logistics, at 39.32%.

Figure 21-2 : Weight of Average Operating Costs by Component

The top five cost drivers for the operating cost estimate are as follows:

1. Concentrate land logistics costs (39.32% of total operating costs). This is by far the largest operating cost incurred by the project.
2. Labour costs (14.61% of total operating costs). This includes all operations and maintenance personnel.
3. Process plant reagents, consumables and maintenance materials (7.49% of total operating costs). This cost includes service agreements with equipment manufacturers to ensure the continual maintenance of the crusher, apron feeder, AG mill and all pumps.
4. Mine maintenance materials costs (7.03% of operating costs) which include maintenance parts, such as tires.

5. Beneficiation plant energy consumption (4.94% of operating costs).

21.2.4 Exclusions

The operating costs exclude:

- Escalation or exchange rate fluctuations
- Exploration costs
- Contingency
- Import duty and taxes (not expected)
- First fill reagents and consumables (in capital cost estimate)
- Sustaining capital (in economic model cash flow)
- Interest and financing charges (assumed 100% equity basis)
- Insurance and marketing costs

21.2.5 Mine Operating Costs

The mine operating costs are estimated from first principles for all mine activities. Equipment hours required to meet the life-of-mine ("LOM") plan are based on productivity factors or equipment simulations. The delivered fuel price to site used in estimating mining costs is C$ 0.80/L. The mine wage scale established for the project has operators making between C$ 42.94/h and C$ 50.40/h, including benefits and bonus allowances. The major equipment hourly operating costs are presented in Table 21-16.

Table 21-16: Major Equipment Hourly Operating Cost

Machines	Maint. Labour (C$/h)	Fuel (C$/h)	Elect. (C$/h)	Parts & Repairs (C$/h)	Lube (C$/h)	GET (C$/h)	Tires (C$/h)	Total (C$/h)
Electric Rotary Drill	39.12	-	29.00	166.74	5.50	4.08	-	244.45
Pre-split Drill (6.5")	14.08	64.85		90.36	10.38	6.20	-	185.87
Electric Hydraulic Shovel (34 m³)	83.46	-	89.72	478.14	19.55	178.35	-	849.22
Wheel Loader (20 m³)	19.82	112.07		241.96	11.81	42.24	89.00	516.91
Mining Truck (240 t)	33.91	137.25		87.36	9.55	10.24	44.40	322.71
Mining Truck (100 t)	7.30	72.22		41.71	4.09	6.67	15.60	147.59
Track Dozer (899 HP)	19.30	95.85		163.65	5.30	24.10	-	308.20
Track Dozer (630 HP)	16.69	68.88		65.30	3.40	16.39	-	170.66
Motor Grader (16 ft)	16.69	25.41		35.52	2.15	3.03	5.28	88.08
Water/Sand Truck (76 kL tank)	7.30	72.22		45.10	4.09	-	15.60	144.31
Wheel Dozer (904 HP)	16.69	72.29		88.55	5.06	16.26	17.60	216.46

For the major mining equipment, the parts and repair costs that have been used are based on a life cycle costing strategy. This was the preferred costing method as opposed to using an average cost over the life of the equipment average cost because most units are used. The mine equipment has between 12,000 and 33,000 hours of usage, meaning that they are nearing the requirement for mid-life or partial overhauls of major components.

The average mining cost during operations is estimated at C$ 2.65/t mined, including re-handling costs. The mining costs are higher during start-up or pre-production with an average of C$ 3.44/t mined as this includes training and mine operational readiness costs. The average mining cost during the early years of operations is below average and increases, due to increased haulage distances and pit deepening in the later years. This operating cost estimate includes capital repairs, which are not treated as sustaining capital.

Haulage is the major mining cost activity, representing 23% of total costs, followed by blasting (17%), and loading (11%). Some haulage costs have been back-charged to the TMF dam construction, as this represents incremental haulage. Loading and haulage for stockpile re-handling is also captured as a separate activity.

Salaries are the dominant cost by element representing 31% of total costs, followed by maintenance parts (22%), bulk explosives (13%) and fuel (12%).

Table 21-17: Mine Operating Costs Detail by Activity

Activity	Total Cost (k$)	Cost ($/t mined)	Cost ($/t milled)	% of OPEX
Mine Operations	66,103	0.11	0.16	4%
Mine Maintenance Admin.	103,353	0.17	0.25	6%
Mine Geology	35,431	0.06	0.09	2%
Mine Engineering	78,642	0.13	0.19	5%
Grade Control	6,492	0.01	0.02	0%
Electrical Cable Handling	25,489	0.04	0.06	2%
Drilling	100,171	0.16	0.24	6%
Blasting	281,213	0.46	0.68	17%
Pre-Split Drilling and Blasting	32,435	0.05	0.08	2%
Loading	182,125	0.30	0.44	11%
Hauling	367,805	0.60	0.89	23%
Dump Maintenance	93,115	0.15	0.23	6%
Road Maintenance	120,504	0.20	0.29	7%
Dewatering	11,207	0.02	0.03	1%
Support Equipment	74,295	0.12	0.18	5%
Other	38,446	0.06	0.09	2.4%
Sub-Total In-Situ Mining	1,616,826	2.65	3.93	99%
Rehandling	11,814	0.02*	0.03	1%
Total Mining Cost	1,628,640	2.60	3.96	100%
Total Mining Cost (Pre-Prod)	41,524	3.44	14.03	3%
Total Mining Cost (Operations)	1,587,116	2.65	3.85	97%

* 0.74 $/t rehandled

Table 21-18: Mine Operating Costs Detail by Period

Mining Cost by Activity (k C$)	Total	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Mine Operations	66,103	1,758	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	3,109	2,165
Mine Geology	35,431	965	2,229	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	1,644	997
Mine Maintenance Admin.	103,353	2,621	4,991	4,569	4,827	4,843	4,835	4,508	4,632	4,736	4,733	5,412	4,758	5,020	4,688	5,025	4,659	4,856	4,779	5,063	4,997	4,708	4,093
Mine Engineering	78,642	2,269	4,260	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,274
Drilling	100,171	1,102	4,900	4,472	6,133	4,777	5,327	5,486	4,517	4,958	5,433	5,070	5,767	5,590	4,960	5,204	6,415	3,496	4,925	3,362	3,699	3,482	1,096
Pre-Split Drilling and Blasting	32,435	32	1,218	1,416	2,248	1,774	1,526	1,740	1,840	2,911	1,204	1,918	982	1,537	1,518	1,773	1,216	1,216	1,554	1,202	1,092	1,437	1,081
Blasting	281,213	3,085	13,319	13,646	13,607	14,059	13,805	15,147	14,461	15,126	15,139	12,973	14,893	13,045	14,404	13,753	13,576	12,987	13,007	11,576	12,170	11,383	6,055
Loading	182,125	2,658	10,440	6,376	11,932	7,679	7,548	11,152	7,167	9,722	10,245	5,803	12,100	7,775	8,708	10,447	9,289	12,355	6,461	7,324	7,503	5,780	3,663
Hauling	367,805	4,986	12,634	15,152	17,886	17,037	17,094	17,244	18,880	20,393	20,469	17,072	22,077	17,311	17,531	19,465	16,508	17,978	18,541	16,191	16,031	16,650	10,675
Dewatering	11,207	224	577	502	503	502	516	516	516	516	516	538	539	538	538	538	539	538	510	510	510	510	510
Dump Maintenance	93,115	1,673	5,067	4,957	4,876	4,967	5,040	5,001	4,879	5,131	4,926	4,878	4,985	5,136	4,945	3,726	3,886	3,180	2,991	3,197	3,267	3,176	3,231
Road Maintenance	120,504	1,578	4,716	6,111	5,837	5,416	5,750	5,756	5,242	5,714	5,870	5,461	5,682	5,965	5,623	5,300	5,800	6,112	5,719	5,203	5,816	6,086	5,746
Grade Control	6,492	150	301	302	302	302	302	302	302	302	302	302	302	302	302	302	302	302	302	302	302	302	300
Support Equipment	74,295	827	3,170	3,671	3,682	3,597	3,572	3,731	3,579	3,576	3,473	3,631	3,579	3,576	3,473	3,631	3,635	3,441	3,306	3,338	3,312	3,246	3,250
Electrical Cable Handling	25,489	388	1,160	1,209	1,210	1,209	1,209	1,209	1,210	1,209	1,209	1,209	1,210	1,209	1,209	1,209	1,210	1,209	1,209	1,209	1,210	1,209	974
Topo Drilling Contract	4,341	64	35	762	817	340	505	331	612	19	-	627	111	60	36	13	-	4	-	-	-	-	4
Overburden Mining Contract	24,308	356	194	4,269	4,574	1,902	2,830	1,853	3,427	104	-	3,514	624	338	202	75	-	22	-	-	-	-	24
Aggregate Plant	9,797	239	425	513	514	507	462	469	447	469	427	474	483	461	414	492	491	351	434	426	384	470	444
Sub-Total In-Situ Mining	1,616,826	24,975	72,745	76,304	87,324	77,287	78,697	82,819	80,087	83,262	82,323	77,259	86,467	76,239	76,927	79,330	75,903	76,423	72,114	67,278	68,668	66,814	47,583
Rehandling	11,814	-	1,395	-	499	730	580	-	660	-	-	-	569	473	-	982	946	205	-	412	1,332	-	3,032
Total Mining Cost	1,628,640	24,975	74,140	76,304	87,823	78,017	79,277	82,819	80,746	83,262	82,323	77,259	87,036	76,712	76,927	80,312	76,849	76,628	72,114	67,690	70,000	66,814	50,615
Total Mining Cost (Pre-Prod)	41,524	24,975	16,549	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Mining Cost (Operations)	1,587,116			19,287	19,587	18,716	76,304	87,823	78,017	79,277	82,819	80,746	83,262	82,323	77,259	87,036	76,712	76,927	80,312	76,849	76,628	72,114	67,690

21.2.6 Crushing and Processing Operating Cost Estimates

21.2.6.1 Basis of Estimate

Both crushing and processing plants operating costs were estimated based on:

- QIO's recommendations for labour rates, fuel costs, electricity and miscellaneous expenses, reviewed against Ausenco's database for reasonableness
- Electrical, reagent and consumable consumptions for the modified magnetic separation and hydrosizer circuits were supplied by Mineral Technologies
- Process design criteria provided by Mineral Technologies
- G Mining supplied the mine production schedule.
- Equipment consumables, reagents and service agreement supplier quotations

21.2.6.2 Inclusions

The crushing and processing operating cost estimate includes:

- Labour for supervision, management and reporting of on-site organizational and technical activities directly associated with the crushing and processing plants
- Labour for operating and maintaining crushing and processing plants
- Auxiliary labour costs
- Fuel, reagents, consumables and maintenance materials for crushing and processing plants
- Electrical power consumption
- Fuel consumption for steam production
- Laboratory operations
- External consultants/contractors

21.2.6.3 Summary

Table 21-19 below provides average production period crushing and processing costs per tonne of concentrate. Processing costs include power, reagents, consumables, fuel, maintenance spares, as well as labour.

Table 21-19 – Average Crushing and Processing Operating Cost Summary (Life of Mine)

Description	Production Period Average	
	CAD$/t ore	CAD$/t dry concentrate
Crushing Plant		
Power	0.10	0.27
Consumables and maintenance materials	0.19	0.49
Overland conveyor maintenance	0.02	0.06
Labour (including auxiliary labour costs)	0.06	0.16
Total Crushing Plant Operating Costs	0.37	0.98
Processing Plant		
Power	0.73	1.94
Consumables, reagents and maintenance materials	1.21	3.21
Fuel	0.07	0.17
Labour (including auxiliary labour costs)	0.68	1.80
Building maintenance	0.09	0.25
Consultants/contractor services	0.01	0.03
Laboratory services	0.02	0.04
Total Processing Plant Operating Costs	2.81	7.44

21.2.6.4 Power

Power costs were calculated using the grid power rate of CAD$0.058/kWh based on Hydro-Quebec L rate as per December 2016. A discounted power rate of CAD$0.050/kWh has been assumed for the production of plant steam produced by electricity rather than fuel oil based on Hydro-Quebec additional electricity option for large-power consumers program. Power was calculated by facility, with installed power taken directly from the existing mechanical equipment list. Additional power for the new magnetic separation and hydrosizer circuits was provided by Mineral Technologies. An additional study was performed by Ausenco to determine the power consumption of the overland conveyor feeding crushed ore from the crushing plant to the processing plant. This power consumption was included in the crushing plant operating costs. Operating hours per year, equipment utilisation and load factors were used to calculate the total power usage in kWh per year.

21.2.6.5 Reagents, Consumables and Maintenance Materials

Crushing and processing plant reagent and consumable costs were estimated based on the annual plant throughput. The costs were based on calculated consumption rates and unit costs supplied by vendors, or pro-rated based on consumptions from previous operating years. Reagent and consumable costs include transport to site.

Crusher, apron feeder and AG mill maintenance costs were provided as part of a service agreement with the manufacturer on a yearly through-put basis. This service agreement includes the cost of parts, wear materials (including AG liners and crusher liner and mantles) and maintenance labour.

The overland conveyor maintenance cost was established at $600,000 in the first year and $400,000 thereafter.

AG mill liner consumption and cost is part of the Metso life cycle service proposal.

Annual pump maintenance costs including consumables, lubricants and wear parts, but excluding labour, was supplied by Weir, based on their previous experience with this operation.

Wear parts and reagent costs for the modified magnetic separation and hydrosizer circuits were supplied by Mineral Technologies as part of their study mandate.

Other consumables and wear parts costs were estimated based on the previous plant operations. Drying and train loading consumables and wear parts costs were adjusted to account for the increased concentrate production.

21.2.6.6 Labour

Salaries for staff are based on Canada Mercer Mining Industry Compensation Survey 2015 using the 75th percentile. Salaries for the hourly based employees are based on the actual collective agreement.

The rosters and salaries were benchmarked against similar operations, and include fringe benefits and inconvenience bonuses. Fringe benefits were established at 30% for all employees. Inconvenience bonuses vary from 0 to 15%, depending on the position.

No maintenance personnel were considered for the crushing equipment or for the AG mill, as this is part of the service agreement with the manufacturer, included in the maintenance materials costs.

Labour auxiliary costs were estimated as a separate item, based on the labour roster. The auxiliary costs include a yearly allowance per employee for general consumables and health and safety equipment. Operating materials, office supplies and employee training and induction programs were estimated as a percentage of yearly labour costs.

21.2.6.7 Fuel

A portion of the plant steam production is performed using No. 2 fuel oil. Steam production was established based on concentrate production. A no. 2 fuel oil cost of CAD$0.75/L delivered to site was considered.

21.2.6.8 Building Maintenance

Annual process plant building maintenance was established, using the maintenance costs from the previous years of operation.

21.2.6.9 External Consultants/Contractors

An annual allowance of CAD$200,000 was included in the process plant operating costs to cover any unforeseen improvement projects. A small allowance of CAD$20,000 was included in the crushing plant operating costs to account for annual belt inspections of the overland conveyor.

21.2.6.10 Laboratory Services

Operating costs of the on-site laboratory were estimated based on the cost of the previous years of operation. These costs included consumables, reagents and maintenance of the laboratory. Laboratory labour is included in the process plant labour costs.

21.2.7 Tailings and Surface Water Management

The opex includes the operating costs, required each year, during the mine operation. A summary table of opex costs for the tailings and water management and operation is presented at the end of the section (table 21.3).

21.2.7.1 Water Management

This section includes operating costs for the surface water management. The costs are divided into two categories: operation and maintenance.

Operation costs include the following:

- Workforce: Cost is provided by QIO and includes all QIO personnel to operate tailings, surface water management, water treatment plant and the environmental services operation.
- Materials and equipment: Costs include all materials and equipment required to manage the tailings and surface water. It is based on past operational costs and adjusted to reflect the present project reality.
- Water treatment plant: Costs include the annual operation costs for the water treatment plant, estimated by QIO, as well as the cost for maintenance and materials. This cost excludes the workforce, since it is included in the item “Workforce”.
- Energy: This includes energy for the surface water management.

Maintenance costs include the following:

- Pump maintenance: Costs include all the surface water management pumps on site. The cost represents the purchasing of replacement parts, as well as general maintenance.
- Pump replacement: The cost is related to replacement of pumps for surface water management. The study considers the probable lifetime of pumps and budgets for replacement. It is estimated that all surface water management pumps will be replaced once during the mine life, starting at year 6.
- Control structure maintenance: Costs include the annual preventive maintenance costs for the two water level control structures.
- Ditch maintenance: Costs include an annual maintenance cost of 10% of the overall ditches on site. Maintenance is related to dredging and rip-rap maintenance.

21.2.7.2 Fine Tailings Management

General maintenance of fine tailings structures will be performed on an annual basis during site operations. Costs include all preventive maintenance of all surface water and tailings containment infrastructures. Cost estimates are based on benchmarking costs for similar structures and represent a diligent investment for proper care and operation of containment areas.

21.2.7.3 Coarse Tailings Management

Operational costs for coarse tailings management are related to the management of the PRG3/PRG2 and the HPA areas. Costs include the operational costs of mine QIO equipment and rentals. Rental equipment is required when the availability of QIO equipment is lower than the required effort. A compactor is also rented when required.

QIO equipment usage and rental costs for PRG3/PRG2 include the following work:

- Spreading the tailings into stockpiles inside PRG-3/PRG-2 until year 10 with CAT D9T dozer and compacting the dozed tailings used to raise PRG-3 embankments with a rented compactor.
- Tailings management in PRG-2 and PRG-3 until year 10 with a CAT 345 DL hydraulic excavator. Deposition in PRG's areas will no longer be required, following year 10.
- Hauling tailings to the required structures to be built during summer season with the two QIO's CAT 777D mine trucks and extra rentals when required. This includes loading of trucks, with a WA1200 QIO wheel loader.

QIO equipment usage and rental costs for HPA include the following:

- Dozing and compacting tailings inside HPA-South and HPA-West areas each year for raising dykes with a CAT D9T dozer and a rented compactor during the summer season.
- Management of line ends with a CAT 345 DL owned by QIO.

21.2.7.4 Tailings Pumping

Operational costs for tailings pumping including energy consumption as well as pump maintenance.

Annual energy cost from year 1 to year 20 for BPH#1 include a consumption of 27,600,000 KWh based on the operation of fine tailings pumps (150 HP motors) and coarse residues (1000 HP motors). In year 21, energy costs include a consumption of 13,800,000 KWh for 6 months of operation.

The energy cost for BPH#2 starts at year 3 for 3 months of operation and include 675,000 KWh based on the operation of the coarse tailings pumps (1,000 HP motors). The annual energy cost for BPH#2 from year 4 to year 20 include 24 840 000 KWh. In year 21, it is estimated at 12,420,000 KWh based on 6 months of operation.

The energy consumption of the booster stations is based on mill availability of 92%.

The annual pump maintenance costs have been estimated by Weir pump supplier which are based on the following:

- Three to four plant shutdowns per year
- Recurring services based on monthly maintenance reports
- Work to replace pump parts completed at the weir service point in Wabush
- The maintenance of the pumps completed weekly at the plant

Maintenance costs around the Booster Pump House # 1 also included the cleaning by excavation of overtopped tailings in and around BPH#1.

21.2.7.5 Dust Emissions Mitigation Measures and Progressive Restoration and Instrumentation

Dust emission mitigation measures and progressive restoration will be required throughout the operational life of the site.

Operation costs for dust monitoring and control include the application of dust emission suppressor on exposed areas of the tailings storage facility for the first five years. Progressive restoration started with D-2 in year zero will continue at year 6. Revegetation efforts will spread over a reasonable time period until the end of the mining operation.

21.2.7.6 Engineering and Project Management

Annual recurring engineering costs for tailings and surface water management, including planning, design and inspection activities are included in order to ensure proper evolution of the operations of the tailings storage facility.

Table 21.3: Tailings and Surface Water Management OPEX (in CAD, without Contingency)

OPEX (k$)									
Years **Activity**	Total	1	2	3	4	5	6 to 10	11 to 15	16 to 21
Water Management	133,344	6,403	6,403	6,403	6,403	6,403	33,015	32,515	35 800
Fine Tailings Management	5,250	250	250	250	250	250	1,250	1,250	1,500
Coarse Tailings Management	51,956	5,948	6,509	7,121	5,294	5,532	9,316	5,268	6,967
Tailings Pumping	96,357	3,057	3,057	3,448	4,960	4,960	24,799	24,799	27,279
Dust Monitoring & Control	2,647	209	209	209	209	209	500	500	600
Progressive Restoration	34,554	-	-	-	-	-	5,052	5,053	24,450
Engineering and Project Management	12,900	600	600	600	600	600	3,600	3,000	3,300
Total OPEX Costs	337,008	16, 468	17,028	18,031	17,716	17,954	77,531	72,384	99,896

21.2.8 Site Support (G&A) Operating Costs Estimate

21.2.8.1 Estimating Method

Operating cost estimates were prepared by Ausenco in collaboration with QIO. The estimate for G&A was broken down into the following categories:

- Electricity and heating
- Building maintenance
- Mobile equipment
- Labour
- Labour auxiliary costs
- Accommodations and transportation
- External consultants/contractors

- Health, safety and environment
- IT, telecommunications and security systems
- Various G&A costs

21.2.8.2 Summary

The G&A costs include camp operations, G&A personnel, health, safety and environmental programs as well as miscellaneous project costs. An average annual G&A operating cost of CAD$36.8 M was estimated. Costs are summarized by category in Table 21-20.

Table 21-20 – Site Support (G&A) Operating Cost Summary

Item	Production Period Average	
	CAD$/t Ore	CAD$/t dry Concentrate
Electricity and heating	0.08	0.22
Administration buildings maintenance	0.09	0.23
Mobile equipment	0.21	0.54
Labour (including auxiliary labour costs)	0.27	0.73
Accommodations and transportation	0.73	1.92
External consultants/contractors	0.02	0.04
Health and safety	0.02	0.06
Environment monitoring and programs, leases and claims	0.30	0.78
IT, telecommunications and security systems	0.09	0.25
Other G&A costs	0.08	0.20
Total	1.88	4.98

The majority of G&A costs are based on costs being incurred by QIO currently or during the previous year's operations, as well as supplier proposals. The following sections describe the build-up of operating costs in the site support (G&A) area.

21.2.8.3 Electricity and Heating

Power costs were calculated using the grid power rate of CAD$0.058/kWh based on Hydro-Quebec L rate as per December 2016. Power requirements for the site support and administration buildings were calculated using the installed power taken directly from the existing mechanical equipment list. Operating hours per year, equipment utilisation and load factors were used to calculate the total power usage in kWh per year.

Electrical costs associated to the operation of the housing complexes (camp) were determined based on the previous year's operating costs for these facilities.

Finally, no. 2 fuel oil is used to heat a number of the buildings. The fuel consumption was provided by QIO based on the consumption of previous years. A no. 2 fuel oil cost of CAD$0.75/L delivered to site was considered.

21.2.8.4 Administration Building Maintenance

G&A building maintenance costs were established based on the cost incurred during the previous years of operation.

21.2.8.5 Mobile Equipment

Costs were estimated for the concentrator and infrastructure light vehicle and mobile equipment fleet for site operations and maintenance. They include mobile equipment, such as front end loaders, graders, bulldozers, tanker truck, boom truck and service trucks that are required for operations, maintenance, and service and support activities. A list of the mobile equipment already at site was established, and operating hours per day for each vehicle were established, in order to determine operating costs of the fleet.

The fuel consumption rate was calculated for vehicles in the fleet according to manufacturer information. A diesel cost of CAD$0.80/L and gasoline cost of CAD$1.50/L delivered to site was considered. An average maintenance rate per engine hour was established and applied to the vehicles in each category to generate maintenance costs.

Costs for the transportation of personnel from the airport to lodging in Fermont and from Fermont to site, as well as transportation on-site are included in the accommodations and transportation section of the G&A costs.

Costs associated with the mining mobile equipment and light vehicles are included in the mining cost estimate. The mining operating costs include the operation of all of the site pick-up trucks, as well as the snow removal equipment.

21.2.8.6 Labour (G&A)

Labour costs for all general and administration positions are based on Canada Mercer Mining Industry Compensation Survey 2015 using the 75th percentile. These positions include the general manager, human resource staff, transportation and logistics personnel, health, safety and security employees, finance and IT staff and warehouse and purchasing departments. Snow removal and landscaping technicians have also been included in this cost area. Salaries for the hourly based employees are based on the actual collective agreement valid until Sept 2017.

The rosters and salaries were benchmarked against similar operations, and include fringe benefits and fly-in/fly-out bonuses. Fringe benefits were established at 30% for all employees. Inconvenience bonuses vary from 0 to 15%, depending on position.

No maintenance personnel were considered for the crushing equipment or for the AG mill, as this is part the service agreement with the manufacturer included in the maintenance materials costs.

No personnel were considered for the operation of the housing complexes, cafeteria and personnel transportation, as these positions will be contracted out to external service providers.

Labour auxiliary costs were estimated as a separate item based on the labour roster. The auxiliary costs include a yearly allowance per employee for general consumables and health and safety equipment. Operating materials, office supplies and employee training and induction programs were estimated as a percentage of yearly labour costs.

21.2.8.7 Accommodations and Transportation

The accommodations and transport cost category includes costs associated with transporting personnel to, and on, site, housing, and cafeteria operations.

Camp lodging and catering costs were calculated based on the organizational structure and rosters. Total number of annual person-days in camp was calculated by grade and roster.

Plant operations will be on a two-week rotating schedule, with personnel flying to and from site bi-monthly. The annual cost of flights was established on the basis of the annual employee roster and flight costs supplied by the local air carrier.

A bus transport schedule was established in collaboration with the local service provider, to account for personnel transport between the plant site and the housing complex, as well as to and from the airport. The service provider then established an annual transport cost to ensure the operation of this schedule. The service provider will supply its own bus fleet and employees.

Camp lodging and catering costs were calculated based on the organizational structure and rosters. Total number of annual person-days in camp was calculated by grade and roster. A service provider was then contacted and provided a cost per day per person to provide the following services:

- Camp management
- Room maintenance
- Room management and help desk
- Catering

The service provider will supply its own equipment, consumables, food, bedding and labour.

21.2.8.8 External Consultants/Contractors

An annual allowance of CAD$300,000 was included in the site support operating costs to cover any unforeseen improvement or maintenance projects to the site infrastructure and support operations.

21.2.8.9 Health & Safety

The cost for health and safety expenditures includes an annual allowance for general safety equipment, an allowance for medical supplies and an allowance for supplemental training related to health and safety concerns. An allowance was also made for various medical fees related to the new employee hiring.

21.2.8.10 Environment Monitoring and Programs, Leases and Claims

A detailed environmental services budget was established for the project by the QIO environmental department. It includes the following cost items:

- Chemical analysis of mining effluents, surface, ground and potable water, sanitary water and contaminated soils
- Environmental chemical results management software licence
- External support for groundwater sampling

- Equipment and consumables such as pumps, filters, weather station maintenance
- Annual reporting and environmental obligations
- Environmental effects monitoring study (federal requirement)
- Permitting and external support such as fuel storage tanks permitting and restauration plan updates
- Spill/leak prevention and management
- Waste management, such as septic tank pumping
- Hazardous waste management, such as waste and soil disposal
- Environmental programs such as community involvement projects, ecotoxicological studies, and environmental training

21.2.8.11 Information Technology, Telecommunications and Site Security

Costs for the information technology, telecommunications and site security cost categories include:

- Information technology costs such as software licenses and IT management tools
- An annual allowance for security systems and security contracts
- Annual telecommunications costs
- Radio services

Costs for information technology, security systems and radio services were based on the costs previously incurred by the site operations and benchmarked against other projects.

Telecommunications costs, such as internet connection, land lines and cell phone services, were established with the local service provider according to the site requirements.

21.2.8.12 Other G&A Expenditures

Various other G&A expenditures were accounted for in the plant operating cost estimate. These expenditures include the following items:

- Annual marketing allowance
- External communications, promotional material and publicity allowance
- Professional membership and association dues
- Radio services
- Head office monthly allowance

The annual marketing allowance includes the cost of business travel for promotional purposes. This allowance, as well as the allowance for external communications, promotional material and publicity allowance, was established in conjunction with QIO, based on their requirements.

21.2.9 Concentrate Transportation

Costs for concentrate transportation were established by QIO based on negotiations with the rail transport providers. The cost of concentrate transportation is variable according to the wet tonnage of concentrate produced and does not consider transport and handling losses. Costs provided are based on average concentrate moisture of 3.5%.

QIO has agreed terms for a rail contract with Quebec North Shore & Labrador (QNS&L) and contract drafting is ongoing.

An additional operating cost for the railcar maintenance was added to this transport cost. The cost of railcar maintenance was established at CAD$3,000 per car annually.

21.2.10 Port Facilities

Costs for port services were developed by QIO based on negotiations with SFP Pointe-Noire (SFPPN) and the Port of Sept Iles. The cost of port services is variable, according to the wet tonnage of concentrate produced and does not consider handling losses. Costs provided are based on average concentrate moisture of 3.5%.

21.2.11 Total Cost for Rail and Port Facilities

The average annual concentrate land logistics, port and berth cost was established at $16.00 per tonne of wet concentrate.

22 Economic Analysis

The economic/financial assessment of the Bloom Lake project of Quebec Iron Ore Inc. is based on Q1-2017 price projections in U.S. currency and cost estimates in Canadian currency. A spot exchange rate of 0.7600 USD per CAD was assumed to convert particular components of the cost estimates into CAD and forward exchange rate estimates were used to convert USD market price projections into CAD. No provision was made for the effects of inflation. The evaluation was carried out on a 100%-equity basis. Current Canadian tax regulations were applied to assess the corporate tax liabilities, while the recently adopted regulations in Quebec (originally proposed as Bill 55, December 2013) were applied to assess the mining tax liabilities. The financial indicators under base case conditions are presented in Table 22-1:

Table 22-1: Financial Indicators Under Base Case Conditions

Base Case Financial Results	Unit	Value
Pre-Tax (P-T) NPV @ 8 %	M CAD	1,674.8
After-Tax (A-T) NPV @ 8 %	M CAD	983.5
P-T IRR	%	43.9
A-T IRR	%	33.3
P-T Payback Period	years	2.5
A-T Payback Period	years	3.1

A sensitivity analysis reveals that the Project's viability will not be significantly vulnerable to variations in capital and operating costs, within the margins of error associated with feasibility-study-level estimates. However, the Project's viability remains more vulnerable to the USD/CAD exchange rate and the larger uncertainty in future iron ore market prices.

22.1 Assumptions

22.1.1 Macro-Economic Assumptions

The main macro-economic assumptions used in the base case are given in Table 22-2. Annual price forecasts for the 66.2% iron ore concentrate were provided by Metalytics. Details on the derivation of these price forecasts are given in Section 19 of this report. The sensitivity analysis examines a range of prices 30% above and below the base case forecast.

Table 22-2 – Macro-Economic Assumptions

Item	Unit	Base Case Value
Iron Ore Concentrate Price (66.2% CFR China) – Year 1	USD/tonne	63.88
Exchange Rate (spot rate for cost estimates)	USD/CAD	0.7600
Discount Rate	% per year	8
Discount Rate Variants	% per year	4 and 6

Metalytics provided annual market price projections over the life of the project in the form of three (3) series, a base case, and high and low cases. The high and low cases represent forecasts under more and less favourable market conditions, respectively. The base-case price projection for the first production year is USD 63.88 per tonne. A spot exchange rate of 0.7600 USD per CAD was used as basis for the purpose of developing capital and operating cost estimates. Exchange rate forwards obtained from Bloomberg (2017.01.25) were used to convert the USD market price projections into Canadian currency. The sensitivity of base case financial results to variations in the exchange rate was examined. Those cost components which include U.S. content originally converted to Canadian currency using the spot exchange rate were adjusted accordingly.

The current Canadian tax system applicable to Mineral Resource Income was used to assess the Project’s annual tax liabilities. These consist of federal and provincial corporate taxes as well as provincial mining taxes. The federal and provincial corporate tax rates currently applicable over the Project’s operating life are 15.0% and 11.5% (decreasing by 0.1% per year from 11.9% in 2016 to 11.5% in 2020) of taxable income, respectively. The marginal tax rates applicable under the recently adopted mining tax regulations in Quebec (originally proposed as Bill 55, December 2013) are 16%, 22% and 28% of taxable income and depend on the profit margin. As the Project concerns the production of iron ore concentrate at the mine site, a processing allowance rate of 10% was assumed.

The economic assessment was carried out on a 100%-equity basis. Apart from the base case discount rate of 8.0%, two (2) variants of 4.0% and 6.0% were used to determine Net Present Values of the Project. These discount rates represent possible costs of equity capital.

22.1.2 Royalty and Impact and Benefit Agreements

This project is not subject to any Net Smelter Return (NSR) royalty agreement. However, the project is subject to an Impact and Benefit Agreement with local First Nations communities.

22.1.3 Technical Assumptions

The main technical assumptions used in the base case are given in Table 22-3.

Table 22-3 – Technical Assumptions

Item	Unit	Base Case Value
Open Pit Resource Mined	k tonnes	411,713
Average Head Grade at Process Plant	% Fe	30.0
Design Processing Rate	k tonnes/year	20,000
Average Stripping Ratio	w : o	0.483
Mine Life	years	20.7
Average Process Recovery	%	83.3
Average Concentrate Grade	% Fe	66.2
Concentrate Production	k tonnes	155,446
Average Mining Costs	($/tonne RoM)	3.92
Average Processing & Crushing Costs	($/tonne RoM)	3.16
Average Water & Tailings Management Costs	($/tonne RoM)	0.83
Average Mine Site G&A Costs	($/tonne RoM)	2.14
Average Municipal Taxes	($/tonne product)	1.28
Concentrate Logistics Costs to Sept-Îles, including Rail Maintenance Costs	($/tonne product)	16.88
Average Total Costs	($/tonne product)	44.62

22.2 Financial Model and Results

Figure 22-2 illustrates the after-tax cash flow and cumulative cash flow profiles of the Project for base case conditions. Note that the total height of a particular bar (i.e., after-tax cash flow plus corporate and mining taxes) represents the before-tax cash flow. The intersection of the after-tax cumulative cash flow curve with the horizontal dashed line represents the after-tax payback period of 3.1 years.

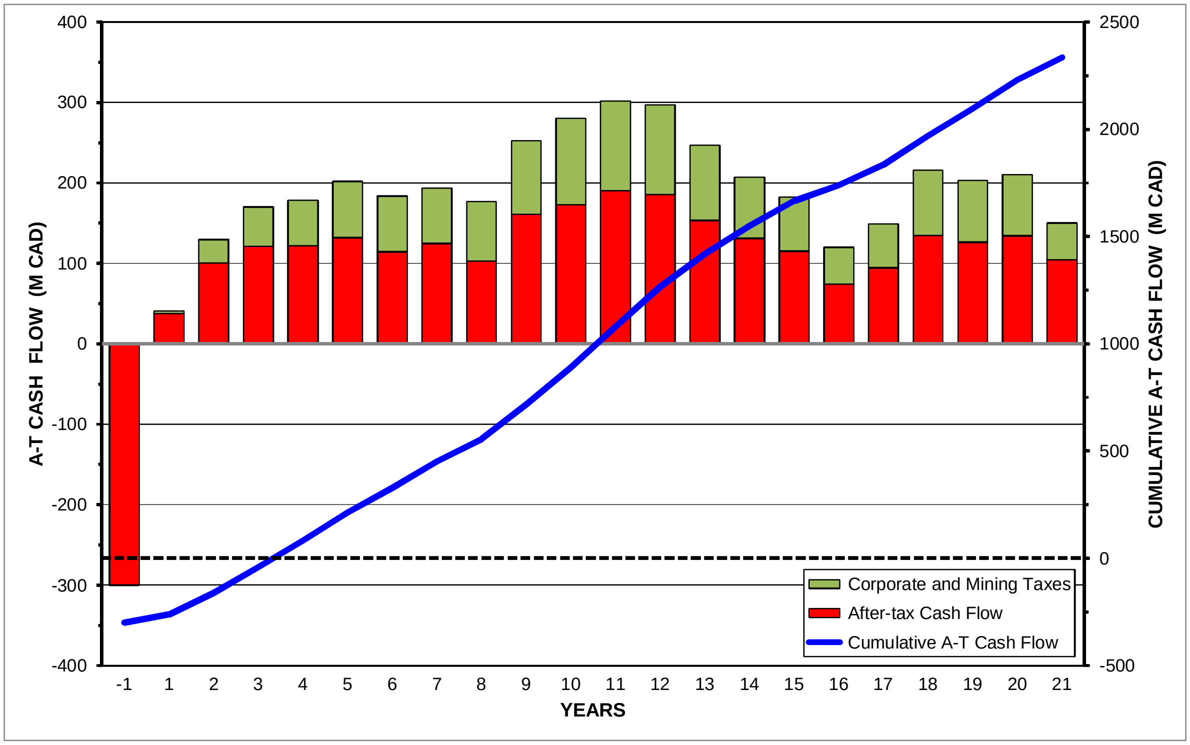


Figure 22-1 – After-tax Cash Flow and Cumulative Cash Flow Profiles

A summary of the evaluation results is given in Table 22-4, and Table 22-5 gives the summary cash flow statement, both for base case conditions.

The summary and cash flow statement indicate that the total pre-production (initial) capital costs, excluding the working capital requirement, were evaluated at $284.5 M. The total sustaining capital requirement was evaluated at $329.5 M. Mine closure costs in the form of trust fund payments at the start of mine production were estimated at an additional $41.2 M.

The cash flow statement shows a capital cost breakdown by area over the one-year pre-production period of the Project. Working capital requirements were estimated at about 1.3 months of total annual operating costs. Since operating costs vary annually over the mine life, additional amounts of working capital are injected or withdrawn as required.

The total revenue derived from the sale of iron ore concentrate was estimated at $15,115.8 M CFR, and $11,367.7 M FOB (i.e., net of ocean transport costs), representing an average of $73.13 FOB per tonne of concentrate. The total operating costs were estimated at $6,935.7 M, or on average, $44.62 per tonne of concentrate.

The financial results indicate a pre-tax Net Present Value ("NPV") of $1,674.8 M at a discount rate of 8.0%. The pre-tax Internal Rate of Return ("IRR") is 43.9% and the payback period is 2.5 years (measured from the start of commercial production).

The after-tax NPV is $983.5 M at a discount rate of 8.0%. The after-tax IRR is 33.3% and the payback period is 3.1 years.

Table 22-4 – Project Evaluation Summary – Base Case

Item	**Unit**	**Value**
Total Revenue CFR	M CAD	15,115.8
Total Ocean Transport Costs	M CAD	3,748.0
Total Revenue FOB	M CAD	11,367.7
Total Operating Costs	M CAD	6,935.7
Initial Capital Costs (excludes Working Capital)	M CAD	284.5
Sustaining Capital Costs	M CAD	329.5
Mine Rehabilitation Trust Fund Payments	M CAD	41.2
Total Pre-tax Cash Flow	M CAD	3,792.3
Pre-tax NPV @ 4%	M CAD	2,468.6
Pre-tax NPV @ 6%	M CAD	2,024.2
Pre-tax NPV @ 8%	M CAD	1,674.8
Pre-tax IRR	%	43.9
Pre-tax Payback Period†	Years	2.5
Total After-tax Cash Flow	M CAD	2,334.6
After-tax NPV @ 4%	M CAD	1,491.1
After-tax NPV @ 6%	M CAD	1,207.2
After-tax NPV @ 8%	M CAD	983.5
After-tax IRR	%	33.3
After-tax Payback Period†	Years	3.1

† Measured from the start of commercial production

Table 22-5: Summary Cash Flow Statement

BLOOM LAKE PROJECT – QUÉBEC IRON ORE LTD

All monetary values in M CAD	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Total
Revenue CFR		**541.9**	**703.6**	**722.7**	**720.2**	**755.9**	**752.7**	**740.6**	**763.8**	**809.4**	**834.9**	**842.6**	**818.6**	**764.7**	**715.4**	**691.0**	**640.0**	**665.5**	**731.2**	**717.1**	**704.4**	**479.5**	**15,115.8**
Ocean Transport		160.0	191.0	186.5	184.8	190.1	189.3	186.1	189.2	191.3	188.2	184.5	179.5	174.7	170.0	172.4	176.5	179.2	181.9	178.4	175.2	119.3	3,748.0
Revenue FOB		**381.8**	**512.6**	**536.2**	**535.4**	**565.8**	**563.5**	**554.5**	**574.6**	**618.2**	**646.7**	**658.0**	**639.1**	**590.0**	**545.5**	**518.6**	**463.5**	**486.3**	**549.4**	**538.8**	**529.2**	**360.2**	**11,367.7**
Mine Site Operating Expenses		172.9	209.2	222.2	212.2	213.8	215.3	212.8	215.3	214.7	209.5	218.3	207.6	208.1	210.8	207.4	207.5	204.5	200.2	203.4	199.9	164.2	4,329.8
Rail Transport		94.7	129.3	127.4	127.1	131.2	132.0	130.3	132.9	135.7	132.4	129.9	126.4	123.1	119.8	121.5	124.4	126.2	128.1	125.6	123.4	84.7	2,605.9
Operating Profit		**114.3**	**174.0**	**186.6**	**196.1**	**220.8**	**216.2**	**211.4**	**226.4**	**267.8**	**304.8**	**309.9**	**305.1**	**258.8**	**214.9**	**189.7**	**131.6**	**155.5**	**221.2**	**209.7**	**205.8**	**111.3**	**4,432.0**
Initial Capital Expenses	237.1	47.4											0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	284.5
Sustaining Capital Expenses		15.7	40.5	17.4	16.9	18.7	33.0	17.2	49.2	16.4	23.8	9.6	8.3	11.9	7.7	6.9	12.0	6.6	5.0	7.1	3.6	2.0	329.5
Mine Closure Costs	20.6	10.3	10.3										0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.2
Change in WC requirements	42.4	0.2	-6.3	-1.1	0.6	0.3	-0.5	0.6	0.2	-0.9	0.7	-1.5	-0.3	-0.1	-0.2	0.3	-0.1	-0.3	0.1	-0.6	-8.1	-25.4	0.0
Federal Corporate Taxes		0.0	9.6	17.2	19.5	23.2	23.0	22.6	24.6	29.5	34.3	35.3	35.1	29.9	24.9	22.1	15.0	18.1	26.4	25.2	24.8	15.1	475.5
Quebec Corporate Taxes		0.0	7.4	13.2	15.0	17.8	17.7	17.4	18.9	22.6	26.3	27.0	26.9	23.0	19.1	16.9	11.5	13.9	20.2	19.3	19.0	11.6	364.7
Quebec Mining Taxes		3.2	12.1	18.6	22.2	29.1	28.6	28.8	30.2	39.0	46.8	48.9	49.2	40.5	32.3	28.1	18.8	22.9	34.7	32.5	32.1	19.0	617.5
PRE-TAX CASH FLOW	**-300.0**	**40.7**	**129.6**	**170.3**	**178.6**	**201.8**	**183.6**	**193.7**	**176.9**	**252.3**	**280.3**	**301.8**	**297.2**	**246.9**	**207.3**	**182.5**	**119.7**	**149.2**	**216.0**	**203.2**	**210.3**	**150.1**	**3,792.3**
AFTER-TAX CASH FLOW	**-300.0**	**37.5**	**100.5**	**121.3**	**122.0**	**131.8**	**114.4**	**124.9**	**103.2**	**161.2**	**172.8**	**190.6**	**185.9**	**153.6**	**131.0**	**115.3**	**74.5**	**94.4**	**134.7**	**126.3**	**134.4**	**104.4**	**2,334.6**

22.3 Sensitivity Analysis

A sensitivity analysis has been carried out, with the base case described above as a starting point, to assess the impact of changes in initial capital costs (“CAPEX”), operating costs (“OPEX”), product price (“PRICE”) and the USD/CAD exchange rate (“FX RATE”) on the Project’s NPV @ 8.0% and IRR. Each variable was examined one at a time. An interval of ±30 % with increments of 10.0% was used for the first three (3) variables. An interval of -15% to +30% (almost reaching par) was used for the USD/CAD exchange rate (an increase in the USD/CAD exchange rate signifies an increase in the value of the Canadian dollar with respect to the U.S. dollar). The U.S. content associated with the capital cost and operating cost estimates were adjusted accordingly for each exchange rate assumption.

The before-tax results of the sensitivity analysis, as shown in Figure 22-2 and Figure 22-3, indicate that, within the limits of accuracy of the cost estimates in this Study (±15%), the Project’s before-tax viability does not seem significantly vulnerable to the under-estimation of capital and operating costs, taken one-at-a-time. As seen in Figure 22-2, the NPV is more sensitive to variations in Opex than Capex, as shown by the steeper slope of the Opex curve. As expected, the NPV is most sensitive to variations in price and the USD/CAD exchange rate. The NPV becomes negative in the lower portion of the price interval but remains positive at the upper limit of the exchange rate interval examined. A break-even net present value (i.e., a NPV @ 8% equal to zero) is achieved at a price variation of about -21%, which corresponds to a concentrate price of approximately USD 50 per tonne (pre-tax basis) in the first production year.

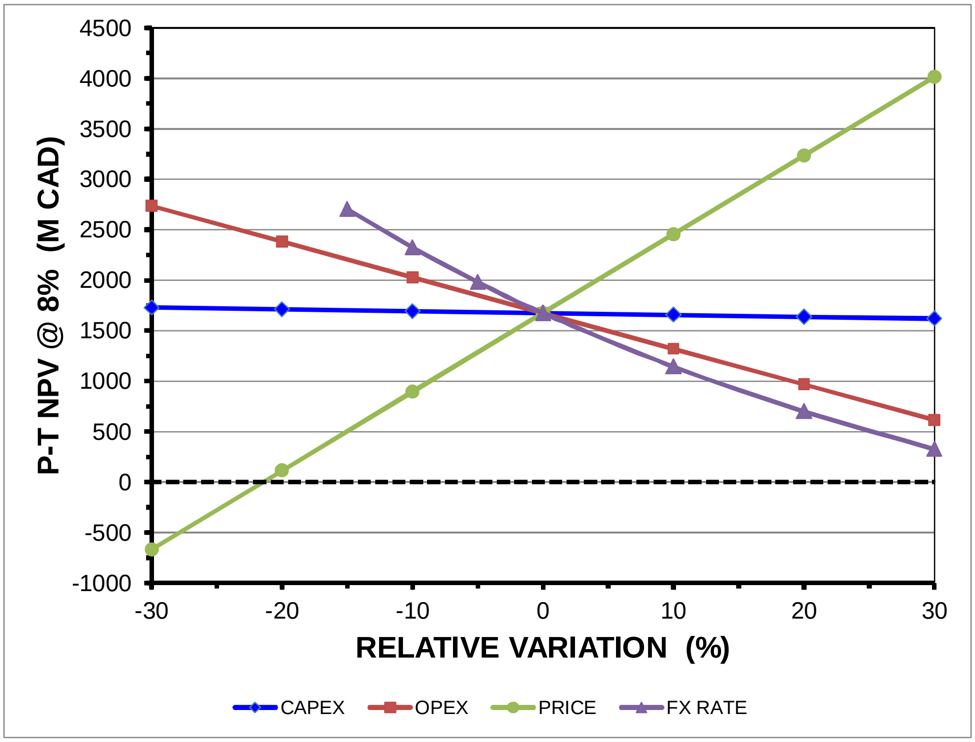


Figure 22-2– Pre-tax NPV$_{8\%}$: Sensitivity to Capital Expenditure, Operating Cost, Price and USD/CAD Exchange Rate

Figure 22-3, showing variations in internal rate of return, provides the same conclusions. The horizontal dashed line represents the base case discount rate of 8%.

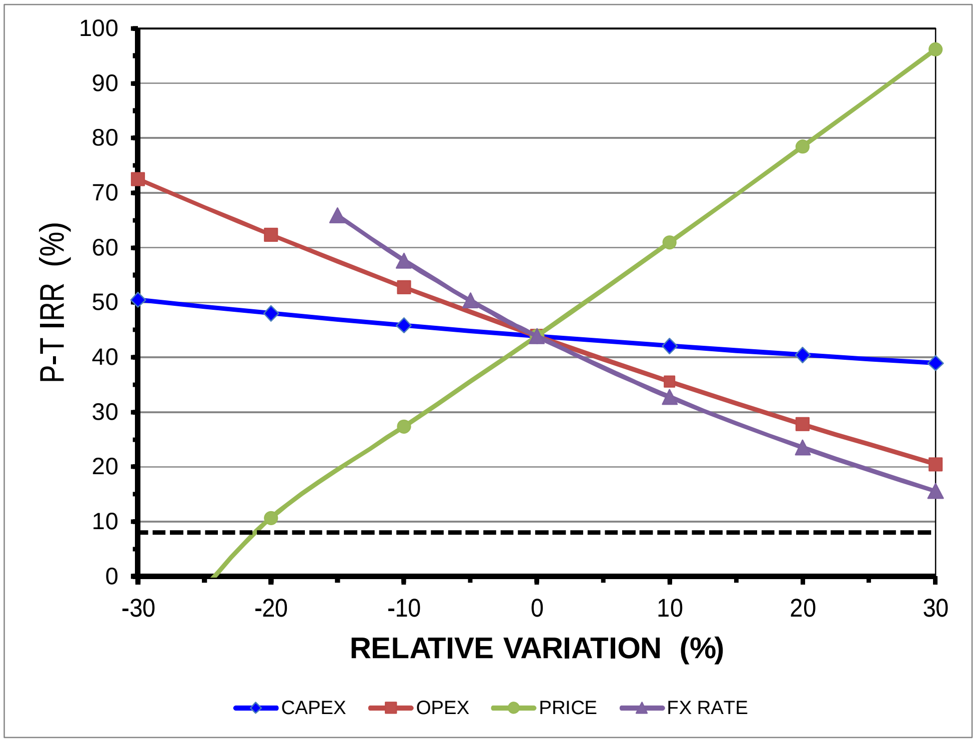


Figure 22-3 – Pre-tax IRR: Sensitivity to Capital Expenditure, Operating Cost, Price and USD/CAD Exchange Rate

The same conclusions can be made from the after-tax results of the sensitivity analysis as shown in Figure 22-4 and Figure 22-5. Figure 22-4 indicates that the Project's after-tax viability is mostly vulnerable to a reduction in price and increase in the USD/CAD exchange rate, while being less affected by the under-estimation of capital and operating costs. The NPV becomes negative in the lower portion of the price interval, but remains marginally positive at the upper limit of the exchange rate interval examined. A break-even net present value (i.e., a NPV @ 8% equal to zero) is achieved at a price variation of about -20%, which corresponds to a concentrate price of approximately USD 51 per tonne (after-tax basis) in the first production year.

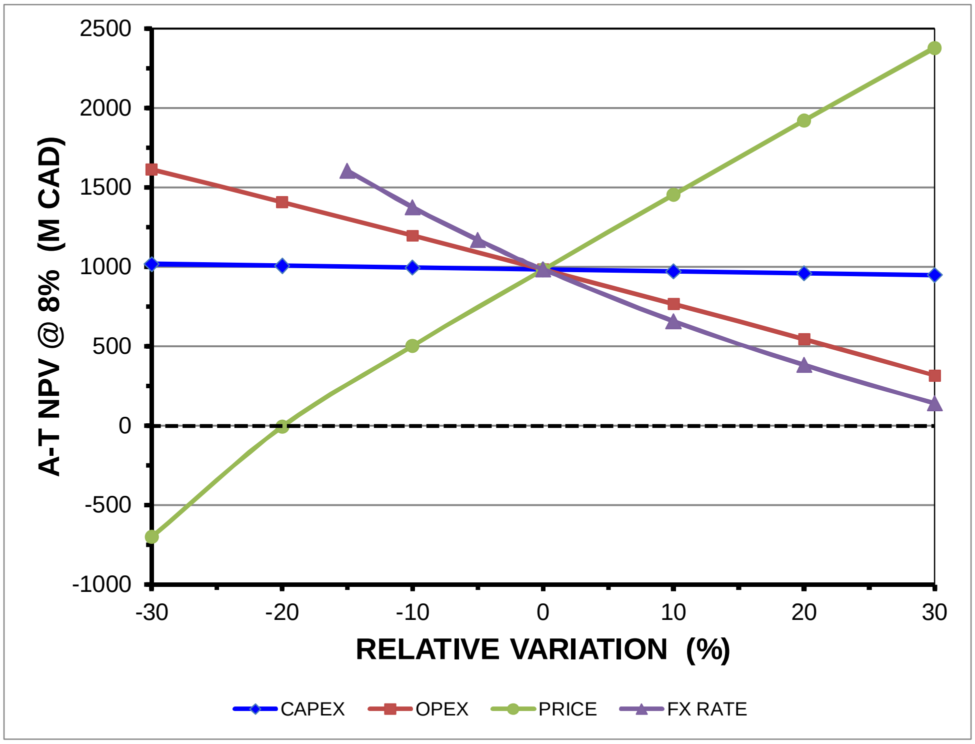


Figure 22-4 – After-tax NPV$_{8\%}$: Sensitivity to Capital Expenditure, Operating Cost, Price and USD/CAD Exchange Rate

Figure 22-5, showing variations in internal rate of return, provides the same conclusions.

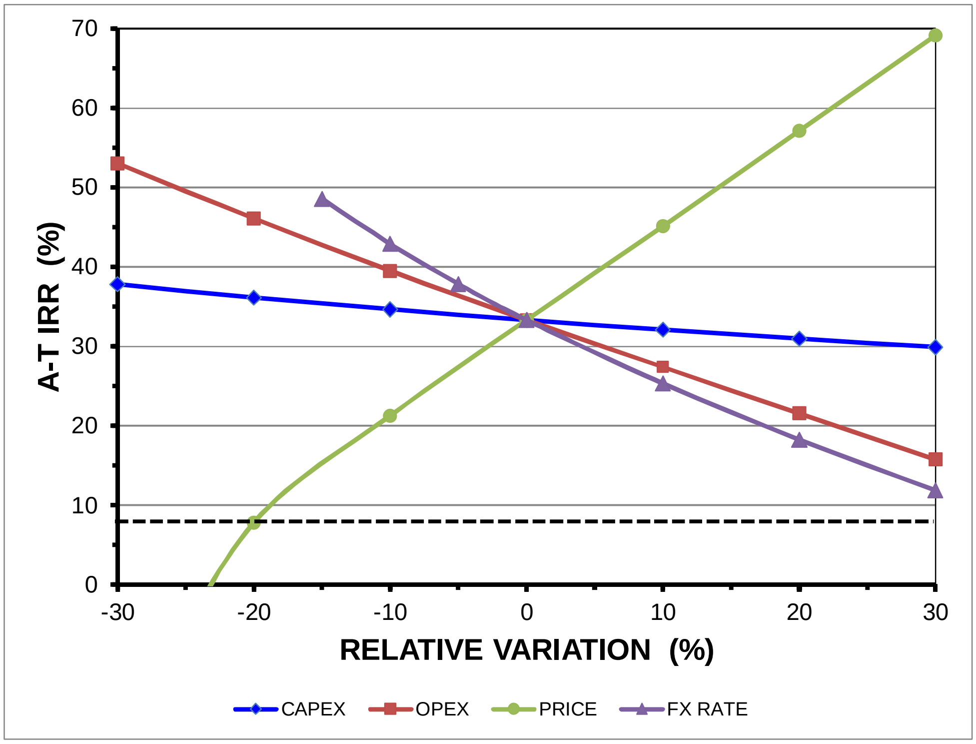


Figure 22-5 – After-tax IRR: Sensitivity to Capital Expenditure, Operating Cost, Price and USD/CAD Exchange Rate

23 Adjacent Properties

The Bloom Lake project is situated in an active iron ore mining district, as illustrated in Figure 23-1.

The Mont-Wright Mine owned by ArcelorMittal is 1 km south of the Bloom Lake Property. Further south, the Fire Lake Project is also operated by ArcelorMittal Canada. Both mines have a combined production of 26 Mt of concentrate per year.

Approximately 30 km northeast of the Bloom Lake Project is the Iron Ore Company of Canada (“IOC”) whose major shareholder is the international mining group Rio Tinto. The mine currently has a production rate of 22 Mt of concentrate each year and has completed the permitting of its latest open pit mine location; Wabush 3. Ore is sent to a concentrator for upgrading to 65-67% iron. Upgrading takes three processes involving the spiral, magnetite and hematite plants. The majority of the concentrate is pelletized with the remainder sold as concentrate. IOC's 2015 combined iron ore sales totalled 17.9 Mt compared to 14.3 Mt in 2014.

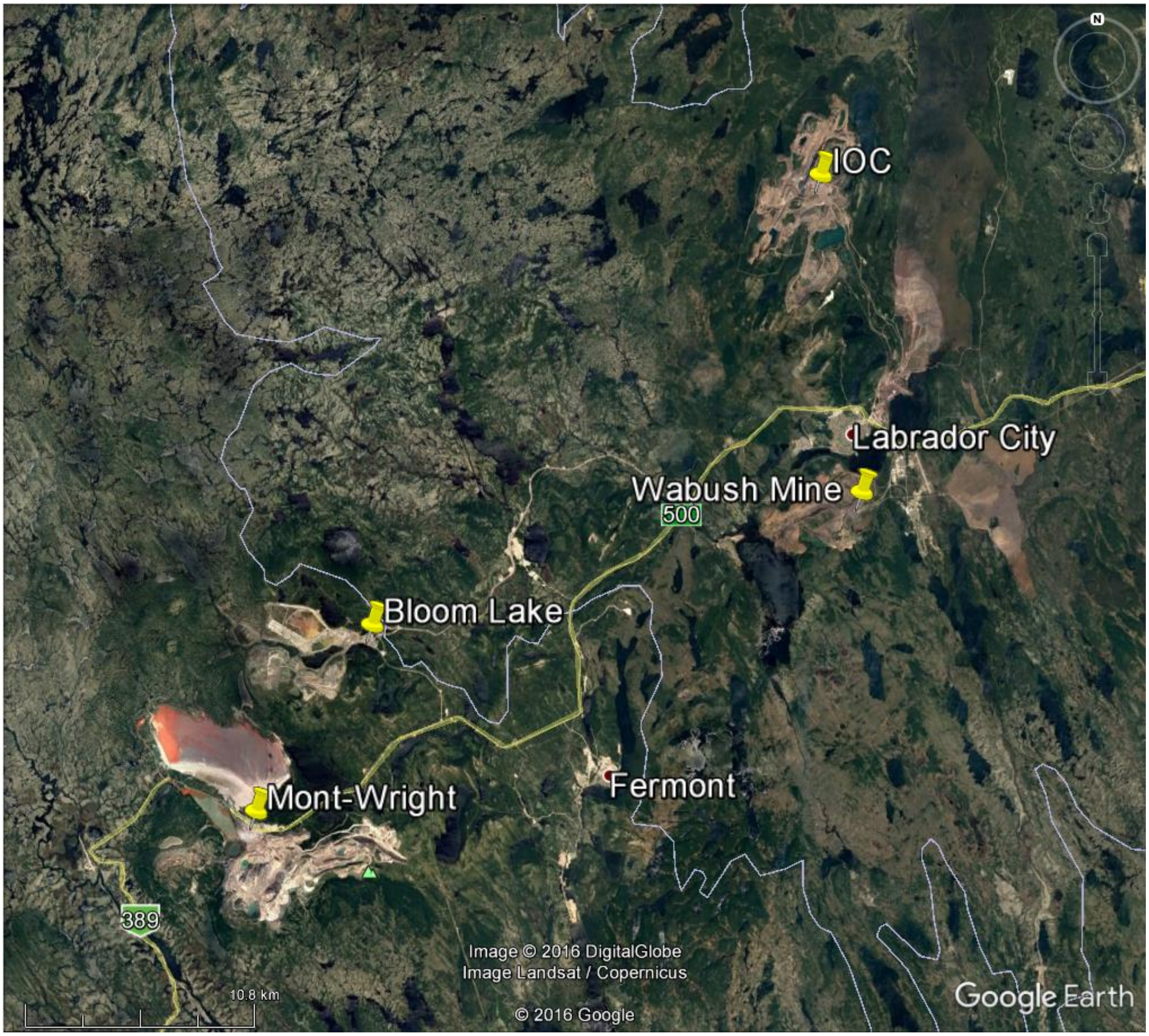


Figure 23-1: Location of Adjacent Properties

24 Other Relevant Data and Information

24.1 Risk Management

24.1.1 Process Overview

In order to determine responsibilities and identify tasks and potential impact of activities which affect risk to the project; an email dialogue was generated including a spreadsheet template to compile possible risks to restart the Bloom Lake mine site activities. This template was circulated to the stakeholders of the project; compiled by a third-party facilitator. On October 15th, 2016, a project Risk Workshop was held, in attendance were stakeholders from Quebec Iron Ore, Ausenco, Mineral Technologies, G Mining, WSP; this team reviewed the compilation. The risks and issues were discussed to provide an assessment for each activity/event, assigned a responsible party, and at least one mitigation action was assigned for each identified risk or issue. Any duplication or redundancies were recorded and eliminated. The resulting materials is reported on below. This initial project risk register should be revisited, reviewed and updated at each and every stage gate of the project – i.e. start-up of construction; commissioning; etc. Each risk owner is responsible to the project to continue to provide any update to the mitigation action items and to re-assess the risk as the project develops. This risk workshop was completed at a high level, to capture project impact activities, it is recommended that the requirement for additional level risk workshops are reviewed as the project develops, for example HAZOP/HAZID as well as Field Risk Assessments or Team Level Risk Assessments in construction/operations.

24.1.2 Assessment Levels

The pie chart in figure 24-1 below indicates the assessment following the first update of the Project risk register.

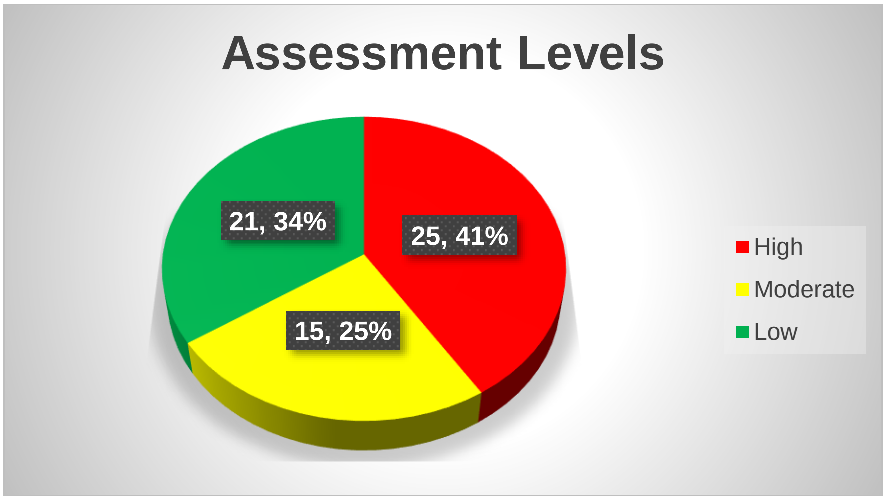


Figure 24-1: Risk Register Assessment Levels

24.1.3 Critical Risks

Below are some relevant risks for the project.

Table 24-1 – Summary of the Project Top Risks

<table>
<tr><th>#</th><th>Assessment</th><th>Description</th></tr>
<tr><td>76</td><td>H2</td><td>The return water from the coarse tailings dam may be more than the existing pumping system can handle.</td></tr>
<tr><th colspan="3">Cause</th></tr>
<tr><td colspan="3">New split of the coarse and fine tailings due to the modified process could result in more water being diverted to the tailings storage facility from the thickener therefore increasing the reclaim water needs.</td></tr>
<tr><th colspan="3">Effect</th></tr>
<tr><td colspan="3">Capacity could be insufficient to meet the plant water needs.</td></tr>
<tr><th colspan="3">Action Item</th></tr>
<tr><td colspan="3">Tailing Management plan developed and included in project execution schedule and monitored process limits provided by WSP. Reclaim water pumping system capacity reviewed and demonstrated sufficient capacity.</td></tr>
</table>

<table>
<tr><th>#</th><th>Assessment</th><th>Description</th></tr>
<tr><td>24</td><td>H2</td><td>Operation and maintenance issues with the overland conveyor.</td></tr>
<tr><th colspan="3">Cause</th></tr>
<tr><td colspan="3">The system has been commissioned near the end of the previous owner operations therefore minimal operation background is available on this critical equipment.</td></tr>
<tr><th colspan="3">Effect</th></tr>
<tr><td colspan="3">Operation cost could be increased by some unplanned modifications required to ensure proper ruggedness and their effect on system availability.</td></tr>
<tr><th colspan="3">Action Item</th></tr>
<tr><td colspan="3">- Mechanical audit held on Oct. 26-28 on conveyor shows that the conveyor is in good working condition and highlighted a few minor issues that will be fixed prior to start-up (walkways, covering of drive station etc.)
- A high level contingency plan is available and includes a high-volume buffer pile in the A-Frame crushed ore storage building has a first mitigation option. In case this would not allow for sufficient time to repair the conveyor, crusher #1 and spare 240t trucks are available and could be used.
- A detailed contingency plan will be developed prior to start-up to address all minor potential issues with conveyor failure. risk is partially mitigated by the fact that a second crusher and 240 t trucks are available if needed.
- A maintenance plan will be developed prior to start-up to identify spare parts needed, working methods and required equipment.</td></tr>
</table>

<table>
<tr><th>#</th><th>Assessment</th><th>Description</th></tr>
<tr><td>77</td><td>H9</td><td>Failure of the AG Mill to produce design levels of production</td></tr>
<tr><th colspan="3">Cause</th></tr>
<tr><td colspan="3">The new mine plan could produce material that would behave differently in the AG Mill and require adjustments.</td></tr>
<tr><th colspan="3">Effect</th></tr>
<tr><td colspan="3">Reduced AG mill throughput would result in less concentrate produced therefore affect revenues.</td></tr>
<tr><th colspan="3">Action Item</th></tr>
<tr><td colspan="3">Ausenco has performed an AG mill grinding study and a simulation modelling to confirm that the AG mill can perform at the desired throughput. Historical data was also used to confirm modelling results. It has been confirmed that the new mine plan results in similar material and grade as the previous mine plan. Only mining sequence can be affected and as recommended in Ausenco’s grinding study, a blending strategy will be further developed.</td></tr>
</table>

<table>
<tr><th>#</th><th>Assessment</th><th>Description</th></tr>
<tr><td>23</td><td>M13</td><td>All unplanned repairs/modifications that would arise during pre-operational verifications.</td></tr>
<tr><th colspan="3">Cause</th></tr>
<tr><td colspan="3">Plant operation has been interrupted for two years which can harm equipment in some ways that are difficult to identify during equipment audits.</td></tr>
<tr><th colspan="3">Effect</th></tr>
<tr><td colspan="3">Unplanned repairs that would be detected during the pre-operational verification could lead to schedule and cost impacts.</td></tr>
<tr><th colspan="3">Action Item</th></tr>
<tr><td colspan="3">Existing equipment analysis done in October and November of 2016. Budget allowance for high cost impact will be part of FS. Verify spares quantities and availability already ongoing on site for major systems such as crusher, mill etc.</td></tr>
</table>

24.2 Operational Readiness

The Operational Readiness (OR) execution plan can be divided into 6 phases, which are:

1. OR definition
2. OR controls
3. OR preparation
4. Pre-commissioning (also called Pre-Operational Verifications or POV)
5. Commissioning
6. Production ramp-up and normal operation

24.2.1 Operational Readiness Definition

The first phase of the OR execution plan is the definition of five other phases. To achieve this definition multiple meetings were held to discuss OR understanding and execution strategies using a generic list of usual OR activities for each of the five next phases. During these meetings, the list was customized with QIO specific requirements to produce a detailed list of OR activities forming a preliminary OR execution plan.

For each activity, a responsible person was defined with a number of resources and related living expenses including material and external services to accomplish the activity in order to define a preliminary OR budget. A preliminary schedule was prepared including all activities in relation with the defined milestones of the FS project execution plan. A preliminary organizational chart combining operation and project resources was also prepared to illustrate the different relations between them.

During this definition effort, many assumptions were taken into consideration to help define OR:

- QIO intends to accomplish most of OR activities using their own resources.
- External services will be retained for specific activities, mainly in the project team.
- Maintenance and operation personnel will be part of pre-commissioning and commissioning activities to gain experience and become familiar with the process and the different technologies used.
- Prior to pre-commissioning, maintenance activities will be required to perform work identified prior to the mine closure.
- Inventory from the existing warehouse will be used for these maintenance activities and the intent is to replenish warehouse inventory only if required.
- A careful evaluation of the min and max level for each warehouse item will be made based on QIO requirements.

The definition phase was performed to a sufficient level of effort to meet the feasibility study requirements and even more on certain aspects like human resources and living expenses, ERP selection, spare parts, training and operation technologies.

24.2.2 OR Controls

The OR controls phase includes the preparation of a OR detailed schedule and a control budget and the required activities to control the OR schedule and budget. During OR definition, it was decided to put in place a project control team under the QIO general manager that will be responsible for controlling the project scope, schedule and budget including the OR scope, schedule and budget. This team will also be responsible of document control.

24.2.3 Execution Phases

The last four phases of the OR execution plan are under the responsibility of the OR and commissioning manager. They will make sure that all parties involved execute their activities as required by the execution plan.

24.2.4 OR Preparation

The OR preparation phase includes all activities to be performed by QIO to be ready to operate the mine, the concentrator, the tailings and the water management facilities including the necessary contractual arrangements to deliver the concentrate to their clients.

24.2.5 POV

The POV phase includes preparation and execution activities to done by the POV and commissioning team supported by QIO resources. The main preparation activities are:

- POV systems identification
- Verification and test check lists for each system
- Control strategy review of each system
- Commissioning strategies (wet and dry commissioning)

The main execution activities are:

- Mechanical reception of systems from construction
- Deficiency identification and management
- Equipment lock-out management
- Verifications and testing of each system
- System handover to QIO operations

24.2.6 Commissioning

The commissioning phase is performed by QIO supported by the POV and commissioning team and includes the execution of the dry and wet commissioning activities before ore is introduced into the process.

24.2.7 Production Ramp-up and Normal Operation

The production ramp-up and normal operation phase is performed by QIO supported by the POV and commissioning team and includes:

- Gradual introduction of ore into the process, until normal production rate are met
- Optimization of control strategies to achieve expected process performance

25 Interpretation and Conclusions

The Bloom Lake Mine re-start project is financially and technically feasible with a total estimated capital cost of C$326.8 M, including mine upgrade capital cost of C$157 M. The economic analysis of the re-start Project shows an IRR of 33.3% and a simple payback period of 3.1 years after taxes.

The level of accuracy of the capital and operating cost estimates is ±15%. The capital cost estimate includes an 8.3% contingency and a 6.2% risk allowance on construction costs. Costs for the contracts with the QNS&L railway and the SFPPN port authority are included in the operating costs.

This study clearly demonstrates the feasibility of re-starting the Bloom Lake mine with the restoration and improvement works planned for 2017.

25.1 Geology and Mineral Resources

- The geological interpretation for the Bloom Lake deposit is based on different data sources such as mapping (1998), multiple diamond drilling programs (from 1956 to 2014) and ground magnetic surveys (1967,1971-1972, 2008). The geology of the deposit is fairly well understood.

- The mineralization is found in bands of iron formations of different composition including the Hematite Iron Formation, Magnetite Iron Formation and Silicate Iron Formation. The mineralization controls of the deposit are also well understood.

- The protocols followed to collect sample data are consistent with industry best practices. The mineralized intervals are sampled as peripheral zones. The sample intervals respect the change of lithology. The sampling is adequate for the mineralization style and samples taken are representative of the deposit.

- The duplicate samples taken from drill core (from 2010, 2012 and 2013 drilling programs) show acceptable to excellent correlations with the original samples.

- In 2012, the company started using blanks selected within waste material from the Bloom Lake deposit. These blanks indicate that the analytical results were not affected by contamination.

- Standard samples made from mineralized material from the Bloom Lake deposit were used in the 2013 drilling campaign. Insufficient description of the material and procedures surrounding the Standard analyses lead to the conclusion that the Standards are not appropriate for the QA/QC.

- Réjean Sirois, P. Eng., from G Mining, has taken core samples during the site visit in September 2016 to validate the grades of the assays in the drilling database of the Bloom Lake Project. G Mining is of the opinion that the check assay results are reasonably close to the grades of the original assays in the database. Consequently, the assay results included in the database of the Bloom Lake Project are reliable and can be used for the resource estimation.

- The geological model includes a total of 8 lithology units which were designed on cross-sections and plan views. The plan views interpretation were extruded into 14 m thick solids (or 28 m for the inferior portion of the model) and integrated in the block model. The 3D wireframes are representative of the folded lithologies present in the Bloom Lake deposit.

- Each mineralization orientation is appropriately defined within the 9 structural domains dividing the geological model in the Bloom Lake Project.

- Mineral Resources were estimated in the mineralization and structural domains, using GEMS from 7.0 m long composites and a large search ellipse, and using a single ordinary kriging interpolation pass. The interpolation parameters are appropriate for Mineral Resource estimation and are in line with industry standards and CIM guidelines.

- The performance of the block model to predict resource estimates was evaluated through reconciliation with production data. The Bloom Lake's resource block model generally produces acceptable predictions of the production tonnages and Fe% grades, between 2012 and 2014.

- The Mineral Resources are reported within a Lerchs-Grossman open pit shell and are effective November 15th, 2016, using a cut-off of 15% Fe and a long-term iron price of USD $60/dmt con as follows:

    - Open pit Measured and Indicated Mineral Resources total 911.6 Mt at an average grade of 27.7% Fe.

    - Open pit Inferred Mineral Resources total 80.4 Mt at an average grade of 25.6% Fe.

- Mineral Resources were classified into Measured, Indicated and Inferred categories according to the CIM Definition Standards on Mineral Resources and Mineral Reserves as adopted by National Instruments 43-101 Canadian Standards of Disclosure for Mineral Projects ("NI-43-101").

25.2 Mining and Mineral Reserves

- Open pit optimization was conducted using Whittle software to determine the optimal economic shape of the open pit to guide the pit design process. Pit optimization is based on a reference iron ore price (Platt's 62% CFR China) of US$50/dmt concentrate and an exchange rate of 1.30 C$/US$. A price adjustment of 1$/dmt per 1% iron was applied (i.e. US$4/dmt for a 66% iron concentrate).

- The mine design and Mineral Reserve estimate have been completed to a level appropriate for feasibility studies. Definitions for Mineral Reserve categories used in this report are consistent with the CIM definitions as adopted by NI 43-101.

- At a cut-off grade of 15% Fe, Proven and Probable Mineral Reserves are estimated to be 411.7 Mt an average grade of 30.0% Fe for 155.4 Mt of iron concentrate at 66.2% Fe.

- All major mine equipment required for the restart of the project is present on site as this equipment was among the assets purchased by QIO from Cliffs.

- The majority of the loading in the pit will be done by two electric drive hydraulic face shovels equipped with a 23 m^3 bucket. The shovels are matched with a fleet of 218 t payload capacity mine trucks.

- The project already owns three Caterpillar 6060 electric drive hydraulic front shovels. Two Komatsu WA1200-6 units are available on site. The existing truck fleets consist of seven

Caterpillar 793D and three Caterpillar 793F mechanical drive trucks which is sufficient for the project excluding equipment replacement.

- Mining of the Bloom Lake Project is planned with four phases with a starter phase and a final pushback in both the East and West pits.
- Waste rock will be disposed of in two distinct waste dumps. In-pit waste storage is initiated in 2022 once the East Pit Phase 1 is depleted. The West Pit Phase 1 in-pit dump will start in 2026 and will consist in filling the mined-out bottom portion of the west pit. If the in-pit dumping scenario would want to be avoided, a spare dump location and footprint are identified on site.
- The life-of-mine ("LOM") plan details 21 years of production, with a three month ramp up and commissioning period followed by a mining rate of 20 Mt per year of ore for the remainder of the mine life. The peak mining rate of approximately 34.2 Mt is reached in 2025. The mining rate declines, starting in 2033, as sufficient ore for the mill is accessible.
- The open pit generates 198.9 Mt of overburden and waste rock for a strip ratio of 0.48:1.

25.3 Mineral Processing

A major objective of this study was to increase the iron recoveries. Mineral Technologies have performed metallurgical modelling and testwork to develop a process flowsheet which includes both gravity and magnetic separation technologies. It is estimated that this revised process design can achieve a minimum iron recovery of 83.3%, at the life of mine feed grade average of 30% Fe.

25.4 Environmental

The mine has been authorized for operation under the federal environmental authorities and provincial governments (decree and numerous certificate of authorizations). A few of these authorizations will require modifications. Among these, are an update of the current authorized infrastructures and the operational certificate of authorization. There are no known significant issues that are believed to materially impact the mine's ability to operate. The mine conducts routine monitoring of water, waste water and air as part of their decrees and authorizations.

MERN approved a revised closure plan at a cost of CAD $41.7 million which was covering five years of mining operations for both Phase I and Phase II. The plan was approved for the previous owner starting in 2012. QIO must provide a financial guarantee covering this five years closure plan cost to the provincial government in accordance with Section 111 of the Regulation Respecting Mineral Substances other than Petroleum, Natural Gas and Brine (Chapter M-13.1, r. 2). In order to estimate a mine closure and restoration costs for the entire life of the new Bloom Lake mining project, WSP used a conservative approach in line with the concepts of the MERN's guide on mine closure and restoration (MRNF, 1997). The mine closure and restoration costs for the entire life of the new Bloom Lake mining project is estimated at CAD $76,435,740, assuming no salvage value for the equipment and that a third party will complete the closure and restoration work. This cost includes the direct and indirect costs of site restoration as well as post-operation and post-closure monitoring

The previous tailings and surface water management strategies have been assessed and revised to meet regulations, industry standards and the new tailings and surface water management strategy. Investments on the surface water management network are required to meet the regulations and in the tailings storage facility in order to restart the mine and operate for the duration of operations. The tailings management strategy has been developed with conservative assumptions and ensured safe containment of tailings and water. Staged over six years, upgrades on the existing booster pump house and the construction of a second booster pump house is required to achieve the tailings management strategy.

26 Recommendations

The following general recommendations are put forward for the continuation of this Project into the next phases which are: detailed engineering, procurement, and construction:

- It is QIO's intent to be operational by Q1 2018. For this to become a reality, it is imperative that critical path purchase orders be placed in Q1 2017. Operational employees will have to be hired back in a timely fashion to allow time for training and participation in the commissioning activities planned for Q4 2017.

- In the development of the feasibility study engineering, drawings which were used as references for this study were not issued "For Construction" or "As Built". During the detailed engineering phase of this project, further field surveys will be required to determine the as-built conditions of the existing brown-field facilities.

26.1 Geology and Mineral Resources

- Silica blanks and standard reference material of industry standards, as well as detailed descriptions of the QA/QC procedures should be introduced in the future drilling programs.

- The geological model should be expanded to include the 23 drill holes located east of the Bloom Lake Project and south of Confusion Lake. The additional drilling information may lead to the modelling of new mineralization domains.

- Comparison analysis (reconciliation) between the resource and grade control block models (produced from blast holes) should be continued to test the performance of the resource block model.

26.2 Mining and Mineral Reserves

- Hydrogeological investigations are recommended for the West Pit in particular to investigate groundwater infiltration and any incidences on the pit slope performance. The current pit elevation is above the water table.

- Additional waste rock storage options should be investigated. In the event of expanded larger open pit limits optimized for higher iron ore prices additional waste dump storage capacity will be required and may limit or defer the possibilities of in-pit waste storage.

- Pit slope recommendations were initially formulated for larger open pits. Pit slope recommendations could be reviewed for the smaller final open pit presented in this study or applied to interim pit walls.

26.3 Permitting

- Infrastructure such as the mining pit, waste rock stockpiles, tailings management facilities, water management structures as well as the water treatment plant have all been authorized. However, a few of the current authorizations will require modifications before site operation resumes, to adjust them to the new mining plan. These include certificates of authorization associated with the new waste rock stockpiles and for the site operational plan which include the new mining pit, the new tailings and water management plan as well as the upgraded concentrator process.

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