NI 43-101 Technical Report

Feasibility Study for the Joyce Lake DSO Iron Ore Project

Newfoundland and Labrador, Canada

Prepared for:

Century Global Commodities Corporation
Joyce Direct Iron Inc.

Effective Date: October 31, 2022
Signature Date: December 13, 2022

Prepared by the following Qualified Persons:

- Derek Blais, P.Eng. ____________________ BBA Inc.
- Joanne Robinson, P.Eng. ____________________ BBA Inc.
- Sheldon Smith, P.Geo.____________________ Stantec Consulting Ltd.
- Claude Duplessis, P.Eng. ____________________ GoldMinds Geoservices Inc.
- Byron O'Connor, P.Eng. ____________________ Pinchin Ltd.
- Guillaume Joyal, P.Eng. ____________________ Englobe Corporation

IMPORTANT NOTICE

This report was prepared as a National Instrument 43-101 Standards of Disclosure for Mineral Projects for Century Global Commodities Corporation ("Century" or the "Corporation") and Joyce Direct Iron Inc. ("JDI"), by BBA Inc. ("BBA") GoldMinds Geoservices Inc. ("GMG" or "GoldMinds"), Stantec Consulting Ltd. ("Stantec"), LVM (a division of Englobe Corporation) ("LVM" or "Englobe"), and Pinchin Ltd. ("Pinchin") collectively known as the "Report Authors". The quality of information, conclusions and estimates contained within the Report is consistent with the level of effort involved in the Study by the Report Authors based on (i) information available at the time of preparation, (ii) data supplied by outside sources, and (iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended for use by Century and JDI subject, to the terms and conditions of its contract with the Report Authors and relevant securities legislation. The contract permits Century and JDI to file this report as a Technical Report with Canadian securities regulatory authorities pursuant to National Instrument 43-101. Except for the purposes legislated under provincial securities law, any other uses of this report by any third party are at that party's sole risk. The responsibility for this disclosure remains with Century and JDI. The user of this document should ensure that this is the most recent Technical Report for the property as it is not valid if a new Technical Report has been issued.

CAUTIONARY STATEMENT ON FORWARD-LOOKING INFORMATION

This Technical Report contains "forward-looking information" within the meaning of Canadian securities legislation. The forward-looking information contained in this Technical Report represents the expectations of Century as of the date of this Technical Report and, accordingly, is subject to change after such date. Forward-looking information includes information that relates to, among other things, Century's ownership and plans for the spin-out, including listing, financing and development of the Joyce Lake DSO Iron Ore Project, including (i) estimates as to resources and reserves for the project, (ii) estimates as to the capital costs, operating costs, production rates, mine life, net present value and rates of return for the project, (iii) projections as to the time frame for the additional work required to comply with the provincial environmental impact assessment guidelines; (iv) the ability of JDI to conclude benefit agreements with first nations and the government of Newfoundland and Labrador; (v) the timeline for completion of the EIS process by JDI; (vi) the ability of JDI to meet all federal and provisional EIS requirements and to ultimately secure the required environmental permitting; and (vii) the ability of JDI to list its common shares on the Neo Aequitas stock exchange, of which there is no assurance. Forward-looking information is based on, among other things, opinions, assumptions, estimates and analyses that, while considered reasonable by Century at the date the forward-looking information is provided, are inherently subject to significant risks, uncertainties, contingencies and other factors that may cause actual results and events to be materially different from those expressed or implied by the forward-looking information. The risks, uncertainties, contingencies and other factors that may cause actual results to differ materially from those expressed or implied by the forward-looking information may include, but are not limited to, risks generally associated with Century's business, as described in Century's annual information form for the year ended March 31, 2022. Investor should also review the FS in detail upon its publication in order to fully understand the risks affecting the project and the estimates included in the project. Readers should not place undue importance on forward-looking information and should not rely upon this information as of any other date. While Century may elect to, it does not undertake to update this information at any particular time except as required in accordance with applicable laws.

DATE AND SIGNATURE PAGE

This Report is effective as of the 31st day of October 2022.

Original signed and sealed on file	December 13, 2022
Derek Blais, P.Eng. BBA Inc.	Date
Original signed and sealed on file	December 13, 2022
Joanne Robinson, Eng. BBA Inc.	Date
Original signed and sealed on file	December 13, 2022
Sheldon Smith, P.Geo Stantec Consulting	Date
Original signed and sealed on file	December 13, 2022
Claude Duplessis, P.Eng. GoldMinds Geoservices Inc.	Date
Original signed and sealed on file	December 13, 2022
Byron O'Connor, P.Eng. Pinchin Ltd.	Date
Original signed and sealed on file	December 13, 2022
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CERTIFICATE OF QUALIFIED PERSON

Derek Blais, P.Eng.

This certificate applies to the NI 43-101 Technical Report entitled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada" (the "Technical Report"), prepared for Century Global Commodities Corporation and Joyce Direct Iron Inc., dated December 13, 2022, with an effective date of October 31, 2022.

I, Derek Blais, P.Eng., as a co-author of the Technical Report, do hereby certify that:

1. I am a Process Engineer and Manager of the Process, Mining and Metals Department in the consulting firm BBA Inc., located at 2020 Robert-Bourassa Blvd., Suite 300, Montréal, Québec, Canada, H3A 2A5.
2. I graduated from McGill University of Montréal with a B. Eng. in Materials Engineering in 2008 and again with an M. Eng. in 2010.
3. I am a member in good standing of the Ordre des ingénieurs du Québec (OIQ #5029897) and Engineers and Geoscientists of British Columbia (EGBC #51133).
4. I have practiced my profession continuously since my graduation. My relevant experience includes working on several projects/studies including many in iron ore processing.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am author and responsible for the preparation of Chapters 13, 17, 18, 19, 21 and 22. I am also co-author and responsible for Chapters 1, 2, 3, 24, 25, 26 and 27 of the Technical Report.
8. I have visited the Joyce Lake Property that is the subject of the Technical Report, on September 16, 2022 as part of this current mandate.
9. I have no prior involvement with the property that is the subject of the Technical Report
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared following NI 43-101 rules and regulations.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Signed and sealed this 13 day of December, 2022.

Original signed and sealed on file

Derek Blais, P.Eng.

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Joanne Robinson, P.Eng.

This certificate applies to the NI 43-101 Technical Report entitled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada" (the "Technical Report"), prepared for Century Global Commodities Corporation and Joyce Direct Iron Inc., dated December 13, 2022, with an effective date of October 31, 2022.

I, Joanne Robinson, P.Eng., as a co-author of the Technical Report, do hereby certify that:

1. I am a Mining Engineer with BBA Inc. with a business address at 10 Carlson Court, Suite 420, Toronto, Ontario, Canada, M9W 6L2.
2. I am a graduate of Queen's University with a Bachelor of Science in Mining Engineering.
3. I am a member in good standing of the Association of Professional Engineers of Ontario (PEO #100049603), and Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL #05208).
4. I have practiced my profession as a mining engineer from 1997 to 2000 and 2004 to present. My relevant experience includes 7 years working at various Canadian open pit operations in progressively senior roles doing production engineering, mine design, and mine planning; over 3 years with an open pit mine development project focusing on the pit optimization, mine design, mine planning, cost estimation, and project management; and over 10 years in mine consulting completing the open pit mine design, optimization, planning, mine cost estimation, and cash flow model analyses for a number of technical studies.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am author and responsible for the preparation of Chapters 15 and 16. I am also co-author and responsible for relevant portions of Chapters 1, 2, 25, 26 and 27 of the Technical Report.
8. I did not visit the Joyce Lake Property that is the subject of the Technical Report.
9. I have no prior involvement with the property that is the subject of the Technical Report.
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared following NI 43-101 rules and regulations.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Signed and sealed this 13 day of December 2022.

Original signed and sealed on file

Joanne Robinson, P.Eng.

Stantec

CERTIFICATE OF QUALIFIED PERSON

Sheldon Smith, P.Geo.

This certificate applies to the NI 43-101 Technical Report entitled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada" (the "Technical Report"), prepared for Century Global Commodities Corporation and Joyce Direct Iron Inc., dated December 13, 2022, with an effective date of October 31, 2022.

I, Sheldon Smith, P.Geo., as a co-author of the Technical Report, do hereby certify that:

1. I am a Senior Hydrologist with the consulting firm Stantec Consulting Ltd., located at 300W-675 Cochrane Drive, Markham, Ontario, Canada, L3R 0B8.
2. I am a graduate of from the Memorial University of Newfoundland with a BSc of Physical Geography in 1994 and from the University of Waterloo with a MSc of Environmental Studies, Environmental Planning and Hydrology in 1997.
3. I am a member in good standing of PEGNL (#07606).
4. My relevant experience includes mine environmental baseline studies, environmental assessments, environmental permitting, Preliminary Economic Assessments, Prefeasibility Studies, Feasibility Studies and Detailed Design.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am author and responsible for the preparation of Chapter 20 (except 20.5 and 20.6), and Section 4.5, 4.6, 5.7, 18.1 and 18.2. I am also co-author and responsible for the relevant portions of Chapters 1, 2, 25, 26, and 27 of the Technical Report.
8. I have visited the Joyce Lake Property that is the subject of the Technical Report in August 2012 as part of this current mandate.
9. I have had no prior involvement with the property that is the subject of the Technical Report
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared following NI 43-101 rules and regulations.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Signed and sealed this 13 day of December, 2022.

Original signed and sealed on file

Sheldon Smith, P.Geo.

CERTIFICATE OF QUALIFIED PERSON

Claude Duplessis, P.Eng.

This certificate applies to the NI 43-101 Technical Report entitled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada" (the "Technical Report"), prepared for Century Global Commodities Corporation and Joyce Direct Iron Inc., dated December 13, 2022, with an effective date of October 31, 2022.

I, Claude Duplessis P.Eng. as a co-author of the Technical Report, do hereby certify that:

1. I am a Geological Engineer with the consulting firm GoldMinds Geoservices Inc., located at 2999 Chemin Ste-Foy suite 200, Québec, Qc, Canada G1X 1P7
2. I am a graduate from the University of Québec in Chicoutimi, Québec in 1988, with a B.Sc.A in geological engineering and I have practised my profession continuously since that time.
3. I am a member in good standing of Ordre des ingénieurs du Québec (Registration #45523) and Professional Engineers and Geoscientists Newfoundland & Labrador (Registration #06981).
4. I have worked as an engineer for a total of 34 years since my graduation. My relevant experience for the purpose of the Technical Report is: Over 30 years of consulting in the field of Mineral Resource estimation, orebody modelling, mineral resource auditing and geotechnical engineering.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am author and responsible for the preparation of Chapters 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, and 23. I am also co-author and responsible for the relevant portions of Chapters 1, 2, 3, 25, 26 and 27 of the Technical Report.
8. I have visited the Joyce Lake Property that is the subject of the Technical Report. I did the personal inspection of the Joyce Lake DSO Iron Ore Project in the province of Newfoundland & Labrador and the Schefferville facilities in Quebec on September 26 and 27 of 2012, in March 9 and 10 of 2013 and on October 3 and 4 of 2013 for a review of exploration methodology, RC drilling technique, core diamond drilling, core density measurement and sampling procedures. I did a recent site inspection at Joyce Lake on September 16, 2021.
9. I have had no prior involvement with the property that is the subject of the Technical Report.
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared following NI 43-101 rules and regulations.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Signed and sealed this 13 day of December, 2022.

Original signed and sealed on file

Claude Duplessis P.Eng.

CERTIFICATE OF QUALIFIED PERSON

Byron O'Connor, P.Eng.

This certificate applies to the NI 43-101 Technical Report entitled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada" (the "Technical Report"), prepared for Century Global Commodities Corporation and Joyce Direct Iron Inc., dated December 13, 2022, with an effective date of October 31, 2022.

I, Byron O'Connor, P.Eng., as a co-author of the Technical Report, do hereby certify that:

1. I am a National Mining Lead with the consulting firm Pinchin Ltd., located in Kingston, Ontario.
2. I obtained a B.Sc. in Geology from the University of New Brunswick (UNB) in 1986 and a B.A.Sc. in Geological Engineering from UNB in 1989.
3. I am a member in good standing of the Professional Engineers Associations of Ontario, Newfoundland and Labrador, Nova Scotia, NWT and Nunavut.
4. My relevant experience includes 33 years in environmental consulting. I have worked on mining projects for the past 23 years. I have previous experience with water management on iron ore projects in the Labrador Trough.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am author and responsible for the preparation of Section 20.6. I am also co-author and responsible for relevant portions of Chapters 1, 25, 26 and 27 of the Technical Report.
8. I have visited the Joyce Lake Property that is the subject of the Technical Report in October 2015 as part of a previous hydrogeological study at the site.
9. I have had no prior involvement with the property that is the subject of the Technical Report
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared following NI 43-101 rules and regulations.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Signed and sealed this 13 day of December, 2022.

Original signed and sealed on file

Byron O'Connor, P.Eng.

CERTIFICATE OF QUALIFIED PERSON

Guillaume Joyal, P.Eng.

This certificate applies to the NI 43-101 Technical Report entitled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada" (the "Technical Report"), prepared for Century Global Commodities Corporation and Joyce Direct Iron Inc., dated December 13, 2022, with an effective date of October 31, 2022.

1. I, Guillaume Joyal, P.Eng., as a co-author of the Technical Report, do hereby certify that:
2. I am a Team Leader – Geotechnical Engineering - Infrastructure with the consulting firm Englobe Corp., located in Laval, Québec.
3. I obtained a B.Sc. in Geology from the University of Quebec in Montreal in 2007 and a M.Sc. in Seismology in University of Quebec in Montreal in 2011.
4. I am a member in good standing of the professional engineer's association of Québec (OIQ), Newfoundland (PEGNL) and Ontario (PEO) and a member in good standing of the professional geologist's association of Québec (OGQ).
5. My relevant experience includes 15 years in geotechnical engineering and geological mineral exploration. I have been involved in numerous mining projects for the past 10 years. I have experience in many rock mechanics projects in mining, infrastructure and hydroelectric projects.
6. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
7. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
8. I am author and responsible for the preparation of Section 20.5. I am also co-author and responsible for the relevant portions of Chapters 1, 25, 26 and 27 of the Technical Report.
9. I have not visited the Joyce Lake Property that is the subject of the Technical Report, as it was not required for the purpose of this mandate.
10. I have had no prior involvement with the property that is the subject of the Technical Report
11. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared following NI 43-101 rules and regulations.
12. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Signed and sealed this 13 day of December, 2022.

Original signed and sealed on file

Guillaume Joyal, P.Eng.

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List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
° / deg	degree
σ	sigma
µm	micron
Actlabs	Activation Laboratories Ltd.
Ai	Bond abrasion index
Al_2O_3	aluminum oxide
ARD	acid rock drainage
AREMA	American Railway Engineering and Maintenance-of-Way Association
Avg	average
BL	blank
BBA	BBA Inc.
bcm	bank cubic metre
CAD / $	Canadian dollar
CaO	calcium oxide
Cr_2O_3	chromium oxide
$/t	Canadian dollar per tonne
CEA Agency	Canadian Environmental Assessment Agency
CEAA	Canadian Environmental Assessment Act
Century or Corporation	Century Global Commodities Corporation
Century Holdings	Century Iron Ore Holdings Inc.
CFAQ	Chemin de fer Arnaud
CFR	cost and freight
Champion	Champion Iron Mines Limited
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
CLM	Consolidated Thompson Limited
cm	centimetre
CO_2	carbon dioxide
COG	cut-off grade
CRA	commercial, regional or Aboriginal
CSRMs	Certified Standard Reference Materials
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSRS	Canadian Spatial Reference System
CSV	comma separated value

List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
CWi	Bond crusher work index
d	day
DDH	diamond drillhole
DGPS	Differential Global Positioning System
DMS	dense media separation
dmt	dry metric tonne
DSO	direct shipping ore
DXF	drawing exchange format
EA	environmental assessment
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
Eh	oxidation-reduction potential
EIS	Environmental Impact Statement
Englobe	Englobe Corporation
EPCM	Engineering, Procurement and Construction Management
EPR	Environmental Preview Report
Fe	iron
FEL	Front-end loader
Fe_2O_3	iron oxide
FIFO	fly-in fly-out
FMG	Fortescue Metals Group Ltd.
FS	Feasibility Study
ft	foot
g	grams
g/t	grams per tonne
G&A	general and administrative
genset	generator set
GMG or GoldMinds	GoldMinds Geoservices Inc.
GPR	ground penetration radar
GPS	global positioning system
GSC	Geological Survey of Canada
GWh	gigawatt hour
h	hour

List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
H_2O	water
ha	hectare
HG	high-grade
HLS	heavy liquid separation
Hollinger	Hollinger North Shore Exploration Company Limited
HSE	Health, Safety & Environment
IAAC	Impact Assessment Agency of Canada
IBA(s)	Impact Benefit Agreement(s)
ID	identification
IOC	Iron Ore Company of Canada
IP	induced polarization
IRA	inter-ramp angle
IRR	internal rate of return
IT	information technology
JDI	Joyce Direct Iron Inc.
K_2O	potassium oxide
kg	kilogram
km	kilometre
km/h	kilometres per hour
km^2	square kilometre
kt	kilotonne
kV	kilovolt
kW	kilowatt
kWh/t	kilowatt hour per tonne
L	litre
lb	pound
LCIO / Labec Century	Labec Century Iron Ore Inc.
LEA	Limit Equilibrium Analyses
LG	low-grade
LGZ	Low-grade zone
LIF	Lower Iron Formation
LIM	Labrador Iron Mine Holdings Limited
LM&E	Labrador Mining & Exploration

List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
LMH	Lower Massive Hematite
LNAPL	Light Non-Aqueous Phase Liquids
LOI	loss on ignition
LOM	Life-of-mine
LRC	Lower Red Chert
LRGC	Lower Red Green Chert
m	metre
M	Million
m^3	cubic metre
masl	metres above sea level
mbgs	metres below ground surface
mg/L	milligrams per litre
MDMER	Metals and Diamond Mining Effluent Regulations
MEND	Mine Environment Neutral Drainage
MgO	magnesium oxide
M&I	Measured and Indicated
mi	mile
MIF	Middle Iron Formation
min	minutes
MIRIAD	Mineral Rights Administration System
ML	metal leaching
mm	millimetre
MMER	Metals Mining Effluent Regulations
MMU	mobile manufacturing unit
Mn	manganese
MnO	manganese oxide
MPSO	MinePlan Schedule Optimizer
Mt	million tonnes
MTO	Material Take-Off
Mtpa	million tonnes per annum
t/h	metric tonnes per hour
MW	megawatt
Mysteel	Mysteel Global

List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
Na_2O	sodium oxide
NAD83	North American Datum 1983
NE	northeast
NFPA	National Fire Protection Association
NLDOEC	Newfoundland and Labrador Department of Environment and Conservation
NL-ECC	Newfoundland and Labrador Department of Environment and Climate Change
NLDIET	Department of Industry, Energy and Technology
NLEPA	Newfoundland and Labrador Environmental Protection Act
NPV	net present value
NW	northwest
OSA	overall slope angle
P	phosphorous
P_2O_5	phosphorus pentoxide
PEA	preliminary economic assessment
PGA	peak ground acceleration
PGC	Pink Grey Chert
pH	hydrogen ion concentrations
Pinchin	Pinchin Ltd.
PMF	potential mill feed
POS	Port of Sept-Îles
POV	pre-operational verifications
PP	Pre-production
PSD	particle size distribution
Pt	platinum
PV	present value
QA/QC	quality assurance / quality control
QAP	Quality Administrative Method
QCP	Quality Control Method
QNS&L	Québec North Shore & Labrador Railway
QOP	QCP Non-Conformance
QP	qualified person
RC	Red Chert
RC	reverse circulation

List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
RF	revenue factor
RFQ	request for quotation
ROM	run-of-mine
RQD	rock quality designation
RS	Ruth Shale
S	sulphur
Si	silicon
SE	southeast
sec	second
SEC	Securities and Exchange Commission
SEDAR	System for Electronic Document Analysis and Retrieval
SFE	Shake Flask Extraction
SFPPN	Société Ferroviaire et Portuaire de Pointe-Noire
SG	specific gravity
SG&A	sales, general and administrative
SiO_2	silicon dioxide
sq.mi.	square mile
Stantec	Stantec Consulting Ltd.
st	short tons
t	tonne
t/d	tonnes per day
tds	total dissolved solids
t/h	tonnes per hour
t/m³	tonnes per cubic metre
tpa	tonnes per annum (year)
TFe	total iron
TML	transportable moisture limit
TOS	trade-off study
TSMC	Tata Steel Minerals Canada Limited
TRT	Tshiuetin Rail Transportation Inc.
TSX	Toronto Stock Exchange
UCS	uniaxial compressive strength

List of Abbreviations and Units of Measurement	
Abbreviation	**Description**
µg/L	microgram per litre
UHF	ultra high frequency
UIF	Upper Iron Formation
UMH	Upper Massive Hematite
URC	Upper Red Chert
USD	United States dollar
USD/t	United States dollar per tonne
US gpm	US gallons per minute
UTM	Universal Transverse Mercator
V	Volt
V_2O_5	Vanadium oxide
VC	Valued Component
VHF	very high frequency
VLF-EM	very low frequency-electromagnetic
WESA	Water and Earth Science Associates Ltd.
WHIMS	wet high intensity magnetic separation
WISCO ADI	WISCO Canada ADI Resources Development & Investment Limited
WISCO International	WISCO International Resources Development & Investment Limited
wt	wet tonne
XRF	X-Ray Fluorescence
2D	Two dimensional
3D	Three dimensional
%	percentage
%Fe	iron grade

1. Executive Summary

1.1 Introduction

BBA has been mandated by Century Global Commodities Corporation ("Century" or the "Corporation") and Joyce Direct Iron Inc. ("JDI"), or collectively (the "Client"), to prepare a Feasibility Study for the Joyce Lake Direct Shipping Ore "DSO" Iron Ore Project ("Joyce Lake DSO Project" or the "Project"), located in Newfoundland and Labrador, 20 km northeast of Schefferville. A total of 17.37 Mt of Mineral Reserves, as classified according to NI 43-101 guidelines, have been defined and will be crushed and screened over approximately seven, years using conventional open-pit mining and a dry crushing and screening process. The nominal 2.5 Mtpa of combined lump and sinter fines products will be trucked to the rail connecting to the existing rail network and loaded into rail cars for delivery to the Pointe-Noire multiuser port terminal located at the Port of Sept-Îles ("POS").

This technical report presents the results of the Feasibility Study ("FS" or the "Study") for the development of the Joyce Lake DSO Project. The effective date of the FS is October 31, 2022. For this Study, the Client retained the services of several specialized firms including:

1. BBA Inc. ("BBA") for general study management, mining, processing, site infrastructure, estimation and financial analysis and report integration;
2. GoldMinds Geoservices Inc. ("GMG" or "GoldMinds"), for the Mineral Resource Estimate;
3. Stantec Consulting Ltd. ("Stantec"), for environmental and permitting;
4. LVM (a division of Englobe Corporation) for geotechnical considerations including the pit slopes ("LVM" or "Englobe"); and
5. Pinchin Ltd. ("Pinchin") for hydrogeology.

While BBA prepared the financial analysis, the product selling price and applicable taxation regimes were provided by Shanghai Ganglian E Commerce Holdings Co., Ltd ("Mysteel") and by the Client respectively.

1.2 Property Description and Ownership

The Joyce Lake Property (the Property") consists of six mineral licences located in Newfoundland and Labrador, 100% owned by the Client. The six mineral licences include a total of 682 mineral claims and cover a total area of approximately 17,049 hectares.

The Property is located 20 kilometres northeast of Schefferville, Québec, in the province of Newfoundland and Labrador. The Schefferville area is characterized by a sub-arctic continental climate with mild summers and very cold winters. This area is in the boreal forest with low rolling hills rising from 600 to 700 metres above sea level ("masl").

1.3 History

The Québec-Labrador Iron Range has a tradition of iron ore mining since the early 1950s and is one of the largest iron producing regions in the world. The former direct shipping iron ore ("DSO") operations at Schefferville, operated by the Iron Ore Company of Canada ("IOC"), produced in excess of 150 million short tons ("st") of lump and sinter fines between 1954 and 1982.

The first serious exploration in the Labrador Trough occurred in the late 1930s and early 1940s when Hollinger North Shore Exploration Company Limited ("Hollinger") and Labrador Mining and Exploration Mining Company Limited ("LM&E") acquired large mineral concessions in the Québec and Labrador portions of the Trough. In 1951 Burgess mapped the Joyce Lake area. Mining and shipping from the Hollinger lands began in 1954 under the management of the IOC, a company specifically formed to exploit the Schefferville area iron deposits.

As the technology of the steel industry changed over the ensuing years, more emphasis was placed on the concentration of ores from the Wabush area, while interest in and markets for the direct shipping ores of Schefferville declined. In 1982, IOC closed its operations in the Schefferville area.

In 2007, 3099369 Nova Scotia Ltd. examined the correlation between aeromagnetic response and iron content by using the iron formations in the area. It was postulated that regions of lower magnetic susceptibility may be enriched in hematite relative to the surrounding, more magnetic, rocks.

Also, in 2007, Champion conducted an airborne magnetic, gamma-ray and very low frequency - electromagnetic ("VLF-EM") geophysical survey on the Attikamagen Property, as well as a preliminary surface-mapping and a reconnaissance sampling program to provide ground reference samples for correlation with the geophysical data.

Champion extended their airborne geophysical study in 2008 to gain coverage on the Québec portion of their Attikamagen Property. Detailed mapping, sampling and trenching done on the Lac Sans Chef, Jennie Lake and Joyce Lake areas confirm that the airborne high resolution vertical gradient magnetic anomalies coincide with Middle and Upper Iron formation. The sampling program focused on the magnetite-(hematite)-chert iron formation outcrops found at the Lac Sans Chef and Jennie Lake areas where these iron host units are repeated by folding, adding significant width potential. These folded areas offer the best potential for significant iron Mineral Resources and are outlined by strong airborne magnetic anomalies within the 60 km strike length of the Attikamagen Property.

1.4 Geology and Mineralization

The Project is located on the western margin of the Labrador Trough, a Proterozoic volcano-sedimentary sequence wedged between Archean basement gneisses. The Labrador Trough, otherwise known as the Labrador-Québec Fold Belt, extends for more than 1,000 km along the eastern margin of the Superior Craton from the Ungava Bay to Lake Pletipi, Québec. The belt is about 100 km wide in its central part and narrows considerably to the north and south.

The Labrador Trough is a sequence of Proterozoic sedimentary rocks including iron formation, volcanic rocks and mafic intrusions, forming the Kaniapiskau Supergroup. The Kaniapiskau Supergroup is comprised of the Knob Lake Group in the western part and the Doublet Group, which is primarily volcanic in the eastern part. The Knob Lake Group rocks underlie the Lac Le Fer and Rainy Lake properties.

To the west of Schefferville, rocks of the Knob Lake Group lie unconformably on Archean gneisses and, to the east, they pass into the eugeosynclinal facies of the Labrador Trough. The Kaniapiskau Supergroup has been intruded by numerous diabase dykes known as the Montagnais Intrusive Suite. These dykes, along with the Nimish volcanic rocks, are the only rock types representing igneous activity in the western part of the central Labrador Trough.

The Knob Lake Group includes the Sokoman formation, which is the main exploration target of the Joyce Lake DSO Iron Ore Project. The Sokoman formation forms a continuous stratigraphic unit, varying in thickness as a result of folding and fault repetition.

Metamorphic grade increases from sub-greenschist assemblages in the west to upper amphibolites through granulite assemblages in the eastern part of the Labrador Trough. Thrusting and metamorphism occurred between 1,840 and 1,829 million years ago. In the vicinity of the Joyce Lake DSO Project, the Knob Lake Group is subdivided into eight formal geological units. The lowermost unit rests unconformably over Archean gneisses of the Ashuanipi Complex. From oldest to youngest, the rock units are the Seward, Le Fer, Denault, Fleming, Dolly, Wishart, Sokoman and Menihek formations. The Knob Lake Group records two sedimentary cycles:

1. Cycle 1 (the Attikamagen Subgroup) is a shallow marine shelf comprising the Le Fer, Denault, Dolly, and Fleming formations;
2. Cycle 2 (the Ferriman Subgroup) is a deeper water slope-rise environment, beginning with a transgressive quartz arenite (Wishart formation) followed by shale and iron-formation of the

Sokoman formation and conformably overlain by clastic shale, slate and siltstone of the Menihek formation.

The iron formations of the Sokoman formation mapped on both properties are classified as Lake Superior type. They consist of a banded sedimentary unit composed principally of bands of magnetite and hematite within chert-rich rocks and variable amounts of silicate-carbonate-sulphide. Such iron formations have been the principal sources of iron throughout the world.

Superior type iron formations with low iron tenor can be locally brought to "ore grade" through the process of enrichment ("enriched ore") by leaching and deep weathering processes (Direct Shipping Ore, "DSO" type) via circulation of meteoric and synorogenic fluids. Hydrothermal and meteoric fluids circulating through the banded iron formation during the Hudsonian orogenesis recrystallized iron minerals to hematite, and leached silica and carbonate gangue. The result is a residually enriched iron formation that may be further enriched, whereby iron oxides (goethite, limonite), hematite and manganese are redistributed into the openings left by the primary leaching phase, and/or deposited along fracture/cleavage surfaces and in veinlets.

Almost all the iron deposits near surface in the Labrador Trough are enriched to some degree by these processes. The minimum iron content required to be considered economic at a given market price is generally greater than thirty percent iron. Iron oxides must also be amenable to concentration (beneficiation) and the concentrates produced must be low in manganese, aluminum, phosphorus, sulphur and alkalis. Beneficiation involves segregating the silicate and carbonate gangue, and other rock types inter-bedded within the iron formation, from the iron-rich oxides.

The iron formation occurring on the Property consists mostly of subunits of the Sokoman formation characterized by recrystallized chert and jasper with bands and disseminations of magnetite, hematite and martite; a type of hematite pseudomorph after magnetite and specularite. Other gangue minerals are a series of iron silicates comprised of minnesotaite, pyrolusite and stilpnomelane and iron carbonate, mainly siderite.

1.5 Status of Exploration

Most historic explorations on the Schefferville area iron ore properties were carried out by IOC until the closure of its operation in the 1980s. A considerable amount of data used in the evaluation of the resource and reserve estimates is provided in the documents, sections and maps produced by IOC or their consultants.

More recent aeromagnetic exploration was carried out by Nova Scotia Ltd. in 2007. During the same year, Champion conducted an airborne magnetic, gamma-ray and VLF-EM geophysical survey on the Attikamagen Property, as well as a preliminary surface-mapping and a reconnaissance sampling program to provide ground reference samples for correlation with the geophysical data.

In the fall of 2010, Century drilled boreholes in the area and found three potential DSO targets. All targets were selected based on geological and geophysical data. The taconite target is a shallow dipping magnetite-rich iron formation with an expected minimum thickness of 60 m to 100 m.

At the end of November 2012, 78 RC drillholes were completed in Joyce Lake. In addition to drilling, 30 tonnes of bulk sample was collected for metallurgical testing at Actlabs and SGS Lakefield.

From 2010 to 2013, Century completed 176 drillholes and 16 channels on the Property, and collected samples to evaluate the deposit. Century also conducted gravity surveys on the Property in 2011 and 2013.

1.6 Mineral Processing and Metallurgical Testing

Metallurgical testwork was conducted to evaluate the Joyce Lake deposit and work commenced in 2011. COREM was mandated to perform mineralogical characterization and beneficiation studies on composite samples from selected drillholes.

Composite samples were produced to achieve three composites representing high-grade and low-grade ore. Only the high-grade sample could be upgraded by a gravimetric process and scrubbing proved to be necessary. A satisfying grade could not be achieved for the low-grade composites by gravity, magnetic concentration or flotation.

In the summer of 2012, Soutex was mandated to design and supervise bulk sampling and metallurgical testwork to satisfy the requirements for a preliminary economic assessment ("PEA") and to design a process to produce lump and sinter fines. Three bulk samples were collected at the Joyce Lake deposit to represent high (>64% Fe), mid (≈60% Fe) and low (≈55% Fe) grade mineralization.

The samples were analyzed by product categories of lump and sinter fines:

1. Bulk Sample #1 was over 64% Fe for all products;
2. Bulk Sample #2 lump and coarse sinter fines are saleable, but the fine fraction needs upgrading (60.5% Fe); and
3. Bulk Sample #3 produced low iron grades for each product category and did not produce saleable products.

Heavy liquid separation tests were also conducted to verify the amenability to upgrade the finer products. Tests were performed on Bulk Sample #2 and #3. Only Bulk Sample #2 fine fraction of the sinter fines can be upgraded to over 64%. Size-by-size analysis of the bulk samples showed that a wide variability of the proportion between lump and sinter fines should be expected.

Different options were considered for processing flowsheet development. Testwork was completed in December 2013 at SGS Lakefield. Based on the results, the process flowsheet developed was the production of lump and sinter fines by crushing and screening:

1. Scrubbing the sample prior to screening showed that iron and weight recoveries were the same following scrubbing and wet screening processes.
2. Beneficiation testing was performed on the fine fractions of Bulk Sample #2 and on the three composites. In general, it was found that Wilfley gravity concentrates more consistently reached the 64% Fe target, and this testing was more efficient at minus 28 mesh (600 microns) than it was at minus 10 mesh (1,700 microns).
3. Filtration testing was conducted on various product streams, but no samples reached the 5% moisture target.
4. Lump iron ore products +6.35 mm from Bulk Sample #1 (wet screened) and Bulk Sample #2 (wet screened and scrubbed) were submitted for pyrometallurgical testing and all samples were shown to have a "good physical and metallurgical quality".

The results of these tests were used in the non-current April 2015 Feasibility Study.

1.7 Mineral Resource Estimation Methodology and Geological Modelling

The following section describes the current mineral resource estimate (2022) which serves as the basis for this Study. Non-current historical resources were reported in 2013 and 2014. The detail of these resource estimates can be found in Chapter 14 of this Report.

1.7.1 Current Mineral Resource Estimate (May 2022)

The resource block model for the Joyce Lake DSO Project uses drillhole data, which comprises the basis for the definition of 3D mineralized envelopes, with the Mineral Resource Estimate limited to the material inside those envelopes. Drillhole data within the mineralized envelopes are then transformed into fixed-length composites followed by interpolation of the grade of blocks on a regular grid and filling the mineralized envelopes from the grade of composites in the same envelopes. All the interpolated blocks below the topography form the mineral inventory at that date and they are classified according to proximity to composites and corresponding precision/confidence level.

Mineral Resource reporting was completed in GENESIS and estimated using variable ellipsoids in conformity with generally accepted CIM Estimation of Mineral Resource and Mineral Reserve Best Practices Guidelines.

In the opinion of the QP of this section, the geological interpretation, sample location, assay intervals, drillhole spacing, QA/QC and grade continuity of the Joyce Lake DSO Iron Ore deposit are adequate for the current resource estimation and classification.

The current Mineral Resource Estimate, as of May 6, 2022, was performed with a cut-off grade of 50% Fe. The Joyce Lake DSO Iron Ore deposit is 23.97 Mt of Measured and Indicated Mineral Resource at an average grade of 58.63% total Iron (Fe) and 0.83 Mts of Inferred Mineral Resource at an average grade of 62.10% Fe. Table 1-1 shows the current Mineral Resource Estimate (50% cut-off grade as well as a 55% sensitivity).

Table 1-1: Current Pit-constrained MRE Statement, Joyce Lake DSO Iron Ore Project, May 6, 2022

Joyce Lake (DSO) Mineral Resource Estimate (1)					
50% Fe Cut-off (2)	**Tonnes (3)**	**% Fe**	**% SiO_2**	**% Al_2O_3**	**% Mn**
Measured ("M")	18,530,000	58.71	12.97	0.55	0.81
Indicated ("I")	5,440,000	58.35	14.09	0.51	0.53
M+I	23,970,000	58.63	13.22	0.54	0.75
Inferred	830,000	62.10	8.30	0.43	0.78
Joyce Lake (DSO) Mineral Resource Estimate Sensitivity (1)					
55% Fe Cut-off (2)	**Tonnes (3)**	**% Fe**	**% SiO_2**	**% Al_2O_3**	**% Mn**
Measured ("M")	12,870,000	61.45	9.01	0.54	0.85
Indicated ("I")	3,590,000	61.55	9.36	0.49	0.64
M+I	16,460,000	61.47	9.09	0.53	0.81
Inferred	790,000	62.50	7.68	0.43	0.81

Notes:

(1) Pit optimized using approximately $68.97/t operating costs and $157/t FOB Sept-Îles for material over 55% Fe (equivalent to approximately USD150/t benchmark price at 0.76 CAD:USD exchange rate).

(2) Within mineralized envelope and optimized pit shell, % Fe Cut-Off on individual blocks.

(3) Variable Density (equation derived from core measurements), tonnes rounded to nearest 10,000.

1.8 Mineral Reserves

The variables contained in the FS resource block model include coordinate location, density of blocks (mineralized block only), percentage of block inside mineralized envelope, classification (1=Measured, 2=Indicated, 3=Inferred) and grades (%Fe, $\%SiO_2$, $\%Al_2O_3$, %Mn). The densities provided with the model for mineralized material ranged from 2.85 t/m^3 to 3.79 t/m^3.

Pit optimization was carried out using the MineSight Economic Planner Module and the pseudoflow algorithm. Like the Lerchs-Grossmann algorithm, both are variations of network flow algorithms, with the pseudoflow algorithm being computationally more efficient. The algorithm calculates the net value of each block in the model. With defined pit optimization parameters such as mining costs, processing costs, transportation costs and pit slopes, the algorithm maximizes the undiscounted value of the pit shell. For this FS, only the Mineral Resources classified as either Measured or Indicated can be counted towards the economics of the pit optimization run. A series of pit optimizations were produced using variable revenue factors (reduction factors on selling prices) ranging from 70% to 130% of the base case selling price for the FS in order to produce the industry standard pit-by-pit graph. Then the Net Present Value ("NPV") of each of the pit shells was calculated at a discount rate of 8% to identify the optimal pit. The NPV is estimated assuming a constant stripping ratio and product for sale on an annual basis and does not account for capital expenditures. Based on this analysis, the chosen pit optimization for this FS was the pit having a revenue factor of 0.90. The milling cut-off grade ("COG") used to classify material as an economic product for the Feasibility Study was determined to be 52% Fe. The ore cut-off grade was determined based on technical considerations that are more restrictive than normal economic considerations for determining the cut-off grade.

The selected optimized pit shell was then used to develop the engineered pit where operational and design parameters such as ramp grades, bench angles and other ramp details were incorporated. Once the engineered pit design was completed, the Mineral Reserves, as shown in Table 1-2, were derived.

Table 1-2: Joyce Lake Mineral Reserves at 52% Fe cut-off grade

Mineral Reserves Mineral Category	Tonnage (t)	Grade (%Fe)	Grade (%SiO_2)	Grade (%Al_2O_3)	Grade (%Mn)
High-grade Proven (Above 55% Fe)	11.32 M	61.65	8.72	0.55	0.84
Low-grade Proven (52% - 55% Fe)	2.84 M	53.49	20.42	0.62	0.69
Total Proven (Above 52% Fe)	**14.16 M**	**60.01**	**11.07**	**0.56**	**0.81**
High-grade Probable (Above 55% Fe)	2.49 M	61.51	9.46	0.50	0.61
Low-grade Probable (52% - 55% Fe)	0.72 M	53.27	21.68	0.59	0.29
Total Probable (Above 52% Fe)	**3.21 M**	**59.65**	**12.21**	**0.52**	**0.54**
Total Reserve (Above 52% Fe)	**17.37 M**	**59.94**	**11.28**	**0.55**	**0.76**
Overburden	2.31 M	-	-	-	-
Waste Rock	71.55 M	-	-	-	-
Total Waste	**73.86 M**				
Total Material	**91.23 M**	**Strip Ratio**			**4.25**

Notes to accompany Joyce Lake open pit Mineral Reserves table:

1. Mineral Reserves are based on Measured and Indicated Mineral Resources with an effective date of May 6, 2022.
2. Mineral Reserves are reported based on open pit mining within designed pits and incorporate estimates for mining dilution and mining losses. As a result of regularization of the block model, an estimated 2.4% mining dilution and 2.4% mining loss were incorporated into the model.
3. Joyce Lake high-grade Mineral Reserves are reported at a diluted cut-off grade of 55% Fe. The cut-off grades and pit designs are considered appropriate for an iron ore price of $117.53/dmt for high-grade, a process recovery of 98% for crushing & screening, and estimated mining, processing, and G&A unit costs during pit operation.
4. Joyce Lake low-grade Mineral Reserves are reported at a diluted cut-off grade of 52% Fe and below the higher cut-off grades identified in Note 3. It is planned that low-grade Mineral Reserves within the designed pits will be stockpiled during pit operation and processed during pit closure. The low-grade cut-off is considered appropriate for an iron ore price of $61.14/dmt for low-grade, a process recovery of 98% and estimated ore rehandle, processing, and G&A unit costs during pit closure.
5. Proven Reserves are all blocks inside the engineered pit design in the Measured Resource category.
6. Probable Reserves are all blocks inside the engineered pit design in the Indicated Resource category.
7. Mineral Reserves were developed in accordance with CIM Definition Standards on Mineral Resources and Mineral Reserves (May 2014) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (2019).
8. Rounding may result in apparent summation differences between tonnes and grade.
9. Mineral Reserves are reported with an effective date of May 6, 2022.

1.9 Mining

A mine plan based on continuous operations over 365 days per year, seven days per week and 24 hours per day was developed using MinePlan Schedule Optimizer ("MPSO") tool in the Hexagon™ MinePlan 3D software. Mining phases, including initial overburden and waste pre-stripping requirements and a mining schedule, was developed. The starter pit was designed to avoid excavation close to Joyce Lake during the pre-production and construction phases. The open pit production schedule has been developed on a 3-month basis for the life-of-mine ("LOM") and was developed based on a fixed production target of 2.5 M dry tonnes per year ("Mtpa") of iron ore lump and fines products at an average grade of 60% to 62% Fe.

The mining method selected for the Project is based on conventional drill, blast, load and haul using a drill/shovel/truck mining fleet. Annual mining equipment fleet requirements were developed based on equipment performance parameters and average hauling distances based on pit design and configuration and location on the site plan for the crusher and waste piles. The primary equipment fleet includes 96-tonne diesel haul trucks, 11 m^3 diesel-hydraulic shovels, 11 m^3 front-end loader and 200 mm DTH blast hole drills. BBA estimated initial and sustaining capital costs required to support the mining operation, as well as annual mining operating costs based on mining operations assumed to be carried out by the Client using its own equipment and workforce, with the exception of explosives supply and blasting services that are assumed to be contracted out.

1.10 Recovery Methods

The Joyce Lake process consists of a two-stage dry crushing and screening process to produce "lump" and "fines" products.

Run-of-mine ("ROM") material is loaded into a hopper and fed to a static grizzly screen to scalp off any oversized material (+600 mm) which is stockpiled to potentially be processed (crushing and screening) at a later date. The material passing the grizzly is fed directly onto a primary inclined linear screen and the screen oversize is crushed in a jaw crusher. The jaw crusher product and the primary screen undersize are conveyed to a secondary screening. The triple-deck screen separates material into three products: an oversize (+31.5 mm) material that is conveyed to a cone crusher for further size reduction to a targeted top size of 32 mm, a lump product (-31.5/+6.3 mm) and a fines product (-6.3 mm).

Each of the crushed products, lump and fines, are discharged onto their respective conveyors and delivered to their dedicated stockpiles. Lump product is first dried to 2% moisture prior to being stockpiled. The lump stockpile is progressively tarped to prevent re-wetting and is later reclaimed for shipment during the winter season. Loaders transfer the lump and fine products from the stockpiles into haul trucks for transport to the rail connecting to the existing Tshiuetin rail line, located 43 km away.

1.11 Project Infrastructure

The Project is staged in two main areas. The open pit mine site area, located to the north of the Iron Arm water body, includes the mineral deposit, mine operations areas including truck shop, truck wash and warehouse, explosive magazine, as well as the processing facility and laboratory, centralized power station and workers permanent camp. The product load out and rail siding area, on the eastern side of the Tshiuetin rail line approximately 20 km south of Schefferville, includes the product rail loadout stockpile, rail siding and facilities and equipment for loading railcars. These two main areas are connected by a new product haul road covering a distance of 43 km. This includes a new 1.2-km rock causeway, crossing the Iron Arm water body that is to be used for year-round access to the open pit mine area. Access to the site from the town of Schefferville, Québec will be by an existing road that will be upgraded over part of its length and extended to connect with the product haul road. The Client will not build, own or operate any other facility outside the aforementioned main Project areas. Product rail transportation services, from the Project rail siding connecting to the main Schefferville to Sept-Iles, Tshiuetin railway, and subsequently the QNS&L railway, will be contracted from service providers, as will product unloading and ship loading at the Port of Sept-Îles.

1.11.1 Power Generation

The Project is not connected to an electric power utility grid as it was confirmed that, even upon construction of a new power line to site, power would not be guaranteed as the power needs of the town of Schefferville would be prioritized. In discussions with Nalcor it was stated that there would be periods of unavailable power in winter, where limited or no power would be available, and thus there would still be need of stand-alone generators. It is, therefore, reasonable that the base case for the project assumes that the site will generate its own power using diesel generator sets. Electric power is provided to the main mine area infrastructure by a centralized diesel power generation station through a local power distribution grid. More remote infrastructure will have local generators for their specific power requirements.

The centralized power plant design consists of five 600 V, 818 kW prime-rated generator sets, each complemented by a step-up transformer (0.6-13.8 kV) delivering power to the processing plant, the mine infrastructure facilities (mine offices, truck shop, wash bay and warehouse), the permanent camp and the administrative buildings via 13.8 kV overhead lines.

Remote areas (rail siding area, explosives magazine area, telecom towers, guard-house, pit perimeter dewatering pumps) will be fed by independent, stand-alone 600 V diesel generator sets.

The estimated power demand used for design of the central power plant is 2.4 MW. The average annual power consumption for the central power plant is estimated at 14.1 GWh.

1.11.2 Fuel

Fuel for mining equipment, product haul trucks, wheel loaders, auxiliary equipment and for the diesel generators will be railed in from Sept-Îles. Fuel will be required for drying lump product prior to being stockpiled in preparation for winter shipment. Four diesel fueling stations (namely the mine equipment station, the power plant station, the product haul truck station and the rail siding station) will be located in proximity to its end users. Gasoline for light vehicles will be purchased directly from a distributor in the nearby communities and delivered to site.

1.11.3 Telecom

The Telecom, IT and networking systems designed for the Project will be provided by two trailer-mounted towers. All services will be installed progressively depending on when they are needed during the Early Works, Construction and Operation phases of the Project.

1.11.4 Site Services

Potable water will be pumped from a fresh water well and treated prior to use. Raw water wells will supply the truck shop, truck wash, load out and rail loading areas, and will also be used to fill the fire water reserve tanks. A centralized sewage treatment facility for the entire site will be located at the workers camp and the solid waste generated will be disposed of through a contracted service in Schefferville.

1.11.5 Water Management

To develop the mine, Joyce Lake will be drained by the end of the first year of mining operations using a floating barge and a series of pumps. Drainage of Joyce Lake is expected to take a total of 52 weeks. The design provides that perimeter trenches also be constructed along the north and south of the open pit and Joyce Lake, as recommended by Stantec. Collected non-contact water in the perimeter ditches will be discharged to Stream T3 downstream of the existing Joyce Lake outlet (which currently drains via Hollinger Lake), and which will discharge north to Timmins Bay in Attikamagen Lake. These trenches are also used to collect water pumped from the open pit perimeter wells and water pumped from the trench system at the bottom of Joyce Lake. This system is designed to collect surface water and precipitation inside the Joyce Lake footprint to avoid draining into the open pit.

Furthermore, following its conceptual level hydrogeological study, BluMetric Environmental recommended that a perimeter deep well dewatering strategy be adopted as part of the mine dewatering strategy. A series of seven perimeter dewatering wells is expected to control the level of the water table to keep the open pit dry and to support pit slope design parameters developed by LVM in its pit stability geotechnical study. Each well will have a dedicated pumping station consisting of a pump with an electric motor and a local generator for providing the required electric power. It is expected that the water pumped from each well will be relatively clean and can be directed, without treatment, into the surrounding watershed via the north/south perimeter trenches via Hollinger Lake which will discharge north to Timmins Bay in Attikamagen Lake.

1.12 Market Studies and Pricing

Mysteel was contracted by the Client to evaluate the Chinese market demand, premiums and penalties and estimated net realized pricing for the Joyce Lake high-grade ("HG") and low-grade ("LG") lump and fines products to be sold in China. Mysteel was provided the Joyce Lake Product Specifications to determine the proper iron ore indexes by which the Joyce Lake selling price would be established. These indices are based upon similar products currently in use in the Chinese market.

1.12.1 Iron Ore Index Pricing

Comparisons were made between Joyce Lake products and comparable indices available in the market to develop a recommended index for pricing purposes. Iron ore indices are developed by combining the spot prices with financial instruments, such as futures contracts, to create models. Three-year trailing averages of the relative iron ore indices, premiums and penalties provide the basis for the assumed base price to be used in the current Study. Penalties and premiums are based upon ranges of elemental grades based off a 62% Fe benchmark, as is the standard for the Chinese market. Table 1-3 details the four products from the Joyce Lake deposit (HG Lump, HG Fines, LG Lump, LG Fines) as well as the index selected as a relative basis.

Table 1-3: Realized price calculations for the four Joyce Lake deposit products (categorized by HG, LG, lump and fines)

Products	Fe (%)	SiO_2 (%)	Al_2O_3 (%)	P (%)	S (%)	Moisture (%)
HG Fines						
Joyce HG Fines	60.31	10.73	0.72	0.02	0.05	7.04
Crude Brazilian Fines	61.90	8.14	0.81	0.04	-	6.80
HG Lump						
Joyce HG Lump	63.36	6.38	0.32	0.02	0.05	4.00
South African Lump	64.49	5.13	1.17	0.05	0.02	1.34
LG Fines						
Joyce LG Fines	52.34	22.27	0.80	0.02	0.05	7.04
Indian Fines	51.88	8.60	6.48	0.06	0.02	8.72
LG Lump						
Joyce LG Lump	54.98	18.47	0.35	0.02	0.05	4.00
Hainan Lump	55.00	17.50	1.50	0.08	0.90	1.00

1.12.2 Selling Price, Premiums and Penalties

Mysteel has provided the price, premium and penalty for each index comparator on a three-year and look-back monthly average. Mysteel uses its seaborne and portside spot price indices (converted to USD/dmt) and the cost and freight ("CFR") China port price as the benchmark for the calculations (Table 1-4).

Table 1-4: Mysteel index summary (as of March 31, 2022)

Mysteel Index (Summary)	3-year look-back (USD/dmt)	5-year look-back (USD/dmt)
62% Fe Australian Fines (SEADEX)	124.95	103.03
62% Fe Low Alumina Fines	126.72	104.87
Crude Brazilian Fines	122.82	100.38
South African Fines	165.03	141.31
Hainan Lump	72.83	58.29
52% Fe Indian Fines	71.43	57.49
57% Fe Indian Fines	84.34	67.64

The price, premium, and penalties used in the summary below are all based on Mysteel indices (Table 1-5). The adjustment of premiums and penalties is based on the principle of proximity. The pricing of low-grade iron ore, which may otherwise be outside of applicable grade ranges, is still primarily based on a 62% Fe benchmark index with applicable discounts.

Table 1-5: Premiums and penalties (Mysteel, 2022)

Specifications	Range	3-year Premiums and Penalties (USD/dmt)	5-year Premiums and Penalties (USD/dmt)
Per 1% Fe	Fe: 60% to 63.5%	1.97	1.70
Per 1% SiO_2	SiO_2: <4.5%	0.79	0.77
	SiO_2: 4.5% to 6.5%	1.44	1.53
	SiO_2: 6.5% to >9%	1.91	2.63
Per 1% Al_2O_3	Al_2O_3: <1% to 2%	3.44	3.52
	Al_2O_3: 2% to 3%	1.48	1.34
Per 0.01% P	P: 0.1% to 0.12%	2.01	1.90

1.13 Environment Studies, Permitting and Social or Community Impact

The Client is currently progressing through the Environmental Assessment ("EA") processes of both the Province of Newfoundland and Labrador and the Canadian federal government. The Project was registered with the Newfoundland and Labrador Department of Environment and Conservation (now called the Department of Environment and Climate Change, "NL-ECC") on October 15, 2012, but the Newfoundland and Labrador process expired November 18, 2016.

A Project Description and Summary were accepted for review by the Canadian Environmental Assessment Agency (the "CEA Agency", now called the Impact Assessment Agency of Canada; "IAAC") on November 19, 2012. On January 4, 2013, IAAC determined that a federal EA was required. An Environmental Impact Statement ("EIS") was prepared following the federal guidelines and expired provincial guidelines. The EIS was submitted to the federal government, and to the provincial government, as a project registration document, on May 21, 2021.

The Minister's decision on the provincial EA process was received by the Client on November 3, 2021 which specified that a provincial EIS was required and guidelines for preparation of the provincial EIS were issued in August 2022. At the recommendation of the federal government, one common EIS will be submitted to satisfy the requirements of both the federal and provincial EA processes. On July 28, 2022, the Project received an extension to the time limit for the ongoing assessment under CEAA 2012. The deadline to submit the required information or studies in the Final Environmental Impact Statement Guidelines is December 31, 2025. The Client expects to provide additional data and other materials to the provincial and federal EA process. The EIS is currently being prepared for filing with provincial and federal authorities. The EIS will be a public document and will undergo a review in accordance with provincial and federal assessment processes.

The communities closest to the Project include those in western Labrador (i.e., Labrador City, Wabush and Churchill Falls; each over 200 km away), as well as Schefferville, Matimekush-Lac John, and Kawawachikamach in Québec, within 25 km from the Project. The population of western Labrador was 9,831 in 2016, with the majority living in Labrador City. In 2016, there were 1,402 people residing in the four communities near the Project that are in eastern Québec.

Several Indigenous communities have asserted Indigenous rights and Indigenous title to lands within the Project development area. These communities are from Newfoundland and Labrador: the Innu Nation (on behalf of the Mushuau Innu First Nation and the Sheshatshiu Innu First Nation) and the NunatuKavut Community Council; and from Québec: the Naskapi Nation of Kawawachikamach, La Nation Innu Matimekush-Lac John, and Innu Takuaikan Uashat mak Mani-

Utenam. None of the Indigenous communities currently has a settled land claim which includes any lands within the Project development area.

1.14 Capital Costs

The Project scope covered in the Feasibility Study is based on the construction of a greenfield facility having a nominal annual production capacity of 2.5 Mt of combined lump and sinter fines products. The capital cost estimate related to the mine, process plant and site infrastructure was developed by BBA. Costs related to the railway transportation, port handling and ship loading at the port terminal have been provided by the Client. Pinchin and Stantec have provided designs for basis of cost estimating for implementing the perimeter dewatering plan and surface water management plan. Table 1-6 presents a summary of total estimated initial capital costs for the Project.

Table 1-6: Summary of initial capital cost estimate

Cost Area	Initial Capital ($M)
Mining (Capitalized Pre-Stripping)	$20.7
Mining Equipment (Initial Owner Fleet)	$26.3
Infrastructure Direct Costs	$143.1
Infrastructure Indirect and Owners Costs	$42.8
Railcars Lease Down Payment	$9.2
Other Mobile Equipment Lease Down Payment	$10.0
Contingency	$18.4
Total	**$270.4**

Further to the capital costs described, additional costs required for the Joyce Lake DSO Project include:

- Sustaining capital costs for additional and replacement mining equipment;
- Closure costs for site closure and remediation;
- Leasing payments for initial mining equipment, rail cars, loaders and other mobile equipment, $22M in pre-production and the remainder over the first four years of operation;
- Pre-payments required to secure access to port and rail services as a buy-in, or pre-payment;
- Salvage value for the sale of rail cars, mobile equipment and specialized equipment after production ends.

Table 1-7: Estimated sustaining capital costs, salvage value and other costs

Description	Capital Costs ($M)
Mining Equipment Sustaining Capital	**$18.3**
Closure Costs	**$6.4**
Leasing payments in pre-production	**$22.0**
LOM Leasing payments during production	**$87.9**
Pre-payments	**$62.4**
Salvage Value	
Project Infrastructure	($3.0)
Rail cars	($23.0)
Other mobile equipment	($5.9)
Total Salvage Value	**($31.8)**

1.15 Operating Costs

The Operating Cost Estimate, related to the mine and low-grade stockpile, site infrastructure including dewatering, processing, product hauling and loading, as well as the site administration and services, was developed by BBA. Costs related to site administration, such as room and board, rail transportation, port and ship loading, were provided by the Client. No corporate G&A costs were included in this estimate which is considered to only include project related costs. Table 1-8 presents a summary of estimated average LOM operating costs per dry metric tonne of combined lump and fines products.

The total estimated operating costs are **$36.26/t** of dry product. Royalties and working capital are not included in the Operating Cost Estimate but are treated separately in the Economic Analysis.

Table 1-8: Estimated average LOM operating cost ($/t Dry Product)

Cost Area	LOM Average ($/dmt)
Mining	15.46
Perimeter Dewatering and Water Management	0.70
Crushing and Screening and Product Handling	3.02
Product Truck Haulage to Astray Lake Rail Loading	6.71
Load-out and Rail Siding Load-out and Rail Siding at Astray Lake	1.81
Site Administration	4.52
Site Services (Room & Board and FIFO Air Tickets)	3.15
Lump Drying	0.89
Total	**36.26**

Once the products are loaded into the railcars at the rail loadout, the Client will subcontract rail transportation from the rail ~20 km south of Schefferville to the Pointe-Noire multiuser port terminal located at the Port of Sept-Îles, as well as port handling and ship loading services. The Client has performed its own analysis based on confidential discussions with the various third-party service providers that would be involved. The Client has estimated an average operating cost of **$25.06/dmt** for railing and port services over the life of mine which, in conjunction with the site operating costs, yields a cost of **61.32$/dmt** FOB Port of Sept-Iles. Including the expected ocean shipping costs of 33.93$/dmt the total cost landed China is **95.26$/dmt**. It was assumed that the agreements made with the rail and port service providers will account for a discount of 20% for the shipping of low-grade ore at the end of high-grade production in LOM year six.

1.16 Financial Analysis

A summary of the results of the before-tax and after-tax project economic analyses based on the projected annual revenues, capital and operating costs, royalties, other costs including rehabilitation and closure costs, as well as any deposit provision payments developed in the Feasibility Study are presented in Table 1-9 and Table 1-10 respectively.

Table 1-9: Before tax financial analysis results

IRR = 27.72%	NPV ($M)	Payback (years)
Discount Rate		
0%	$660.2 M	3.2
4%	$489.4 M	-
8%	$357.2 M	-

Table 1-10: After tax financial analysis results

IRR = 20.01%	NPV ($M)	Payback (years)
Discount Rate		
0%	$394.7 M	3.7
4%	$276.4 M	-
8%	$184.6 M	-

The Financial Analysis was performed with the following assumptions and basis:

- The Project Execution Schedule considered key project milestones;
- The Financial Analysis was performed on a quarterly basis for the entire life-of mine ("LOM") for the Mineral Reserve estimated in this FS. Production is estimated to span approximately 7 years;
- The financial analysis was based on a benchmark sinter fines price of USD124.95/dmt CFR China Port for 62% Fe content. Applicable premiums and penalties were applied as described in Chapter 19;
- Ocean freight from Sept-Îles to a Chinese port is assumed to be USD26.06/dmt shipped over the life of the mine;
- All fines products are sold in the year of production;
- Lump products are sold in Q4 of the year of production as well as Q1 of the following year;
- Initial production will focus on processing of high-grade ore. Once exhausted, the low-grade stockpile generated during the mining of the high-grade ore will be crushed and screened;
- All capital and operating costs are in constant Q2-2022 dollars (no escalation or inflation has been taken into account);
- A royalty is payable to Champion as outlined in Chapter 4 of this report and has been included in the financial evaluation;
- An exchange rate of CAD1.00 = USD0.77 was used.

A sensitivity analysis on the before tax Project IRR and NPV was conducted at a discount rate of 8%. The results illustrating the impact of initial capital and LOM operating cost variations of +/-20%, as well as selling price fluctuations of -20/+80%, are illustrated in Figure 1-1 and Figure 1-2.

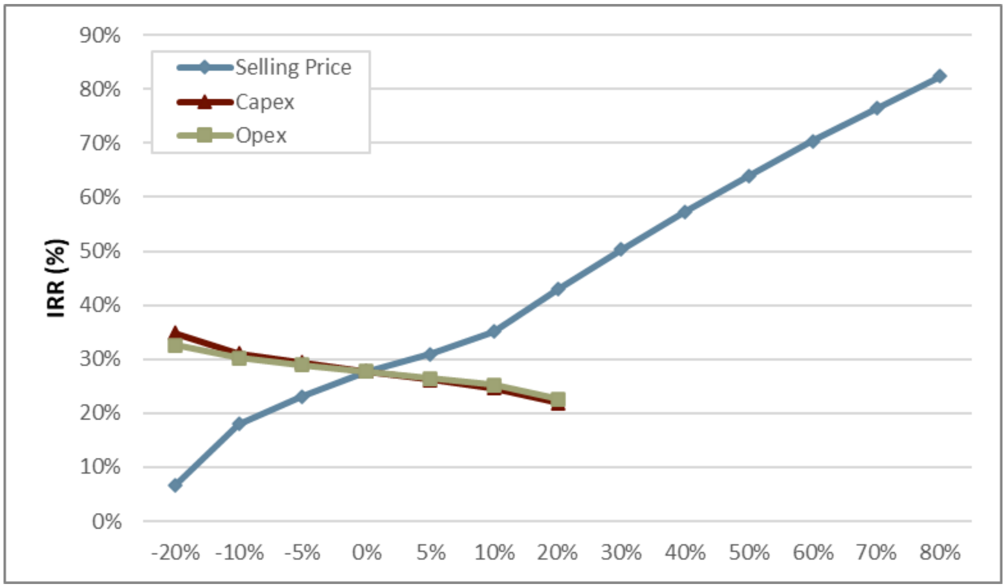


Figure 1-1: Sensitivity analysis for IRR (before tax)

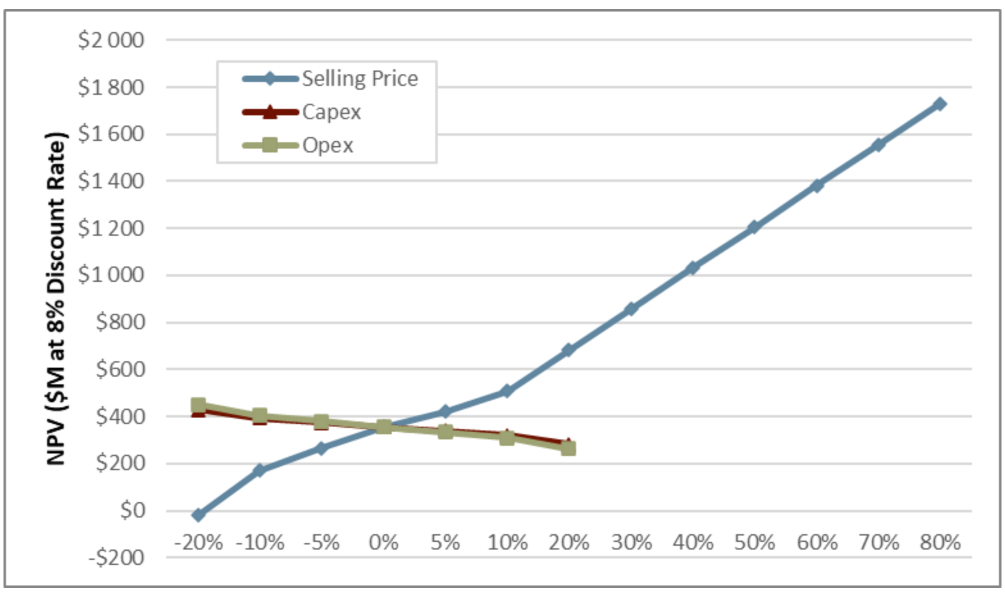


Figure 1-2: Sensitivity analysis for NPV (before tax)

The Project is forecasted to provide a pre-tax IRR of 27.72% and an NPV of $357.2M at a discount rate of 8%. The payback period is 3.2 years after the start of production. Based on the sensitivity analyses performed, it is clear that both the NPV and IRR are most sensitive to iron ore prices.

1.17 Project Schedule

A Project Implementation and Construction Execution Plan was developed as part of the FS and it was assumed that the Client will have obtained all environmental permits required to begin construction. The major project milestones are listed in Table 1-11. The two monthly columns show the time of occurrence in months relative to the start of construction and to the start of commercial production. Production (crushing and screening) commences mid-April in the spring season, following the completion of construction.

Table 1-11: Key project construction milestones

Major Milestones	Month vs Start Construction
Award EPCM mandate	-8
Award Mobile Crushing/ Screening Plant Order	-7
Award Mining Equipment Order	-7
Environmental Permit Approval	-3
Start Construction	0
Initial Iron Arm Crossing	5
Telecommunication available across site	5
Start pumping Joyce lake	5
Haul Road and Astray Rail Siding Completed	7
Export Infrastructure Completed	9
Power Available at site	9
Truck shop dome completed	9
Permanent camp available (144 rooms)	10
Mechanical Completion (Turn-Over to POV)	10

1.18 Conclusions and Recommendations

The following pre-construction recommendations are made to de-risk the Project and also to reduce the timeline for a Client construction decision. While BBA has made these recommendations to facilitate de-risking and expediting the Project, the results of this Feasibility Study are not dependent on execution of these recommendations prior to a Project construction decision by the Client. The recommendations can be summarized as follows:

Proceed with the Environmental Assessment Process

- It is recommended to continue to advance the federal and provincial Environmental Assessment ("EA") process so as to obtain permits prior to a Client construction decision.

Perform Further Technical Studies before Construction

- Confirmatory metallurgical test work is suggested to be performed on core samples representative of the Mineral Resources estimated for this Feasibility Study pit design to:
  - Confirm lump (35%) to sinter fines (65%) crushing ratio assumed in this Feasibility Study;
  - Confirm distribution of key elements (Fe, SiO_2, Al_2O_3, etc.) in lump compared to fines products used in this Feasibility Study and derived from prior metallurgical test work; and
  - Develop a better understanding of ROM ore moisture used in this Feasibility Study and impacts on process flowsheet, product particle size distribution and lump drying requirements, as well as fines product transportation moistures.
- Further to metallurgical testwork, a more detailed geotechnical study could be performed to confirm pit slope and bench configuration. In order to do so, the following work is recommended:
  - Complete the six oriented drill boreholes and do optical and acoustic tele-viewer surveys, a laboratory testing program, and a study of the final geotechnical pit slope design. Structural data of rock joints orientation should also be collected to perform kinematics analysis for the bench configuration; and
  - Do a geotechnical investigation to determine gap data on the ROM ore and product stockpiles, and also perform a stability analysis for the construction sequence of the waste stockpile.
- A more detailed hydrogeological study to confirm perimeter dewatering parameters and design.
  - The Feasibility Study of open pit perimeter dewatering requirements (number of wells and dewatering rates) was partially based on the results of testing from 50-mm monitoring wells. It is recommended that further pumping tests be done in test wells of a minimum 200 mm diameter.

- It is also recommended to perform further evaluation for in-situ resource density confirmation.
  - Two sets of drill hole core samples were used to determine the mineralized density for the Feasibility Study. To confirm the densities used, it is recommended that bulk density, dry density and moisture content be determined from available drill core from triple tube and sonic drilling.

Exploration of DSO Targets in Immediate Joyce Area

This Feasibility Study mines only the Joyce Lake deposit. The Joyce Lake DSO Project economics could be enhanced by mining additional DSO deposits from discoveries on nearby Client-owned claims and/or acquired claims.

- It is recommended the Client considers exploring other DSO exploration targets in the immediate vicinity of the Project, specifically Joyce South, Lac Sans Chef and Jennie Lake.
- New DSO exploration discoveries in the immediate area of Joyce Lake could have significant positive economic impact on the Project; however, as this Feasibility Study excludes new DSO discoveries, BBA has not provided an exploration expenditure recommendation.

Detailed Engineering and Construction Decision by the Client

BBA recommends a production decision is taken by the Client when market conditions or outlook are compliant with key market condition parameters used in this Feasibility Study, including product selling prices.

2. Introduction

This Technical NI 43-101 Report (the "Report") summarizes the results of the Feasibility Study for development of the Joyce Lake DSO Project in Newfoundland and Labrador.

In December 2021, Century and its 91.6% owned subsidiary JDI commissioned the engineering consulting group BBA to perform this FS. JDI owns 100% of the Joyce Lake DSO Project. This Report was prepared at the request of Mr. Sandy Chim, Chairman, President and CEO of the Corporation. This Report was prepared based on contributions from several independent consulting firms including, Stantec, GoldMinds, Pinchin, and Englobe.

Century is a Canadian publicly traded company listed on the Toronto Stock Exchange ("TSX") under the symbol CNT. Century was originally incorporated under the *Canada Business Corporations Act*. On October 17, 2014, Century continued its jurisdiction of incorporation from Canada to British Columbia. On February 1, 2016, it continued its existence from British Columbia to the Cayman Islands to be governed by the *Companies Law (2013 Revision)* of the Cayman Islands. Upon completing the Company's continuation to the Cayman Islands, its headquarters were relocated from Canada to Hong Kong. The head office of Century is located at Unit 905-6, 9/F, Houston Centre, 63 Mody Road, Tsim Sha Tsui, Kowloon, Hong Kong SAR, the People's Republic of China. JDI is a company incorporated under the *British Columbia Business Corporations Act* with an office at 200 University Avenue, Suite 1401, Toronto, Ontario, Canada M5H 3C6.

This Report titled "Feasibility Study for the Joyce Lake DSO Iron Ore Project, Newfoundland and Labrador, Canada", concerns development of the Joyce Lake DSO deposit located on the Attikamagen Property. This Attikamagen Property includes both the Joyce Lake DSO deposit and the Hayot Lake deposit, however this FS concerns the Joyce Lake DSO deposit only and does not consider the Hayot Lake deposit. The report was prepared by Qualified Persons following the guidelines of the "Canadian Securities Administrators" National Instrument 43-101 (effective June 30, 2011), and the guidelines of the Canadian Mining, Metallurgy and Petroleum ("CIM") Standard on Mineral Resources and Reserves.

This Report is considered effective as of October 31, 2022.

2.1 Scope of Study

A prior Feasibility Study on the Joyce Lake Property was completed by BBA in April 2015 with a Technical NI 43-101 Report filed on SEDAR (BBA, 2015c). The Project, as defined in the 2015 report, was retained as a baseline for the current evaluation. The 2022 Feasibility Study goals were to:

- Optimize the Project by simplifying and optimizing the design, especially concerning the 43 km haul road by reducing the width of the road from two lanes to one lane, with the exception of low visibility turns and select pull-outs. By moving less material (load, haul, dump, place) the diesel and materials requirements during construction would be reduced;
- Evaluate potential for year-round product transportation rather than seasonal;
- Review Project design to find opportunities to improve environmental, social and governance impacts. The main focus of these investigations was:
  - Optimization selection of products used in blasting;
  - Reduction of earthworks to minimize construction emissions;
  - Evaluate potential for use of grid electrical power supply.
- Consider operating during the summer months only to reduce winter diesel use, even though year-round operations would allow easier management of personnel and contracts;
- Calculate operating costs to reflect 1/3 of employees as local hires including participation in apprenticeship programs focused on providing gender equality and indigenous peoples participation;
- Investigate the availability of equipment (dryers and generators), which could be run on LNG rather than diesel fuel should the former become readily available in the region;
- Update the Project costs, concentrate selling price and transportation logistics to 2022 pricing;
- Redesign and simplify the rail siding configuration.

2.2 Report Responsibility and Qualified Persons

The following individuals, by virtue of their education, experience, and professional association, are considered QPs as defined in the NI 43-101, and are members in good standing of appropriate professional institutions.

- Derek Blais, P.Eng. — BBA Inc.
- Joanne Robinson, P.Eng. — BBA Inc.
- Sheldon Smith, P.Geo. — Stantec Consulting Ltd.
- Claude Duplessis, P.Eng. — GoldMinds Geoservices Inc.
- Byron O’Connor, P.Eng. — Pinchin Ltd.
- Guillaume Joyal, P.Eng. — Englobe Corporation

The preceding QPs have contributed to the writing of this Report and have provided QP certificates, included at the beginning of this Report. The information contained in the certificates outlines the sections in this Report for which each QP is responsible. Each QP has also contributed figures, tables and portions of Chapters 1 (Summary), 2 (Introduction), 24 (Other Relevant Data and Information), 25 (Interpretation and Conclusions), 26 (Recommendations), and 27 (References). Table 2-1 outlines the responsibilities for the various sections of the Report and the name of the corresponding Qualified Person.

Table 2-1: Qualified Persons and areas of report responsibility

Chapter	Description	Qualified Person	Company	Comments and exceptions
1.	Summary	D. Blais	BBA	All QPs contributed based on their respective scope of work and the Chapters/Sections under their responsibility.
2.	Introduction	D. Blais	BBA	All QPs contributed based on their respective scope of work and the Chapters/Sections under their responsibility.
3.	Reliance on Other Experts	D. Blais	BBA	
4.	Project Property Description and Location	C. Duplessis	GoldMinds	The Client provided information on property description and ownership.
5.	Accessibility, Climate, Local Resource, Infrastructure and Physiography	C. Duplessis	GoldMinds	
6.	History	C. Duplessis	GoldMinds	
7.	Geological Setting and Mineralization	C. Duplessis	GoldMinds	
8.	Deposit Types	C. Duplessis	GoldMinds	
9.	Exploration	C. Duplessis	GoldMinds	
10.	Drilling	C. Duplessis	GoldMinds	
11.	Sample Preparation, Analyses and Security	C. Duplessis	GoldMinds	
12.	Data Verification	C. Duplessis	GoldMinds	
13.	Mineral Processing and Metallurgical Testing	D. Blais	BBA	
14.	Mineral Resource Estimates	C. Duplessis	GoldMinds	
15.	Mineral Reserve Estimates	J. Robinson	BBA	Pit slope design parameters provided by LVM. Hydrogeology provided by Pinchin.

Chapter	Description	Qualified Person	Company	Comments and exceptions
16.	Mining Methods	J. Robinson	BBA	
17.	Recovery Methods	D. Blais	BBA	
18.	Project Infrastructure	D. Blais	BBA	
19.	Market Studies and Contracts	D. Blais	BBA	The Client commissioned an external iron ore market review by MySteel who provided commodity benchmark prices and penalties/premiums.
20.	Environmental Studies, Permitting, and Social or Community Impact	S. Smith	Stantec	All Chapter 20 except Sections 20.5 and 20.6. The Client provided the section on Community Relations.
		G. Joyal	Englobe	Section 20.5 (Geotechnical)
		B. O'Connor	Pinchin	Section 20.6 (Hydrogeology)
21.	Capital and Operating Costs	D. Blais	BBA	Stantec provided cost estimate for site closure plan.
22.	Economic Analysis	D. Blais	BBA	
23.	Adjacent Properties	C. Duplessis	GoldMinds	
24.	Other Relevant Data and Information	D. Blais	BBA	All QPs contributed based on their respective scope of work and the Chapters/Sections under their responsibility where applicable.
25.	Interpretation and Conclusions	D. Blais	BBA	All QPs contributed based on their respective scope of work and the Chapters/Sections under their responsibility.
26.	Recommendations	D. Blais	BBA	All QPs contributed based on their respective scope of work and the Chapters/Sections under their responsibility.
27.	References	D. Blais	BBA	All QPs contributed based on their respective scope of work and the Chapters/Sections under their responsibility.

2.3 Sources of Information

This Report is based in part on internal company technical reports, maps, published government reports, company letters and memoranda, and information, as listed in Chapter 27 "References" of this Report. Sections from reports authored by other consultants may have been directly quoted or summarized in this Report and are so indicated where appropriate.

It should be noted that the authors have relied upon selected portions or excerpts from material contained in previous NI 43-101 compliant technical reports available on SEDAR (www.sedar.com). Other information used to complete the present Feasibility Study includes, but is not limited to, the following reports and documents:

- Mineral Resource block model provided by SGS Canada Inc.;
- Corem, SGS Canada Inc., Soutex results and reports;
- Internal and commercially available databases and cost models;
- Canadian Milling Practice, Special Vol. 49, CIM;
- Various reports produced by LVM (a division of Englobe Corporation), WESA (now WSP), Stantec and others concerning environmental studies and permitting, site hydrology, hydrogeology and geotechnical and site closure plan.

2.4 Terms of Reference

Unless otherwise stated:

- All units of measurement in the Report are in the metric system;
- All costs, revenues and values are expressed in terms of Canadian dollars (CAD or $);
- All metal prices, unless specifically indicated, are expressed in terms of US dollars (USD);
- A foreign exchange rate of USD1.00 = CAD0.77 was used.

Grid coordinates for the block model are given in the UTM NAD 83 and latitude/longitude system; maps are either in UTM coordinates or latitude/longitude system.

2.5 Site Visits

Mr. Claude Duplessis of GoldMinds visited the Property on September 26th and 27th of 2012, for a review of exploration methodology, RC (Reverse Circulation) drilling technique and sampling procedures for 2013 technical report. A subsequent visit was conducted on March 9th and 10th of 2013 and October 3rd and 4th 2013, for a review of exploration methodology, RC drilling technique, core diamond drilling and sampling procedures with density measurements for the 2014 Mineral Resource Estimate update.

On September 16, 2021, Claude Duplessis and Derek Blais of BBA, performed a site visit. Claude Duplessis walked the area around the Joyce Lake deposit to re-familiarize himself with the Project site. Derek Blais performed an aerial tour of the site with a focus on the planned trajectory of the haul road towards the planned rail siding.

Derek Blais also relied upon a site visit that was conducted on October 16 and 17, 2014, by Mr. Angelo Grandillo of BBA. The purpose of the visit was to survey the site areas as well as areas of existing and future roads and infrastructure that will be required to support the Project in all its phases of development. A visit of the core storage area was also conducted, and several cores were viewed on a spot check basis.

Representatives from Stantec also performed visits to the site on different occasions from 2012 to 2014. These representatives were: Roy Skanes, Glen Campbell, Stacey Camus, Mary Murdoch, Maria Ma, Sundar Premasiri, and Nikolay Sidenko. Mr. Sheldon Smith, the current QP representing Stantec, visited the site in September 2012. Ms. Carolyn Anstey-Moore, the former QP representing Stantec, visited the site in August 2012.

Byron O'Connor of Pinchin visited the site in October 2015 as part of a previous hydrogeological study.

Joanne Robinson of BBA, the Qualified Person for mining, did not visit the site.

Guillaume Joyal of Englobe did not visit the site.

2.6 Effective dates and declaration

The following summarizes closeout/cutoff dates for key information and data used for the evaluation of the current FS.

- Latest metallurgical test work incorporated: 2013
- Mineral Resources effective date: May 6, 2022
- Mineral Reserves effective date: May 6, 2022
- 3-year look back pricing for diesel and iron concentrates is effective March 31, 2022
- Capital and operating cost, effective date: Q2 2022
- Effective date of FS: October 31, 2022
- Issue date of FS: December 13, 2022

3. Reliance on Other Experts

3.1 Introduction

Neither BBA, GoldMinds, Stantec, Pinchin, nor Englobe has verified the legal titles to the Property nor any underlying agreement(s) that may exist concerning the licenses or other agreement(s) between third parties but has relied on the Client to have conducted the proper legal due diligence. The Project design requires that certain infrastructure be located outside the mineral property limits. The Client currently does not have surface rights to use these areas but has indicated that they will acquire these rights at an appropriate time during the Project development.

Any statements and opinions expressed in this document are given in good faith and in the belief that such statements and opinions are not false or misleading at the effective date of this Report. BBA has the responsibility for assuring that this technical report meets the guidelines and standards stipulated.

3.2 Mineral Tenure and Surface Rights

The Client has provided a description of the ownership structure in Chapter 4 of this Report, including the history of the joint venture agreement between Century and WISCO International. BBA has relied on the Client to provide all information that is material to this Feasibility Study.

3.3 Taxation

The Financial Analysis performed by BBA in this Feasibility Study was done on a pre-tax basis. The Client has provided a statement, outlined in Chapter 22 of this Report, pertaining to the impact of taxes on the Project, as well as taxation amounts that BBA incorporated into the after-tax financial analysis. The estimated impact of the taxes on the Project and its economics is based on any applicable federal and provincial taxes in Canada.

3.4 Markets

The Client has contracted Mysteel to undertake a market study to derive the base case iron ore product prices used in the Project economic analysis presented in Chapter 22. As such, the Client has provided support for its conclusion on prices based on this study by Mysteel.

4. Property Description and Location

4.1 Property Location

The Property consists of six Mineral Licences located in the province of Newfoundland and Labrador, 100% owned by JDI. The six map-staked Mineral Licences include a total of 682 mineral claims and cover a total area of 17,049 hectares ("ha").

The Project is located 20 km northeast of Schefferville, Québec, at Attikamagen Lake, in the province of Newfoundland and Labrador (see Figure 4-1).

The Property area covers part of NTS Map sheets 23J15, 23J16, and 23O02, and lies between 643,910 m and 673,824 m Easting, and 6,098,023 m and 6,070,600 m Northing under NAD83 in UTM Zone 19. The coordinates of the Project are shown in Table 4-1.

Table 4-1: Project coordinates

Feature	Longitude (X)	Latitude (Y)
Joyce Lake DSO Iron Ore Project Site	66° 31' 26.783" W	54° 54' 0.768" N

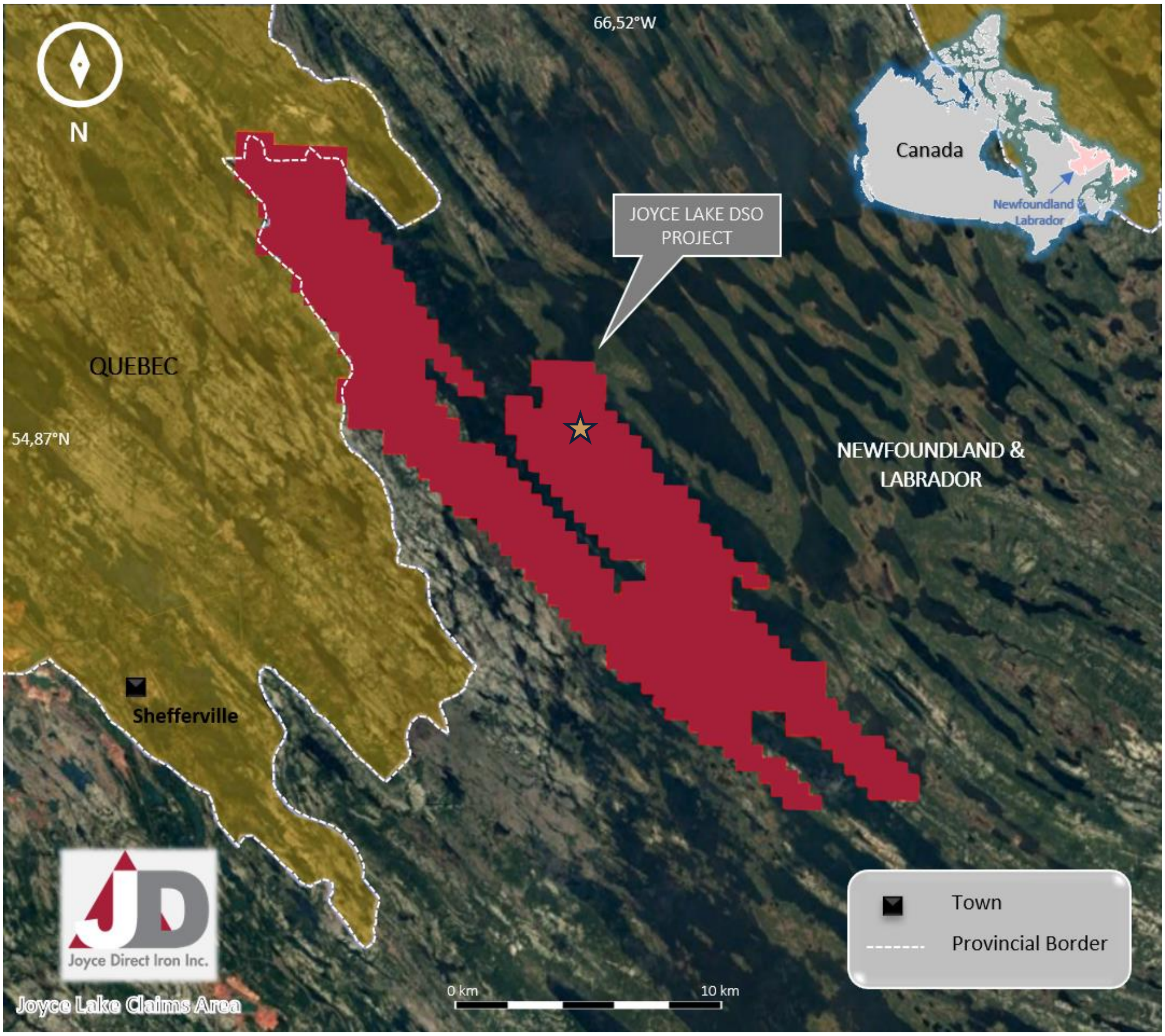


Figure 4-1: Property location map from NL Natural Resources management system
The golden star is Joyce Lake

4.2 Mineral Tenure in Newfoundland and Labrador

Generally, in Canada, natural resources are of provincial jurisdiction. In the province of Newfoundland and Labrador, the management of Mineral Resources and the granting of exploration and mining rights for mineral substances and their use are regulated and administered by the Department of Industry, Energy and Technology ("NLDIET").

4.2.1 Mineral Claims

In Newfoundland and Labrador, a mineral claim grants the exclusive right to explore for all minerals. Mineral claims are maps staked online by accessing the staking section of the Province's Mineral Rights Administration System except for restricted areas such as Ecological and Wilderness reserves, National and Provincial Parks. In map-staking, a claim is 500 m x 500 m or 25 ha, which is also one quarter of a UTM grid square – bounded by one corner of a UTM grid square.

There are no restrictions on the shape of an area being applied for; an application for a Map Staked Licence must be a full 25 ha claim, or greater, and no greater than 256 full-sized claims. All the claims in the electronic application must be contiguous and may not overlap existing claims or areas that are exempted from staking by regulation. Assessment work must be filed annually with the NLDIET to keep the Newfoundland and Labrador claims in good standing. The annual report of the assessment work performed is due no later than 60 days after the anniversary of their issuance date. For this Project, with the 682 claims, the eligible assessment work is scheduled in Table 4-2 below.

Table 4-2: Annual report assessment work cost per claim

Anniversary Year	Value ($) for single claim per year	Value ($) for 682 Claims per year
1	200	136,400
2	250	170,500
3	300	204,600
4	350	238,700
5	400	272,800
6-10	600	409,200
11-15	900	613,800
16-20	1,200	818,400

JDI has over $16M excess work credits over these 682 claims, so no extra work will be required for the renewal of these claims. Cost of renewal fees before the expiry are below $15,000 and deemed non-material compared to the Project development cost.

4.2.2 Mineral Exploration Licences

In Newfoundland and Labrador, a mineral exploration licence is issued for a term of five years. However, a mineral exploration licence may be held for a maximum of 20 years, provided the required annual assessment work is completed and reported upon and the mineral exploration licence is renewed every five years. In each year of the licence, the minimum annual assessment work must be completed on or before the anniversary date. The assessment report must then be submitted within 60 days after the anniversary date. Any excess assessment work completed in any one year is carried forward for a maximum of nine years and it is automatically credited to the licence.

4.2.3 Extraction Rights

There are two types of extraction rights in Newfoundland and Labrador: 1) a mining lease for mineral substances; and 2) a lease to mine surface mineral substances. The second one is a prerequisite to obtain a mining lease. In Newfoundland and Labrador, a licence holder has a right to a mining lease for the minimum area necessary to cover an identified Mineral Resource at any time during its currency, provided the equivalent of the first three years assessment work has been completed and acceptable reports submitted to the Department of Environment and Climate Change.

In addition, the applicant for a mining lease must demonstrate to the satisfaction of the NLDIET Minister that a Mineral Resource exists under the area of application that is of significant size and quality to be potentially economic. This must be confirmed by a qualified person. A qualified person is an engineer or a geoscientist with at least five years' experience in mineral exploration or mine development (or operation or mineral project assessment or a combination of these) who has experience relevant to the Project and is a member in good standing of a professional association. An application for a mining lease made pursuant to a map-staked licence is to be accompanied by two original copies of the legal survey and a description and sketch of the area being applied for.

In order to develop a Mineral Resource, it is necessary for a licence holder to obtain title to the surface rights to the area of the mining lease and areas for sitting the infrastructure required for the mineral development.

4.3 Property Ownership

4.3.1 Mineral Licences

The Project comprises six map-staked licences totalling approximately 17,049 ha on 682 claims. JDI is the registered owner of the Project claims. A description of the Project's Mineral Licenses is shown in Table 4-3 below.

Table 4-3: JDI Mineral Licences and status

Licence	Claims	Area (ha)	NTS Areas	Issuance Date	Expiry Date	Work Due Date
020231M	256	6399.7	23J15 & 23J16	2005-11-07	2025-11-07	2023-01-06
020238M	253	6324.7	23J15 & 23J16	2005-11-07	2025-11-07	2023-01-06
020517M	51	1274.9	23J15	2012-10-18	2027-10-18	2022-12-19
020518M	4	100.0	23J15 & 23J16	2012-10-18	2027-10-18	2022-12-19
020753M	10	250.0	23J16	2013-01-11	2023-01-11	2023-03-13
020232M	108	2699.9	23J/15 & 23O02	2008-03-20	2023-03-20	2024-05-19

The "Attikamagen Property" – which includes the Project – was originally the subject of a joint venture agreement between Labec Century Iron Ore Inc. ("Labec Century") and Champion Iron Mines Limited ("Champion") dated May 12, 2008 (as amended on July 9, 2009 and March 25, 2010). The joint venture provided Labec Century with an earn-in right to the Attikamagen Property. On September 30, 2013, the joint venture agreement was terminated and Century Attikamagen Inc. ("Century Attikamagen"), a wholly-owned subsidiary of Century, entered into a purchase agreement with Champion to acquire the remaining interest Century did not own in the Attikamagen Property. Under the purchase agreement, Century Attikamagen designated Labec Century as the transferee of Champion's interest in the Attikamagen Property. The transaction closed in escrow on November 19, 2013 and the escrow release conditions were satisfied and legal title to the Attikamagen Property transferred to Labec Century on January 31, 2014. In connection with this acquisition, Labec Century entered into the Champion Royalty Agreement (as described below) pursuant to which the Champion Royalty (as described below) was granted to Champion.

On December 29, 2020, JDI acquired the Project from Labec Century and the Labec Century Royalty Agreement (as described below, and as amended and restated) was entered into between JDI and Labec Century on the same date. Labec Century was originally established as a joint venture company with 60% owned by Century Iron Ore Holdings Inc. ("Century Holdings"), a wholly-owned subsidiary of Century, and 40% by WISCO Canada ADI Resources Development & Investment Limited (formerly known as WISCO Canada Attikamagen Resources Development & Investment Limited) ("WISCO ADI"). The joint venture company was governed by a shareholders' agreement dated December 19, 2011 (the "Attikamagen Shareholders Agreement") between Century, WISCO International Resources Development & Investment Limited ("WISCO International"), WISCO ADI and Labec Century. WISCO ADI, as a wholly-owned subsidiary of WISCO International, invested an aggregate of $40M under the Attikamagen Shareholders' Agreement in consideration for the acquisition of its 40% interest in Labec Century. Century subsequently acquired the 40% interest in Labec Century from WISCO ADI in November 2020 thereby increasing its interest in Labec Century to a 100% interest. JDI is 100% owner of the Joyce Lake DSO Project.

4.4 Underlying Agreements and Royalties

4.4.1 Royalties

The mineral licenses comprising the Joyce Lake DSO Project (the "Mineral Licenses") are subject to the following royalty agreements, which are binding on JDI as the current owner of the Mineral Licenses with respect to minerals produced from the lands that are the subject of the Mineral Licenses:

- Mineral Licences 011363M, 011499M and 011500M (all of which are now entirely comprised within the Licences as a result of subsequent splitting and groupings of licences) are subject to a production royalty agreement dated July 20, 2007 and amended February 15, 2008, made between 3099869 Nova Scotia Ltd. and Champion Minerals Inc. ("Champion Minerals"), which agreement is registered against the Mineral Licenses in the Confidential Registry maintained by the Newfoundland and Labrador Mineral Claims Recorder (the "Attikamagen Royalty Agreement"). Pursuant to the Attikamagen Royalty Agreement, Champion Minerals granted and agreed to pay to 3099869 Nova Scotia Ltd. an aggregate royalty (the "Attikamagen Royalty") of $1.50/tonne of "Iron Content in any and all Minerals mined and processed' from Mineral Licences 011363M, 011499M and 011500M "measured and calculated at the port when shipped." As it relates to the current Mineral Licences:
  - As a result of splitting and regroupings, the lands previously covered by Licence 011363M are now covered by Licence 020231M and Licence 020238M.
  - As a result of regrouping, the lands previously covered by Licence 011499M are now covered by Licence 020231M.
  - As a result of splitting and renumbering, the lands previously covered by Licence 011500M are now covered by Licence 020231M and Licence 020238M.

Champion subsequently assigned its rights under the Attikamagen Royalty to Labec Century and Labec Century concurrently assumed the obligations of Champion under the Attikamagen Royalty. The Attikamagen Royalty will continue as long as iron ore of economic value exists on the Royalty Properties. Pursuant to the terms of the Attikamagen Royalty Agreement, Joyce Direct, as the ultimate assignee of Champion Minerals, has the right, at any time, to purchase 3099869 Nova Scotia Ltd.'s royalty interest upon payment of $2,500,000. The Attikamagen Royalty has been assumed by JDI under the Labec Century Royalty Agreement described below.

- A royalty agreement dated November 29, 2013 between Champion Minerals, Labec Century and Century that has been registered at the Confidential Registry maintained by the Mineral Claims Recorder under the names of Champion Minerals, Labec Century and Century (the "Champion Royalty Agreement'). Further to Section 2 of the Champion Royalty Agreement, Labec Century (as payor) agreed to pay Champion Minerals (as payee) a royalty as follows (with capitalized terms as defined in the Champion Royalty Agreement) (the "Champion Royalty"), which Champion Royalty has been assumed by JDI under the Labec Century Royalty Agreement described below:
  - One percent (1%) in total (and not individually if the payor is comprised of more than one person) of the sale price of any and all Minerals mined from the Area of Interest by or on behalf of the payor or any affiliate, until such time as the sum of $2,500,000 has been paid or become payable by the payor to the payee as royalty payments, which sale price shall be equal to the invoice price at the point of sale less all transportation, loading, stockpiling or other costs from the time the minerals leave the Area of Interest to the completion of the sale.
  - After the sum of $2,500,000 has been paid or become payable by the payor to the payee as royalty payments, two percent (2%) in total (and not individually if the payor is comprised of more than one person) of the sale price of any and all minerals mined from the Area of Interest by or on behalf of the Payor or any Affiliate, which sale price shall be equal to the invoice price at the point of sale less all transportation, loading, stockpiling or other costs from the time the minerals leave the Area of Interest to the completion of the sale.
  - The lands subject to the Champion Royalty are all now entirely comprised within the Mineral Licences as a result of subsequent splitting and groupings of licences and the Mineral Licences are, accordingly, subject to the Champion Royalty Agreement in accordance with its terms. For the purposes of the Champion Royalty Agreement, "Area of Interest" includes the property subject to the Champion Royalty and the part of any and all mining or mineral claims, licences or other forms of tenure that are at the time hereof, or at any time hereafter, wholly or partially within a ten-kilometre boundary of the external perimeter of such properties.

- An amended and restated royalty agreement dated effective December 30, 2020, between JDI and Labec Century (the "Labec Century Royalty Agreement') pursuant to which JDI has assumed the Attikamagen Royalty and Champion Royalty obligations and agreed to pay JDI a royalty as follows (the "Labec Century Royalty"):
  - JDI has assumed and agreed to pay and otherwise discharge all of the royalty payment obligations under the Attikamagen Royalty that apply to the Mineral Licenses with respect to the Attikamagen Royalty;
  - JDI has assumed and agreed to pay and otherwise discharge all of the royalty payment obligations under the Champion Royalty that apply to the Mineral Licenses with respect to the Champion Royalty; and
  - JDI agreed to pay to Labec Century, for any month that the Average Monthly Benchmark Iron Ore Price (as defined in the Labec Century Royalty Agreement) is equal to or greater than USD130.00 per tonne, a royalty determined as:
    - Three percent (3%) in total of the product of (i) the average Benchmark Iron Ore Price for the applicable calendar month (average determined over all days in which a Benchmark Iron Ore Price is available during the applicable month), multiplied by (ii) the total of any and all minerals sold from the Joyce Lake Property during each month, less;
    - the total amounts payable under the Attikamagen Royalty Agreement and the Champion Royalty Agreement for the applicable month.
  - For the purposes of the Labec Century Royalty:
    - "Benchmark Iron Ore Price" means the daily spot price for 62% Fe fines or lumps, as the case may be, delivered to China as determined by reference to a minimum of three widely quoted exchanges, such as the Dalian Commodity Exchange, Hong Kong Stock Exchange, Singapore Stock Exchange, or industry indices or publications, such as The Steel Index, Platts, acceptable to the Payee, adjusted to the actual grade shipped for any difference in pricing due to grade variation from 62% according to the prices quoted by these Exchanges or indices for the varying grades.
- JDI may repurchase all or a portion of the Labec Century Royalty, at the option of JDI, by delivering written notice of the exercise of such option to Labec Century and paying to Labec Century within 30 days of exercise the following amounts as the purchase price:
  - JDI may repurchase 100% of the Labec Century Royalty at any time for a purchase price of $20 million;
  - JDI may repurchase 50% of the Labec Century Royalty at any time for a purchase price of $10 million;
  - At any time after JDI has repurchased a 50% interest in the Royalty, JDI may repurchase the remaining 50% for a purchase price of $15 million.

4.5 Environmental Considerations

The Joyce Lake DSO Project is at an advanced development stage. The immediate Project area is uninhabited and cannot be accessed by road. The area has been the object of limited historical surface exploration work. The surface disturbances arising from the historical exploration work, including work undertaken by JDI and its predecessor companies, are negligible. Further details regarding the Project's environmental setting are provided in Chapter 20.

4.6 Permitting

The federal Environmental Assessment ("EA") for the Project is regulated under the *Canadian Environmental Assessment Act, 2012* ("CEAA 2012") and is administered by the Impact Assessment Agency of Canada ("IAAC"). Under the CEAA 2012, projects included in the *Regulations Designating Physical Activities* require federal EA. The Project is a Designated Project pursuant to the *Regulations Designating Physical Activities* (Schedule of Physical Activities, Section 16(a)) as it involves the construction, operation, and decommissioning of a metal mine, other than a gold mine, with an ore production capacity greater than 3,000 t/d. The production target for the Project is up to 2.5 Mtpa, which is equivalent to over 5,000 t/d on an annual basis. Designated Projects are "screened" under the process described in Sections 8 through 12 of the CEAA 2012 to determine whether an EA is required.

The Project is also subject to EA under the Newfoundland and Labrador *Environmental Protection Act* ("NLEPA") and associated *Environmental Assessment Regulations*. The EA Division of the Newfoundland and Labrador Department of Environment and Climate Change ("NL-ECC") administers the process. An undertaking that is subject to the NLEPA is required to be registered for examination by the NL-ECC. The registration outlines the proposed project and describes how it will affect the biophysical and socio-economic environment. At the conclusion of the review period, the Minister advises the proponent whether the undertaking will require an Environmental Preview Report ("EPR") or an Environmental Impact Statement ("EIS"), or if the undertaking has been released or rejected.

A Project Description and Summary were accepted for review by the Canadian Environmental Assessment Agency (now the IAAC) on November 19, 2012. On January 4, 2013, the federal government determined that a federal EA was required. An EIS was submitted to the IAAC on May 21, 2021. The IAAC requested additional information on July 5, 2021, as part of the conformity review. A revised draft EIS was submitted to the IAAC on October 1, 2022. The IAAC determined, on November 7, 2022, that the revised draft EIS is in conformity with the federal EIS guidelines and can proceed to technical review. On July 28, 2022, the Project was granted an extension to continue under the CEAA 2012 process until December 31, 2025.

The Project was first registered with the NL-ECC on October 15, 2012, but the Newfoundland and Labrador process expired on November 18, 2016. The Project was registered anew with the NL-ECC on May 21, 2021 by filing the EIS submitted to the IAAC as the Registration document. The Minister's decision on the provincial EA process, issued on November 3, 2021, specified that a provincial EIS was required and that guidelines for preparation of the provincial EIS would be provided. The provincial draft EIS guidelines were issued on February 1, 2022 and the final EIS guidelines were issued on August 12, 2022, which are substantially similar to the former provincial guidelines. The Company is in the process of collecting and analyzing additional data, as necessary, to conform to the provincial final EIS guidelines.

One combined EIS will be submitted to both the provincial and federal authorities. The combined EIS will undergo a coordinated review in accordance with provincial and federal EA processes.

5. Accessibility, Climate, Local Resources, Infrastructure and Physiography

5.1 Accessibility

The Joyce Lake DSO Project is located approximately 20 km northeast of the town of Schefferville, Québec. Schefferville is accessible via the passenger and freight Tshiuetin railroad that connects to Sept-Îles, Québec. There is no road access to Schefferville but the town is serviced by an airport with daily flights to Sept-Îles and other communities. The unpaved Iron Arm Road connects Schefferville with Iron Arm Camp, which is on the west shore of the Iron Arm Channel in Attikamagen Lake. The Project is located on a peninsula in Attikamagen Lake, directly across the Iron Arm Channel from Iron Arm Camp. Access to the Project area is by boat in summer and snowmobile in winter from Iron Arm Camp. Helicopter access is available at any time.

5.2 Climate

Schefferville Airport's climate station provides comprehensive year-round monitoring with a record period that is sufficient for characterizing long-term climate conditions in the Project area. The station is located approximately 20 km from the Project site and the average year data are summarized in Table 5-1.

Landforms associated with permafrost such as pingos, palsas and stone nets are found in the physiographic region, however, have not been identified within the Joyce Lake regional study area. Construction over permafrost terrain is not an issue in western Labrador due to the limited distribution of permafrost and the thin sediment cover over bedrock (Vasseur and Catto, 2008). The presence of permafrost and permafrost-related landforms will be determined through site-wide geotechnical investigations to be completed prior to mine development.

Permafrost in the area of Schefferville is sporadic. Usually, permafrost is found in high ground areas where snow cover is minimized by winds and is not generally present under and in immediate proximity of wetlands and lakes. From geotechnical investigations, no evidence of permafrost was observed within the Project drillholes to date.

Table 5-1: Average year – Climatic data (1971-2000)

Month	Temperature	Rainfall (mm)	Snowfall (cm)	Precipitation (mm)	Snow Depth (cm)
January	-24.1	0.2	57.4	53.2	62.0
February	-22.6	0.2	42.6	38.7	70.0
March	-16.0	1.6	56.6	53.3	71.0
April	-7.3	8.4	54.8	61.4	69.0
May	1.2	27.7	22.9	52.1	18.0
June	8.5	65.4	8	73.7	0.0
July	12.4	106.8	0.5	107.2	0.0
August	11.2	82.8	1.7	84.5	0.0
September	5.4	85.3	12.7	98.4	0.0
October	-1.7	24.4	57.2	80.5	7.0
November	-9.8	4.5	70.7	69.4	26.0
December	-20.6	0.9	55.4	50.7	49.0
Year	**-5.3**	**408.1**	**440.5**	**822.9**	**31.0**

Average wind speed and direction is presented in Table 5-2. The annual average wind speed is approximately 17 km/h and the most frequent annual wind direction is from the northwest.

Table 5-2: Schefferville area – Average wind speed/direction (1971 – 2000)

	Speed (km/h)	Most Frequent Direction	Max Hourly Speed (km/h)	Max Gust Speed (km/h)	Direction of Max Gust	Days with Winds ≥52 km/h	Days with Winds ≥52 km/h
Jan	16.4	NW	85	134	W	0.7	0.7
Feb	16.8	NW	97	148	W	1.4	0.5
Mar	17.4	NW	83	148	SW	1.9	0.4
Apr	16.5	NW	77	130	W	1.1	0.2
May	16	NW	66	101	W	0.9	0.1
Jun	16.2	NW	97	126	W	0.4	0.1
Jul	15.1	NW	65	103	W	0.6	0.2
Aug	15.6	NW	61	117	W	0.4	0.1
Sep	16.9	NW	80	137	SW	0.8	0.1
Oct	17.8	NW	89	137	SW	1.1	0.1
Nov	17.3	NW	84	142	SW	1.8	0.3
Dec	16	NW	80	153	SW	2.1	0.6
Year	**16.5**	**NW**	**80**	**131**	**SW**	**13.9**	**3.3**

Due to its high latitude location, the Schefferville area has short daylight periods in the winter and extended daylight hours in summer.

5.3 Local Resources

The workforce for this Project can be sourced from fly-in-fly-out workers based in communities in the Labrador Trough region of Newfoundland and Labrador and additionally from road-accessible local towns and Indigenous communities in Québec, close to the Project.

The modern airport at Schefferville includes a 1,520 m paved runway and navigational aids for passenger jet aircraft. There is also a floatplane aerodrome at Squaw Lake, 4 km east of Schefferville airport. From the main airport, air service is provided three times per week to Wabush, Labrador, with less frequent service to Montréal or Québec City, via Sept-Îles. In summer, the flight frequency is higher.

Tshiuetin Rail Transportation Inc. provides regularly scheduled, year-round, passenger and freight service between Sept-Îles and Schefferville.

5.4 Infrastructure

Schefferville is in the heart of Naskapi and Innu territory in northern Québec. The town completely surrounds the autonomous Innu reserve of Matimekosh, and it abuts the small Lac-John Reserve.

Schefferville is also close to the Naskapi community of Kawawachikamach, which is the closest community to the Project. The Schefferville waste, recycling and accompanying landfill services supports the three local communities.

Schefferville has a fire department, a fire station and firefighting equipment. The police force serves both Schefferville and Matimekush-Lac John. Schefferville Indigenous healthcare and social services are provided by the Innu Local Community Service Centre. The Dispensaire de Schefferville provides the non-Indigenous community with limited healthcare services. Drinking water is taken from Lac Knob which lies within the municipal boundary. The town also boasts a municipal garage, small motor repair shops, a local hardware store, a mechanical shop, and a local convenience store. There are four hotels in the Schefferville region.

The Menihek hydro-power plant is 35 km southeast of Schefferville and was originally constructed to support iron ore mining but now provides power particularly for winter heating of housing in and around the Schefferville area. A small quantity of excess power is available in summer months but the combination of restricted and seasonal supply and the hydro-generating plant and power line locations makes economical power supply to the Project unlikely.

5.5 The Railroad

Schefferville is accessible by train from Sept-Îles. The Québec North Shore & Labrador Railway ("QNS&L") was established in 1954 by IOC to haul iron ore from Schefferville area mines to Sept-Îles; a distance of 568 km. After shipping some 150 million long tons of iron ore from the area, the mining operation was closed in 1982, but a division of IOC, QNS&L, maintained a passenger and freight service between Sept-Îles, Labrador City and Schefferville until 2005.

In 2005 IOC sold the 208 km section of the railway between Emeril Yard at Ross Bay Junction and Schefferville (the Menihek Division) to Tshiuetin Rail Transportation Inc. ("TRT"), a company owned by three Québec First Nations. The mandate of TRT is to maintain the passenger and light freight traffic between Sept-Îles and Schefferville. Train departures from Sept-Îles and Schefferville occur three times a week (schedule may be impacted due to COVID-19).

Rail operators in the Project region are listed in Table 5-3.

Table 5-3: Rail operators in the Labrador Trough

Iron Ore Products – Rail Operators in the Labrador Trough		
Operator	**From**	**To**
KéRail	TMSC Mine	Connects to TRT at Schefferville
Tshiuetin Rail Transportation Inc (TRT)	Schefferville	Connects to QNS&L at Emeril/Ross Junction
Champion Railway	Bloom Lake Mine	Connects to QNS&L at Labrador City
Québec North Shore and Labrador Railway (QNS&L)	Wabush/Labrador City	Sept-Iles IOC Port
	Wabush/Labrador City	Arnaud Junction/ Sept- Îles, connects SFPPN
	Emeril/Ross Junction	Sept-Iles IOC Port
	Emeril/Ross Junction	Arnaud Junction/ Sept- Îles, connects SFPPN
SFP Pointe Noire ("SFPPN")	Arnaud Junction/ Sept- Îles	Pointe-Noire Multiuser Port
Arcelor-Mittal Industries[(1)]	Mont Wright	Port Cartier

Note:

(1) Rail runs only between Mont Wright and Port Cartier and is not connected to other rail lines.

SFPPN includes a short 34-km rail line from Arnaud Junction to Pointe Noire and railcar dumping and ore stockpiling facilities that proceed and feed the Multiuser Port. Some expansion of SFPPN's ore dumping and stockpiling capacity may be necessary for the Joyce Lake DSO Project. The Multiuser dedicated iron ore port at Pointe Noire is a year-round deep water ocean port capable of handling up to China Max vessels. A preliminary assessment indicates the Multiuser Port has adequate capacity to handle the Joyce Lake DSO Project.

5.6 Physiography

The topography of the Schefferville mining district is bedrock controlled, with the average elevation varying between 600 m and 700 m above sea level. The terrain is generally gently rolling to flat, sloping northwest, with a total relief of approximately 50 m to 100 m.

In the main mining district, the topography consists of a series of northwest and southeast trending ridges while the Astray Lake and Sawyer Lake areas are within the Labrador Lake Plateau. Topographic highs in the area are normally formed by more resistant quartzites, cherts and silicified horizons of the iron formation itself. Lows are commonly underlain by softer siltstones and shales.

Generally, the area slopes gently west to northeast away from the land representing the Québec–Labrador border and towards the Howells River valley. The finger-shaped area of Labrador that encloses the Howells River, drains southwards into the Hamilton River watershed and from there into the Atlantic Ocean. Streams to the east and west flow into the Kaniapiskau watershed, which flows north into Ungava Bay.

5.7 First Nations Social Context

The Client has been mandated by the Government of Canada to consult with five Indigenous groups with asserted land claims or traditional territory identified in the vicinity of the Project:

- Innu Nation of Labrador;
- Naskapi Nation of Kawawachikamach;
- NunatuKavut Community Council;
- Innu First Nation of Matimekush-Lac John; and
- Innu First Nation of Uashat mak Mani-Utenam.

Consultation and engagement with Indigenous groups began in 2010 and will be ongoing through the Federal and Provincial Environmental Assessment ("EA") processes and is expected to continue though construction, operation and closure of the Project.

Additionally, negotiation of IBA's are expected to take place prior to construction of the Project, with up to five of the Indigenous communities listed above.

Two Indigenous communities are located in the immediate vicinity of the Project: the Naskapi Nation of Kawawachikamach and the Innu Nation of Matimekush-Lac John. The following Figure 5-1 shows the Project location in relation to the local Indigenous communities.

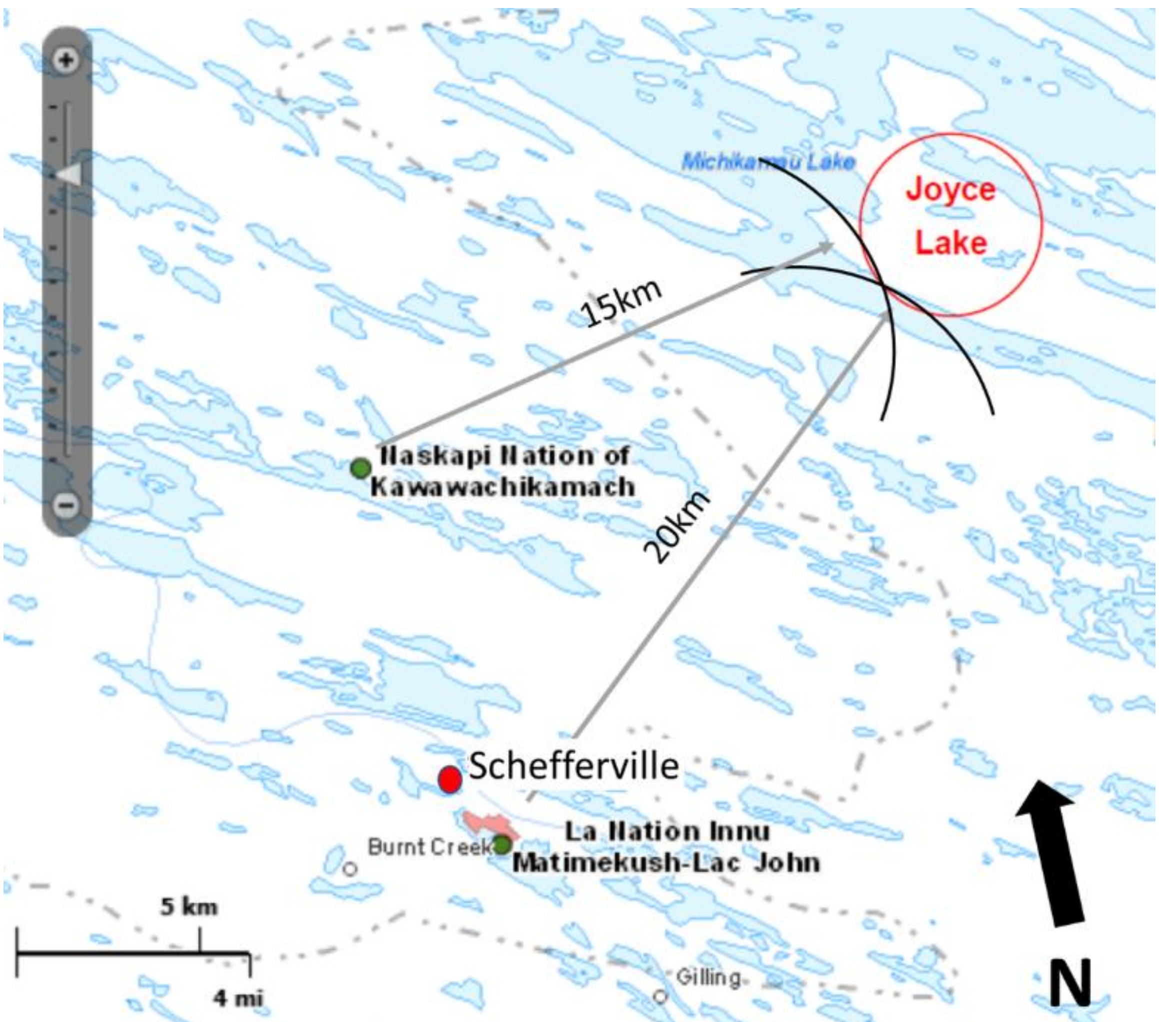


Figure 5-1: Indigenous community locations
(from Aboriginal Affairs and Northern Development Canada)

5.7.1 The Naskapi Nation

The Naskapi Nation of Kawawachikamach is located approximately 10 km northeast of the Town of Schefferville, close to the Québec-Labrador border, and has a population of approximately 691 registered members (as of December 2020). The village itself is situated on approximately 41 km^2 of Category IA-N land and covers an area of approximately 16 ha. There is ample room for expansion, whether for residential, commercial, or industrial purposes. Based on the 2021 Census, approximately 28% of the population was under 15 years of age (Statistics Canada, 2022a).

The majority of the residents of Kawawachikamach are Naskapi. Naskapi is the principal language, and it is spoken by all Naskapi and written by many. English is the second language, although many residents also speak French.

The Naskapi still preserve many aspects of their traditional way of life and culture. Like many northern communities, the Naskapi rely on subsistence hunting, fishing, and trapping for a large part of their food supply, and for many raw materials. Harvesting is at the heart of Naskapi spirituality.

5.7.2 The Innu Nations

There are two Innu reserves on the outskirts of Schefferville: Matimekosh 3 and Lac John, which comprise the Innu Nation of Matimekush-Lac John. Both are in the North Shore Administrative Region, in the Regional County Municipality of Caniapiscau. The Matimekosh 3 Reserve is adjacent to Lac Pearce, while the Lac John Reserve is some 4 km east of Schefferville. The Lac John Reserve covers 0.5 km^2 (Statistics Canada, 2022a) and the Matimekush Reserve covers an area of 0.69 km^2 (Statistics Canada, 2022b).

Approximately 680 members of the Innu Nation of Matimekush-Lac John live on the two local reserves. Based on the 2021 Census, approximately 35% of the population was under 15 years of age (Statistics Canada, 2022b).

6. History

The following history dialogue from 1937 and 1982 is an extract from: MRB & Associates, Geological Consultants NI 43-101 technical report, the Attikamagen iron property, western Labrador, Newfoundland and Labrador by John Langton, M. Sc., P. Geo., and Doug Clark, P. Geo., April 8, 2009 (Amended September 24, 2009) (Langton and Clark, 2009).

> *"Labrador Mining and Exploration ("LM&E") discovered iron formation in 1937 and explored the area between Petitsikapau and Iron Arm from 1937 to 1939. Work by B.C. Freeman and another project by J.A. Retty consisted of 1:4,800 scale surfaces mapping and sampling. A limited control grid was established to provide a systematic framework for subsequent chip sampling across the iron-rich rocks. This sampling included the metallic iron formation (unleached iron formation beds), as well as the lean chert and chert/jasper horizons.*
>
> *LM&E returned to the Property in 1942-1943. A.E Moss compiled data from other workers and produced detailed maps at 1:4,800 scale. He reports that "several prospecting teams (have) examined much of the area...and a great many specimens have also been collected". During this time two bulk samples were obtained and submitted to the American Cynamid Co. to determine the amenability of the ore to beneficiation. "The results were that the intimate association of the silica and iron prevented any of the siliceous ores of the area from being amenable to the large-scale methods of beneficiation which were being employed at that time in the Lake Superior region". It was noted, however, that "tremendous tonnages of these siliceous ores are available in the area and may become of commercial value with the improvement of beneficiation methods" (Retty, 1945). Analysis of Sample "A" gave 45.9% Fe and 20.2% SiO2. Sample "B" contained 41.1% Fe and 34% SiO2. In reference to the metallurgical test work there were very few details of the testing procedure employed. It is significant to note that metallurgical test work at that time typically involved the grinding of samples to 100 mesh - 200 mesh. Today, prospective iron samples are ground as fine as 325 mesh to achieve acceptable liberation of gangue minerals.*
>
> *In 1951, a geological mapping project was conducted west of Attikamagen Iron by L.C.N. Burgess working for the Iron Ore Company of Canada ("IOC"). This program focused on the area between Attikamagen and Schefferville. The iron formation on the finger of land between Iron Arm and Petitsikapau Lake was also examined. In 1952, a regional survey by T.N. Walthier of IOC examined 100km of iron formation in the areas around Iron Arm, Dyke Lake and Snelgrove Lake (54°35'N, 64°50'W). He reports a small number of analytical results from hand samples and chip samples.*

In 1953, IOC evaluated the area north of Attikamagen Lake. R. Girardin led a five-man field party. LM&E examined the Attikamagen area in 1961 as reported by R.A. Crouse. Work consisted of 31 magnetometer lines totalling 24 km over mainly drift-covered areas to delineate the iron formation. Seventy grab samples and one bulk sample were collected and analyzed.

In 1978, J.B. Stubbins did geological reconnaissance mapping and sampling for LM&E in the Lac Sans Chef and Joyce Lake areas. Locations and analytical results of 15 iron formation samples were reported. Forty-eight lake sediment samples were collected near the shores of Iron Arm by J.M. Grant in the same year. The locations and analytical results of 16 samples were reported.

In 1979, LM&E drilled one diamond drillhole at the northern end of the deposit. This 6 m hole was logged by J.M. Grant as cherty metallic iron formation and had an estimated iron content of 25% to 30%. A regional airborne geophysical survey was conducted over parts of the Labrador Trough by Scintrex Ltd. for LM&E in 1980. Instruments used included a GAD-6 scintillometer, an HEM-802 electromagnetic instrument and a MAP-4 proton precision magnetometer (Grant, 1980). The results of the survey indicated seven high U/Th ratios mostly over the slates. The magnetic intensity ranged from a background of 57,000 gammas to as high as 65,000 gammas over the iron formation. Many conductive horizons were recorded over the Menihek, Attikamagen (Le Fer formation) and Dolly Slate formation. This was thought to represent an increase in magnetite content.

Also, in 1980 LM&E contracted Scintrex to fly an airborne geophysical survey consisting of 328 line kilometres over the Attikamagen Iron area. The airborne survey was focused on possible base metal mineralization not iron ore. Work continued in the area in 1981 with an induced polarization ("IP") survey conducted by Phoenix Geophysics Ltd. The intent of this work was to follow up on previously outlined anomalies resistivity and IP anomalies. Limited ground spectrometer surveys indicated and identified a low-level uranium anomaly on the Property. No boulders or outcrops were found that would have accounted for these readings

In 1982, IOC closed its mining operations in the Schefferville area and exploration ceased. However, due to the extraordinary iron ore demand from China during its remarkable historic economic development and creating an unprecedented Super Cycle in the early 2000s, subsequent investments of over a billion dollars were made in the Schefferville area by the Client, Tata Steel (Canada), New Millennium and Labrador Iron Mines in exploration and development as well as restoration of the heavy duty iron ore rail line used to transport iron ore products from Schefferville area to Sept Iles ocean ports.

In 2007, Champion conducted an airborne magnetic, gamma-ray and VLF-EM (very low frequency - electromagnetic) geophysical survey on the Attikamagen Property, as well as a preliminary surface mapping and a reconnaissance sampling program to provide ground reference samples for correlation with the geophysical data. In May 2008, the Attikamagen property was optioned to Century Iron Ore Inc.

In early 2010, the ground gravity survey provided crucial information leading to the drilling programs of 2010 and 2011. Gravity profiles were carried out on Joyce Lake Area. Strong gravity highs were systematically associated with low magnetic anomalies indicative of potential DSO targets. They were identified in each of the investigated areas. At Joyce, the high gravity mostly matched well with low magnetic anomalies, while at south, high gravity correlating to a magnetic high may indicate magnetic iron formation.

From 2010 to 2013, Century conducted several drill programs using reverse circulation and core drilling. Four exploratory holes were drilled in 2010, followed by definition drilling of the deposit from 2011 to 2013. In total, 176 holes were drilled, approximately 19,453.42 metres of drilling, to support mineral resource estimates, economic studies of the non-current 2015 Feasibility Study as well as the current Feasibility Study.

From 2012 through 2015, Century conducted geological, metallurgical, hydrogeological, and geotechnical test work in addition to biophysical surveys in support of economic studies culminating in a May 2013 PEA and an April 2015 FS, neither of which is now current.

7. Geological Setting and Mineralization

This chapter describes the geology of Schefferville including the geological structures of Joyce Lake and its deposits mineralization.

7.1 Regional Geology

The Iron Arm - Attikamagen Lake area is located northeast of Schefferville, Québec, and is part of the much larger area that includes the Schefferville Mining District. The area is underlain primarily by rocks that form the western, miogeosynclinal part of the Labrador Trough (Figure 7-1) in the Churchill Province of the Canadian Shield. These rocks are mainly sedimentary strata of early Proterozoic (Aphebian) age.

To the west (Howells River area) these sediments lie in unconformity on the Archean gneisses of the basement complex and to the east they pass into the eugeosynclinal facies of the Labrador Trough. The sedimentary sequence is referred to as the Knob Lake Group (Kaniapiskau Supergroup) and in the central Labrador Trough it consists of the following members (ascending order) as seen in Figure 7-2:

- Seward Subgroup (Wardle, 1982) consisting of the Discovery Lake, Snelgrove Lake and Sawyer Lake formations;
- Attikamagen Subgroup (Wardle, 1982) consisting of the Le Fer, Denault, Dolly and Fleming formations; and
- Ferriman Subgroup (Wardle, 1982) consisting of the Wishart, Sokoman, Nimish (a local name/time equivalent unit to the Sokoman cherty iron formation), and Menihek formations.

The Kaniapiskau Supergroup has been intruded by numerous diabase dykes known as the Montagnais Intrusive Suite. These dykes, along with the Nimish volcanics (greenstones), are the only rock types representing igneous activity in the western part of the central Labrador Trough.

Harrison et al. (1972) divided the area structurally into three zones Figure 7-3:

- A western marginal zone (Howells River area);
- A zone of close spaced folds and thrust faults (Schefferville Mining District); and
- An eastern zone of more widely spaced folds and faults.

The Iron Arm - Attikamagen Lake area is within the Eastern Zone and lies on the eastern limb of the Petitsikapau Synclinorium, a major structural feature in the central part of this zone.

The Eastern Zone, as defined by Harrison et al. (1972), lies to the northeast of the Knob Lake thrust fault and extends to the Iron Arm - Attikamagen Lake area.

According to Harrison et al. (1972), it is believed to be underlain by strata of the Attikamagen (i.e., Le Fer formation of Wardle, 1982), Denault, Dolly, Wishart, Ruth, Sokoman and Menihek formations.

Apart from the Knob Lake fault, only one other major thrust fault was defined by Harrison et al. (1972) in this area. This fault lies about 3.2 km east of the Knob Lake fault and brings strata of the Denault against the Sokoman formation. The fault has a stratigraphic shift of several thousand metres. A number of straight lineaments in the broad belt underlain by Menihek slatey rocks northeast of this fault have been interpreted as thrust faults. The displacement on these faults is unknown.

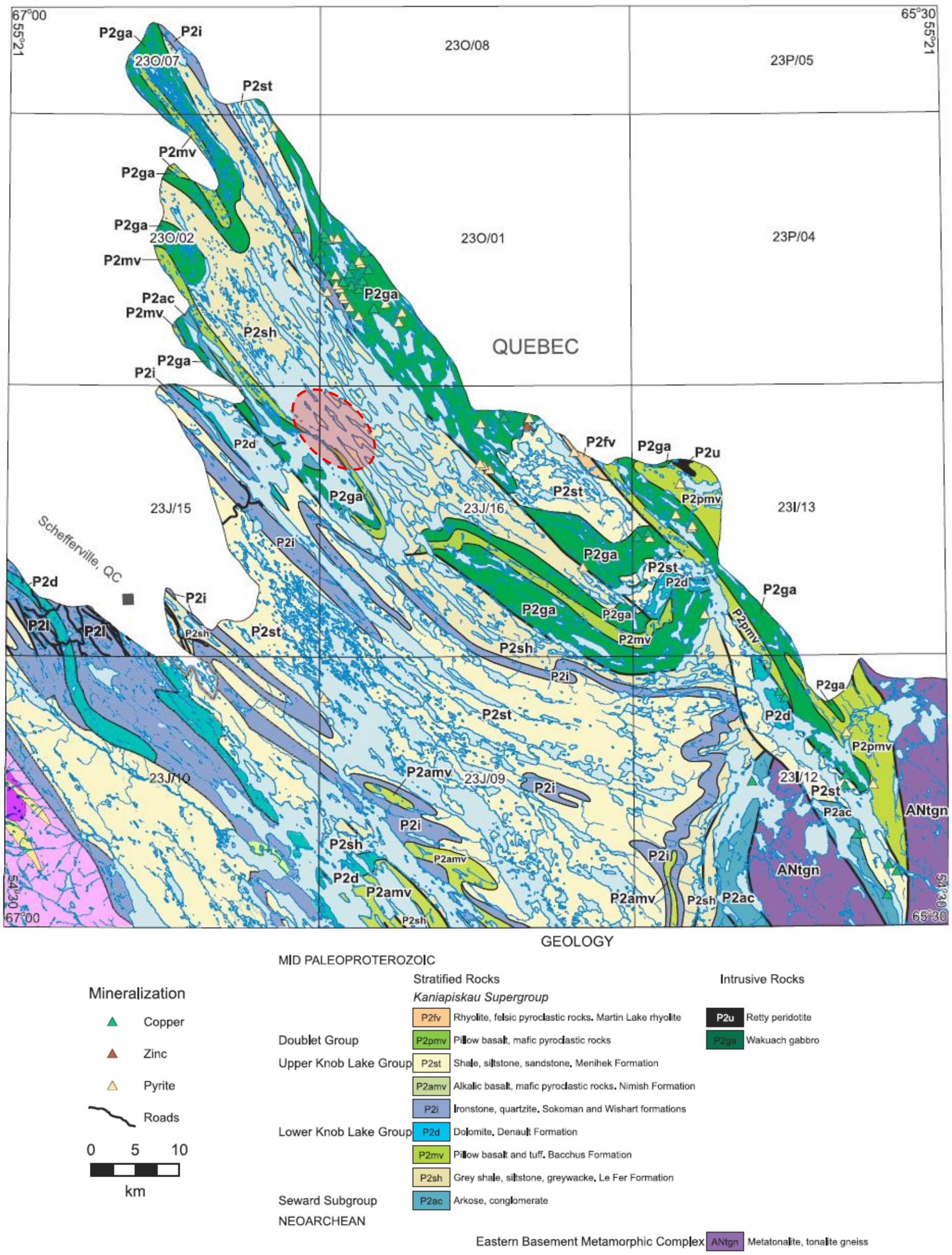


Figure 7-1: Geology of Schefferville area from Newfoundland and Labrador Department of Natural Resources
The red oval presents the Joyce Lake DSO Project area

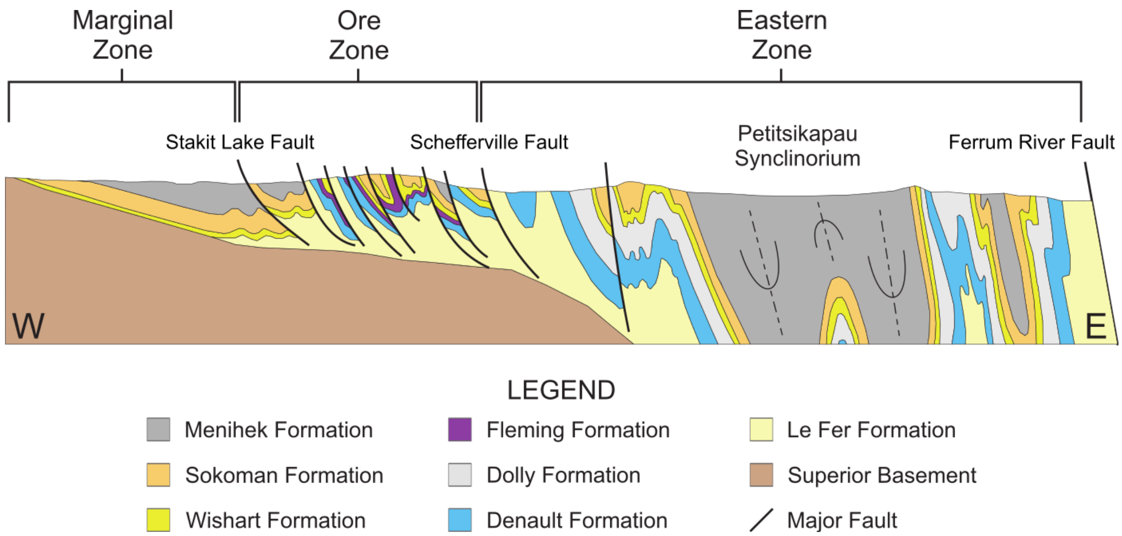


Figure 7-2: Schematic cross-section through the central Labrador Trough (modified after Conliffe, 2015)

Open to tightly closed folds with axial planes dipping about 80 degrees to the northeast are believed to be the characteristic fold pattern of the competent units of the zone (Harrison et al., 1972).

The Menihek slates are intersected by a pronounced axial cleavage plane that dips 80 degrees to the northeast. The Menihek strata may be much more complexly deformed than the underlying, stronger layers (Harrison et al., 1972).

Harrison et al. (1972) stated that the, rather abrupt, change in the style of deformation east of the Knob Lake fault is attributed to stratigraphic factors. Probably, the development of an intricate pattern of faults and folds in the Eastern Zone was inhibited by the greater thickness of strata. This increased thickness is due to the appearance of the Dolly formation and to an increase in the thickness of the Denault formation.

Burgess, summarized the local structure in the Attikamagen area as being simple, consisting of gently plunging linear folds that strike in a northwest direction. More complex structures occur west of Lac Sans Chef and in the vicinity of Joyce Lake. In both cases, faulting accompanies the folding and, in the area west of Lac Sans Chef, there are numerous folds which die out in a matter of thousands of metres.

According to Burgess (1951), around Joyce Lake, the structural picture is a confused one. The syncline is not a simple one for it seems quite certain that there are second magnitude folds, which account for the distribution of the lenses of Wishart and Attikamagen (Dolly formation of Harrison et al., 1972). On the east limb of the syncline there is iron formation faulted up between the Wishart and Dolly formations.

7.1.1 Geology of Schefferville Area

The sedimentary sequence of the Knob Lake Group consists of two sedimentary cycles (Figure 7-4).

- **Cycle 1** (the Attikamagen Subgroup of Wardle. 1982) is a marine shelf succession comprising the Le Fer, Denault, Dolly, and Fleming formations.
- **Cycle 2** (the Ferriman Subgroup of Wardle, 1982) represents deposition in a deeper water slope-rise environment. It begins with a transgressive quartz arenite, Wishart formation, followed by shale and iron-formation of the Sokoman formation and conformably overlain by the Menihek formation.

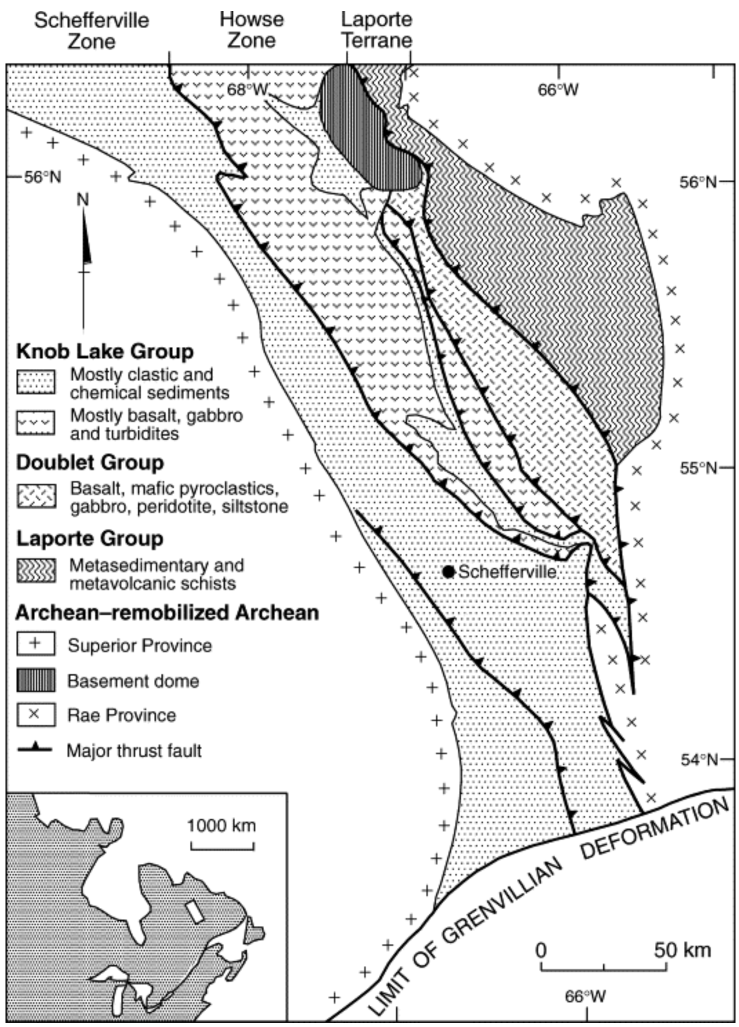


Figure 7-3: Lithotectonic subdivisions of the Central Labrador Trough (from Williams and Schimdt, 2004)

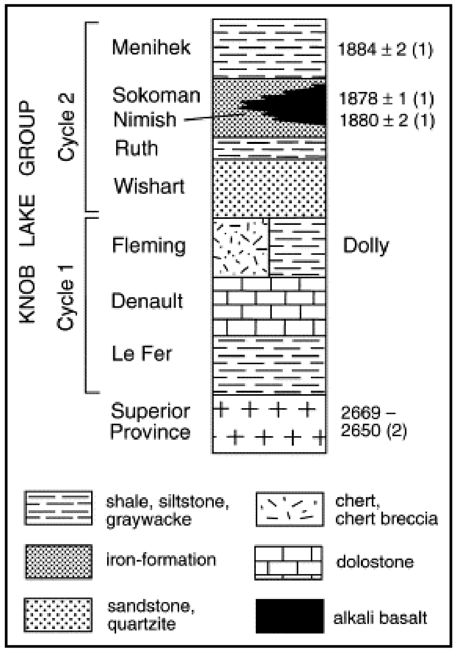


Figure 7-4: Generalized stratigraphy of the Knob Lake Group (from Williams and Schmidt, 2004 with numbers representing ages of rock units in million years)

Attikamagen Subgroup – Is exposed in folded and faulted segments of the stratigraphic succession where it varies in thickness from 30 m near the western margin of the Labrador Trough. The lower part of the formation has not been observed. It consists of argillaceous material that is thinly bedded (2-3 mm), fine grained (0.02 mm to 0.05 mm), grayish green, dark grey to black, or reddish grey. Calcareous or arenaceous lenses, as much as 30 cm in thickness, occur locally inter-bedded with the argillite and slate, and lenses of chert are common. The formation grades upwards into Denault dolomite, or into Wishart quartzite in areas where dolomite is absent. Beds are intricately drag-folded, and cleavage is well-developed parallel with axial planes, perpendicular to axial lines of folds and parallel with bedding planes.

Denault Formation – Is inter-bedded with the slates of the Attikamagen formation at its base and grades upwards into the chert breccia or quartzite of the Fleming formation. The Denault formation consists primarily of dolomite, which weathers buff-grey to brown. Most of it occurs in fairly massive beds that vary in thickness from a few centimetres to about one metre, some of which are composed of aggregates of dolomite fragments.

Fleming Formation – Has a maximum thickness of about 100 m and consists of rectangular fragments of chert and quartz within a matrix of fine chert. In the lower part of the formation the matrix is dominantly dolomite, grading upwards into chert and siliceous material.

Wishart Formation – Quartzite and arkose of the Wishart formation form one of the most persistent units in the Kaniapiskau Supergroup. Thick beds of massive quartzite are composed of well-rounded fragments of glassy quartz and 10-30% rounded fragments of pink and grey feldspar, well-cemented by quartz and minor amounts of hematite and other iron oxides. Fresh surfaces of the rock are medium grey to pink or red. The thickness of the beds varies from a few centimetres to about one metre but exposures of massive quartzite with no apparent bedding occur most frequently.

Ferriman Subgroup

Ruth Formation – Overlying the Wishart formation is a black, grey-green or maroon ferruginous slate, 3 m to 36 m thick. This thinly banded, fissile material contains lenses of black chert and various amounts of iron oxides. It is composed of angular fragments of quartz with K-feldspar sparsely distributed through a very fine mass of chlorite, white mica, iron oxides and abundant finely disseminated carbon and opaque material. Much of the slate contains more than 20% iron.

Sokoman Formation – The Sokoman formation is the main iron formation host throughout the Labrador Trough. Its thickness varies between 120 m and 240 m. The basal facies of the Sokoman formation at Joyce Lake are composed of alternating micro- to macro-bands of hematite, magnetite, siderite (ankerite) with red, white and green cherts. This assemblage was affected by alteration and oxidation processes through which carbonate and silica were leached out while magnetite oxidized to martite. Based on field observations and logging data gathered from RC-chips at Joyce Lake, three members of units can be identified as follows: UIF, MIF, LIF.

The Upper Iron Formation ("UIF"), between 10 m and 20 m average thickness, consists of mesobands of cherts and iron oxides that can be divided into two sub-members, UMH and RC.

- Upper Massive Hematite ("UMH") consists of Hematite, Magnetite, Jasper and white, grey and red cherts. This sub-member has more Hematite, Magnetite and significantly less jasper (occurs as uncommon globules and laths) than the RC and is considered to be an enriched variety of the RC. It is moderately massive with the dominant mineral being medium-grained hematite and with minor magnetite, also with occasional pockets of specularite and abundant goethite. It weathers easily in the field, leaving minimal-to-no outcrop.
- Red Chert ("RC") has much more red chert, so percentage iron is reduced when compared to the UMH. It is usually mesobanded hematite and red chert with a weak planar fabric, some jasper (15-20%) and coarse oolites of hematite with ringed jasper - fine oolites. No discernible bedding or cleavage. There is also no green chert in RC compared with LIF, which can be clearly separated into these two units.

The Middle Iron Formation ("MIF") (10-60 m), which is highlighted on the Joyce Lake map as LMH, is similar to the UMH. This member contains significantly more Hematite and Magnetite than UIF and LIF. MIF contains Hematite, Magnetite, white chert and carbonate. It is also moderately massive with interlaying bands of white chert to carbonate and massive hematite and specularite. It is weakly magnetic with occasional pods of specularite and tension gashes of specularite and/or magnetite. It displays a leached texture typical of DSO, with large (>5 m) zones of massive hematite and specularite with minor, or no, white chert bands. Red chert is present only in very small amounts. It comprises sub-units known as Upper Red Chert ("URC"), Pink Grey Chert ("PGC") and Lower Red Chert ("LRC").

- In the field, the URC consists of light to dark red coarse-grained three- to fifteen-centimetre-thick non-magnetic cherty layers inter-bedded with light to dark grey or bluish hematite-magnetite medium- to coarse-grained weakly to non-magnetic iron formation layers (Figure 7-5). This unit usually forms topographic highs.
- The PGC comprises 10 cm to 30 cm thick layers of thinly laminated, light to dark grey, fine-to medium-grained moderately to strongly magnetic iron formation with light grey to brown, medium-grained, 0.5 cm to 5.0 cm thick, weakly to non-magnetic cherty layers (Figure 7-6). PGC is recessive in both Hayot and Hayot East Areas and outcrops in topographic lows, while at Sans Chef North it occupies kilometric outcrops of anticline structure. Both the PGC and URC are the most consistently magnetic, illustrating the higher concentration of magnetite from field observations.

The URC is locally magnetic at the base, but it is commonly non-magnetic. In general, the URC is coarser grained with corresponding coarser beds when compared to the PGC that is composed of finer grain sized beds and corresponding thinner beds, suggesting a deeper depositional environment.

The Lower Iron Formation ("LIF") is the lowest member in the Sokoman formation stratigraphy column that contains much more chert and low hematite. Based on field observation, it has micro to medium banding of chert and iron oxides. The LIF consists of two sub-members: LRC and Ruth shale.

- The Lower Red Chert ("LRC/LRGC-LIF") consists of green and red chert, magnetite (5 cm to 20 cm thick), carbonate and hematite. Green chert and higher magnetite are key factors for this sub-member.
- The Ruth Shale ("RS") sub-member, previously considered as a separate formation, contains black shale with traces of pyrite and also magnetite, hematite or quartz at the top. Few thin hematite layers are rarely observed at the top of this sub-member. Please note, this sub-member was highlighted on the Joyce Lake geologic map and all cross sections by its historical name, "Ruth formation".

This rock shows a very continuous horizon of thinly banded hematite-jasper rich layers with carbonate blobs, some of them being fresh and others totally altered. The matrix is the same colour on fresh and altered surface and some horizons have magnetite introduced in. In the LRC, magnetite occurs in 5 cm to 20 cm thick, strongly magnetic, laminated magnetite beds intercalated with weakly magnetic red magnetite-bearing chert over a thicknesses of approximately 15 m.

Menihek Formation – A thin-banded, fissile, grey to black argillaceous slate conformably overlies the Sokoman formation in the Joyce Lake area. The total thickness is not known, as the slate is found in faulted blocks in the main mineralized zone and forms the large hills south of the Joyce Lake area.

The Menihek slate is mostly dark grey or jet black. It has a dull sooty appearance but weathers light grey or becomes buff coloured where leached. Bedding is less distinct than in the slates of other slate formations but thin laminations or beds are visible in thin sections.

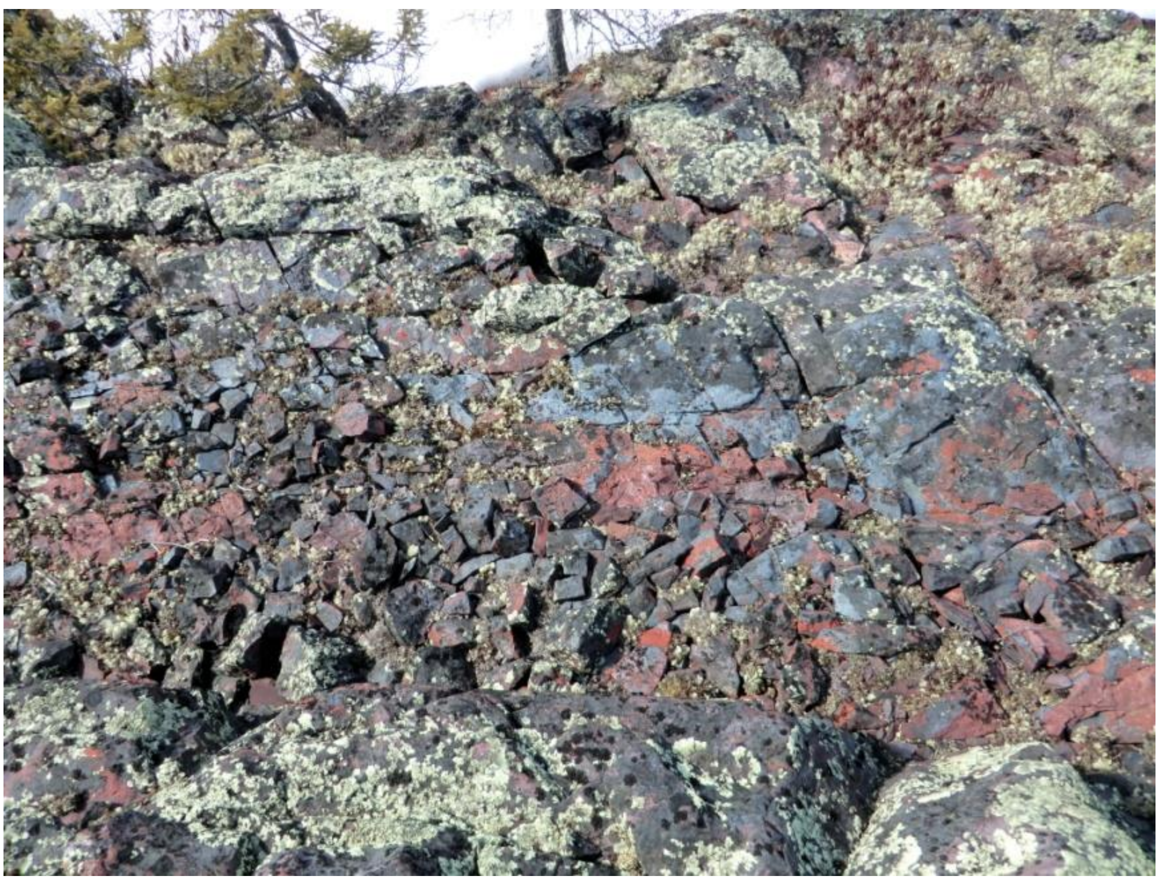


Figure 7-5: URC outcrop at Joyce Lake DSO Project

7.1.2 Joyce Lake Geological Structure

Field mapping done by Century geologists indicates that the fold structure at Joyce Lake is trending NW-SE. There are zones of minimal strain and the units appear undeformed. These low-strain zones are particularly interesting because they would represent unshortened, and therefore thicker, iron beds outside the nose of the fold. It was observed in the field, especially from the massive hematite units on one limb of the fold structure, that there were specularite and hematite veinlets and tension gashes (ranging between 1 mm and 3 mm) oriented obliquely to the strike of the perceived bedding. These brittle features likely helped to accommodate the volume change during shortening and thus the shortening to be oriented along a strike of NE-SW.

Figure 7-6: PGC outcrop at Joyce Lake DSO Project

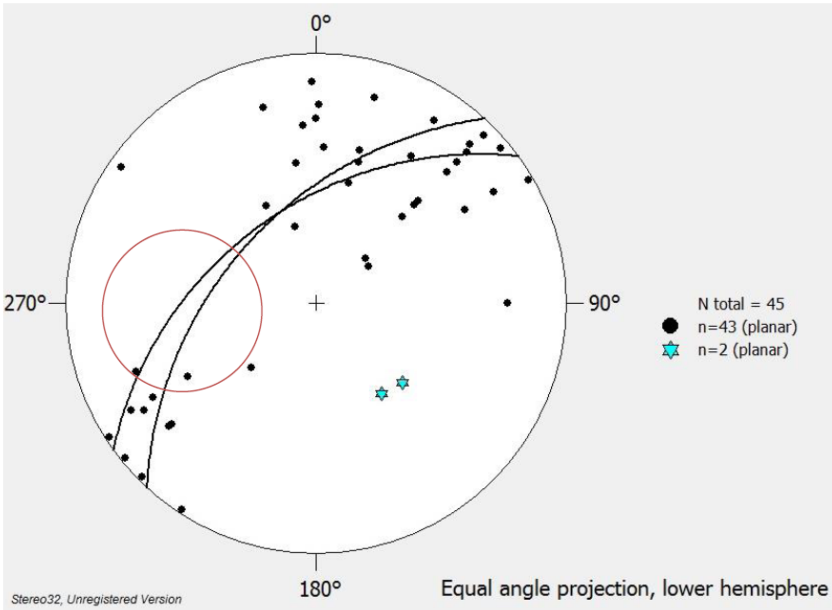


Figure 7-7: Stereo-net of field mapping at Joyce Lake

Figure 7-7 is a plot of the poles of perceived bedding planes (black dots) measured in the field at Joyce Lake. The red circle represents an obvious gap in the dataset, which likely indicates the lack of reliable structural measurements in the nose of the fold. The blue stars are two inferred fold axes with accompanying great circles. The geologist noticed that there is an obvious gap in the number of measurements concerning the fold structure; however, this is likely accounted for by the lack of outcrop in the nose of the fold and, hence, it is assumed that those missing orientations would belong to that set of strikes and dips. It was deduced that the fold was trending at approximately 135° with a dip of approximately 42°.

The Ruth shale provides an impermeable layer at depth to cap the down flow of meteoric water and therefore encourage leaching of silica and the deposition of enriched hematite as a Direct Shipping Ore ("DSO") type deposit. This enrichment is expected to be most significant where there is the greatest brittle deformation and would carry the greater tonnage where the massive hematite units are thicker. These conditions are satisfied within the nose of the fold structure and within the minimal strain zones identified in the field. The fold structure plunges to the Southeast and one would expect the hematite beds to thicken. Eventually, the strata should be capped by the impermeable Menihek Shale unit. Thus, by moving away from the zone of brittle deformation where being capped by an impermeable layer retards the percolation of meteoric water, it therefore reduces the potential of enrichment and DSO formation along this trend.

The mineralization is an iron enrichment, as shown in Figure 7-8 below, with red and yellow colouration, the blue being the higher grade and higher quality material and was not present in the exposed core boxes during the site visit of the author. Figure 7-9 presents Joyce Lake Geology after Burgess (1951), recompiled by Century with associated gravity anomalies. Figure 7-10 and Figure 7-11 represent an idealized cross-section and longitudinal section respectively of the Joyce Lake deposit.

Figure 7-8: Mineralization of red and yellow DSO in fresh core

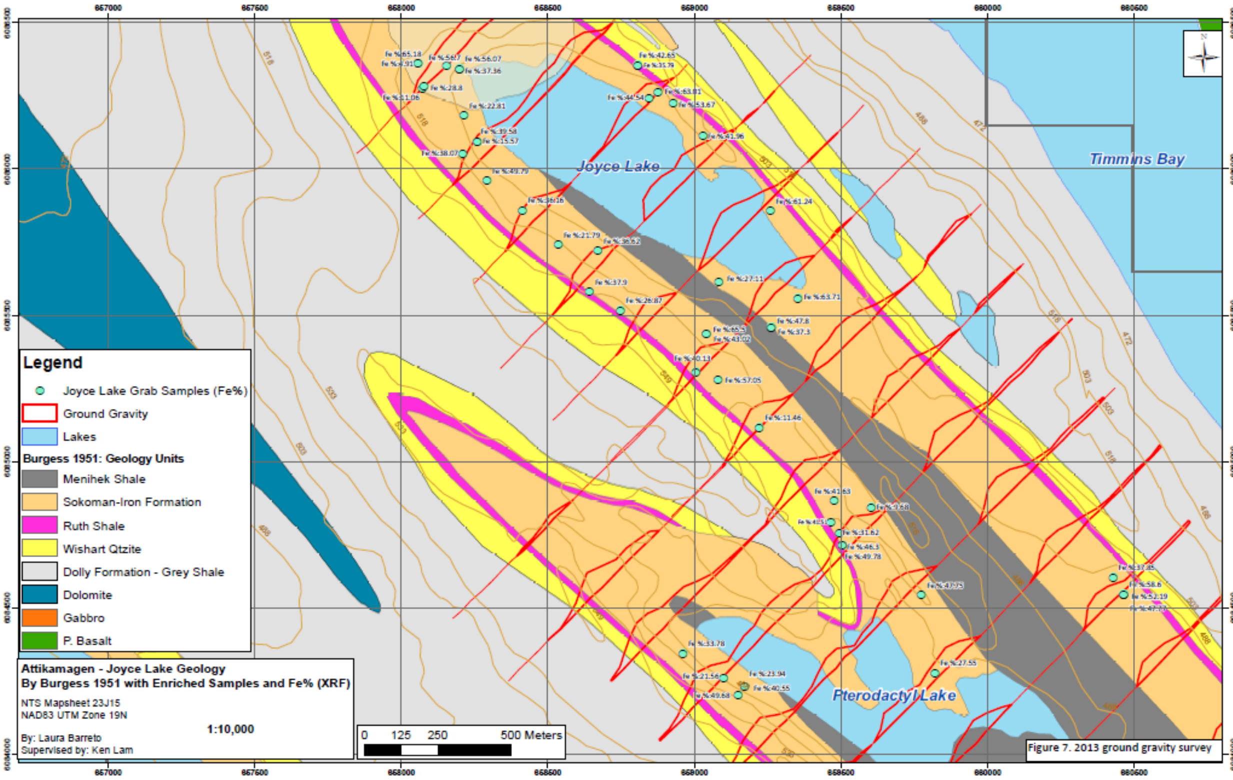


Figure 7-9: Joyce Lake geology – Burgess, 1951
(source 8th assessment report (Geosig & SGS Lakefield, 2014))

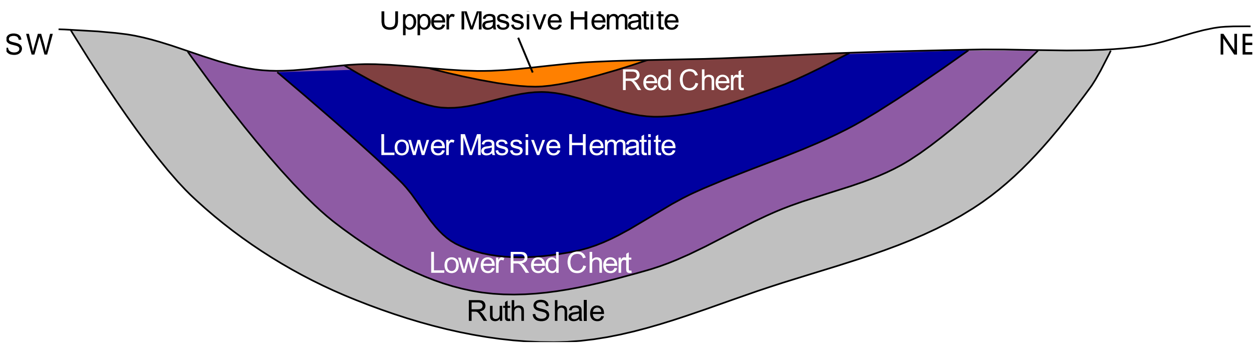


Figure 7-10: Idealized cross-section of Joyce Lake deposit
The Middle Iron Formation has been enriched to the point of forming the Lower Massive Hematite unit

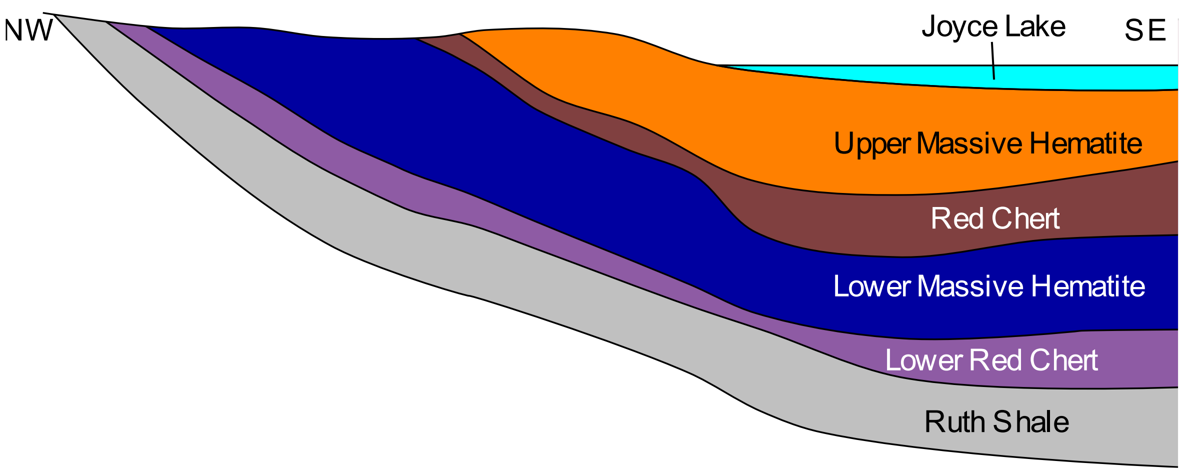


Figure 7-11: Idealized longitudinal section of Joyce Lake deposit
The Middle Iron Formation has been enriched to the point of forming the Lower Massive Hematite unit

8. Deposit Types

The Labrador Trough contains four main types of iron deposits:

- **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).
- **Taconites**, fine-grained weakly metamorphosed iron formations with above-average magnetite content which are also commonly called magnetite iron formation.
- More intensely metamorphosed, coarser-grained iron formations, termed **meta-taconites**, which contain specular hematite and subordinate amounts of magnetite as the dominant iron minerals.
- Occurrences of **hard high-grade hematite ore** occur southeast of Schefferville at Sawyer Lake and Astray Lake.

The Sokoman iron formation was formed as chemical sediment under varied conditions of oxidation-reduction potential ("Eh") and hydrogen ion concentrations ("pH") in varied depth of seawater. The resulting irregularly bedded, jasper-bearing, granular, oolitic and locally conglomeratic sediments are typical of the predominant oxide facies of the Superior-type iron formations, and the Labrador Trough is the largest example of this type.

The facies changes consist commonly of carbonate, silicate and oxide facies. Typical sulphide facies are poorly developed. The mineralogy of the rocks is related to the change in facies during deposition, which reflects changes from shallow- to deep-water environments of sedimentation. In general, the oxide facies are irregularly bedded, and locally conglomeratic, having formed in oxidizing shallow-water conditions. Most carbonate facies show deep-water features, except for the presence of minor amounts of granules. The silicate facies are present in between the oxide and carbonate facies, with some textural features indicating deep-water formation.

The carbonate, silicate and oxide facies contain typical primary minerals ranging from siderite, minnesotaite, and magnetite-hematite respectively. The most common mineral in the Sokoman formation is chert, which is closely associated with all facies. Carbonate and silicate lithofacies are present in varying amounts in the oxide members.

The sediments of the Labrador Trough were initially deposited in a stable basin which was subsequently modified by penecontemporaneous tectonic and volcanic activity. Deposition of the iron formation indicates intraformational erosion, redistribution of sediments, and local contamination by volcanic and related clastic material derived from the volcanic centers in the Dyke-Astray area.

The Joyce Lake deposit is an enrichment zone along the nose of the main fold of the Joyce Lake syncline (Figure 8-1). This enrichment extends laterally within the iron formation, forming a vase (or bowl) shape with significant thickness in the hinge of the syncline.

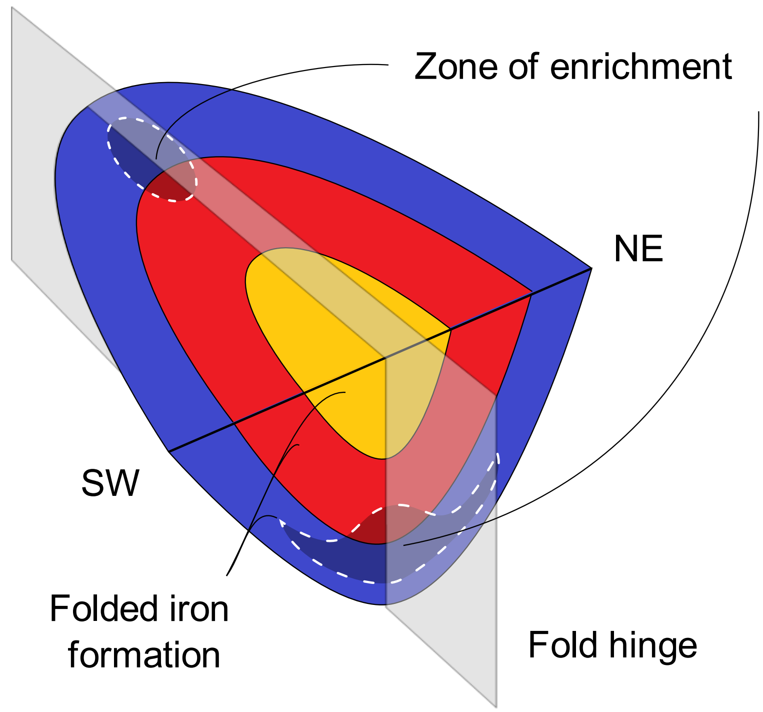


Figure 8-1: Joyce Lake deposit model

9. Exploration

This chapter contains the historical exploration that occurred around the Project area.

9.1 History

Iron ore enrichment was discovered along the northeast side of Joyce Lake by Labrador Mining and Exploration Co. Ltd. ("LM&E") in 1943. The enrichment (known as the Timmins Bay deposit) was examined by J.A. Retty at that time and found to have a length of 152 m and a width of 12 m at its widest point (Griffis et al., 1944).

Two samples collected by Retty in 1943, from the northeast side of Joyce Lake, gave the following results (Griffis et al., 1944):

- No. R-1 (Grab); 1.2 m Width; 69.0% Fe, 1.34% Insol. 0.16% Mn, 0.01% P, 0.09% S;
- No. R-2 (Grab); 6.7 m Width; 69.1% Fe, 0.86% Insol. 0.39% Mn, 0.01% P, 0.07% S.

In 1944, the ore was traced along an additional 152 m bringing the total length of the deposit to 305 m. No surface work had been done at the deposit up to that time (Retty and Moss, 1945). According to Stubbins (1981), the area around Joyce Lake had been mapped on a scale of 1" = 200' in 1949. No other information regarding this work is available at present.

In 1951, a geological mapping project was conducted west of Lake Attikamagen by L.C.N. Burgess of the Iron Ore Company ("IOC"). The area mapped covers about 259 km^2. Mapping was done on a scale of 1" = 1,000'.

In summarizing the economics of the area, Burgess stated that it almost certainly contains small ore bodies near some of the ore outcrops on Lac Sans Chef and Joyce Lake, but these were not considered to be large enough to meet the million short ton minimum. He added that there are large areas of unexposed iron formation throughout the region that have room for larger tonnages of ore.

Work was done by Harrison et al. of the Geological Survey of Canada ("GSC") in the 1950's and has provided much of the material for a detailed account of the stratigraphy and structure of a strip 3.2-4.8 km wide and 45 km long across the southwest margin of the Labrador Trough (Harrison et al., 1972). This study included part of the Iron Arm - Attikamagen Lake area, which was mapped by Burgess during his 1951 project.

In 1978, a geological reconnaissance traverse and collection of samples were carried out in the Joyce Lake area (Block No. 11) by LM&E. Nine samples were collected and assayed, all of which were channel chip rock samples taken from surface outcrops of 'middle massive iron formation' outcropping in a syncline adjacent to Joyce Lake. All nine samples were submitted for Davis Tube testing to determine their amenability to magnetic concentration (Stubbins, 1981). Stubbins (1981) commented that of the three outcrop areas sampled around Joyce Lake, one sample in each should be iron ore and/or lean ore. However, when tested by Davis Tube, only one sample (No. 29623) had results of interest and even that had relatively low weight recovery at 27%.

More recent aeromagnetic exploration has been carried out by Nova Scotia Ltd in 2007. The same year, Champion conducted an airborne magnetic, gamma-ray and VLF-EM (“very low frequency -electromagnetic”) geophysical survey on the Attikamagen Property, as well as a preliminary surface-mapping and a reconnaissance sampling program to provide ground reference samples for correlation with the geophysical data.

A comprehensive program of exploration work was completed on the Attikamagen Property during the 2008 field season. At the beginning of the season two experts in iron formations, P. K. Pufahl, PhD., and E. E. Hiatt, PhD., were brought to the Property to familiarize the exploration team with the local geology, especially the Sokoman formation. The group targeted Lac Sans Chef and Jennie Lake where Pufahl and Hiatt offered guidance on the history, formation, geochemistry, deposition and stratigraphy of the Sokoman formation; providing a framework for the summer’s geological mapping program. Pufahl and Hiatt (2008) confirmed the potential for the magnetite rich pink-grey chert (“PGC”) units and commented on the potential for magnetite rich iron formation and for direct shipping ore (“DSO”) on the Property.

Detailed mapping (1:2,500 scale) ensued using the Pufahl and Hiatt criteria of the Sokoman formation along flagged grid lines, oriented northeast-southwest and spaced 150 m to 300 m apart. Seven lines, comprising a total of 11 km, were mapped on the Joyce Lake grid. Compiled geological data, plotted in the field on 17×11 topographic map sheets, were sent to MRB & Associates GIS services in Val-d’Or where they were digitized and assembled into individual geological maps for each grid area. These were then superimposed with the airborne magnetic data, for interpretation of geology in areas covered by water or overburden.

9.2 Exploration (2008-2015)

A ground gravity survey was undertaken in 2010 by Century and carried out by Geosig Inc., from Québec City, Québec. The gravity method was chosen in order to discriminate between hematite and magnetite mineralization based on their density contrast.

Gravity profiles were carried out on Joyce Lake Area (Claim 013445M), selected on the basis of interpretation of previous work by Champion and compilation. The selected targets are most often located in fold hinges either where the limbs are characterized by magnetic highs, indicative of magnetite rich mineralization or where the hinge is characterized by magnetic lows, frequently indicative of hematite or iron hydroxide rich mineralization. Results in Figure 9-1 show a magnetic high (magnetite) area surrounding a magnetic low (hematite) area. The results delineated magnetic low anomalies located in Joyce Lake that suggested DSO type mineralization in this property.

In the fall of 2010, Century started to drill boreholes in the area and found three potential DSO targets. All targets were selected based on geological and geophysical data. The taconite at Hayot Lake area is a shallow dipping magnetite-rich iron formation with an expected minimum thickness of 60 m to 100 m.

The Joyce Lake DSO Iron Ore deposit was confirmed by Century through ground gravity survey, surface geological mapping and sampling. A systematic reverse circulation drilling program was conducted at Joyce Lake in 2011-2012, which included 116 drillholes totalling 12,601.1 m and covering an area of 1,100 m along strike and 600 m in width. Drillhole spacing of 50 m x 50 m was used at the central part of the deposit. The 2012-2013 drilling campaign delineated a high-grade zone and tested the extension of the deposit along strike and depth and provided a detailed information base for the mineral resource estimate. The mineralization remains open to the south.

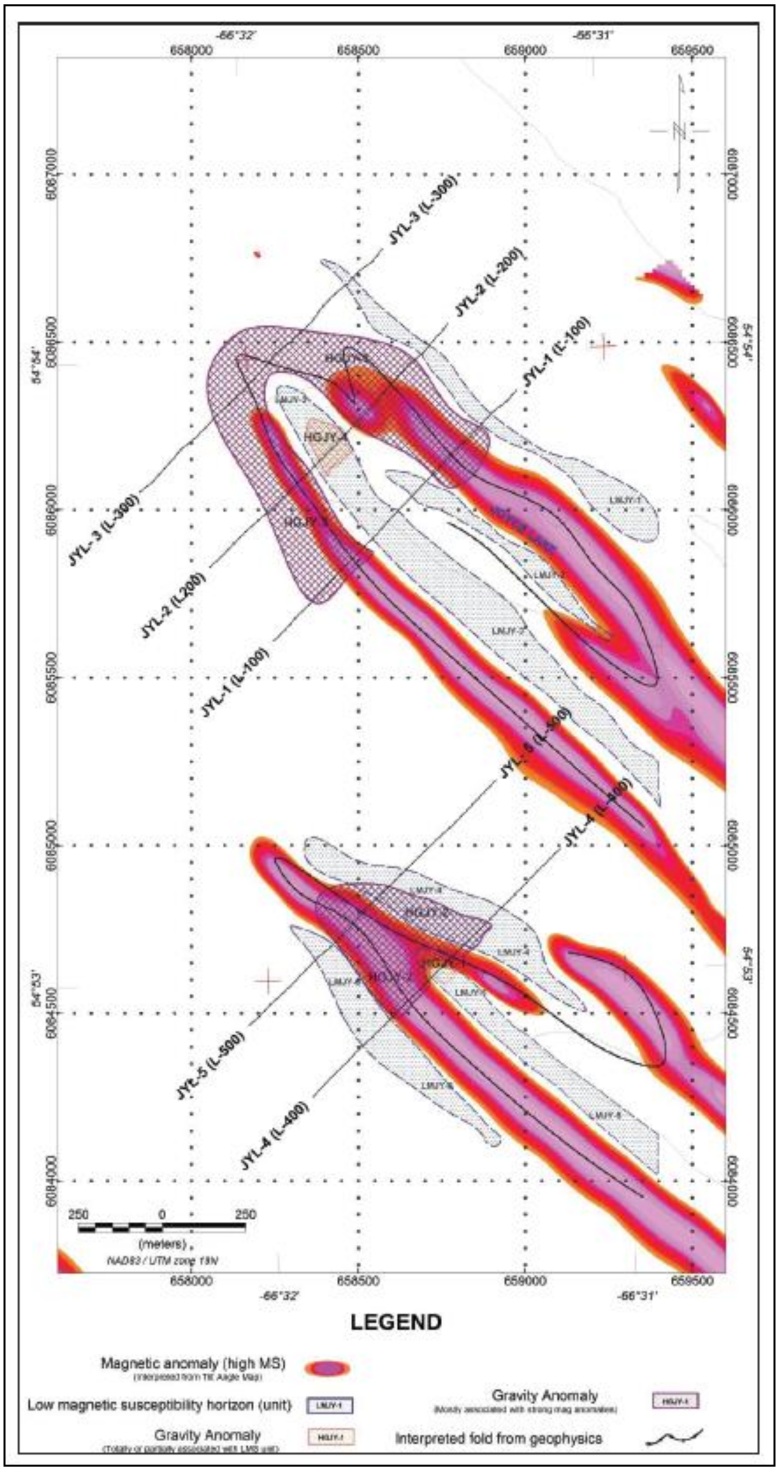


Figure 9-1: Geophysical interpretation, Joyce Lake area (from SRK Consulting, not to scale)

In 2013, field mapping was undertaken during the months of May to October to find surface exposures of high-grade mineralization for the dual purpose of extending the mineral resource and to better understand the local geology. A total of 253 GPS stations were recorded as outcrops around Joyce Lake and Pterodactyl Lake and an outcrop example is shown below in Figure 9-2. Additionally, 110 structural measurements were recorded where bedding measurements largely exhibit the synclinal structure and, locally, the complex folding of the Joyce Lake Property.

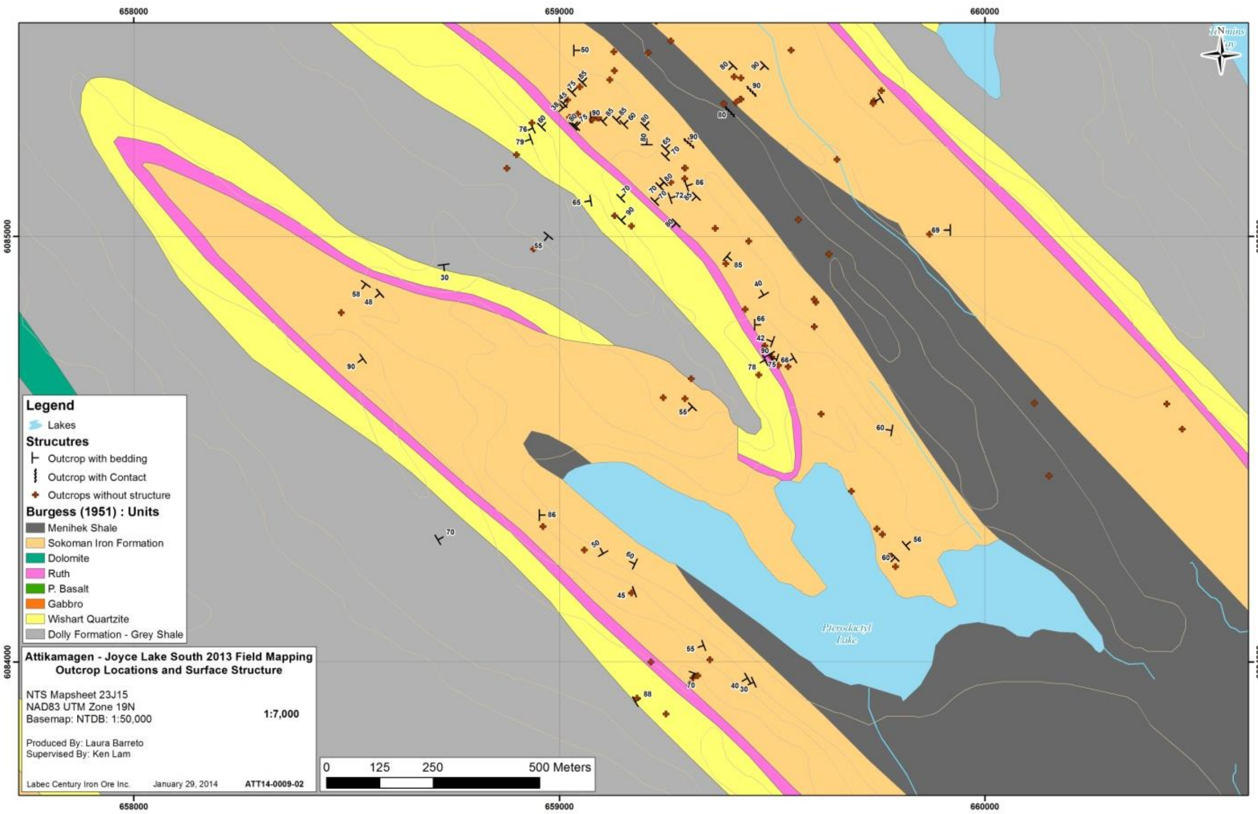


Figure 9-2: Example of outcrop map location with surface structure measurement from 8th Assessment report (Geosig & Lakefield, 2014)

Four grab samples from the northern area of the lake (NE flank of mineralized body/section 1S) were sent for analytical assay. The results showed Fe values ranging from 40.1% to 64.8%.

The ground gravity survey covered all of Joyce Lake and extended to the SE. Station spacing was set to 50 m while readings were taken over 1.5 km and 2.0 km.

Additional gravity surveys on the Attikamagen Property were conducted between February 18 and March 30, 2013 by Geosig Inc., as shown in Figure 9-3, to extend the gravity survey coverage 3.0 km SE of the 2010 survey. The surveys consisted of 1,205 gravity points, of which 30 points were repeated for quality control.

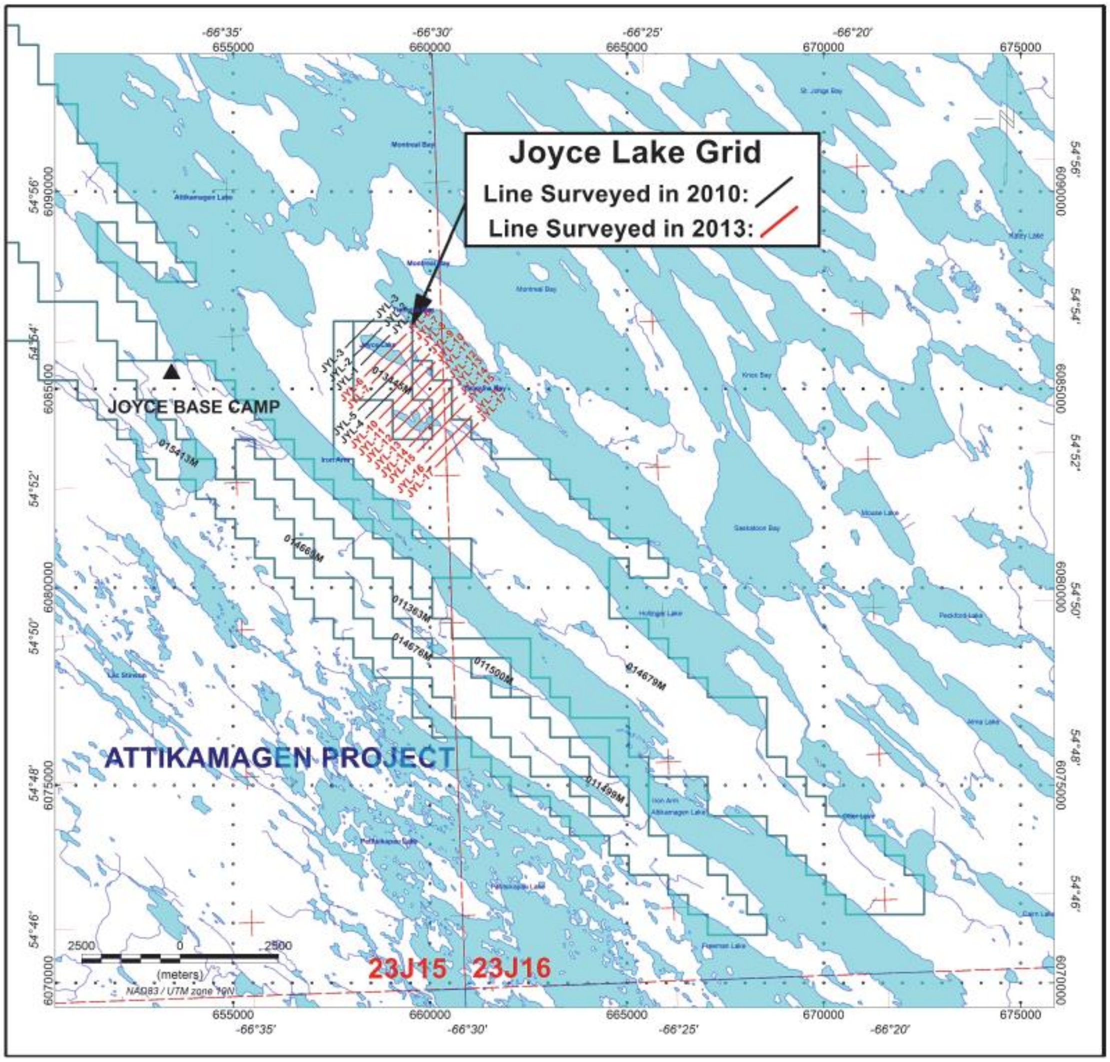


Figure 9-3: Geophysical gravity survey, Joyce Lake area lines (from 8th Assessment report)

A high-resolution differential GPS was used to position the survey lines as well as the gravity points. Figure 9-4 presents the survey lines and residual Bouguer anomaly map.

The total distance covered was 25,160 m. Geological interpretation of the magnetic and gravity data was done by Joel Simard, P.Geo., consulting geophysicist.

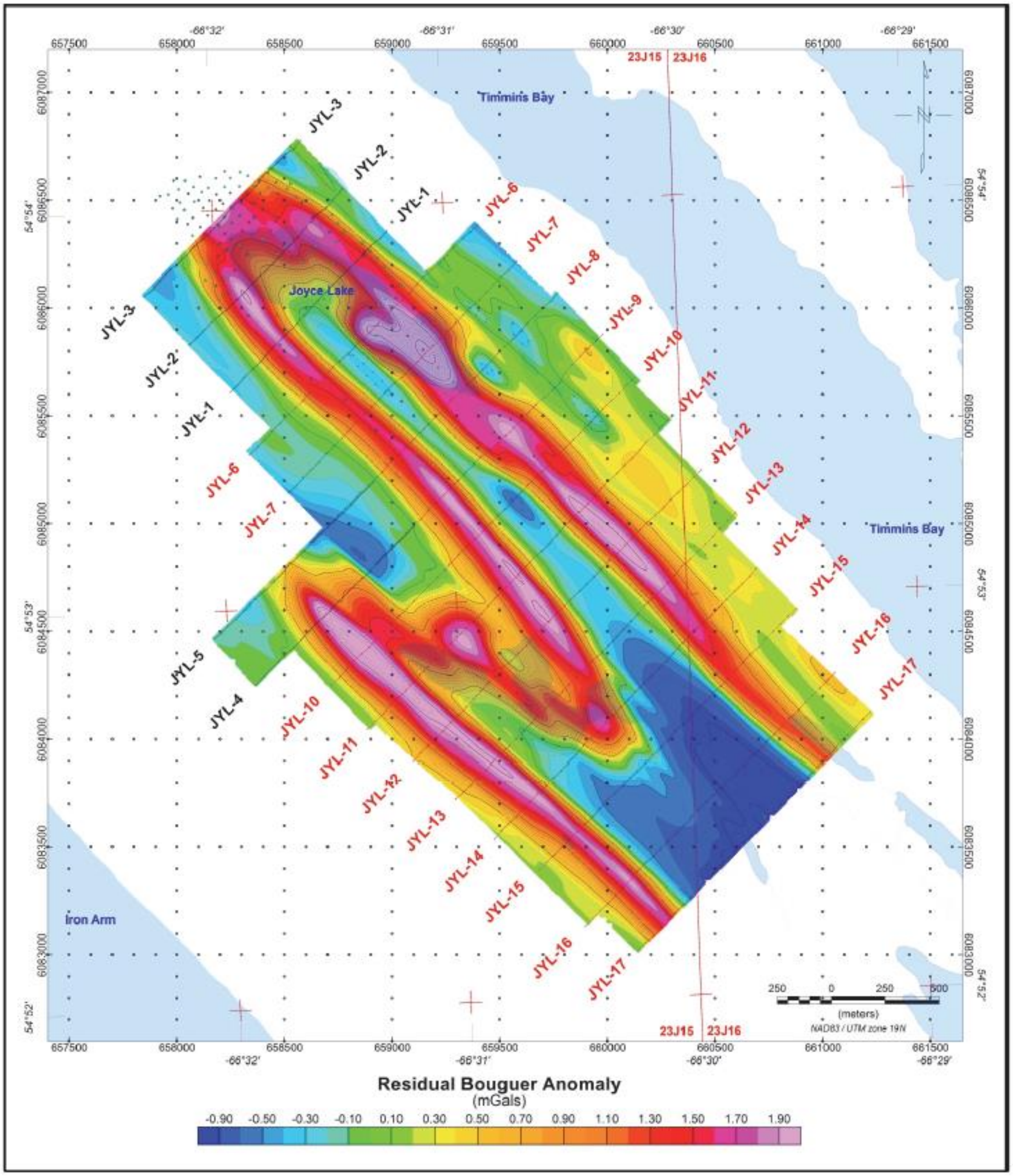


Figure 9-4: Gravimetric survey with residual anomaly over the Joyce Lake area (from Geosig report, not to scale)

10. Drilling

Drilling at Joyce Lake started in 2010 up to 2013 in different exploration phases using reverse circulation and core drilling (conventional and triple tube core barrel). The following Table 10-1 presents the list of drillholes and the following sections present information about each of the drilling phases in time.

The coordinates are in Universal Transverse Mercator ("UTM") for zone 19, NAD83.

Table 10-1: List of drillholes

Hole Name	X	Y	Z	Azimuth	Dip	Length	Type
Joy-10-01	658863.16	6086243.153	514.94	40	-65	110	DDH
Joy-10-02	658193	6086388	526.37	0	-90	129	DDH
Joy-10-03	658464	6085964	511.59	220	-65	84	DDH
Joy-10-04	658713	6084605	536.36	0	-90	39	DDH
Joy-11-05	658329	6086247	504.88	0	-90	50	RC
Joy-11-06	658193.35	6086383.592	526.56	0	-90	143	RC
Joy-11-07	658051.12	6086531.959	524.92	0	-90	102	RC
Joy-11-08	658326.03	6086527.701	528.57	0	-90	114	RC
Joy-11-09	658865.32	6086240.166	514.70	0	-90	141	RC
Joy-11-10	658707.64	6086352.332	517.04	0	-90	123	RC
Joy-11-11	659019.47	6086046.251	507.39	0	-90	105	RC
Joy-11-12	658458.42	6086405.467	514.30	0	-90	156	RC
Joy-11-13	658579.25	6086489.205	528.21	0	-90	105	RC
Joy-11-14	658381.04	6086588.159	527.76	0	-90	69	RC
Joy-11-15	658119.57	6086317.948	521.55	0	-90	147	RC
Joy-11-16	658183.36	6086101.215	529.94	0	-90	123	RC
Joy-11-17	658333.3	6085964.489	530.46	0	-90	99	RC
Joy-11-18	658480.8	6085829.1	530.30	0	-90	114	RC
Joy-11-19	658622.28	6085671.379	541.50	0	-90	147	RC
Joy-11-20	658780.57	6085574.893	540.35	0	-90	142	RC
Joy-11-21	658925	6085434	535.10	0	-90	117	RC
Joy-11-22	659041.99	6085567.782	521.22	0	-90	144	DDH
Joy-11-23	658122.68	6086463.057	530.93	0	-90	138	RC
Joy-11-24A	659260.77	6085210.656	533.49	225	-65	248	DDH
Joy-11-25	658107.15	6086607.878	536.10	0	-90	60	RC
Joy-11-26	658259.08	6086464.159	528.69	0	-90	153	RC

Hole Name	X	Y	Z	Azimuth	Dip	Length	Type
Joy-11-27	658184.82	6086527.029	533.68	0	-90	120	RC
Joy-11-28	658336.11	6086398.315	518.20	0	-90	162	RC
Joy-11-29A	659396.82	6085350.468	517.42	50	-65	175	DDH
Joy-11-30	658189.59	6086241.705	520.06	0	-90	174	RC
Joy-11-31	659548.63	6085481.73	514.64	50	-65	134	DDH
Joy-11-32	658396.64	6086455.551	521.38	0	-90	174	RC
Joy-11-33	658470.5	6086529.908	528.75	0	-90	138	RC
Joy-11-34	658049.16	6086389.135	529.30	0	-90	130	RC
Joy-11-35	657981.15	6086461.881	530.75	0	-90	90	RC
Joy-11-36	657921.18	6086519.146	530.63	0	-90	51	RC
Joy-11-37	659474.4	6085424.722	507.34	50	-65	197.1	DDH
Joy-11-38	659659.7	6085311.422	511.48	50	-65	155	DDH
Joy-11-39	658221.4	6086422.25	527.63	0	-90	168	RC
Joy-11-40	657985.47	6086590.373	530.31	0	-90	45	RC
Joy-11-41	658631.1	6086421.606	524.05	0	-90	171	RC
Joy-11-42	658268.54	6086173.315	512.67	0	-90	159	RC
Joy-12-43	658298.56	6086208.13	504.87	0	-90	176	RC
Joy-12-44	658647	6086289	504.86	0	-90	102	RC
Joy-12-45A	658574	6086216	504.79	0	-90	58.5	RC
Joy-12-46	658501	6086284	504.82	0	-90	109.5	RC
Joy-12-47	658363	6086289	504.84	0	-90	102	RC
Joy-12-48	658826	6086183	504.89	0	-90	126.5	RC
Joy-12-49	658753	6086111	504.89	0	-90	118.5	RC
Joy-12-50	658684	6086042	504.86	0	-90	92.5	RC
Joy-12-51	658895	6085974	504.91	0	-90	69	RC
Joy-12-52	658968	6086042	504.83	0	-90	116	RC
Joy-12-53	658257	6086321	504.91	0	-90	82.5	RC
Joy-12-54	658468	6086253	504.81	0	-90	141	RC
Joy-12-55	658400	6086321	504.83	0	-90	126	RC
Joy-12-56	658330.09	6086248.82	504.87	0	-90	97.5	RC
Joy-12-57	658359.69	6086565.394	526.81	0	-90	128	RC
Joy-12-58	658424.64	6086627.692	535.42	0	-90	60	RC
Joy-12-59	658443.41	6086642.194	536.63	0	-90	66	RC
Joy-12-60	658424.14	6086559.432	526.67	0	-90	95.5	RC
Joy-12-61	658513.42	6086553.509	531.33	0	-90	99	RC
Joy-12-62	658528.05	6086577.584	532.10	0	-90	69	RC

Hole Name	X	Y	Z	Azimuth	Dip	Length	Type
Joy-12-63	658460.58	6086582.484	532.26	0	-90	91.5	RC
Joy-12-64	658330.65	6086612.006	536.27	0	-90	69	RC
Joy-12-65	658076.5	6086562.03	529.37	0	-90	81	RC
Joy-12-66	658009.42	6086550.54	529.52	0	-90	82.5	RC
Joy-12-67	658016	6086488.656	525.05	0	-90	90	RC
Joy-12-68	658051.96	6086530.585	524.92	0	-90	88.5	RC
Joy-12-69	658080.18	6086493.107	524.82	0	-90	118.5	RC
Joy-12-70	658115.76	6086538.62	528.86	0	-90	93	RC
Joy-12-71A	658034.44	6086454.033	524.73	0	-90	90	RC
Joy-12-72	658747.43	6086394.388	518.93	0	-90	84	RC
Joy-12-73	658719.22	6086430.7	521.37	0	-90	33	RC
Joy-12-74	658776.62	6086355.25	516.37	0	-90	90	RC
Joy-12-75	658897.19	6086263.864	521.86	0	-90	93	RC
Joy-12-76	658862.95	6086300.962	522.71	0	-90	99	RC
Joy-12-77A	658931.74	6086232.495	524.48	0	-90	81	RC
Joy-12-78	658179.22	6086159.563	524.01	0	-90	30	RC
Joy-12-79	658242.25	6086076.111	527.51	0	-90	82.5	RC
Joy-12-80	658220.19	6086136.422	526.30	0	-90	85.5	RC
Joy-12-81	658133.01	6086126.211	530.43	0	-90	63	RC
Joy-12-82	658214.1	6086057.711	533.04	0	-90	42	RC
Joy-12-83	658289.27	6086043.166	529.82	0	-90	90	RC
Joy-12-84	658147.33	6086208.211	521.63	0	-90	43.5	RC
Joy-12-85	658221.28	6086344.513	509.75	0	-90	177	RC
Joy-12-86	658146.49	6086557.748	533.00	0	-90	79.5	RC
Joy-12-87	658220.86	6086633.182	544.13	0	-90	48	RC
Joy-12-88	658220.58	6086562.526	534.06	0	-90	69	RC
Joy-12-89	658293.91	6086629.477	538.04	0	-90	45	RC
Joy-12-90	658290.39	6086564.817	530.15	0	-90	78	RC
Joy-12-91	658435.6	6086359.693	507.23	0	-90	171	RC
Joy-12-92	658672.05	6086387.817	521.18	0	-90	42	RC
Joy-12-93	658747.22	6086312.499	512.29	0	-90	76.5	RC
Joy-12-94	658553.05	6086515.4	529.76	0	-90	73.5	RC
Joy-12-95	658964.17	6086192.449	527.63	0	-90	129	RC
Joy-12-96	658994.71	6086153.163	527.81	0	-90	103.5	RC
Joy-12-97	658356.73	6086484.923	525.36	0	-90	150	RC
Joy-12-98	659037.93	6086099.495	525.87	0	-90	45	RC

Hole Name	X	Y	Z	Azimuth	Dip	Length	Type
Joy-12-99	658037.99	6086590.089	531.45	0	-90	57	RC
Joy-12-100	658299.45	6086484.818	528.49	0	-90	141	RC
Joy-12-101	657960.5	6086526.073	529.63	0	-90	54	RC
Joy-12-102	658002.83	6086412.082	530.74	0	-90	49.5	RC
Joy-12-103	658182.26	6086456.375	530.02	0	-90	153	RC
Joy-12-104	658143.67	6086428.358	529.93	0	-90	153	RC
Joy-12-105	658108.41	6086375.25	523.53	0	-90	135	RC
Joy-12-106	658073.14	6086418.298	524.39	0	-90	117	RC
Joy-12-107	658151.52	6086498.195	530.94	0	-90	123	RC
Joy-12-108	658213.16	6086482.754	531.27	0	-90	147	RC
Joy-12-109	658247.18	6086534.485	531.06	0	-90	102	RC
Joy-12-110A	658292.26	6086422.966	524.41	0	-90	171	RC
Joy-12-111	658256.16	6086394.495	520.91	0	-90	171	RC
Joy-12-112	658198.09	6086292.031	519.79	0	-90	3	RC
Joy-12-112A	658231	6086269	515.07	0	-90	57	RC
Joy-12-112B	658225	6086266	517.00	0	-90	162	RC
Joy-12-113	658394.22	6086518.081	522.97	0	-90	117	RC
Joy-12-114	658184.88	6086600.615	541.29	0	-90	117	RC
Joy-12-115	658248.98	6086595.342	536.61	0	-90	109.5	RC
Joy-12-116	658077.77	6086330.356	527.13	0	-90	100.5	RC
Joy-12-117	658357.86	6086422.895	520.44	0	-90	177	RC
Joy-12-U1	658146.97	6086345.143	525.08	0	-90	159	RC
Joy-13-119	658540	6086321	505.00	0	-90	102	RC
Joy-13-120	658303	6086358	505.00	0	-90	171	RC
Joy-13-121	658289	6086289	505.00	0	-90	72	RC
Joy-13-122	659139	6085929	505.00	0	-90	93	RC
Joy-13-123	659072	6085871	505.00	0	-90	150	RC
Joy-13-124	659209	6085860	505.00	0	-90	91.5	RC
Joy-13-125	659285	6085655	505.00	0	-90	100	RC
Joy-13-126	659213	6085725	505.00	0	-90	101	RC
Joy-13-127	659145	6085805	505.00	0	-90	45	RC
Joy-13-128	658925	6085871	505.00	0	-90	7	RC
Joy-13-129	658998	6085941	505.00	0	-90	88.5	RC
Joy-13-130	658352	6086341	504.84	0	-90	178.5	RC
Joy-13-131	658936	6086012	505.00	0	-90	82.5	RC
Joy-13-132	658899	6086110	504.00	0	-90	96	RC

Hole Name	X	Y	Z	Azimuth	Dip	Length	Type
Joy-13-133	658831	6086184	504.00	0	-90	93.2	RC
Joy-13-134	658251	6086318	505.00	0	-90	180	RC
Joy-13-135	658725	6086208	505.00	0	-90	91.5	RC
Joy-13-136	658623	6086254	505.00	0	-90	55	RC
Joy-13-137	658095.96	6086577.906	532.94	0	-90	60	RC
Joy-13-138	658221.24	6086277.529	516.50	0	-90	192	RC
Joy-13-139	658015.93	6086436.242	529.95	0	-90	69	RC
Joy-13-140	658404.05	6086610.84	533.12	0	-90	66	RC
Joy-13-141	658086.43	6086429.413	524.29	0	-90	95.5	RC
Joy-13-142	658151.02	6086202.826	521.68	0	-90	134	RC
Joy-13-143	658423.57	6086431.571	518.60	0	-90	168	DDH
Joy-13-144	658976	6084451	494.74	0	-90	59.5	RC
Joy-13-145	658466.19	6086467.326	517.91	0	-90	159	RC
Joy-13-146	658525.93	6086451.699	520.16	0	-90	171	RC
Joy-13-147	658432.66	6086492.292	519.89	0	-90	138	RC
Joy-13-148	658605.66	6086394.326	519.45	0	-90	192	RC
Joy-13-149	658865.85	6086241.082	514.75	61	-60	31.5	DDH
Joy-13-149A	658865.85	6086241.082	514.75	61	-50	99	DDH
Joy-13-150	658851.4	6086219.016	510.07	46	-80	99	DDH
Joy-13-151	658829.26	6086251.982	511.99	46	-70	99	DDH
Joy-13-152	658747.26	6086312.691	512.31	46	-60	78	DDH
Joy-13-153	658237.15	6086228.062	516.77	46	-67	199.5	DDH
Joy-13-154	658747.26	6086312.691	512.31	46	-85	88.5	DDH
Joy-13-155	658905.24	6086184.635	507.64	46	-60	90	DDH
Joy-13-156	658386.45	6086384.591	512.13	0	-90	198	DDH
Joy-13-157	658182.54	6086309.391	521.37	0	-90	180	DDH
Joy-13-158	658789.95	6086273.916	510.06	46	-63	79.5	DDH
Joy-13-159	658312.32	6086585.841	531.98	0	-90	60	DDH
Joy-13-160	658707.83	6086353.618	517.08	46	-60	63	DDH
Joy-13-161	658632.23	6086421.851	524.03	46	-65	70	DDH
Joy-13-162	658675.46	6086391.387	521.38	46	-50	63	DDH
Joy-13-163	658573.37	6086437.657	522.95	46	-50	91.5	DDH
Joy-13-164	658674.75	6086390.496	521.44	46	-80	105	DDH
Joy-13-165	658572.38	6086436.7	522.68	46	-80	129	DDH
Joy-13-166	658791	6086264	509.18	46	-80	108	DDH
Joy-13-167	658990.49	6086090.537	507.84	46	-60	123	DDH

Hole Name	X	Y	Z	Azimuth	Dip	Length	Type
Joy-13-168	658442.61	6086374.948	511.28	226	-55	264	DDH
Joy-13-169	658990.49	6086090.537	507.84	46	-50	99	DDH
Joy-13-170	658991.03	6086089.153	507.72	0	-50	136.5	DDH
Joy-13-171	658176.34	6086296.886	521.96	226	-50	129	DDH
Joy-13-172	658906.02	6086185.972	507.87	90	-50	109.5	DDH
Joy-13-173	658220.3	6086210.532	519.58	226	-70	150	DDH

Notes:

1. X and Y reported under UTM zone 19, NAD83.
2. DDH: Diamond drillholes.
3. RC: Reverse circulation drillholes.

Detailed drillhole map locations are presented in Section 12.1, while Figure 10-1 presents holes with channels in plan view in Genesis and Figure 10-2 in isometric view.

Surface channel samples were also taken on the northeast flank and are considered as horizontal drillholes (Joy-13-130).

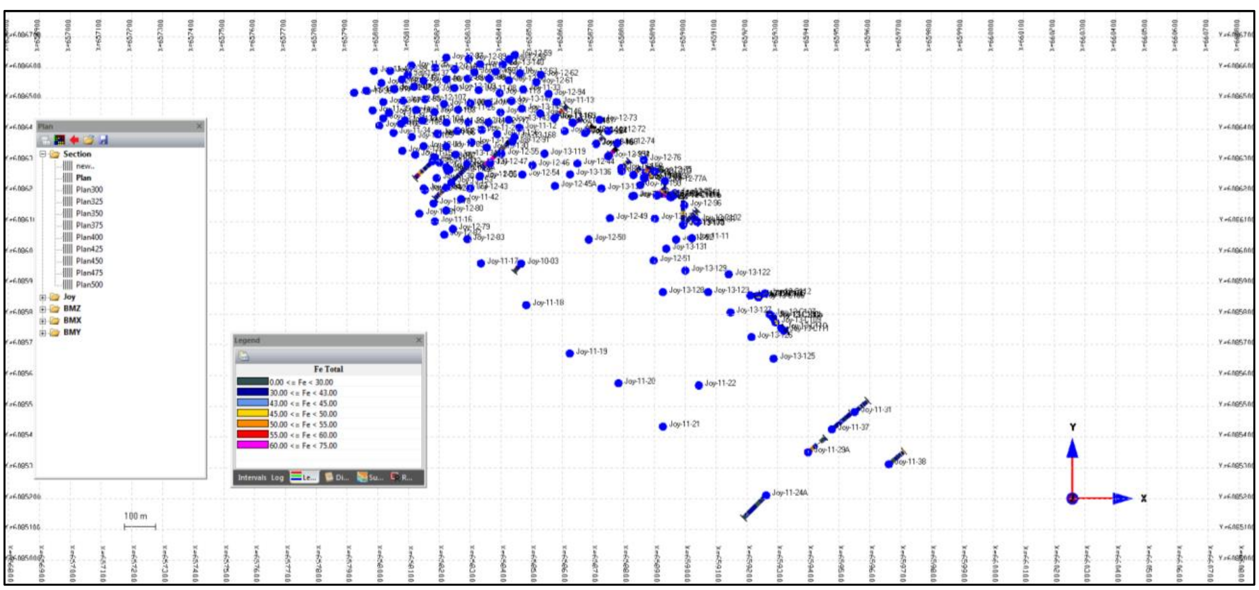


Figure 10-1: Plan view of drillholes and channel positions in Genesis©

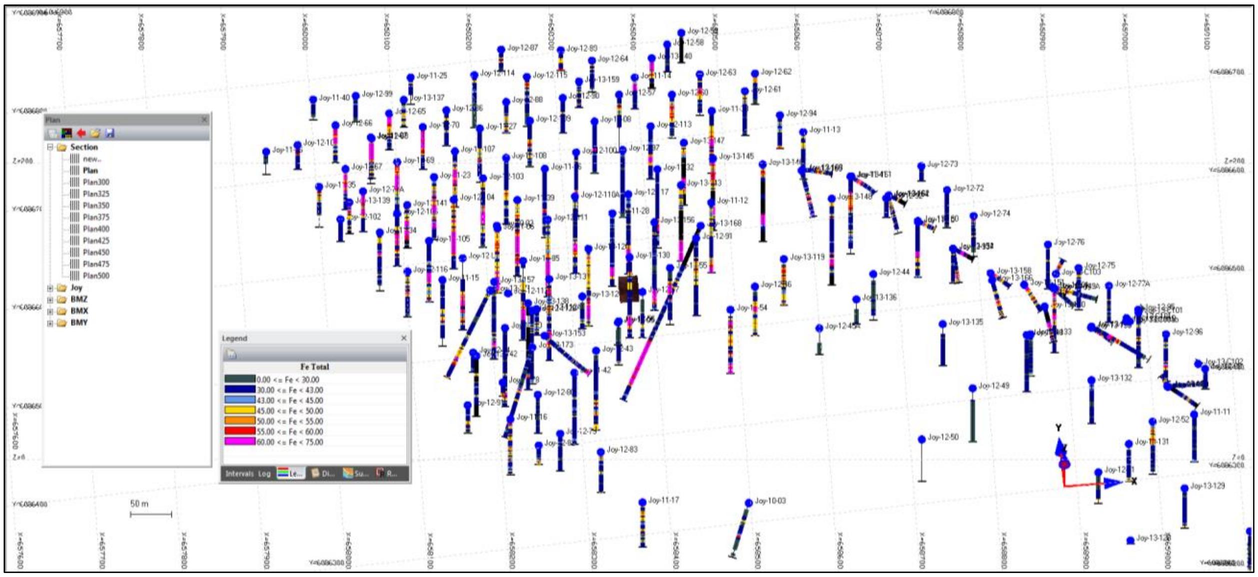


Figure 10-2: Isometric view, looking north, of drillholes and channel positions in Genesis©

Figure 10-3 presents the Acker RC drill in action at Joyce Lake in 2013. The reverse circulation ("RC") drilling produces cuttings and fines which are processed at the drill site with a rotary splitter attached to the drill's RC system. The general sampling procedure is applied to each drill run. Each 3-m run sample is collected using three 5-gallon pails that are connected to the output of the drill splitter. A 5/16 portion (around 12 kg) for Acker drill, a 1/2 portion (around 32 kg) for the Hornet, and all portion for the Discovery drills of the original sample is taken as the main drill sample (from pail SA & pail SB), the remaining 11/16, or 1/2 sample, are rejects and are discarded at the drill. The SA & SB pails, such that SA is the coarse portion and SB the fines, are carried in bags within plastic pails to the core shack in Schefferville where they are blended in a concrete mixer and afterward passed through a riffle splitter to achieve a 1/8 mass reduction of the sample, where (SA+SB) reduced weighs between 3 kg to 8 kg. The Hornet drill bit has a diameter of 9 cm while Acker has a 7.5 cm diameter bit.

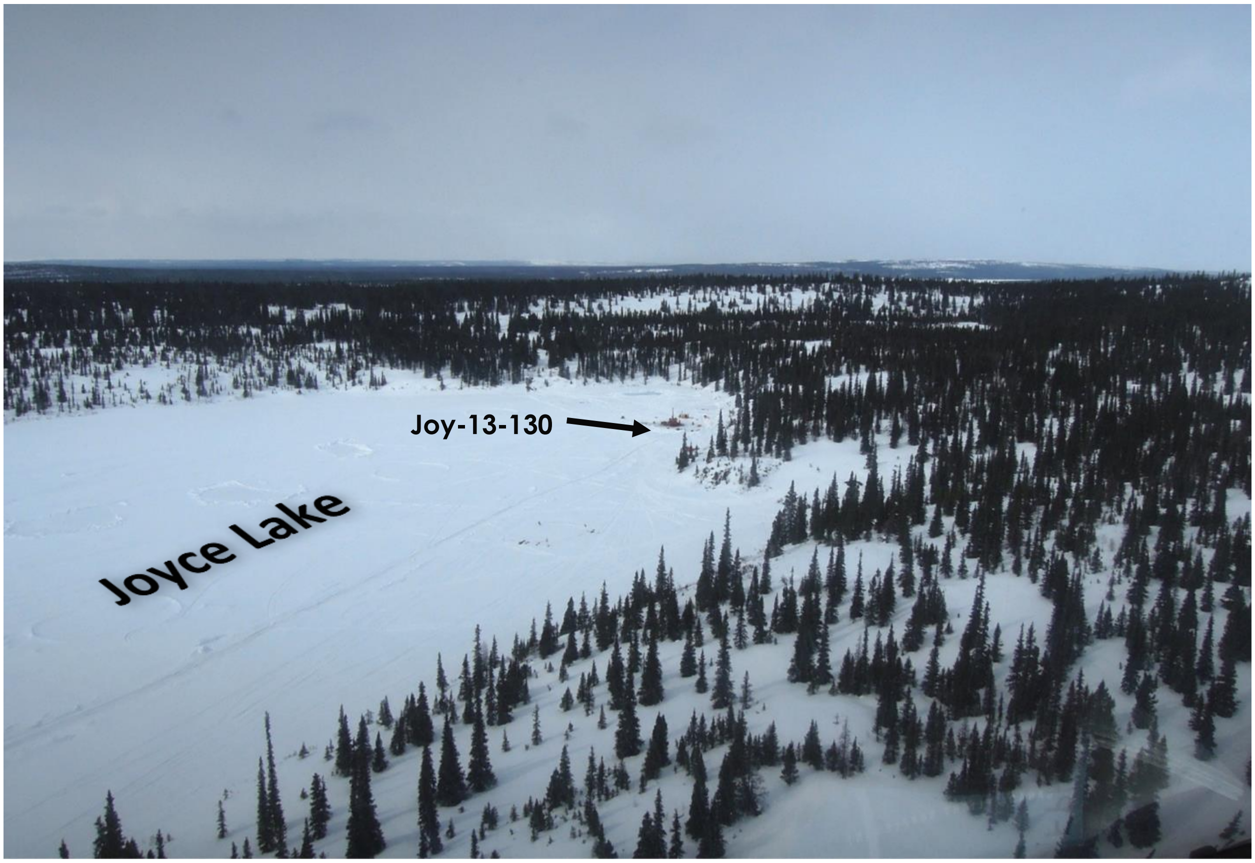


Figure 10-3: Drill rig at Joyce Lake in operation at hole Joy-13-130, looking northwest, March 2013 field visit

10.1 Drilling Program 2010-2012

In 2010, direct shipping ore ("DSO") targets were tested by Century in Joyce Lake. Four boreholes (362 m) were drilled at the Joyce Lake syncline using conventional diamond core drilling. Blocky and sandy ground was encountered in boreholes resulting in poor core recovery. A total of 90 samples were sent to COREM for testing (78 samples and 12 QA/QC).

In 2011, to relieve the poor core recovery a drilling program consisting of mainly RC drilling was planned. A total of 38 holes were drilled in the Joyce Lake area, 32 RC holes (3,930 m) and six diamond drillholes (1,053.1 m). The resulting samples were sent to Activation Laboratories for XRF analysis. Century identified a potential DSO target as a result of the RC drilling completed at Joyce Lake. Drillhole Joy-11-06 intersected 139.0 m grading 52.8% total iron (Fe), and drillhole Joy-11-07 intersected 91.0 m grading 52.5% Fe, including 42.0 m grading 65.3% Fe (see Table 10-3).

Following the discovery of DSO type mineralization at Joyce Lake during the 2011 drill campaign, an exploration and definition drilling program was initiated in February 2012 to expand and better define the zone of high-grade iron mineralization. In September 2012, a total of 7,618 m of RC drilling was completed of which 78 holes were effectively drilled in 2012. Additionally, 30 tonnes of bulk samples were collected for metallurgical testing.

The area of high-grade mineralization at shallow depth has been drilled on a 50 m × 50 m grid. The higher-grade mineralization occurs mostly within a synclinal fold closure and partly on both flanks. The synclinal structure has a shallow 15° plunge to the southeast. Bedding in the fold closure is sub-horizontal to moderately dipping. All RC drillholes are vertical.

The mineralization reaches bedrock surface which is covered by 3 m to 6 m of overburden. The first batch of assay results confirmed a zone of high-grade iron mineralization at Joyce Lake with intercepts up to 54 m over 60% total iron (% Fe) and with an average of 6.09% silica (SiO_2).

Between 2010 and 2012, a total of 120 holes (12,963.1 m) were drilled in the Joyce Lake area.

Table 10-2: Drill length summary between 2010 and 2012

Historical	Core Hole	Reversed Circulation	Total Length (m)
2010	4	-	362
2011	6	32	4,983.1
2012	-	78	7,618
Total	**10**	**110**	**12,963.1**

Table 10-3: High-grade mineralization occurrences 2010–2012 drilling program

Hole Number	From (m)	To (m)	Length (m)	% Fe Total
Joy-10-02	24	51	27	54.13
and	93	123	30	59.87
Joy-11-06	3	142	139	52.8
including	96	138	42	64.19
Joy-11-07	12	93	91	52.46
including	12	54	42	65.26
Joy-11-09	2	126	123	46.64
including	9	18	9	61.26
including	54	69	15	64.8
Joy-12-46	30	102	72	48.25
Including	45	57	12	61.13

Hole Number	From (m)	To (m)	Length (m)	% Fe Total
Joy-12-53	27	81	54	49.83
Including	27	39	12	61.37
Joy-12-55	30	87	57	50.62
Including	42	57	15	64.56
Joy-12-65	3	45	42	58
including	6	30	24	63.7
Joy-12-66	6	78	72	51.59
including	6	42	36	63.5
Joy-12-68	6	87	81	54.25
including	12	48	36	61.11
Joy-12-69	6	117	111	51.96
including	9	63	54	61.59
Joy-12-70	6	93	87	52.75
including	6	60	54	61.2
Joy-12-71A	6	90	84	51.62
including	6	48	48	61.27
Joy-12-85	90	132	42	59.8
including	108	132	24	66.33
Joy-12-100	87	93	6	64.49
Joy-12-103	63	102	39	61.02
Joy-12-104	57	123	66	62.75
Joy-12-105	72	93	21	66.4
Joy-12-106	45	72	27	60.47
Joy-12-107	39	75	36	63.52
Joy-12-110A	105	129	24	62.05
Joy-12-111	93	150	57	66.72
Joy-12-113	63	84	21	60.87
Joy-12-117	117	150	33	63.41

10.2 Drilling Program 2013

Based on the previous geological model, a detailed validation drilling and exploration program was undertaken at the Project during the year 2013, as seen in Figure 10-4.

Figure 10-4: Drill rig 'Acker' Joy-13-130, looking east, March 2013 field visit

There were two phases of drilling in 2013. Phase I was managed by Cabo, using the Acker drill and Hornet drill. Phase II was managed by Downing, mainly done using triple tube core drilling. The program was planned to validate and extend the existing geological model by adding holes in early 2013. Those holes are located in the north-western end of the lake and on the north-eastern flank of the lake.

The program started on March 7th and ended November 15, 2013. During that period, 56 holes were drilled including 30 RC holes and 26 core holes with triple tube totalling 6,244.2 m in length. The first phase consisted in drilling of 17 RC holes on the frozen lake during winter to validate iron mineralization in the centre of the syncline, test the gravity anomalous zone delineated by the ground gravity survey of February 2013 and extend it to the southeast. The second phase focused on the validation of extension, getting core in the main zone for density measurement and infill drilling to upgrade the mineral resource in the pit-shell area. Drill core holes were set up with specific azimuth and dip in order to intercept the iron formation.

The following assay results (Table 10-4) confirmed the continuity, extension down plunge and along strike of the high-grade mineralization (>60% Fe) at Joyce Lake. The highlights of the 2013 campaign include:

- Drillhole Joy-13-153 intersected 70.5 m of enriched iron mineralization with an average of 62.83% Total iron (Fe);
- Drillhole Joy-13-120 intersected 30 m of enriched iron mineralization with an average of 66.80% Total Iron (Fe); and
- Drillhole Joy-13-152 intersected 11.2 m of enriched iron mineralization with an average of 67.93% Fe.

Table 10-4: High-grade mineralization occurrences 2013 drilling program

Hole Name	From (m)	To (m)	Length (m)	Average Fe (%)
Joy-13-119	24	45	21	56.24
Joy-13-120	57	63	6	50.95
and	126	156	30	66.80
including	132	135	3	69.2
Joy-13-127	9	21	12	53.67
Joy-13-130	33	39	6	53.19
and	132	159	27	62.82
Joy-13-134	21	36	15	58.76
and	117	147	30	65.08
Joy-13-138	159	168	9	58.73
Joy-13-139	0	12	12	57.08
and	18	27	9	56.17
Joy-13-140	3	30	27	63.71
Joy-13-141	33	48	15	62.02
and	54	78	24	62.46
Joy-13-143	123	144	21	62.84
and	150	168	18	64.99
Joy-13-145	21	57	36	56.05
and	108	126	18	66.12
Joy-13-146	15	27	12	54.85
and	111	135	24	63.08
Joy-13-147	78	96	18	61.98
and	102	111	9	56.40
Joy-13-148	135	150	15	64.88

Hole Name	From (m)	To (m)	Length (m)	Average Fe (%)
Joy-13-149A	3	11	8	67.70
and	20	35.5	15.5	55.27
Joy-13-150	45	60	15	66.12
Joy-13-151	12	24	12	66.30
including	18	21	3	69.4
Joy-13-152	29.8	41	11.2	67.93
Joy-13-153	129	199.5	70.5	62.83
Joy-13-154	57	63	6	53.35
Joy-13-155	29	38.5	9.5	58.90
Joy-13-156	152	183.7	31.7	63.60
including	155	158	3	69.3
Joy-13-157	139.4	151.4	12	59.70
Joy-13-158	0.4	10.8	10.4	63.58
and	14.1	27	12.9	59.52
Joy-13-160	23	28.4	5.4	65.05
Joy-13-161	15.3	21.3	6	60.15
Joy-13-163	42.4	54.4	12	55.67
Joy-13-164	17.8	35.5	17.7	50.93
Joy-13-165	72	78	6	61.95
Joy-13-166	57.8	72.8	15	57.78
Joy-13-168	174	243	69	65.42
Joy-13-172	30.8	39.8	9	64.60

Figure 10-5: Downing diamond drills in action during site visit by Claude Duplessis, Autumn 2013, fresh core review from both drill with Allan Gan P. Geo. & Claude Britt

All collars except for lake holes and those after Joy-12-113 sequentially of the holes completed during the 2011-2012 seasons have been surveyed using differential GPS by Allnorth Engineering Consultants based out of Labrador City. The holes from the 2013 drilling program were surveyed with DGPS by Century under the supervision of Zhihuan Wan, P.Geo., an employee of Century, except for the lake holes completed in the Phase I drilling in March to April 2013.

10.3 Drilling Discussion and Additional Information

10.3.1 2010-2012 Drill Campaigns

In November of 2010, DSO targets were tested with conventional diamond core drilling by Century in Joyce Lake. Four boreholes (362 metres) were drilled at the Joyce Lake Syncline. Drilling was conducted by Forages Dibar Inc. of Sainte-Anne-des-Monts, QC. Blocky and sandy ground was encountered in boreholes resulting in poor core recovery. A total of 90 samples were sent to COREM for testing (78 samples and 12 QA/QC).

In 2011, to address poor recovery, Century applied RC drilling and conventional core drilling techniques. Drilling was conducted by Cabo Drilling Corp. of Kirkland Lake, ON, from April to October 2011 with a short break from April 28 – May 16 to honour local Indigenous goose hunting traditions. 38 holes were drilled in the Joyce Lake area for a total of 4,983.1 m; from which 1,425 samples and 164 QA/QC samples were sent for analysis. Among these holes, 32 holes totalling 3,930 m were drilled with an Acker RC drill, mainly at the nose and hinge zone of the Joyce syncline, while six holes using a diamond core drill, totalling 1,053.1 m, were completed to test the flank and southern extension of the Joyce syncline. The proposed drillholes were spotted by field geologists using a handheld GPS unit. All completed drillholes were surveyed by Allnorth Consultants Ltd. of Labrador City using Differential GPS ("DGPS"). Allnorth set seven fixed references (nails driven into bedrock) around Joyce Lake proper, in addition to the pre-existing Schefferville CACS station, to calibrate the reported drillhole locations. Data collection was done using a Leica GS15 receiver with horizontal accuracy of 3 mm + 0.1 ppm. The 2011 drilling was aimed at outlining the general geometry of the mineralized zone and extension along strike of the fold axis. The controlled mineralized zone was found to be over 1,000 m long and up to 400 m wide, with the highest-grade zone >60% Fe, at 15-42 m of depth.

Based on the drilling results from 2011, in 2012, Century drilled 78 vertical holes giving a total meterage of 7,618 m. Drilling took place from March to September 2012; with a short break from April 26 – May 14 to respect local Indigenous goose hunting traditions. These holes were drilled using two RC drill rigs (Hornet and Acker) and drilling was once again conducted by Cabo Drilling Corp. of Kirkland Lake, ON. This program exposed DSO within the hinge and the northern limb of the syncline. 2,373 samples along with 264 QA/QC samples were sent to the lab giving a total meterage of 7,058 m. The area of high-grade mineralization at shallow depth has been drilled on a 50 m×50 m grid and assay results confirmed the continuity and extension down plunge, along strike of the high-grade mineralization (>60% Fe) at Joyce Lake with a thickness up to 66 m. The higher-grade mineralization occurs mostly within a synclinal fold closure and partly on both flanks. The synclinal structure has a shallow 15° plunge to the southeast. Bedding in the fold closure is sub horizontal to moderately dipping. Additionally, 30 tonnes of bulk samples were also collected for metallurgical testing.

10.3.2 2013 Drill Campaign

In the 2013 exploration season, two phases of drilling were completed. Phase I drilling took place from March to July, using the RC drilling to delineate the extension of the main mineralization zone at Joyce south, and to test the gravity anomalies at lake area. Phase II drilling took place from September to November 2013 using triple tube HQ core drilling to test the DSO potential at the NE flank of the Joyce Lake syncline and explore the potential of the SW limb.

The Phase I drilling program was initiated on March 7, 2013. A break was taken during goose hunting season from April 28 to May 18, in respect to local community traditions, and restarted on May 23. This first phase of drilling ended on July 15, 2013. The drilling was conducted by Cabo Drilling Corp. of Kirkland Lake, ON, using one Acker RC (reverse circulation) rig and one Hornet drill (reverse circulation hammer) for the program. A total of 30 RC holes were drilled at depths ranging from 7-192 m, totalling 3,301.7 m. Holes were drilled to infill previous holes within the main mineralized body, to test the gravity anomalies delineated by the ground gravity survey in February 2013 as well as to test the DSO potential in the southern extension of high-grade zone.

A 9 cm diameter drill bit and 7.5 cm diameter drill bit were used for the Hornet and Acker drill rigs respectively. Generally, sampling for a 3 m sample run uses three 5-gallon pails that are connected to the output of the drill cyclone-splitter. 5/16 of the original sample is taken as the main sample – a coarse and fine sample and the remaining 11/16 is discarded as a reject sample. The samples were collected continuously once the bedrock-overburden contact was established by the on-site geologist who periodically checked the cuttings using a sieve to ascertain the bedrock geology.

The Phase II drilling program was targeted at the NE flank of Joyce Lake syncline, SE extension of high-grade zone, and infill holes at main mineralized zones, in efforts to upgrade the mineral resource in the main mineralized zones and test the mineralization at NE and SW flank. The program consisted of 26 boreholes, totalling 2,942.5 m, and was completed between September 15, 2013 and November 15, 2013. Downing Drilling Ltd. from Grenville-sur-Rouge, QC, was contracted to conduct the drilling program. The program used two triple-tube HQ3 diamond core drilling rigs (LF-70), with drillhole depths ranging from 31.5-264 m, at angles between -50° to -90°, toward the NE or the SW on the section lines. A Reflex instrument was used for measuring the down hole deviation and provided accurate location of the holes in the deposits.

In the 2013 drilling season, 2011 samples representing 5,921.2 m of sampled core, in addition to the duplicates, standards and blanks inserted as QA/QC samples to monitor laboratory performance. Nominal samples for core drilling length were 3 m but ranged from 1.5 m to 4.5 m in order to honour the main lithological contacts. The core was cut in half using a diamond saw and hydraulic splitters where half was sent to the lab, and half was kept for reference.

Regardless of drill technique, the hole was spotted by a field geologist using a hand-held GPS (Garmin GPSmap 62s and Garmin Etrex 30 with 3-5 m accuracy). The field geologist monitored the set-up of the drill floor, ensuring that the drillholes met the proposed azimuth and dip. Once the hole is complete, a final collar location reading was taken using a Trimble GeoExplorer 6000 series GeoXH centimetre edition receiver with internal antenna. Terrasync centimetre edition firmware was also used. The Schefferville CACS station and several staked drillholes surveyed by Allnorth were used as references to calibrate and validate the observations. After processing, the nominal accuracy of the GPS receiver is 2.5 cm + 1.2 ppm horizontally and 4 cm + 1.5 ppm vertically. This reading will be the final location measurement. Prior to abandonment of the drill site, all garbage is removed and environmental conditions are left as close to the original state as possible. Lastly, the drillholes are covered and flagged for identification purposes.

10.3.3 Logging Procedures

Core logging was done directly by Century geologists into the dedicated software GeoticLog. Where applicable, field geologists logged for recovery, Rock Quality Designation ("RQD"), magnetic susceptibility, mineralogy and characteristics, geological structures, and specific gravity ("SG"). This task was supervised by Senior Exploration Manager Mr. Allan Gan, P.Geo. and Exploration Manager Ms. Zhihuan Wan, P.Geo.

For RC drilling, a small portion of the mixed sample is collected and placed into muffin tins by the on-site geologist. The muffin tins containing the logging sample are placed into a warm open area for drying. Once dried, the logging samples were examined under the microscope, mineral abundances are estimated using an abundance chart and mineralogy is logged by geologists. Based on the mineral abundances and characteristics, unit boundaries were identified. Magnetic susceptibility readings were taken using the MPP Probe from GDD Instrumentation.

For core diamond drilling, recovery and RQD were measured based on the 3 m tags marked by the drill help while all other procedures were logged based on sample tags marked by the logging geologist. The samples (approximately 3 m each) do not cross lithologies and are separated based on mineralogical and characteristic differences. Magnetic susceptibility readings were taken at every 20 cm using the KT-10 Magnetic Susceptibility Meter. These readings were then averaged to give one reading per sample. Structural readings were taken with respect to the core axis. Multiple SG measurements were taken for each sample using a fish scale or a graduated cylinder (depending on the nature of the material) based on water displacement and an average length-weighted value was calculated for each sample (various methods were used by Century and a detailed report was provided to the author.

10.3.4 QA/QC and Sampling Procedures

10.3.4.1 RC Drilling

The RC samples were collected at drill site using the 3-bucket-system, in which overflow from one bucket is passed into another allowing fine samples to settle. Once each run was completed, the samples were transferred into plastic bags and put into plastic pails with drillhole number, sample number, and sample intervals marked on both the plastic bags and the plastic pails. Subsequently, the plastic pails containing samples bags were transported to the core shack in Schefferville.

In the core shack, all samples from one sample interval were mixed using a concrete mixer and passed through a riffle splitter with a 1:7 splitting ratio in order to get a representative portion of the sample to send for laboratory assay. The 1/8 portion of the sample is sent for lab assay and the 7/8 portion is saved and stored in Schefferville as reference samples.

Further to this, Century field geologists conducted a systematic QA/QC program consisting of inserting two sample blanks, four certified reference materials (SCH-1) and in-house reference materials (STD-1, STD-2 STD-3, STD-4), and four duplicate samples. For every 100 samples, 10 control samples were used. Additional to the 10 control samples per 100 samples, a reject for approximately every 15th sample was also sent to the core shack where it was split and sent for assay. All assay samples, together with the QA/QC samples, were sent to Activation Laboratories in Ancaster, ON. for analysis.

10.3.4.2 Triple Tube Core Diamond Drilling

Triple tube diamond drill core is sampled approximately every 3 m, where the sample interval is determined according to the uniformity of the iron mineralization and geological boundaries in order to constrain high-grade zones. Once logged by Century field geologists, the core is split in half lengthwise by core shack helpers where half is stored for reference, and the other half is sent for assay at Activation Laboratories by freight in rice bags tied with tamper resistant security tags. Similar to RC drilling, ten control samples for every 100 samples were inserted for quality control measures. Duplicates for control samples were sampled by splitting witness core to quarters and leaving the remaining quarter as witness.

11. Sample Preparation, Analyses and Security

The quality assurance and quality control ("QA/QC") protocol employed during the 2011-2013 exploration programs included procedures for monitoring the "chain-of-custody" of samples and the insertion of nine different types of reference material, four types of blanks and sample duplicates.

In 2011, all the collected Joyce Lake DSO Iron Ore Project samples were prepared and assayed by Activation Laboratories ("Actlabs") Ltd. in Ancaster, ON; while a portion of samples from early 2012 drilling programs were prepared and assayed by SGS Canada Inc. in Lakefield, ON. In 2013, Century used Actlabs for assaying samples.

The in-situ preparation remained the same in 2013. Additionally, Century personnel weighed and packed every sample for shipping into a sealed bag under geologist supervision, samples were tracked with security seals and logged into the drilling database. The laboratories received packing lists associating sample numbers with security seals via paper and electronic formats. In 2013, Century personnel recorded sample bag weights and requested the labs to provide a weight report for every sample received to track material lost or potential sample mix-ups.

11.1 Drill Core Handling and Sample Preparation

11.1.1 Logging Procedures

Core logging was done directly by Century geologists into the dedicated software GeoticLog. Where applicable, field geologists logged for recovery, Rock Quality Designation ("RQD"), magnetic susceptibility, mineralogy and characteristics, geological structures, and specific gravity ("SG"). This task was supervised by Senior Exploration Manager Mr. Allan Gan, P.Geo., and Exploration Manager Ms. Zhihuan Wan, P.Geo.

For RC drilling, a small portion of the mixed sample is collected and placed into muffin tins by the on-site geologist. The muffin tins containing the logging sample are placed into a warm open area for drying. Once dried, the logging samples were examined under the microscope, mineral abundances are estimated using an abundance chart and mineralogy is logged by geologists. Based on the mineral abundances and characteristics, unit boundaries were identified. Magnetic susceptibility readings were taken using the MPP Probe from GDD Instrumentation.

For core diamond drilling, recovery and RQD were measured based on the 3 m tags marked by the drill help while all other procedures were logged based on sample tags marked by the logging geologist. The samples (approximately 3 m each) do not cross lithologies and are separated based on mineralogical and characteristic differences. Magnetic susceptibility readings were taken at every 20 cm using the KT-10 Magnetic Susceptibility Meter. These readings were then averaged to give one reading per sample. Structural readings were taken with respect to the core axis. Multiple SG measurements were taken for each sample using a fish scale or a graduated cylinder (depending on the nature of the material) based on water displacement and an average length-weighted value was calculated for each sample (various methods were used by Century and a detailed report was provided to the author, see Chapter 14 for Density measurements details).

11.1.2 QA/QC and Sampling Procedures

11.1.2.1 RC Drilling

The RC samples were collected at drill site using the 3--bucket system, in which overflow from one bucket is passed into another allowing fine samples to settle. Once each run is completed, the samples were transferred into plastic bags and put into plastic pails with drillhole number, sample number, and sample intervals marked on both the plastic bags and the plastic pails. Subsequently, the plastic pails containing samples bags were transported to the core shack in Schefferville.

In the core shack, all samples from one sample interval were mixed using a concrete mixer and passed through a riffle splitter with a 1:7 splitting ratio in order to get a representative portion of the sample for sending to laboratory assay. The 1/8 portion of the sample is sent for lab assay and the 7/8 portion is saved and stored in Schefferville as reference samples.

Further to this, Century field geologists conducted a systematic QA/QC program consisting of inserting two sample blanks, four certified reference materials (SCH-1) and in-house reference materials (STD-1, STD-2 STD-3, STD-4), and four duplicate samples. For every 100 samples, 10 control samples were used. Additional to the 10 control samples per 100 samples, a reject for approximately every 15th sample was also sent to the core shack where it was split and sent for assay. All assay samples, together with the QA/QC samples, were sent to Activation Laboratories in Ancaster, ON, for analysis.

11.1.2.2 Triple Tube Core Diamond Drilling

Triple tube diamond drill core is sampled approximately every 3 m, where the sample interval is determined according to the uniformity of the iron mineralization and geological boundaries in order to constrain high-grade zones. Once logged by Century field geologists, the core is split in half lengthwise by core shack helpers where half is stored for reference, and the other half is sent for assay at Activation Laboratories by freight in rice bags tied with tamper resistant security tags. Similar to RC drilling, ten control samples for every 100 samples were inserted for quality control measures. Duplicates for control samples were sampled by splitting witness core to quarters and leaving the remaining quarter as witness.

11.2 Sample Analysis and Security by Actlabs (2011-2013)

To minimize the matrix effects of the samples, heavy absorber fusion technique (Norrish and Hutton 1969 Geochim Cosmochim Acta, volume 33) is used for major element oxide analysis. Prior to fusion, the loss on ignition ("LOI"), which includes H_2O, CO_2, S and other volatiles, can be determined from the weight loss after roasting the sample at 1,050 °C for 2 hours. The fusion disk is made by mixing a 0.5 g equivalent of the roasted sample with 6.5 g of a combination of lithium metaborate and lithium tetraborate with lithium bromide as a releasing agent. Samples are fused in Pt crucibles using an AFT fluxer and automatically poured into Pt moulds for casting. Samples are analyzed on a Panalytical-Axios Advanced XRF. The intensities are then measured and the concentrations are calculated against the standard G-16 provided by Dr. K. Norrish of CSIRO (Commonwealth Scientific and Industrial Research Organisation), Australia. Matrix corrections were made by using the oxide alpha – influence coefficients also provided by K. Norrish. In general, the limit of detection is about 0.01% for most of the elements, as described in Table 11-1.

- X-Ray Fluorescence Analysis Code: 4C used at Actlabs;
- Variables (%): SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, P_2O_5, MnO, LOI.

Table 11-1: Borate fusion whole rock XRF reporting limits for Actlabs

Element	Limit (%)	Element	Limit (%)	Element	Limit (%)
SiO_2	0.01	Na_2O	0.01	CaO	0.01
Al_2O_3	0.01	TiO_2	0.01	MgO	0.01
Fe total as Fe_2O_3	0.01	Cr_2O_3	0.01	K_2O	0.01
P_2O_5	0.01	V_2O_5	0.001	MnO	0.01

Note: Also includes loss on ignition

The following is a description of the QA/QC protocols used at the Actlabs facility. This description is based on input from Actlabs. A total of 34 standards are used in the calibration of the method and 28 standards are checked weekly to ensure that there are no problems with the calibration. Certified Standard Reference Materials ("CSRMs") are used and the standards that are reported to the client vary depending on the concentration range of the samples.

The re-checks are done by checking the sample's oxide total. If the total is less than 98% the samples are reweighed, fused and analyzed. The number of duplicates done is decided by the Prep Department; their procedure is one for every 50 samples, only if there is adequate material. If the work order is over 100 samples, they will pick duplicates every 30 samples. General QC procedure for XRF is: The standards are checked by control charting the elements. The repeats and pulp duplicates are checked by using a statistical program that highlights any sample that fails the assigned criteria. These results are analyzed, and any failures are investigated using their QCP Non-Conformance (error or omission made that was in contrast with a test method ("QOP"), Quality Control Method ("QCP") or Quality Administrative Method ("QAP").

Moreover, sample analysis codes remain the same, with a RX1 preparation code and 4C XRF fusion element package. Sample security has also remained largely unchanged in 2013, as Century technical team weighed and packed every shipped sample into a sealed bag under geologist supervision and tracked the security seals via their drilling database. The labs received box lists associating sample numbers with security seals in both paper and electronic formats. One change was made to sample security, it was requested the labs provide a weight report for every sample received. The technical team then compared this to the records to check for sample mix-ups, broken bags, etc.

11.3 Sample Analyses and Security at SGS-Lakefield (2012)

The analysis used was whole rock XRF (X-Ray Fluorescence) by Borate fusion. The following is a description of the exploration drillhole analytical protocols used at the SGS-Lakefield laboratory facility in Lakefield, ON. This description and the following table (Table 11-2) were supplied by SGS-Lakefield:

- X-Ray Fluorescence Analysis Code: XRF76Z;
- Variables (%): SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, P_2O_5, MnO, LOI;
- Typical sample size: 0.2 to 0.5 g;
- Type of sample applicable (media): Rocks, oxide ores and concentrates;
- Method of analysis used: The disk specimen is analyzed by Wavelength Dispersive XRF spectrometry;
- Data reduction: The results are exported via computer, online, data fed to the Laboratory Information Management System with secure audit trail;
- Corrections for dilution and summation with the LOI are made prior to reporting.

Table 11-2: Borate fusion whole rock XRF reporting limits for SGS

Element	Limit (%)	Element	Limit (%)	Element	Limit (%)
SiO_2	0.01	Na_2O	0.01	CaO	0.01
Al_2O_3	0.01	TiO_2	0.01	MgO	0.01
Fe_{total} as Fe_2O_3	0.01	Cr_2O_3	0.01	K_2O	0.01
P_2O_5	0.01	V_2O_5	0.003	MnO	0.01

Note: Also includes Loss on Ignition

The following description of the quality assurance and quality control protocols used at the SGS-Lakefield laboratory facility in Lakefield, ON, was supplied by SGS-Lakefield. One blank, one duplicate and a matrix-suitable certified or in-house reference material per batch of 20 samples. The data approval steps are shown in the following table (Table 11-3).

Table 11-3: SGS-Lakefield laboratory data approval steps

Step	Approval Criteria
1. Sum of oxides	Majors 98 – 101% Majors + NO + CoO 98 –102%
2. Batch reagent blank	2 x LOQ
3. Inserted weighed reference material	Statistical Control Limits
4. Weighed Lab Duplicates	Statistical Control Limits by Range

11.4 2010 – 2012 Drill Programs Verification

For the Mineral Resource Estimates, the data verification was done on the iron (Fe) and silica (SiO_2) assay results from the 2011 and 2012 drilling program. Assay analyses were performed by Corem in 2010, Actlabs in 2011-2012 and SGS analytical Laboratory in 2012. A series of quality control procedures including duplicates, standards and blanks were introduced. From 2011 to 2012, a total of 93 blanks were used, including 68 silica blanks and for the rest feldspar blanks, halite blanks or dolomite blanks were used. A total of 164 duplicates were used from the 2011 to 2012 programs and one from the 2010 program. From 2011 to 2012, 170 standards were analyzed and six from 2010. Adequate correlation has been demonstrated with high R^2 factors.

The limit of plus or minus 20% variation was chosen as an acceptable variance for the XRF analytical process. Most of the differences observed were within the 20% variance range throughout the QA/QC process, and only a few results were found outside these boundaries and considered as failures. For the 2011 to 2012 drilling program, results return good correlation.

For the blanks, a 1% error line was set as an acceptable limit. However, several issues were found in Iron and Silicate values. The difference was too high to come from sampling contamination; after consultation with the Century geologist it was determined that high iron values of blanks came from the blanks sampling process in the Schefferville area and for that reason it did not affect the QA/QC results.

Reported results for the standards inserted in the 2011-2012 drill program have shown good correlation except for three samples where the compared values are higher than the expected mean values for those standards. Those three values are not considered to invalidate all the results.

As part of the Joyce Lake QA/QC protocol, 75 samples analyzed by Actlabs were re-assayed by SGS Laboratory in June 2012. In order to represent acceptable error limits of the duplicates values, the plus or minus 20% lines were added to the graphics. The following plotted values confirm good correlation between both analyses. The sample re-analysis returned 51% of the values higher and likewise 49% lower, which is a distribution that indicates very little bias. The SGS data show a difference of 2.8% higher on average grades than Actlabs.

The term "lake hole" is a conceptual expression used to designate holes drilled during winter on the lake. A separate QA/QC process for "lake holes" was conducted at SGS Laboratory to confirm their validity as required by the Mineral Resource Estimate. As a result, the variation between the three "lake holes" when comparing lab assays to JDI's internal XRF assays appears to be the same as the other holes. Furthermore, "lake hole" duplicates were compared, and good correlation is observed for the duplicates such that all values are close to the median line.

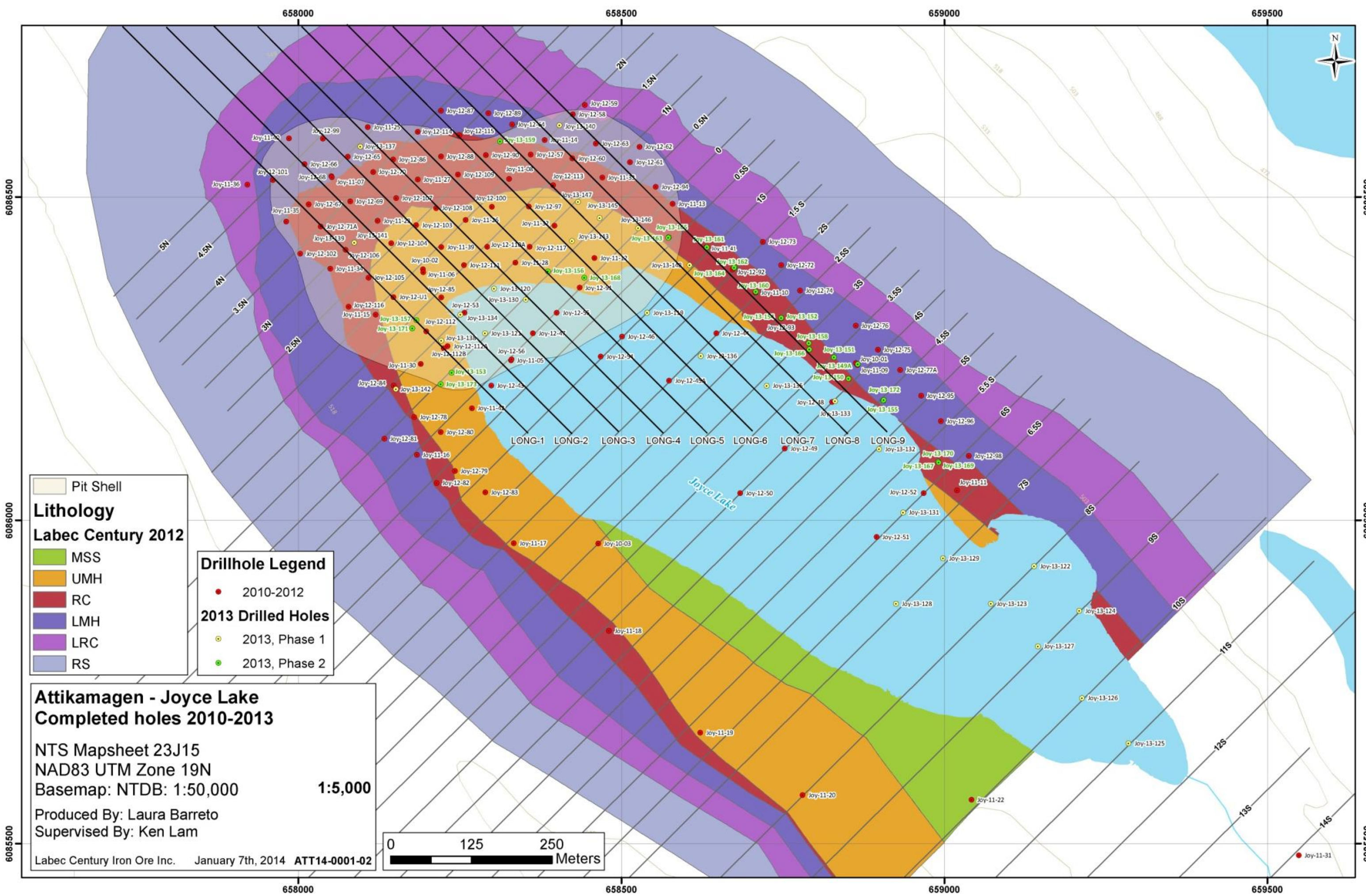


Figure 11-1: Map of collars location with lithological formations (from Century)

11.5 2013 Drill Program Verification

The QP, Claude Duplessis P.Eng., has conducted a verification of the entire database before Mineral Resource estimation. The digital drillhole database supplied by Century has been validated for the following fields: collar location, azimuth, dip, drillhole length, survey data, and analytical values. Some minor errors were found and were subsequently corrected to produce the final Mineral Resource Estimate.

The Joyce Lake database contains 176 drillholes, with the following distribution: 36 core drillholes dipping at -45° to -90°, 140 RC drillholes dipping at -90°, and the database also includes 16 channels. The hole Joy-12-53 was considered by Century as not reliable due to the technical problem encountered in 2011 and was re-drilled in winter 2013 as Joy-13-134.

The assay coverage of Joyce Lake area is comprised of 5,657 assayed intervals totalling 17,030.42 m (of 17,800.22 sampled metres including un-assayed intervals). Joyce Lake holes were drilled in a 3.96 km^2 zone from 657900E/6084451N to 659700E/6086650N in the UTM zone 19N NAD83 coordinate system. Most holes are located on the north-western portion of the Property and spaced approximately 50 m along the NW-SE trending and approximately 40 m along the NE-SW trending.

The year 2013 data contains 2,042 assay intervals totalling 5,998.32 m. The data verification was done on iron (Fe) and silica (SiO_2) assay results from the 2013 drilling program. A series of quality control procedures including duplicates, standards and blanks were introduced. A total of 336 quality control samples were inserted.

During the 2013 drilling program a total of 44 blanks were used, all blanks used in 2013 were silica blanks (Type: BL). A total of 208 duplicates and 84 standards were analyzed. Five types of standards were used. The correlation coefficients produced indicate adequate correlation between populations.

11.5.1 Duplicates

Comparisons of field duplicates are illustrated in Figure 11-2 and Figure 11-3. The red-dotted lines represent the original value plus 20% and minus 20%. On Figure 11-2, the orange dots are the original values and the blue dots the duplicate values. The green circle and the red bar highlight the only value outside the ±20% limit.

Note: the hole Joy-13-130 was duplicated with reject stream at the drill and was treated as other duplicates.

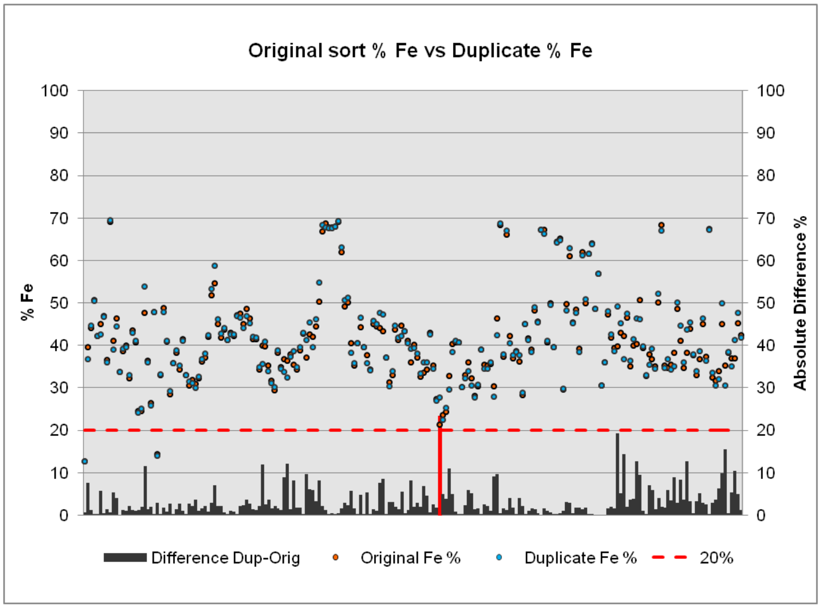


Figure 11-2: Original samples vs. duplicate samples with differences in %

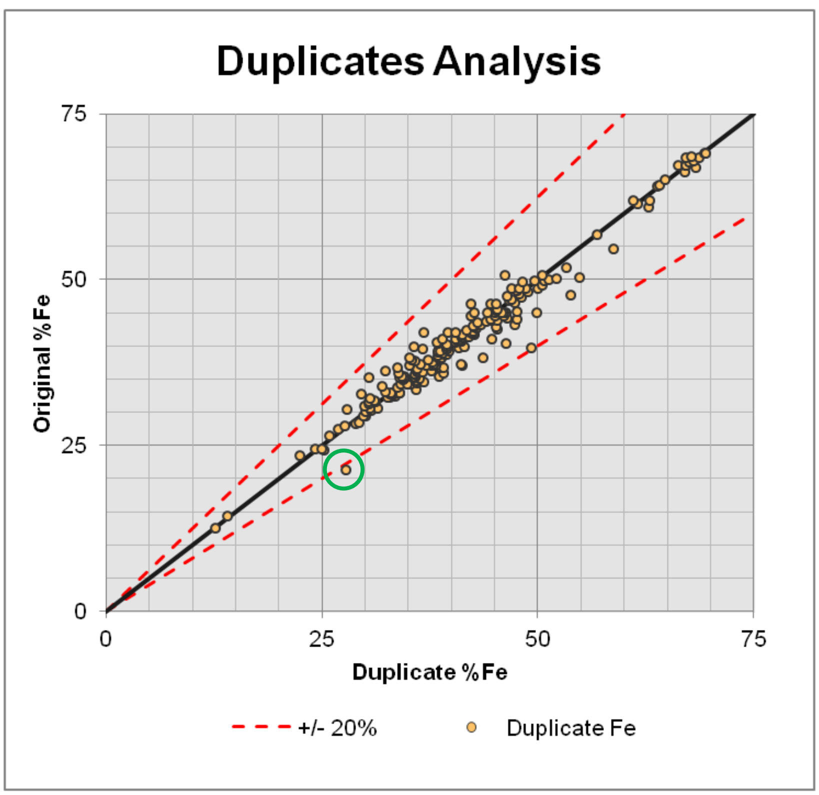


Figure 11-3: Assays results for 2013 Drilling Program

11.5.2 Blanks

In 2013, one type of blank was used for the Joyce Lake QA/QC process. The blank ("BL") used was the silica, with a total of 44 measurements. The average grade was for Fe 0.48% and for the SiO_2 97.48%. Blank values were considered acceptable when the value was less than 1% Iron (Fe). In general, blank analyses are acceptable. Figure 11-4 and Figure 11-5 show the blank values for iron and silica respectively and the acceptable control lines. Figure 11-4 does not show any failures for Fe% assays with the BL type blank. The silica blank is almost pure SiO_2, which is why we decided to set the limit to three standard deviations. Even though one value was outside the 3σ limit it was not considered relevant to invalidate the quality of the data.

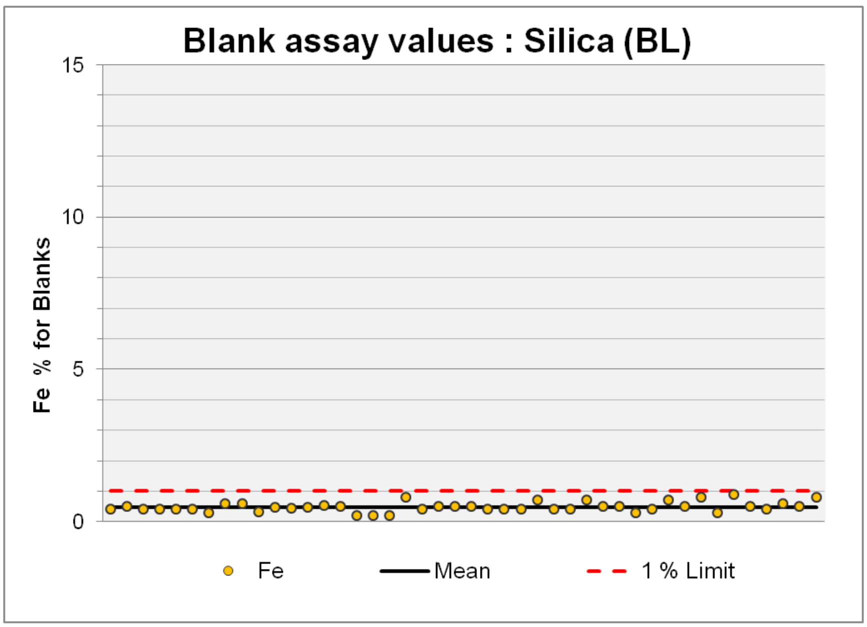


Figure 11-4: Fe blank comparison (2013 Drilling Program)

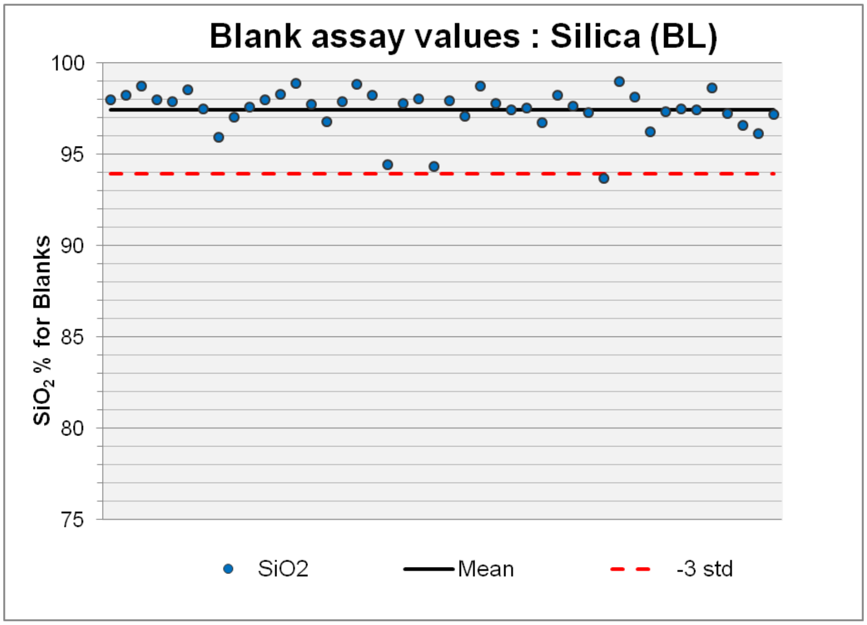


Figure 11-5: SiO2 blank comparison (2013 Drilling Program)

The 2013 data verification has not encountered issues with blanks as encountered in the 2011-2012 verification. Thus, it appears that past contamination problems are resolved and the QP encourages JDI to keep this procedure and continue to monitor SiO_2 values closely.

11.5.3 Standards

In 2013 five different standards were used in the sampling process for a total of 84 reference material samples inserted during the sampling process. Table 11-4 shows a summary of drill database average values and quantity of standards used in the process.

Table 11-4: Standards summary (2013 Drilling Program)

Standard	Count	%SiO_2 Mean	% SiO_2 Deviation	%Fe Mean	% Fe Deviation
SCH 1	14	8.03	0.29	60.62	0.56
STD 1	29	35.68	0.26	39.08	0.25
STD 2	16	44.33	0.18	31.86	0.20
STD 3	13	43.42	0.24	30.44	0.19
STD 4	12	45.30	0.14	27.66	0.12

The standard deviation (calculated from the population) was used to determine the quality of measurements. The QP considered that the values within two standard deviations of the mean were demonstrated valid, those between two and three standard deviations were characterized as acceptable. However, standard values outside of the plus or minus three standard deviations were judged as failures.

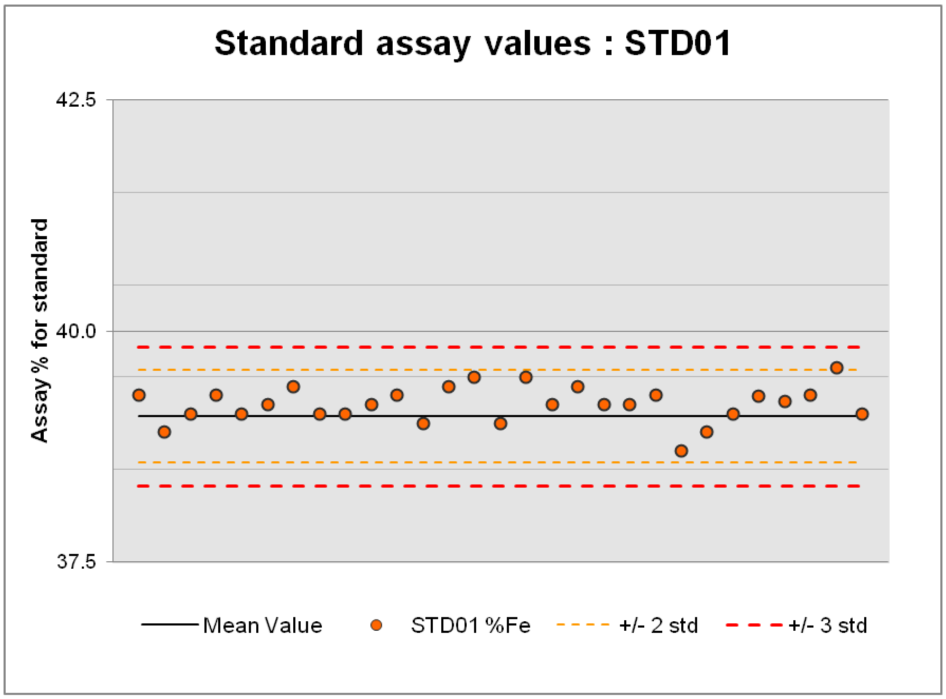


Figure 11-6: Standard analysis STD01 - Fe

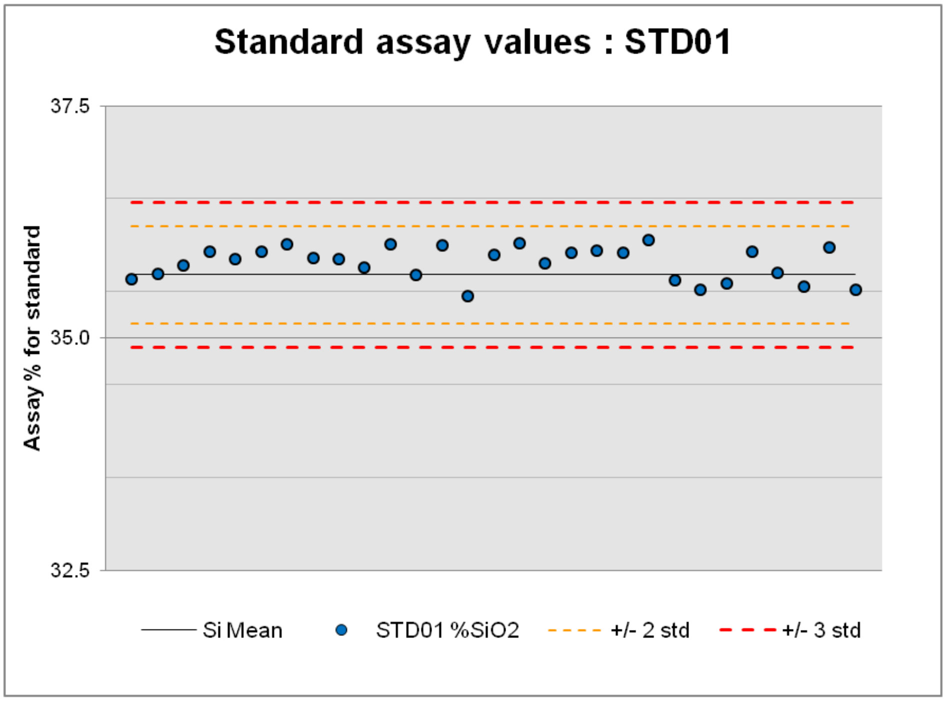


Figure 11-7: Standard analysis STD01 - SiO_2

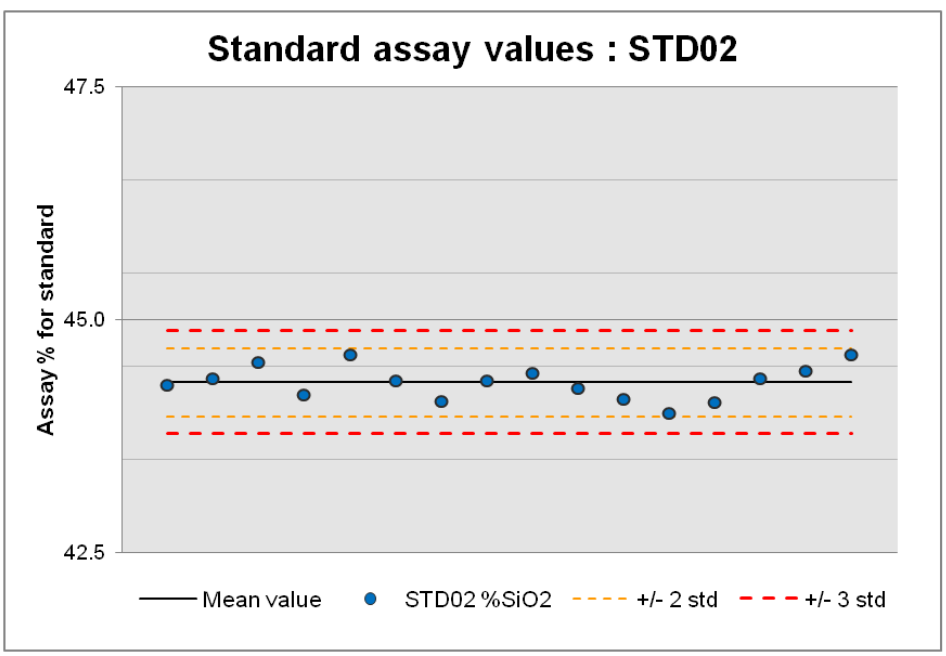


Figure 11-8: Standard analysis STD02 - SiO_2

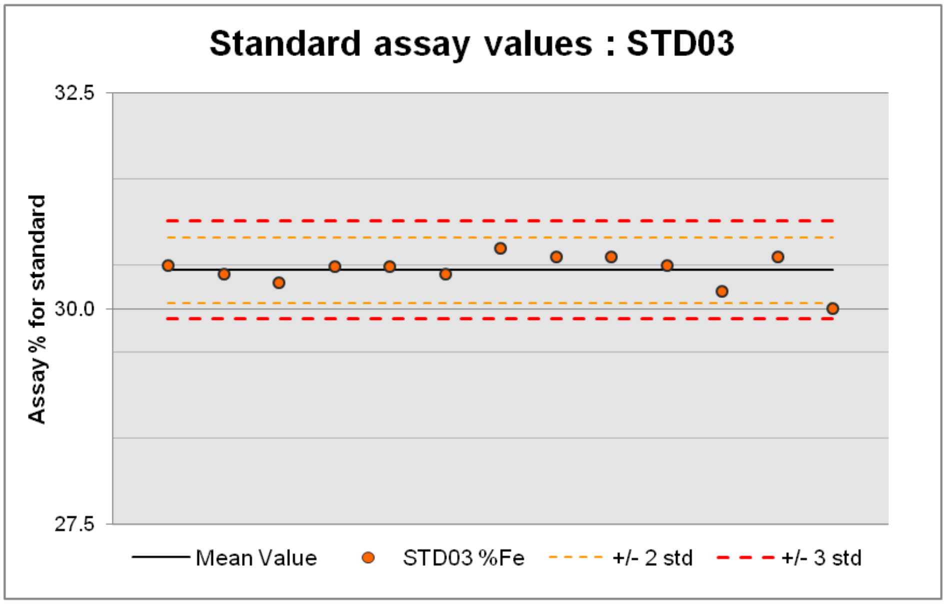


Figure 11-9: Standard analysis STD03 – Fe

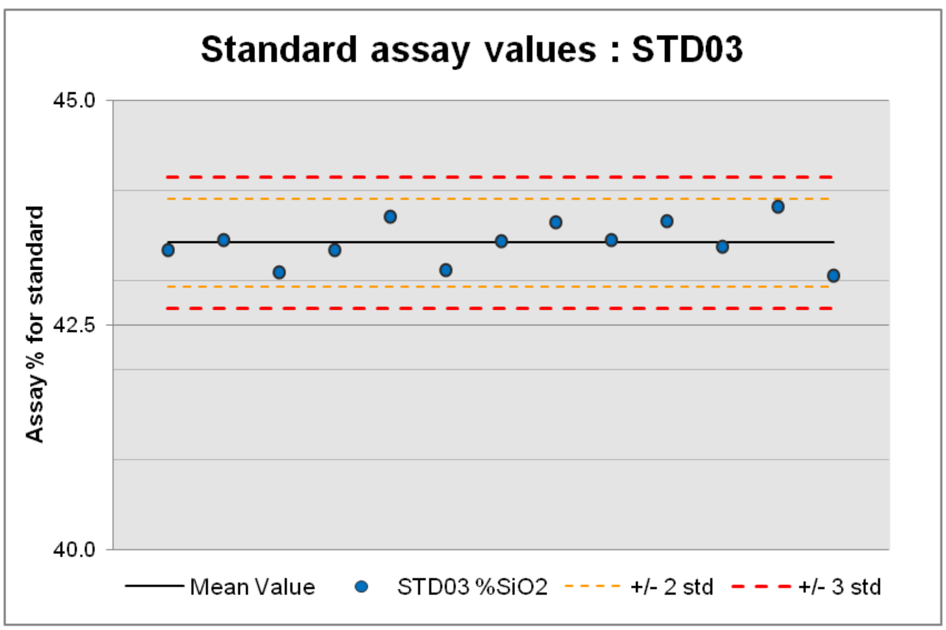


Figure 11-10: Standard analysis STD03 - SiO_2

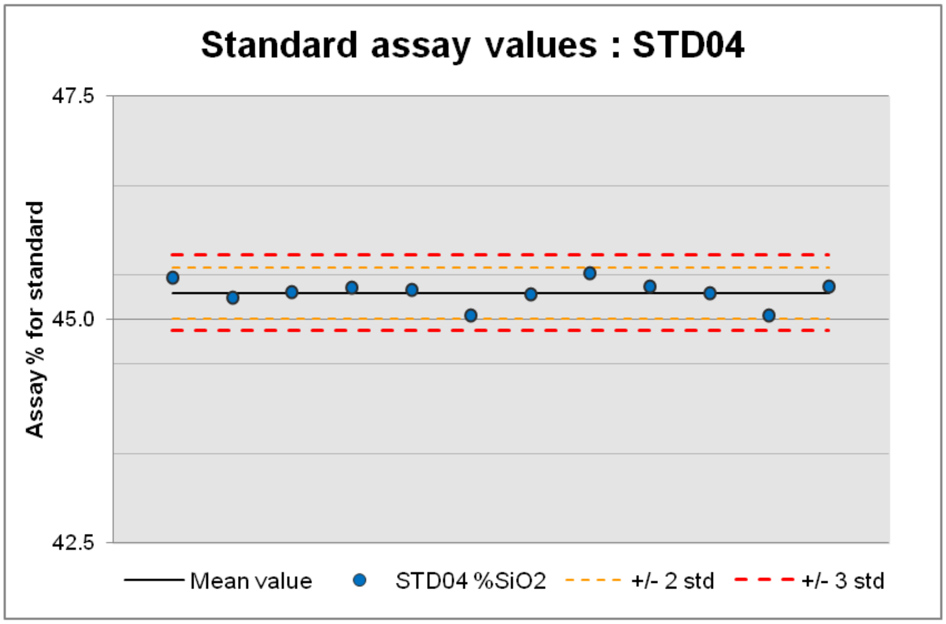


Figure 11-11: Standard analysis STD04 - Fe

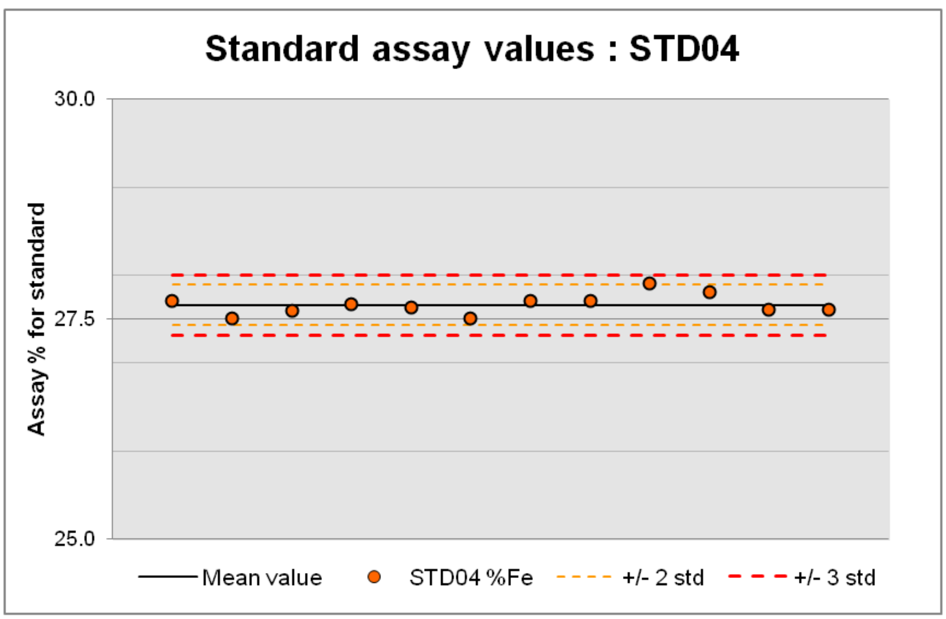


Figure 11-12: Standard analysis STD04 - SiO_2

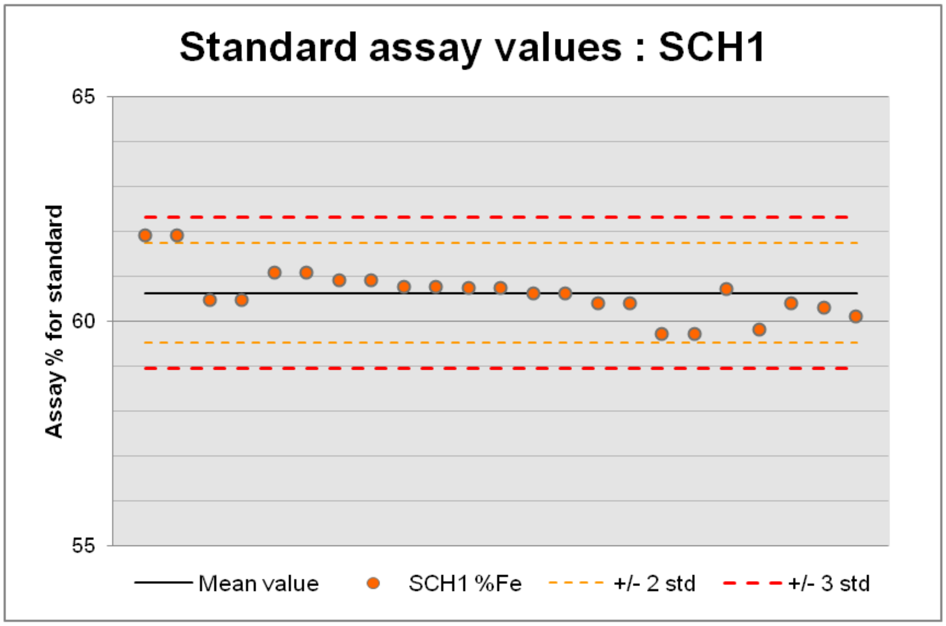


Figure 11-13: Standard analysis SCH1 – Fe with target mean

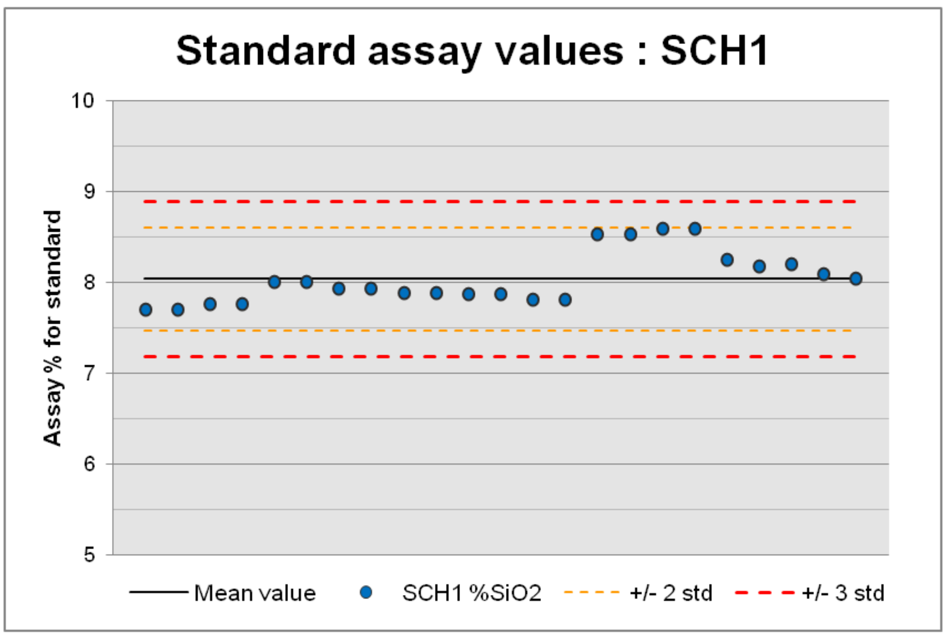


Figure 11-14: Standard analysis SCH1 - SiO_2 with target mean

Reported results for the standards inserted in the 2013 drill program have met the control limit requirements, indicating the unknown samples are valid. Only seven samples returned values outside the two standard deviation limits of its population. Those seven values are not considered to invalidate all the results considering that they are not outside three standard deviations lines. We can conclude the quality of the standard is better than the past exploration program; as such Century seems to have improved infield QA/QC.

12. Data Verification

GMG conducted a verification of the entire database before resource estimation. The digital drillhole database supplied by Century has been validated for the following fields: collar location, azimuth, dip, drillhole length, survey data, and analytical values.

12.1 Independent Sampling 2013

During the site visit in March 2013, the QP, Claude Duplessis, Eng., selected independent samples. A total of 31 samples were taken from the hole Joy-13-120. The procedure consisted of a selection of 15 witness intervals of Century original samples and the 15 corresponding intervals from the rejects. Samples were divided using a splitter and bagged at the preparation laboratory of Century in Schefferville under the QP's supervision. All the samples were then sent to SGS laboratory located in Lakefield, ON for analysis. Table 12-1 summarizes the Century original sample numbers and the QP's independent sample numbers.

Table 12-1: Standards summary (2013 Drilling Program)

Independent samples JOY-13-120					
From (m)	To (m)	Sample Number		Reject Number	
		Century	SGS	Century	SGS
114	117	490355	42451	-	42466
117	120	490356	42452	-	42467
120	123	490357	42453	-	42468
123	126	490358	42454	-	42469
126	129	490359	42455	-	42470
129	132	490360	42456	-	42471
132	135	490361	42457	-	42472
135	138	490363	42458	-	42473
138	141	490364	42459	-	42474
141	144	490365	42460	490366	42475
144	147	490368	42461	-	42476
147	150	490369	42462	-	42477
150	153	490370	42463	-	42478
153	156	490371	42464	-	42479
156	159	490372	42465	-	42480

In order to validate the correlation between the batches of samples, the following pairs were plotted:

- SGS (Duplessis) independent samples versus Century original samples;
- Century original samples versus rejects;
- SGS (Duplessis) independent samples versus rejects.

The analytical results for % Fe and % SiO_2 are plotted in the diagrams below. The diagrams show a good correlation and validate the reproducibility of the analytical samples for the % Fe. As expected, the best correlation appears to be between Century original samples and SGS independent samples. However, if we look at the rejects results, SiO_2 values appear to be significantly different than the Century samples and SGS independent samples as well. We can see several results out of the ±20% lines. For % Fe, the rejects appear to be systematically higher in % Fe and lower in % SiO_2. This could be indicative of an existing bias in the values of rejects.

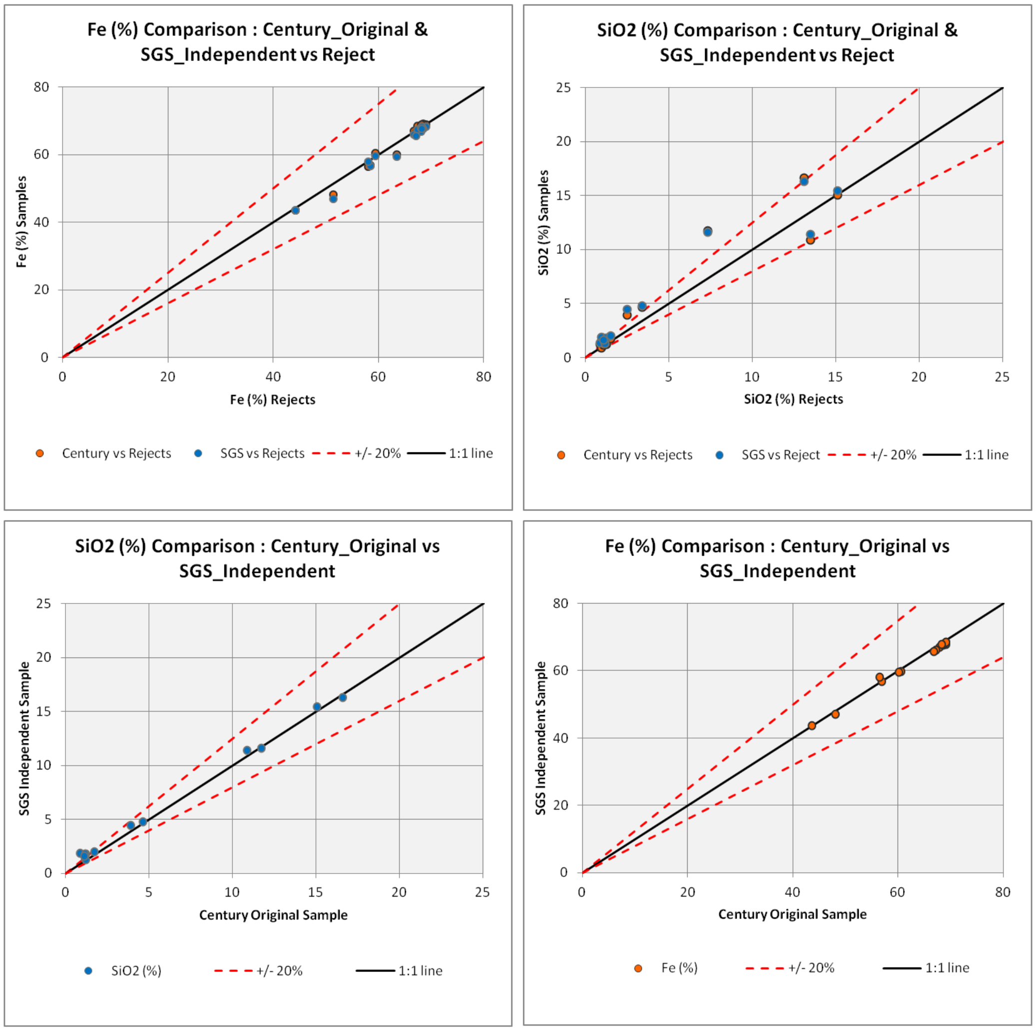


Figure 12-1: Comparison correlation SGS Independent vs. Century Fe % & % SiO_2

In order to validate the bias possibility, a T-test was performed. Table 12-2 shows the results.

Table 12-2: T-Test analysis

N=15				
Element	SGS vs. Century		SGS vs. Reject	
	Bias	Estimated Difference	Bias	Estimated Difference
% Fe	99.9%	1.0%	98.5%	2.0%
% SiO_2	96.8%	-3.0%	96.0%	-16.0%

The T-test results show a bias at 99.9% for the % Fe values between SGS independent samples and Century original samples. The difference in % Fe of the SGS independent sample value is estimated at the original value +1%. For the SiO_2, the possibility of bias is 96.8% with an estimated difference of -3% in % SiO_2 of the SGS analysis. Those results show that the assay values from SGS Lakefield have systematically higher % Fe than the original data set and lower % SiO_2. However, the estimated differences are low and can be explained by differences between calibration curves, sample size used for analysis and sample division.

For the reject, the bias possibility regarding the SGS independent samples is 98.5% with +2% Fe in the rejects than in the SGS independent sample. The bias possibility is 96% for the SiO_2 with an estimated difference of -16% of SiO_2 in the reject than in the SGS sample. The estimated differences are relatively high and required more investigation to find the origin of observed difference. The rejects were not used for the estimation and had not impacted the resource estimates.

The bias analyses concluded that the current data used for the resource estimation have systematically had lower % Fe grade and higher % SiO_2 values and thus, as well, for the rejects than for the SGS independent samples. We can conclude that the actual resources based on the original dataset is a conservative estimate.

12.2 Data Verification Conclusions and Recommendations

As part of the 2013 work program at Joyce Lake, Century implemented a QA/QC protocol which consists of inserting reference materials in the sample series (including both standards and blanks). The QA/QC program also included analysis of duplicates on selected samples.

Actlabs proceeded to the 2013 assays analysis. The data verification was done on the iron grade (% Fe) assay results from 2013 drilling program. Visual analyses of duplicates of Actlabs assays show satisfactory correlation. Only one result is outside the minus 20% boundary (indicated by a red bar and green circle in Figure 11-2 and Figure 11-3). The error is 23.32% in the hole Joy-13-132 at the depth of 51 m (the duplicate sample number is 494369). This result could be related to the error either at sample collection in the field or sample preparation at Lab. However, there are not enough failures to invalidate the results.

For the blanks, a 1% error line was set as an acceptable limit for iron. The verification did not return any relevant issues.

Reported results for the standards inserted in the 2013 drill program have shown good correlation with the expected mean. Only seven sample values compared were outside of its respective two standard deviation limits. Those seven values are not considered likely to invalidate all the results considering that they are not three standard deviations beyond the expected mean.

Independent samples return a good correlation between samples from SGS and Century with an existing bias in the SGS analysis having systematically higher % Fe and lower % SiO_2. The bias cannot be considered significant to impact the Mineral Resources Estimates quality. The rejects analysis returns a strong bias for silica analysis. The SiO_2 is systematically underestimated in the rejects and the Fe overestimated may be related to segregation of the material in the rejects bag.

Considering these analyses, the data used for the estimation appear to be conservative.

13. Mineral Processing and Metallurgical Testwork

Metallurgical testwork performed on the Joyce Lake mineral deposit samples is documented in three reports:

1. 'Mineralogical Characterization of Samples from Joyce Lake Deposit' by Corem, report number T1362, dated September 18, 2012 (Corem, 2012).
2. 'Beneficiation of the Joyce Lake Deposit' by Corem, report number T1371, dated May 1, 2013 (Corem, 2013).
3. 'Metallurgical Testing of Samples from the Joyce Lake Location at Attikamagen' by SGS Canada, report number 13609-002, dated December 10, 2013 (SGS, 2013).

Physical and metallurgical tests were performed on various composite and bulk samples extracted from the Joyce Lake deposit. The composite samples, used mainly for beneficiation testwork, generally covered the deposit and the author believes them to be reasonably representative. With regard to the bulk samples, one of the three samples was deemed not to be representative of the general deposit nor of the mineralized material that will be processed. This testwork was performed as part of the Joyce Lake DSO Project Preliminary Economic Assessment ("PEA"), having an effective date of May 8, 2013. No new testwork has been performed for the current Feasibility Study.

The results of the testwork were used to perform a trade-off study ("TOS") to compare the merits of processing the Joyce Lake material by wet processing entailing concentration versus the base case of dry processing consisting of crushing and screening material to produce a lump and a fine product without the generation of any concentration rejects. The results of this TOS are discussed in Chapter 17 of this Report.

13.1 Corem Testwork Summary

The first phase of the testwork performed by Corem consisted of mineral characterization on 13 composite samples prepared using 185 individual samples from various locations within the Joyce Lake deposit. The composite samples Fe_{tot} grade varied from 33.4% to 62.2% and the predominant iron species is hematite. A few samples showed the presence of significant quantities of manganese oxide ("MnO"). This characterization testwork showed that hematite is of fine and very fine grain and is often intimately associated with quartz. The composite samples grading lower in iron were characterized by very fine hematite intimately associated with fine quartz grains. Although such particles were also observed in the higher iron grade composite samples, these samples were characterized by a predominance of particles consisting mainly of very fine hematite and free coarse quartz. It was found that the liberation size of the fine hematite was less than 150 µm. The testwork concluded that it would be difficult to achieve a high-grade concentrate using gravity or flotation processes due to the porous nature of the hematite reducing its apparent density and the presence of a very fine mix of iron and silica dust (<20 µm) coating the particles thus lowering selectivity in flotation.

In a second phase of the testwork, Corem prepared three composite samples from approximately 190 samples based on instructions from LCIO. The composite samples were first homogenized and crushed to 100% passing 850 µm and were then subjected to gravity separation tests using Wilfley Tables and Dense Media Separation ("DMS"). Reverse Flotation tests and Wet High Intensity Magnetic Separation ("WHIMS") tests were also performed on the composite samples. It was determined that test results were influenced by the presence of a significant amount of 'very fine orange dust' in the samples that negatively impacted the test results. Some of the testwork was subsequently repeated on samples that were pre-treated by a scrubbing step to remove very fine particles smaller than 25 µm.

The head analysis of the three composite samples was as shown in Table 13-1:

Table 13-1: Sample head assays for Corem test program

	Composite 1+3	Composite 2	Composite 4
% Fe	58.2	40.1	39.7
% SiO_2	13.6	40.4	40.0
% Al_2O_3	0.45	0.81	0.63
% CaO	0.02	0.02	0.03
% MgO	0.06	0.06	0.06
% TiO_2	0.02	0.08	0.06
% P_2O_5	0.11	0.12	0.16
% MnO	0.53	0.16	0.48
% Cr_2O_3	0.01	0.01	0.02

The general conclusions from the testwork were as follows:

- Wilfley Table test results on un-scrubbed samples showed a very poor weight and iron recovery for all three samples;
- DMS test results on un-scrubbed samples also showed a poor upgrade result. Mineralogical testwork performed on the sink products of all three samples showed that iron oxide particles contained a significant quantity of very fine quartz inclusions suggesting that further upgrade would only be possible if samples were subjected to very fine grinding;

- Scrubbing removed very fine 'orange dust' of significant iron content. It was not possible to remove all of this dust;
- The scrubbed high head grade sample, Sample #1-3, was subjected to repeats of various tests. Following scrubbing, the iron and silica grade of the scrubbed sample were essentially the same as that of the un-scrubbed sample. Test results are summarized as follows:
  - DMS test results were similar to the results obtained with the un-scrubbed samples;
  - Wilfley Table test results were similar to the results obtained with the un-scrubbed samples;
  - Flotation and WHIMS tests were performed on Wilfley Table concentrate and middling. Good flotation results were only obtained after the Wilfley Table concentrate sample was reground. WHIMS results showed that iron concentration of Wilfley Table middling product beyond a grade of about 50% Fe could not be achieved, suggesting that grinding would be required in order to upgrade further.
- The scrubbed low head grade sample, Sample #2, was subjected to a repeat of WHIMS and flotation tests. Test results for both were in line with what was observed with Sample #1-3.

This testwork by Corem was performed to evaluate the response of the samples to beneficiation. Although this testwork is of limited use for evaluating the potential of the Joyce Lake deposit as a Direct Ship Operation ("DSO"), it is however useful to assess the response of the mineralized material to various beneficiation processes and the challenges that would be encountered should such a route be considered. It was clearly shown that the lower head grade mineral (in the grade range of 40% Fe_{tot}) iron liberation would require very fine grinding in order to upgrade to an acceptable iron grade.

13.2 SGS Testwork Summary

Testwork at SGS was performed on three bulk samples and three composite samples that were submitted for various characterization and beneficiation tests. All samples were submitted for particle size distribution, direct head assays, while the three as-received bulk samples (at minus 8" or 200 mm) were also submitted to bulk density and angle of repose determination. The average angle of repose for the three bulk samples was found to be between 35° and 38°. The bulk density for Bulk Sample #1 and for Bulk Sample #2 was identical at 2.55 t/m^3, whereas for Bulk Sample #3 the bulk density was measured at 2.21 t/m^3.

The three bulk samples were subsequently crushed to minus 1-1/4 inch (31.5 mm) and they, along with the composite samples that were composed of assay reject material previously crushed to minus 10 mesh (1.7 mm), were submitted to full Particle Size Analysis and head assay. One of the three bulk samples (Bulk #3), taken from a localized, low-grade zone of the Joyce Lake deposit, had a relatively low iron grade and a very high MnO level. This sample was deemed as non-representative, as confirmed following the review of MnO distribution in the geological block model. Consequently, testwork performed on this sample will not be discussed. The head analyses of the two remaining bulk samples and three composite samples used for testing by SGS are indicated in Table 13-2.

Table 13-2: Sample head assays for SGS test program

	Bulk #1	Bulk #2	47-53% Fe Comp.	53-57% Fe Comp.	57-62% Fe Comp.
% Fe	68.5	63.6	50.6	55.0	59.4
% SiO_2	1.3	7.0	25.5	18.5	11.4
% Al_2O_3	0.35	0.75	.48	72	57
% CaO	0.03	0.04	0.05	0.04	0.03
% MgO	0.03	0.04	0.01	0.02	0.01
% Na_2O	0.01	0.01	< 0.01	0.01	< 0.01
% K_2O	0.03	0.05	0.03	0.05	0.07
% TiO_2	0.01	0.03	0.03	0.05	0.07
% P_2O_5	0.1	0.14	0.1	0.13	0.13
% MnO	0.2	0.19	0.71	0.88	1.75
% Cr_2O_3	< 0.01	< 0.01	0.01	< 0.01	< 0.01
% V_2O_5	< 0.01	0.02	< 0.01	0.02	< 0.01
LOI	0.98	1.58	1.19	1.21	1.45
Sum	101.0	100.8	100.5	100.3	100.3
Fe[1]	68.5	63.6	50.6	55.0	59.4
% S	0.02	0.02	0.01	0.01	0.01
% C(t)	< 0.01	< 0.01	0.07	0.06	0.03
% Sat	0.15	0.05	0.70	0.60	0.3
% FeO	< 0.02	< 0.02	< 0.02	0.03	< 0.02
Ag(g/t)	< 2	< 2	< 2	< 2	< 2
As(g/t)	< 30	< 30	< 40	< 40	< 30
Ba(g/t)	20.8	72.0	50.6	105	57.0
Be(g/t)	1.01	1.16	1.14	1.42	1.12

	Bulk #1	Bulk #2	47-53% Fe Comp.	53-57% Fe Comp.	57-62% Fe Comp.
Bi(g/t)	< 20	< 20	< 20	< 20	< 20
Cd(g/t)	< 2	< 2	< 2	< 2	< 2
Co(g/t)	< 20	< 20	< 30	< 30	<8
Cu(g/t)	245	125	4.8	4.5	4.8
Li(g/t)	< 30	< 30	< 20	< 20	< 20
Mo(g/t)	< 5	< 5	< 5	< 5	< 5
Ni(g/t)	< 20	< 20	< 20	< 20	< 20
Pb(g/t)	< 30	< 30	< 50	< 50	111
Sb(g/t)	<10	<10	<10	<10	<10
Se(g/t)	< 30	< 30	< 30	< 30	< 30
Sn(g/t)	< 20	< 20	< 20	< 20	< 40
Sr(g/t)	6.63	51.6	79.2	150	128
Tl(g/t)	< 30	< 30	< 30	< 30	< 30
U(g/t)	< 80	< 80	< 80	< 80	44
Y(g/t)	5.5	10.7	9.9	8.8	8.6
Zn(g/t)	57	54	< 40	< 40	8
% Fe (dichromate titration)	68.35	63.33	50.59	55.12	59.35

The results also showed that, in general, the iron grade decreased with the particle size, and this was noted, particularly, in the three composites at sizes finer than 100 microns. This also suggests that in producing a coarser lump product and a fine product, a slight iron concentration in the lump product can be expected. The testwork generally supports this as seen in Table 13-3. The bulk densities and angle of repose measured for both the lump and fines products are presented in Table 13-4.

Table 13-3: Product assays for bulk samples #1 and #2

Sample	Bulk Sample 1		Bulk Sample 2	
	Lump	Fines	Lump	Fines
% SiO_2	0.6	1.9	4.8	7.6
% Al_2O_3	0.2	0.5	0.4	0.8
% P	0.03	0.05	0.04	0.06
% Mn	0.09	0.21	0.09	0.16
% Fe	69.2	67.5	65.6	62.9
% S	0.00	0.00	0.00	0.00

Sample	Bulk Sample 1		Bulk Sample 2	
	Lump	Fines	Lump	Fines
% K_2O+Na_2O	0.00	0.04	0.04	0.04
% Pb	<0.003	<0.003	<0.003	<0.003
% Zn	0.01	0.01	0.01	0.01
% As	<0.003	<0.003	<0.003	<0.003
% Cu	0.02	0.02	0.01	0.01
% Sn	<0.002	<0.002	<0.002	<0.002
% MgO	0.02	0.05	0.03	0.06
% CaO	0.01	0.05	0.02	0.06
% TiO_2	0.00	0.01	0.01	0.03
% Cr_2O_3	0.00	0.00	0.00	0.00
V_2O_5	0.00	0.01	0.02	0.02

Table 13-4: Angle of repose and 30 bulk density measurements for bulk samples #1 and #2

Sample ID	Product20	Angle of Repose (°)	Bulk Density (t/m³)
Bulk #1	Lump (+6.3 m)	28	2.34
	Fines (-6.3 mm)	28	2.68
Bulk #2	Lump (+6.3 mm)	33	2.14
	Fines (-6.3 mm)	32	2.27

The bulk samples were prepared in order to be subjected to some grindability testwork such as Bond crusher work index ("CWi") and Bond abrasion index ("Ai") tests. These parameters were used for this Feasibility Study to provide crushing circuit design criteria. The average CWi for the two representative bulk samples was 9.6 kWh/t for Bulk Sample #1 and 10.7 kWh/t for Bulk Sample #2, with overall variation between 8.6 kWh/t and 11.4 kWh/t. Testwork also indicated that samples from the two representative bulk samples were of relatively high abrasiveness and quite variable. The average Bond Ai for Bulk Sample #1 was 0.374 g and for Bulk Sample #2 the index was 0.555 g.

Mineralogical testwork was performed on the minus 10 mesh (1.7 mm) fractions of each of the bulk samples. Results indicated that the iron in both Bulk Sample #1 and Bulk Sample #2 was present predominantly as goethite, followed by hematite.

Scrubbing tests were performed on each sample and results did not show any significant improvement compared to wet screening with the exception of Bulk Sample #1, which showed iron distribution to be slightly finer than wet screening suggesting that some attrition took place. A series of beneficiation tests were conducted on the samples with the objective of reaching a target grade of 64% Fe.

Heavy Liquid Separation ("HLS") tests were first performed. Bulk Sample #1, having a head grade of 68% Fe, as expected, showed a very high weight recovery to the sink product. Bulk Sample #2 achieved a grade of 66% Fe. None of the size fractions of the composite samples 47-53% Comp and 53-57% Comp reached the targeted Fe grade of 64%, however some upgrading was observed. The 57-62% Comp did reach 64% Fe at the finer size fractions.

A sub-sample of Bulk Sample #2 at minus 850 µm was submitted for WHIMS testing. Results were the same for scrubbed and wet screened material. A grade of 64.5% Fe and 5.3% SiO_2 was achieved with an 80% weight recovery and an 85% Fe recovery. The concentrates were significantly coarser than the tailings, showing that the finer fractions were higher in liberated silica. The 47-53% Comp was also submitted for WHIMS testing. The best results were obtained at the lowest magnetic intensity where a grade of 60.5% Fe and 11% SiO_2 were achieved, but with only a 50% weight recovery and a 62% Fe recovery. As the magnetic field intensity was increased, weight recovery increased at the detriment of Fe grade.

Wilfley Table tests were conducted on Bulk Sample #2, as well as on the three composite samples. Test results for the bulk sample generally indicated that an Fe grade of 63% was achieved with weight recovery between 77% and 81% and an Fe recovery between 79% and 83%. Tailings Fe grade was high at 57%. Of the three composite samples at minus 1.7 mm subjected to Wilfley Table tests, only the 57-62% Comp sample achieved the targeted 64% Fe grade, albeit at only 60% Fe recovery. The tests performed on the 47-53% Comp sample at minus 850 µm, however, showed that the targeted 64% Fe grade was achieved but Fe recovery was only 43%.

Testwork performed with a hydroseparator showed negligible Fe concentration to the underflow and very high weight recovery for all samples.

13.3 Conclusions from the Testwork

The testwork performed during the PEA provided some general orientation for predicting performance of a DSO project using dry processing. Some material characteristics such as bulk density and angle of repose were measured for as-received bulk samples, as well as for lump and fines products, which are used in this Feasibility Study for developing design criteria for the stockpile design. Some key grindability parameters were also measured, including CWi and Bond Ai, which are required design criteria for the sizing of the crushing circuit for producing lump and fines products.

More importantly, the beneficiation testwork performed by both Corem and SGS highlights the challenges to be expected if wet processing and beneficiation of lower grade ore were to be considered in the Joyce Lake process flowsheet.

BBA used these testwork results to perform a TOS to compare the merits of processing Joyce Lake material by wet processing entailing concentration versus the base case of dry processing consisting of crushing and screening material to produce a lump and a fine product without the generation of any concentration rejects. The results of this TOS are discussed in Chapter 17 of this Report and a recommendation is made regarding the processing route that is adopted for this Feasibility Study.

Although the author is of the opinion that no further testwork is required for this Feasibility Study if a dry processing flowsheet is adopted, the following recommendations are aimed at reducing Project risks and better predicting future operations:

- Following the completion of this Feasibility Study, and prior to the confirmation of the final design, a new bulk sample should be prepared grading 60% to 62% Fe. The Particle Size Distribution of the sample should: firstly, be such that it is reasonably representative of run of mine ore expected from the mining operation; and secondly, the material should be crushed to produce lump and fines products reasonably representative of the final product expected from the dry processing plant. Considering that lump product attracts a premium over fines product, there is value in better predicting the lump to fines ratio of the operation. Also, this type of testwork would confirm the degree of iron upgrading to the lump product determined from the previous testwork.
- The bulk density and angle of repose for lump and fines products have been characterized in the previous testwork. Although these are not critical parameters, it would be beneficial to have additional data from a representative sample for confirmation.

Based on the beneficiation testwork performed to date and the results obtained, the author is of the opinion that, if a wet processing route were to be followed to upgrade lower iron grade ore for this Feasibility Study, the testwork performed to date is insufficient to make a proper assessment of the metallurgical performance and cut-off grade for the development of a definitive wet processing flowsheet.

14. Mineral Resource Estimates

This chapter describes the several methodologies used for the estimation of the Mineral Resource, including geological modelling, and final interpretation of the Mineral Resource Estimate.

14.1 Introduction

The resource block models for Joyce Lake use drillhole data, which is the definition basis of 3D mineralized envelopes with the Mineral Resource limited to the material inside those envelopes. Within the mineralized envelopes, drillhole data are then transformed into fixed length composites followed by interpolation of the grade of blocks on a regular grid, and then filling the mineralized envelopes from the composite grade in the same envelopes. All interpolated blocks below the topography make the mineral inventory at that date and are classified according to proximity to composites and its corresponding precision/confidence level. Technical and economic factors are then applied to the blocks, in the form of cut-off grades, to constrain the Mineral Resource to the blocks to present a reasonable prospect of economic extraction.

14.2 Geological Interpretation and Modelling

The Joyce Lake iron deposit is hosted in folded and fractured banded iron formations of the Proterozoic Sokoman formation. The iron mineralization is stratabound, sedimentary in origin, and occurs within a synclinal structure plunging shallowly to the southeast. The main DSO enrichment is within the nose of the syncline.

The Client provided a 3D model to GMG of the main stratigraphic rock units (indicated below) as GEMS wireframes interpreted from the drilling data:

- **UMH** (Upper Massive Hematite)
- **RC** (Red Chert)
- **LMH** (Lower Massive Hematite)
- **LRC** (Lower Red Chert)

Each stratigraphic unit exhibits different iron content and variable magnetite and hematite proportions. The UMH and LMH are generally the DSO bearing units. For resource modelling, a 3D model for the interpreted DSO was generated, hereafter referred to as the "mineralized envelope". The geological model has changed slightly from the last estimates; the new interpretation takes into account new logs indicating a potential thrust fault as evidenced by fractured zones resulting in a splitting of the UMH deposit along an azimuth of 135°.

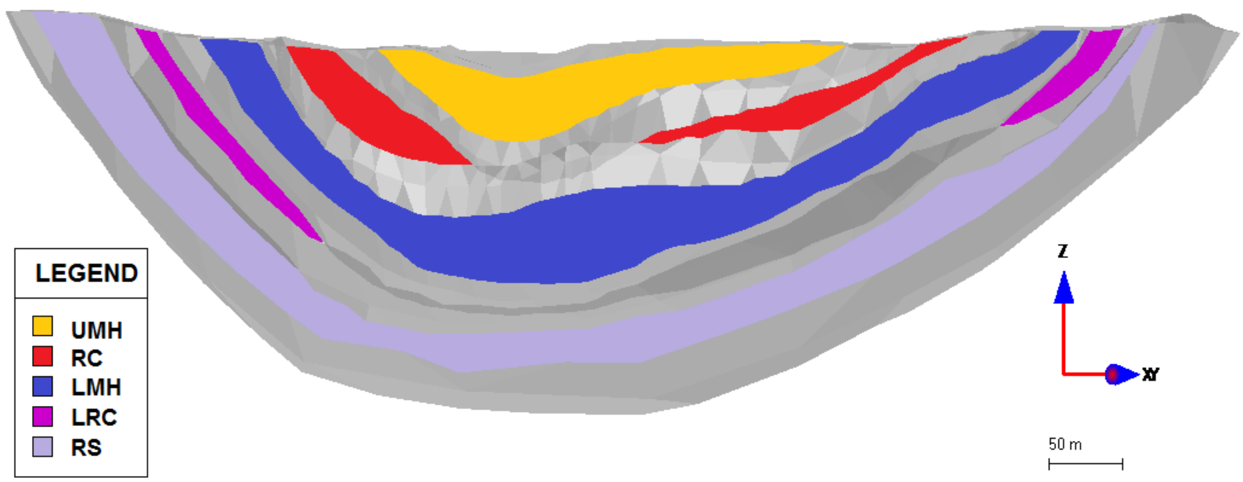


Figure 14-1: Lithological layers of Joyce Lake property (Section Joy_1.5N)

Because the deposit folds NW-SE and slopes SE, transverse sections were used rather than longitudinal sections. A total of 18 prisms were used with a spacing of about 50 m.

14.3 Mineral Resource Estimation Methodology and Geological Modelling

The Mineral Resources estimation and classification section of this Report on the Joyce Lake DSO Project Mineral Resource Estimate was prepared by Claude Duplessis, P.Eng. Mr. Duplessis is responsible for this chapter and is a qualified person by virtue of education, experience and membership in a professional organization.

The current classified Mineral Resource Estimate of the Joyce Lake deposit reported below are compliant with National Instrument 43-101.

14.3.1 Mineral Resource Estimation

As usual, the Joyce Lake DSO Mineral Resource Estimate was done through the construction of a resource block model with fixed-sized blocks on a regular grid filling an interpreted mineralized envelope and with grades interpolated from measured grades of composited drillhole samples around the blocks and within the same envelope. Blocks are then assigned to resource categories according to average proximity to samples.

14.3.2 Envelopes and Block Model Definition

The block model coordinates were based on the local UTM grid. It was made using 5,657 assayed intervals totalling 17,030.42 m. The block model was defined by blocks measuring 5 m long by 5 m wide by 3 m thick. The blocks were confined to the wireframe described above as well as a surface defining the base of overburden. The block model was computed by the percent of block within envelope in order to avoid over estimation of the tonnage. The base of overburden was defined by a wireframe joining the base of drillhole casings across the area and rock outcroppings. A total of 1,315 composited assay intervals, totalling 3,945 m from 111 holes and one channel, were used to make the block model estimation.

Limits of mineralized zones were interpreted on sections from drillhole assay information available on the sections. The assay value of 45% Fe was used to delineate potentially mineralized material applied to original (3 m) assay intervals with a minimum sample length of 1.5 m. The mineralized intervals were also verified and revised individually to limit the high SiO_2 values. The current mineralized solid models include local internal waste with grade less than 45% Fe cut-off, which is necessary for geological continuity. The main iron deposit called LMH is located in the Lower Massive Hematite ("LMH") lithological layer between the Red Chert ("RC") and the Lower Red Chert ("LRC"). Two other block models, UMH_1 and UMH_2, were also created in the Upper Massive Hematite Layer.

Table 14-1: Block models parameters & block counts

Parameters	X (m)	Y (m)	Z (m)
Size	5	5	-3
Discretization	1	1	1
Starting Coordinate	657900mE	6085310mN	590
Ending Coordinate	659175mE	6086685mN	302
Block Counts	**LMH**	**UMH_1**	**UMH_2**
Total number of blocks	106,935 (100%)	9,549 (100%)	22,891 (100%)
Total estimated blocks	106,935 (100%)	9,549 (100%)	22,891 (100%)
Volume	6,135,525 m^3	716,175 m^3	791,475 m^3

The Mineral Resource Estimate was completed using the 3D wireframe modelling of DSO followed by block model interpolation methodology.

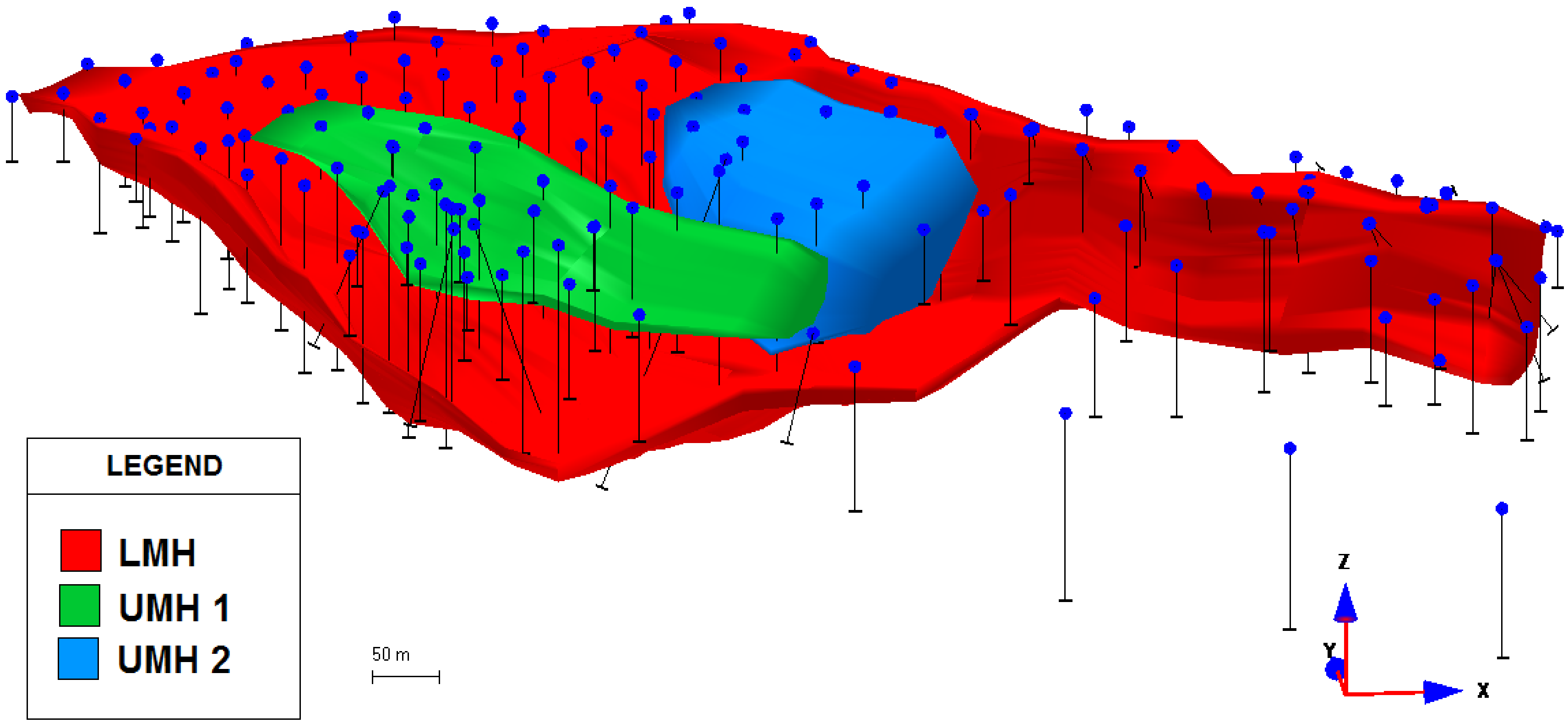


Figure 14-2: Joyce Lake mineralized envelopes for block modelling (2014), looking north in GENESIS

14.3.3 In-situ Density Correlation

The density measurement was only conducted on the drill core samples from the 2013 Phase II drilling program, while the samples from other drilling season, mostly the RC drilling, cannot be used for the density measurement due to nature of the samples from the drilling. This section presents analysis of available density measurements on the core with conclusion. For reader information, density is used to convert volume in tonnage, the specific gravity ("SG") of the material cannot be used directly since presence of voids are observed in the core which is typical of DSO iron deposits in the region.

Basic univariate statistics (Table 14-2) have been performed on the total density population (N=752), the population within the envelope LMH (N=147), the population of holes Joy-13-153 and Joy-13-155 (N=53) and finally the mineralized zone of holes Joy-13-153 and Joy-13-155 (N=13).

Table 14-2: Univariate statistics on density populations

	Entire Population	LMH Envelope	Joy-13-153 and Joy-13-155	Mineralized Zone
Count	752	147	53	13
Min	1.90	2.53	2.42	2.75
Average	3.25	3.59	3.12	3.48
Median	3.20	3.54	3.06	3.54
Max	6.00[1]	6.00[1]	4.30	4.30
StDev	0.44	0.56	0.37	0.41

Note:

(1) Total and LMH both have a high-density measurement of 6.0 and pure hematite has an SG of 5.24, which indicates there may be measurement error on the sample.

The total population and the Joy-13-153 and Joy-13-155 holes have similar averages as the LMH zone and the mineralized zone; however, it appears that there is some anomalous data in the larger populations, as evidenced by lower standard deviations and calculated densities. It appears that the Joy-13-153 and Joy-13-155 holes are a reasonable proxy for the total population and the mineralized zone for the LMH envelope. The Joy-13-153 and Joy-13-155 holes have been selected by the QP, due to higher confidence in the density measurements, for use as a reduced data set for our determination of density; but not without first investigating all populations, as tedious work has been done by the technical team to gather the density measurements. High recovery was observed at the core shack during the site visit, which is very positive.

It must be stated that relation between analysis of oxides (especially iron) and the density measurement on core is investigated, since the author's goal is to use the grades of the RC analysis and associate a calculated density. This is why several mathematical tests have been performed to get comfort on the regression to be used.

Figure 14-3: Well recovered drill core showing voids at the core shack during site visit October 3-4, 2013

14.3.3.1 Method 1: Density Correlation – Within the LMH Envelope

A linear regression of all the density data available within the LMH envelope, using both the % Fe and the % Si values, was conducted. First, all the samples within the LMH envelope that contained density measurements were located. These samples were from 19 holes, in Table 14-3.

Table 14-3: Holes and count of density observations

Hole ID	# of Tests
Joy-13-153	5
Joy-13-155	9
Joy-13-156	11
Joy-13-157	4
Joy-13-158	11
Joy-13-159	1
Joy-13-160	5
Joy-13-161	5
Joy-13-162	2
Joy-13-163	9
Joy-13-164	7
Joy-13-165	10
Joy-13-166	14
Joy-13-167	4

Hole ID	# of Tests
Joy-13-168	24
Joy-13-169	3
Joy-13-170	3
Joy-13-171	8
Joy-13-172	12
Total	**147**

At first, it was decided to use only Fe as a proxy for density in the linear regression. However, the following correlation matrix (Table 14-4) indicates that silica also has a strong correlation to the density, however negative; additionally, silica and iron are very strongly (negatively) correlated.

Table 14-4: Correlation matrix

	Density observed	Si	Fe
Density observed	1	-	-
Si	-0.5475	1	-
Fe	0.5744	-0.9904	1

After running the regression package, the following results were achieved:

Table 14-5: Regression statistics

Regression Statistics					
Multiple R	0.59				
R Square	0.35				
Adjusted R Square	0.34				
Standard Error	0.46				
Observations	147				
ANOVA					
	df	SS	MS	F	Significance F
Regression	2	16.44	8.22	39.43	0.00
Residual	144.00	30.03	0.21		
Total	**146.00**	**46.47**			
	Coefficients	Standard Error	t Stat	P-value	
Intercept	-2.1349	1.77	-1.21	0.23	
SiO_2	0.0418	0.02	2.31	0.02	
Fe	0.0898	0.03	3.47	0.00	

We can see from the Multiple R stat 0.59 the regression of Si and Fe is superior to Si or Fe alone, since 0.59 is larger than either correlation from Table 14-4. However, the gain is marginal. An SG calculation formula can be created from the Coefficients such that:

Calculated Density = %SiO_2 * 0.0418 + %Fe * 0.0898 - 2.1349

A plot of the pairs, observed density versus calculated, was created (Figure 14-4) to examine the regression formula. Though the bulk of the data is around the 1:1 line, there appears to be an abnormal population for the high iron samples.

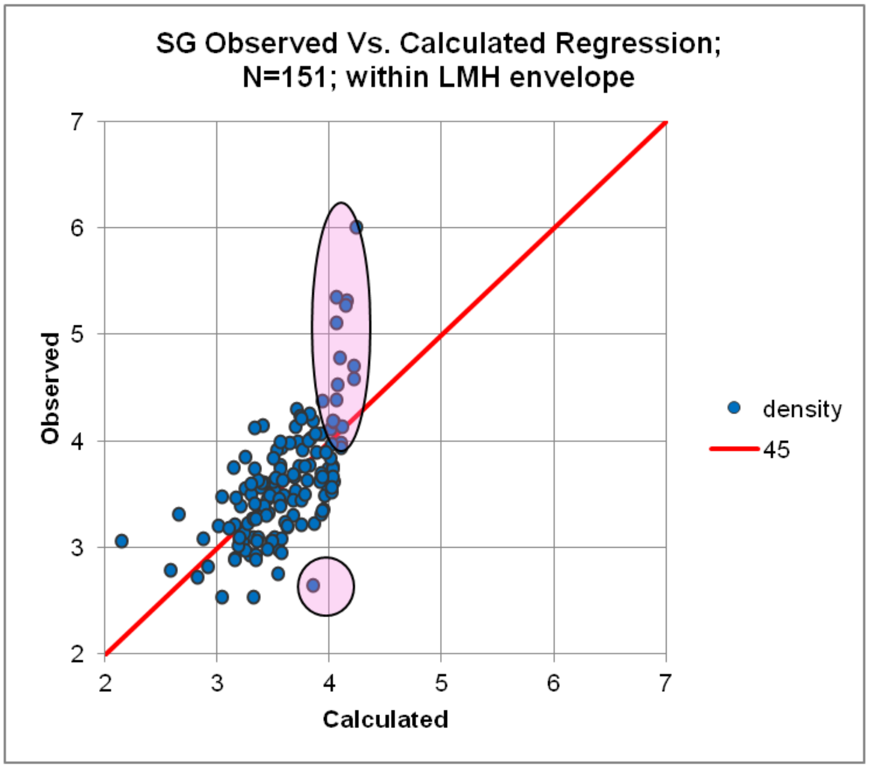


Figure 14-4: Density observed within the LMH envelope vs. calculated

The non-conclusive correlation for these samples may indicate an error with either the calculation or the observations. It is possible, because the observations were on sub-samples within a run and not done on a complete run (3 m), that the porosity and average density is not adequately reflected for these samples if the run is not homogeneous. So, it was decided to conduct further tests using two holes Joy-13-155 and Joy-13-153 to test the hypothesis; these holes had density tests on complete run intervals.

14.3.3.2 Method 2: Density Correlation – Complete Intervals for Joy-13-155 and Joy-13-153

A new correlation matrix (Table 14-6) was created for the 53 samples in Joy-13-153 and -155, and they are more strongly correlated than the previous population, as evidenced in Table 14-5.

Table 14-6: Comparison correlation matrices

	N=53 [Joy-13-153 and -155]			N=143 Within LMH Envelope		
	Density	SiO_2	Fe	Density	SiO_2	Fe
Density	1			1		
SiO_2	-0.6492	1		-0.5475	1	
Fe	0.6590	-0.9974	1	0.5744	-0.9904	1

Two linear regressions were done with Fe and Si, one on the complete 53 samples, and a subset of 13 samples within the mineralized zone. The results are presented in Table 14-7.

Table 14-7: Regression statistics – Joy-13-153 and -155 Density
All samples vs Ore* Mineralized Zone Samples

N = 53; Joy-13-153 and Joy-13-155 S.G. samples

Regression Statistics	
Multiple R	0.6687
R Square	0.4471
Adjusted R Square	0.4250
Standard Error	0.2782
Observations	53

ANOVA	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	2	3.1297	1.5649	20.2160	0.0000
Residual	50	3.8704	0.0774		
Total	52	7.0001			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-0.9542	3.0214	-0.3158	0.7535
% Fe	0.0676	0.0444	1.5236	0.1339
% SiO_2	0.0328	0.0305	1.0764	0.2869

N = 13; Joy-13-153 and Joy-13-155 [Ore Zone] S.G. samples

Regression Statistics	
Multiple R	0.5403
R Square	0.2919
Adjusted R Square	0.1503
Standard Error	0.3800
Observations	13

ANOVA	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.5951	0.2975	2.0610	0.1780
Residual	10	1.4437	0.1444		
Total	12	2.0388			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.1586	8.8207	0.0180	0.9860
% Fe	0.0522	0.1292	0.4038	0.6949
% SiO_2	0.0204	0.0887	0.2302	0.8226

* The term "Ore" zone here is used to refer to a mineralized intercept that has not yet been identified as Ore with respect to the definitions within NI 43-101.

The multiple regressions of both Fe and SiO_2 illustrate a correlation factor higher than either element individually. The Multiple R for the 53 samples is higher than that of the 153 samples within the LMH envelope, whereas the mineralized zone samples Multiple R is lower; however, it is decided that it comes from a more reliable dataset, that of holes Joy-13-153 and Joy-13-155.

In Figure 14-5, we can compare the observed density versus calculated density for the two populations.

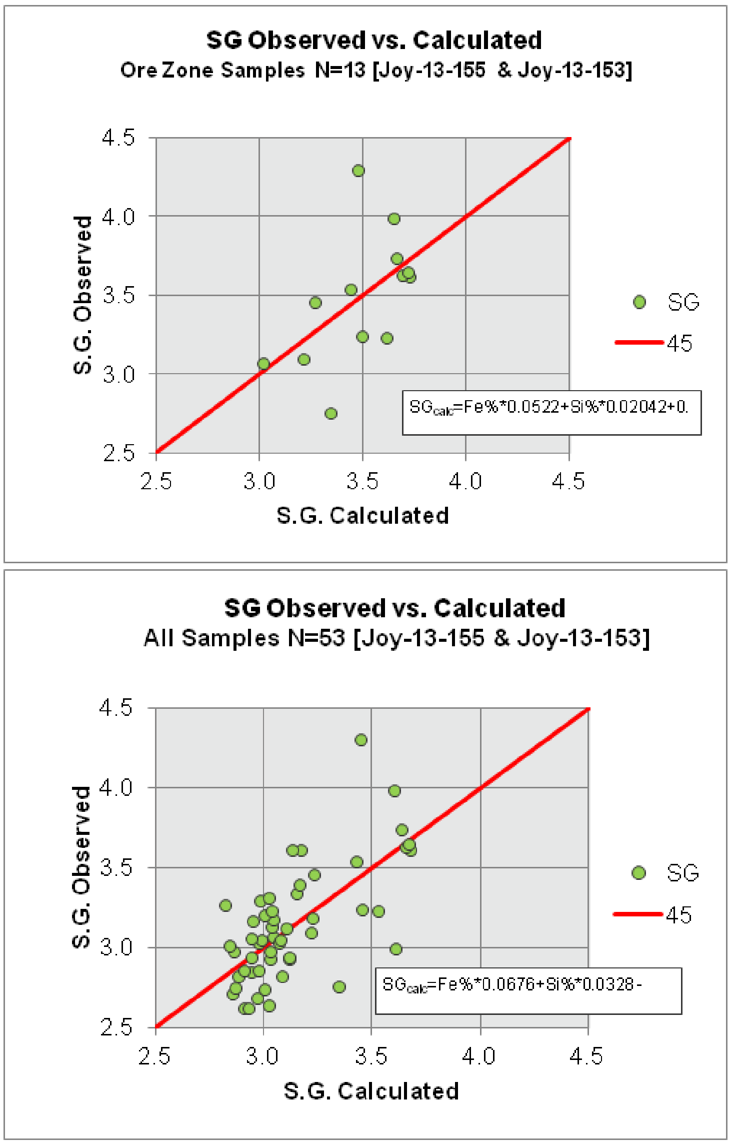


Figure 14-5: Scatter-plots comparing density observed versus regressed

Table 14-8: Multivariable linear regression equations

Zone	Population	Formula
All Samples	53	$Dens = Fe\% \cdot 0.0676 + SiO2\% \cdot 0.0328 - 0.9542$
Mineralized Zone	13	$Dens = Fe\% \cdot 0.0522 + SiO2\% \cdot 0.0204 + 0.1586$
Low Grade	40	$Dens = Fe\% \cdot 0.0521 + SiO2\% \cdot 0.0282 - 0.2972$

It can be observed that the formula for the mineralized zone has a positive intercept compared to the other two equations; this is simply related to the difference in the sub population. A conclusion was made by the author that these holes have the most reliable information, and thus the author checked the regression on the full population, which provides reasonable global confidence. To formulate an equation suited to the Mineralized (ore) zone and the grades, a regression formula has been calculated from within that demonstrated population, even though it does not have the highest amount of data.

It can be observed in the following table (Table 14-9), that we have negative correlation of similar magnitude between Fe and Si for all populations, and that, individually, Fe and Si have a similar but opposite correlation with density which is best demonstrated for the full population and for the mineralized zone; this correlation appears weaker in the low-grade zone of Joy-13-155 and Joy-13-153. We can also see that the mineralized zone population is slightly different in which the median is higher than the average.

Table 14-9: Correlation matrices for Joy-13-155 & -153 and statistics for density, total iron, and SiO_2

Correlation Matrices											
Full N = 53				Mineralized Zone N = 13				Low-Grade Zone N = 40			
	Density	% Fe	% Si		Density	% Fe	% Si		Density	% Fe	% Si
Density	100%			Density	100%			Density	100%		
% Fe	65.9%	100%		% Fe	53.6%	100%		% Fe	35.1%	100%	
% Si	-64.9%	-99.7%	100%	% Si	-52.9%	-99.6%	100%	% Si	-33.3%	-99.3%	100%
Descriptive Statistics											
Count	53	53	53	Count	13	13	13	Count	40	40	40
Minimum	2.42	26.70	0.86	Minimum	2.75	36.60	0.86	Minimum	2.42	26.70	3.32
Average	3.12	41.55	38.64	Average	3.48	57.75	15.38	Average	3.01	36.28	46.20
Median	3.06	38.00	43.82	Median	3.54	58.60	13.65	Median	3.00	34.50	48.90
Maximum	4.30	68.00	59.88	Maximum	4.30	68.00	46.32	Maximum	3.61	65.90	59.88
Std. Dev.	0.37	12.11	17.61	Std. Dev.	0.41	9.82	14.29	Std. Dev.	0.26	7.07	10.57

Table 14-10: Verifying the regression coefficients with the means

	Coefficients		Ratios		Average from Table 14-10			Calculated	
	Fe	Si	Si:Fe	Fe:Si	Ave_{Fe}	Ave_{Si}	Ave_{Dens}	Calc Dens	-Int
Full N = 53	0.0676	0.0328	0.4852	2.061	41.55	38.64	3.12	4.08	-0.9562
Mineralized zone N = 13	0.0522	0.0204	0.3908	2.559	57.75	15.38	3.48	3.33	0.1517
LGZ N = 40	0.0521	0.0282	0.5413	1.848	36.28	46.20	3.01	3.19	-0.1830

Through a simple verification, we can see the coefficients and their ratios, the mineralized (Ore) zone places a higher importance on the iron value; additionally, the means of the population calculated density without including the intercept was used. The calculated density was then subtracted from the average density to determine an intercept; when compared to the intercepts from the regression algorithm there is reasonable correlation.

It is not the intention to indicate or emphasize much meaning into the intercept; in this case it is a way to ground the formula into reality (density observed), but does not have other significant meaning. If values were 0% Fe and 0% Si, a negative density would not exist. That being said, without all the factors including porosity and humidity, the statistical validity of a negative intercept would not be rejected.

14.3.3.3 Method 3: Density Correlation – Calculating Density Based on Idealized Mineral Properties

For this method, the following assumptions were made:

1. The Fe is all in the hematite form and has an SG of 5.24;
2. The Si is all in quartz form and has an SG of 2.65;
3. The porosity is 100%-(%Hematite + %Quartz) and has a density of zero.

Fe total was converted to % hematite by using a conversion factor of $\%_{hem} = \%_{Fe} * 1.4297$.

There is an inherent problem with assumption 3: This will not effectively normalize or predict the porosity, as such porosity is not properly accounted.

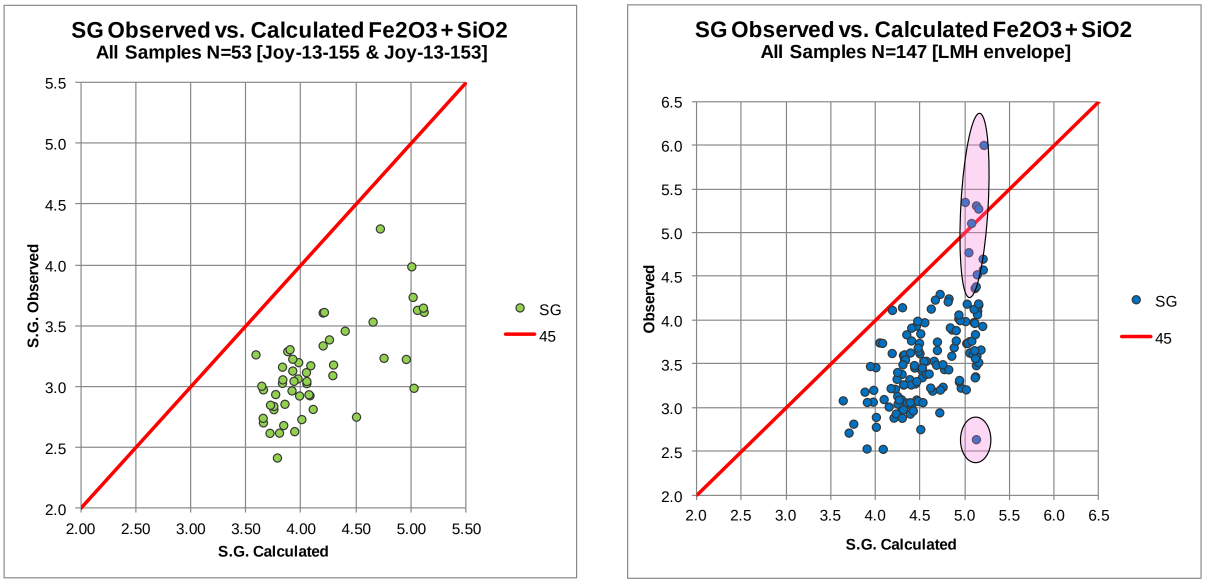


Figure 14-6: Density observed vs mineral calculated (hematite and quartz)

Because this method does not properly account for the porosity of the rock, all the calculated densities are high. If a constant porosity of about 25% is arbitrarily selected, then the population would reasonably match the given data.

14.3.3.4 Applying the Formulas to the Block Model

Different density formulas were checked and compared when applied to the entire block model. The following results were obtained.

Table 14-11: Table of results after adding the formulas to the block model

	SiO_2	Fe	Original	Density Joy-13 N=53	Density Joy Mineralized Zone	Density LMH zone	Idealized Fe_2O_3 + SiO_2
Block Count	143769	143769	143769	143769	143769	143769	143769
Min	0.49	32.31	2.91	2.77	2.85	2.75	3.75
Average	18.69	54.93	3.45	3.37	3.41	3.58	4.61
Median	19.56	54.17	3.44	3.35	3.39	3.55	4.58
Max	51.82	69.30	3.86	3.75	3.79	4.11	5.21
StDev	10.26	6.95	0.15	0.15	0.16	0.22	0.26

Using the idealized hematite formula produces erroneously high densities, especially since it does not adequately account for porosity. From previous experience the rocks of the Schefferville area have highly variable porosities, and tests would be required to determine a sufficient average. The in-situ square excavation is usually used, but in our case, it is not possible to do this test as it is under the lake. Maybe additional density tests could be completed in the coming summer.

Because this model is entirely in the mineralized envelope, there is no worry applying the formula derived from mineralized (ore) zone samples. It is believed that the previous density formula may be conservative, as is the density from the LMH since there are few erroneous high values included in the data set.

14.3.3.5 Conclusions

Because of the low distribution of the appropriate method for measurement of density data in Joyce Lake, the specific gravity correlation with iron was made using the only two holes fully tested with Canadian standard of the industry method. The two drillholes available are Joy-13-153 and Joy-13-155. A multivariable linear regression was completed using the regression feature of the data analysis tool pack in Microsoft Excel. From the coefficients table, the following regression formulas were created. Density versus regression density was plotted to visually inspect the results. While sufficient, a larger population would be preferable, particularly within the mineralized (ore) zone.

It is recommended to use the population of density samples for Joy-13-155 and Joy-13-153 as the more reliable population, because it is believed those holes have improved quality control and no major outliers.

It is not recommended to use the theoretical hematite and quartz formula, because it produces more values significantly above the mean, unless additional parameters can be determined.

For the time being it is recommended to use the SiO_2 and Fe regression of method two until more reliable density data becomes available.

According to the fact that the modelled envelopes are in the mineralized (ore) zone, the following equation from mineralized (Ore) zone was judged as a better estimation for density in block models and was inserted as a calculated variable:

$$\text{Density} = \text{Fe}\% \cdot 0.0522 + \text{SiO}_2\% \cdot 0.0204 + 0.1586$$

The average density value returned after a whole block model estimation was **3.41** and considered as a reasonable estimation of this type of DSO iron deposit.

The author is aware that measurement of DSO iron is not an easy task in the region. The process of enrichment creates voids and, thus, are sometimes not real voids, filled by sandy to clayish iron silica material. The contractor has succeeded in recovering the core and pieces of material in the triple-tube core barrel and one cannot guarantee material was not washed away and/or a real void was encountered.

The author of this chapter believes it is necessary to present the best reliable estimator to convert the volume to tonnage in the context. It is better to stay on the safe side than overestimating the amount. It must also be stated that mining and processing methods on the material will have an impact on the yield of the iron ore which could go to market.

The author suggests the trial of a down the hole Gamma Ray measurement used in coal (geophysical log) could provide a good reading of the in-situ density (as it is used for seam location and density measurement).

When unconsolidated material is encountered (sandy pebbles, clayish material), the wax method could be used; however, it is extremely tedious and may not come with a better appraisal than a visual estimation of the core recovered for the sampling length and apply the density by the geologist logging the core.

Additionally, the author recommends the use of Ground-Penetrating Radar survey for localization of caverns, if any, if production is to occur; it could help to position any voids or caverns within 8 m depth.

In conclusion, one must note that the equation incorporates a certain amount of cavity as high-grade iron samples shows a lower density than the direct conversion of mass. The author considers the equation to be adequate for the conversion of volume in-situ into in-situ tonnes.

14.3.4 Composites Used for Estimation

Block model grade interpolation was conducted on composited assay data. A composite length of 3 m was chosen to reflect the 3 m drill sampling intervals used on the Joyce Lake deposit. Compositing was done on the complete drillholes and channels. A total of 1,315 composited assay intervals totalling 3,945 m from 111 holes and one channel were used to make the block model.

Geostatistical analysis was done with the composite set to validate the continuity of the % Fe within the mineralized envelope. The following graph shows good continuity along the deposit following directions with a range of around 200 m:

- Down Plunge of the deposit: Az 135 Dip -25;
- Down Northeast Flank: Az 225 Dip -55.

There is less continuity in the downhole direction, which is expected given the stratiform geometry of the deposit. This illustrates the very low nugget effect of around 10%.

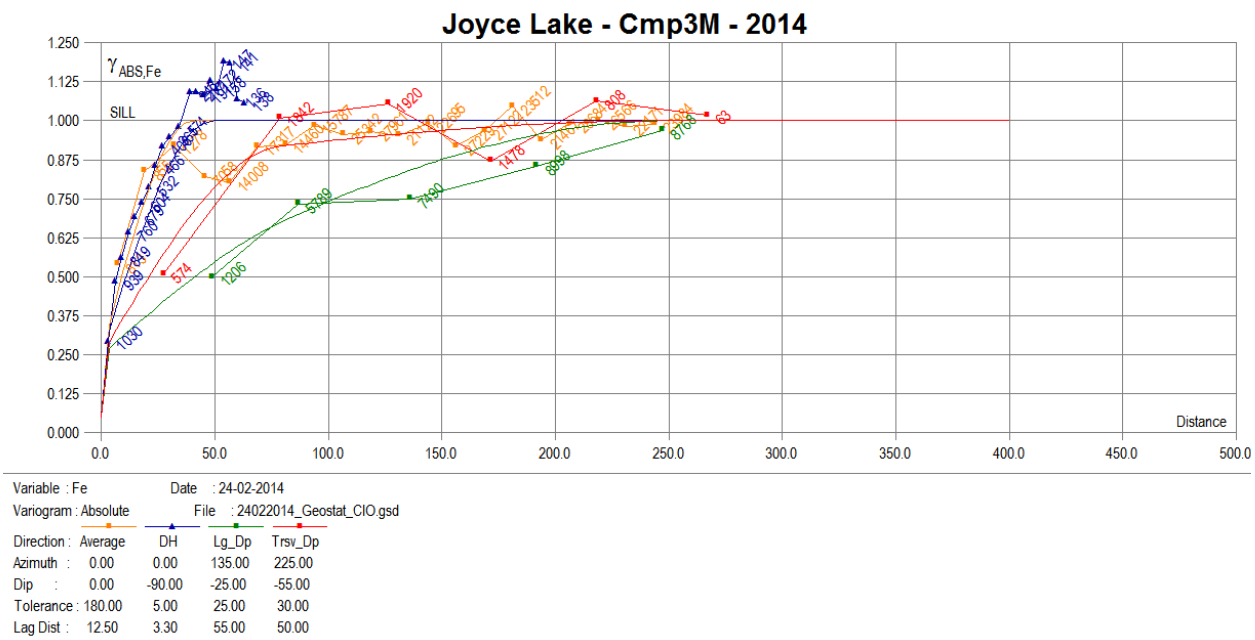


Figure 14-7: Joyce Lake DSO 3 m composites variography

14.3.5 Block Model Estimation with Variable Ellipsoids

This section describes the variable ellipsoid parameters used for the block model estimations.

14.3.5.1 Block Model Estimation

For block model estimation, 3 m regular length composites were used to generate the point composites within the mineralized intervals. Interpolation of the average grade of blocks within interpreted mineralized solids from nearby mineralized composites was accomplished by an inverse distance square interpolation, with ***three sequentially larger variable ellipsoids***. The procedure was run in several passes with search conditions (size of search ellipsoid, minimum data in search ellipsoid) relaxed from one pass to the next until all blocks within the mineralized solid were interpolated. The variable ellipsoid method establishes an orientation for each individual block according to the trend of the modelled geological interpretation. This method was chosen to accommodate the folded structure of the deposit. The following table summarizes the variable ellipsoid parameters used for estimation.

Table 14-12: Ellipsoid parameters

Ellipsoid	Shape	X/Y/Z (m)	Min Composites	Max Composites	Limit/Sample/Hole
A	Saucer	75/60/5	6	9	3
B	Saucer	150/120/10	6	9	3
C	Saucer	150/150/75	3	9	3

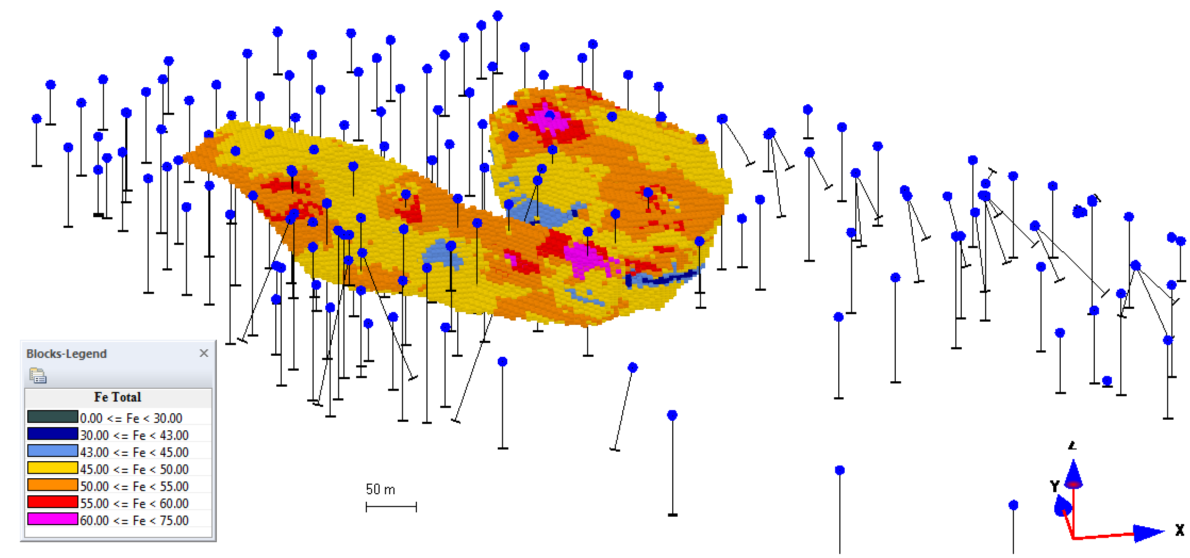


Figure 14-8: Block grade estimation Joyce Lake DSO iron deposit (GMG), UMH_1 and UMH_2, looking north (~30-degree plunge)

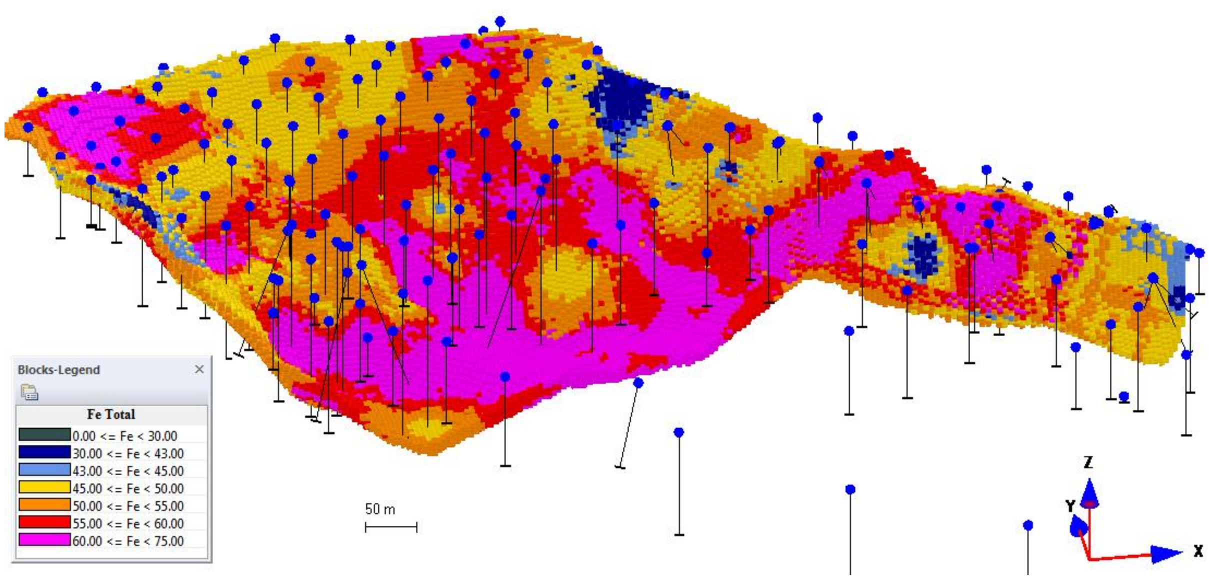


Figure 14-9: Block grade estimation, Joyce Lake DSO iron deposit (GMG), LMH, looking north (~30-degree plunge)

14.3.5.2 Variable Ellipsoids

GENESIS' variable ellipsoid feature uses geology geometry as the parameter source for the ellipsoid orientation at each block's coordinate. To do so, a wireframe using the drill grid was created with geolines (2D polylines) following the deposit's geometry. These geolines, as illustrated in Figure 14-10, are divided into two sets: a UMH set in orange and a LMH set in blue. These sets help avoid interaction effects between the two deposits. This feature appears to be particularly appropriate in the case of the Joyce Lake folded and fractured banded deposit.

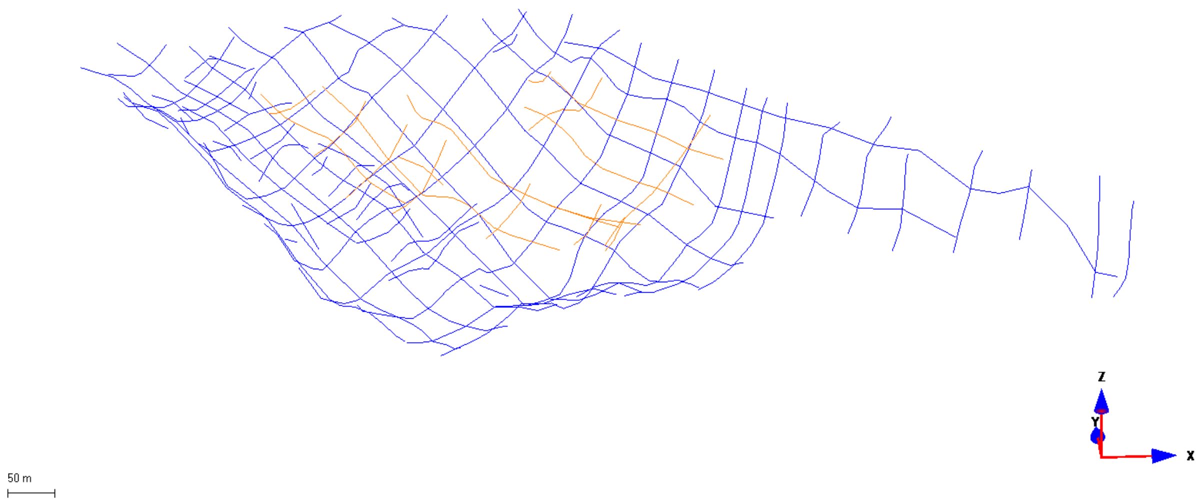
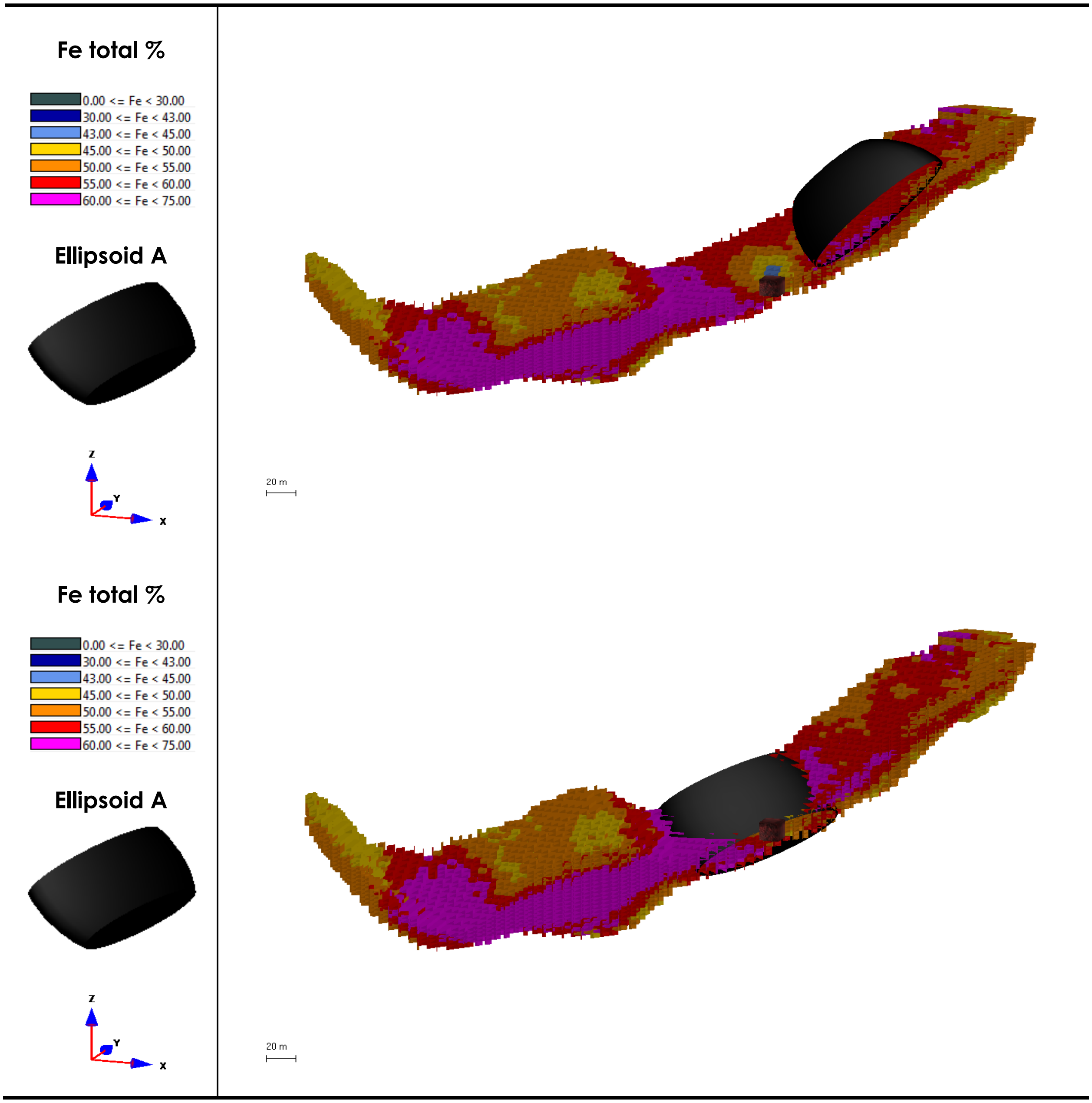
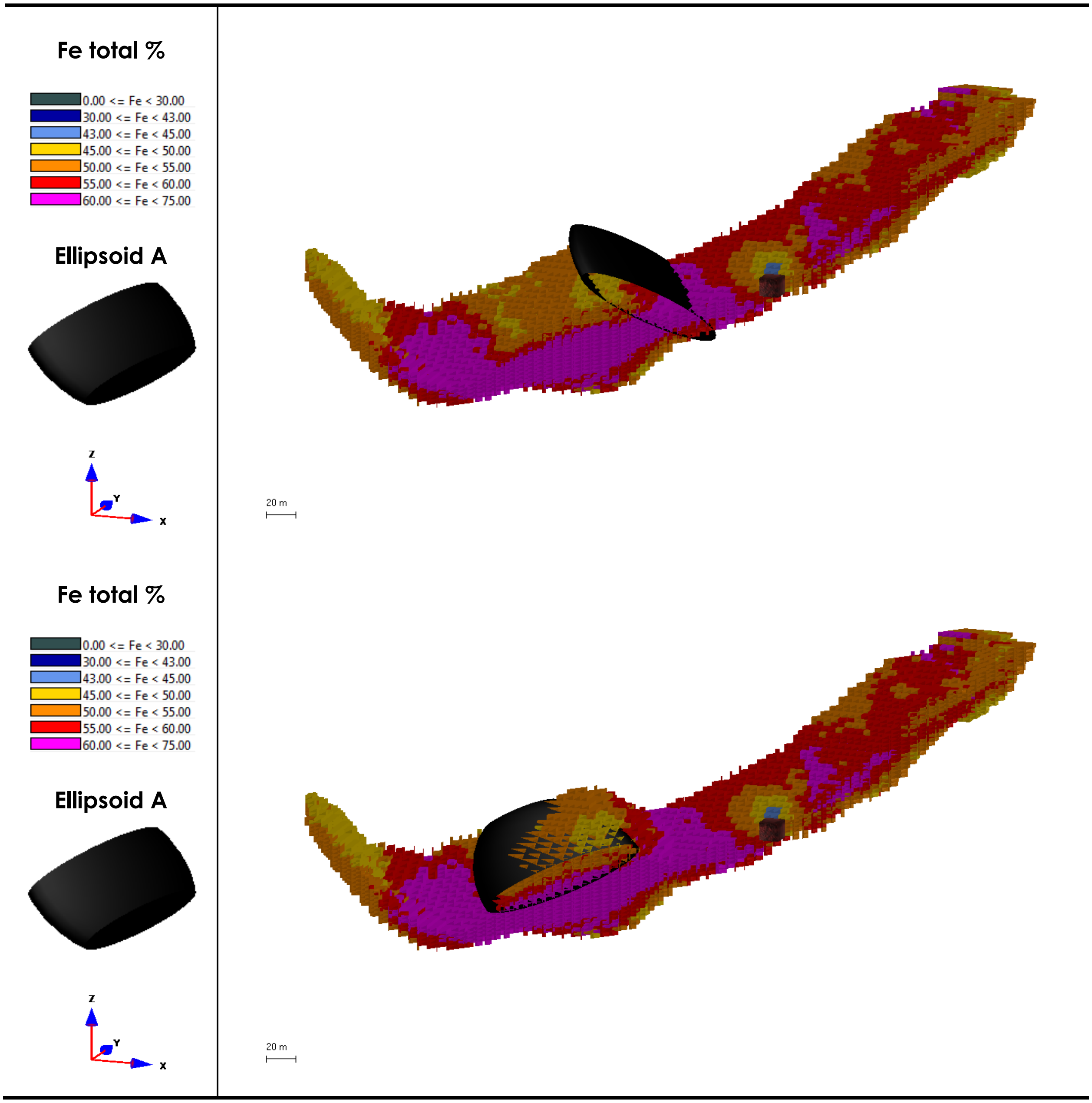


Figure 14-10: Geolines grid for variable ellipsoids looking north (~30-degree plunge)

The following graphics (Figure 14-11) show the evolution of Ellipsoid A along Section 1.5N.




Fe total %
0.00 <= Fe < 30.00
30.00 <= Fe < 43.00
43.00 <= Fe < 45.00
45.00 <= Fe < 50.00
50.00 <= Fe < 55.00
55.00 <= Fe < 60.00
60.00 <= Fe < 75.00
Ellipsoid A
Z
Y
X
20 m
Fe total %
0.00 <= Fe < 30.00
30.00 <= Fe < 43.00
43.00 <= Fe < 45.00
45.00 <= Fe < 50.00
50.00 <= Fe < 55.00
55.00 <= Fe < 60.00
60.00 <= Fe < 75.00
Ellipsoid A
Z
Y
X
20 m

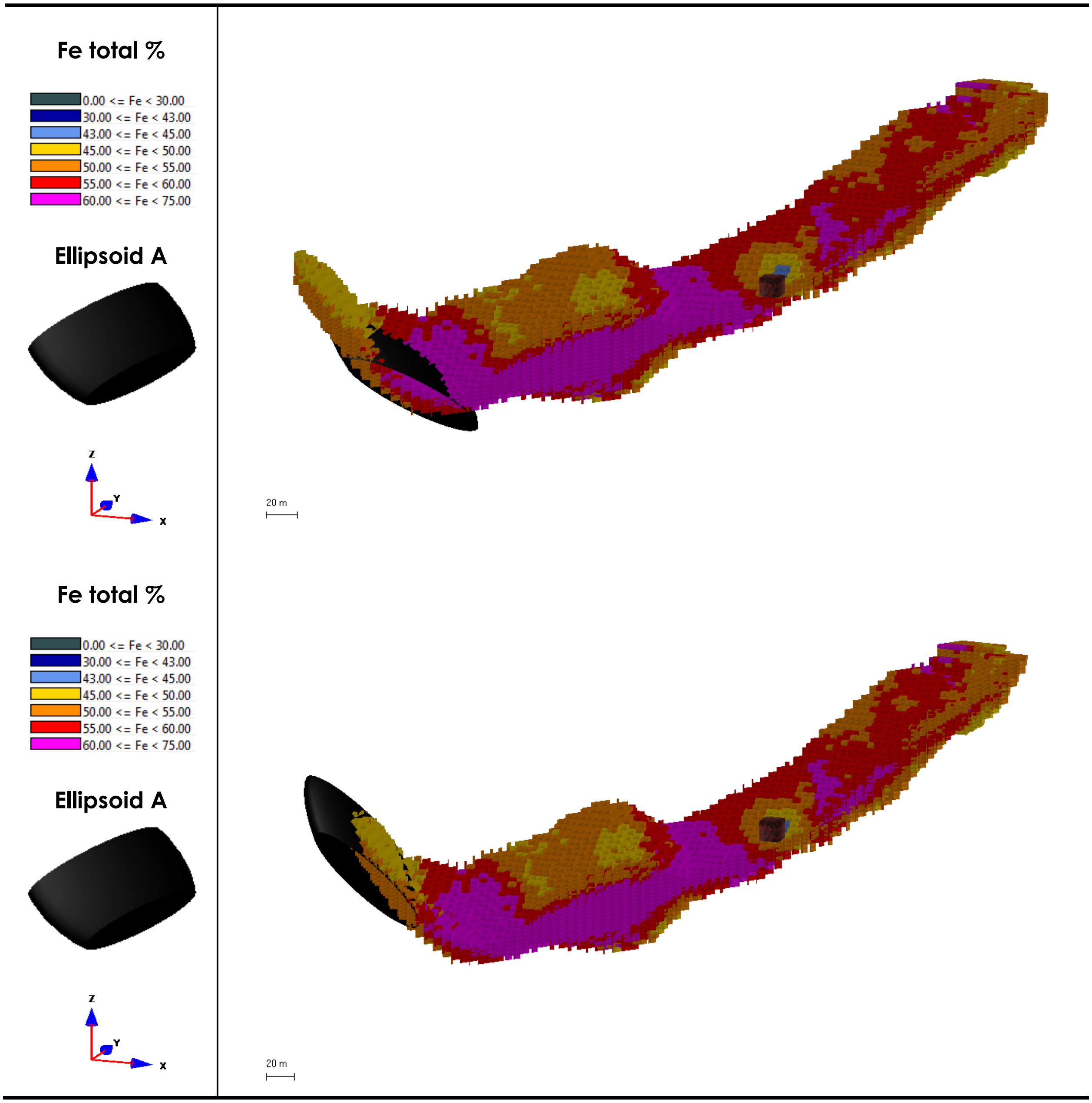


Figure 14-11: Evolution of Ellipsoid A along Section 1.5N

14.3.6 Block Model Classification

Similar to the estimation, the classification procedure was run in several passes with search conditions (size of search ellipsoid, minimum data in search ellipsoid) relaxed from one pass to the next until most blocks within the mineralized solid were interpolated. The orientation of variable ellipsoids is fixed by geolines. Moreover, the size of variable ellipsoids, as well as the minimum/maximum numbers of data used in the ellipsoid, are fixed to nine composites. In this case, three variable ellipsoids were used with fixed radii (Table 14-13). As a result, blank blocks were not estimated. The variable ellipsoid method establishes an orientation for each individual block according to the trend of the modelled geological interpretation. This method was chosen to accommodate the folded structure of the deposit. The following table summarizes the variable ellipsoid parameters used for classification.

Table 14-13: Classification parameters

Ellipsoid	Shape	X	Min Composites	Max Composites	Limit/sample/Hole
A Measured	Saucer	75/60/5	6	9	3
B Indicated	Saucer	150/120/10	6	9	3
C Inferred	Saucer	150/150/75	3	9	3

Without applying a cut-off grade, mineralized material within the geologically determined mineralized envelope are shown in Table 14-14:

Table 14-14: Mineralized material in envelopes

0% Fe cut-off within mineralized envelopes	Tonnes	% Fe	% SiO_2	% Al_2O_3	% Mn
Measured	25,800,000	55.41	17.84	0.52	0.75
Indicated	8,520,000	54.41	19.97	0.48	0.44
M+I	34,320,000	55.16	18.37	0.51	0.67
Inferred	870,000	61.57	9.08	0.44	0.75

14.4 Current Mineral Resource Estimation Result and Conclusion, May 2022

The Mineral Resource reporting was completed in GENESIS and Mineral Resources were estimated in conformity with generally accepted CIM Estimation of Mineral Resource and Mineral Reserve Best Practices Guidelines of 2019.

The Mineral Resource Estimate, based on the drilling results from the 2011-2013 drilling program show 23.97 million tonnes of Measured and Indicated Mineral Resources at an average grade of 58.63% total Iron (Fe) plus an additional 0.83 million tonnes of Inferred Mineral Resources, at cut-off grade of 50% Fe, the base case. The results at a 55% cut-off grade are also shown in Table 14-15 for sensitivity. The current May 2022 Mineral Resource Estimate (the "Current MRE") shown in Table 14-15 is constrained within an optimized pit as per CIM 2019 guidelines for the reasonable prospect of economic extraction. The cut-off grade was applied within an optimized pit shell. The cut-off grade was selected to achieve an overall resource iron content that would, in the author's opinion, meet typical direct-shipping grade market specifications and have a reasonable prospect for economic extraction.

Table 14-15: Summary of current pit-constrained MRE at Joyce Lake DSO Project, May 6, 2022

Joyce Lake (DSO) Mineral Resource Estimate (1)					
50% Fe Cut-off (2)	Tonnes (3)	% Fe	% SiO_2	% Al_2O_3	% Mn
Measured ("M")	18,530,000	58.71	12.97	0.55	0.81
Indicated ("I")	5,440,000	58.35	14.09	0.51	0.53
M+I	23,970,000	58.63	13.22	0.54	0.75
Inferred	830,000	62.10	8.30	0.43	0.78
Joyce Lake (DSO) Mineral Resource Estimate Sensitivity (1)					
55% Fe Cut-off (2)	Tonnes (3)	% Fe	% SiO_2	% Al_2O_3	% Mn
Measured ("M")	12,870,000	61.45	9.01	0.54	0.85
Indicated ("I")	3,590,000	61.55	9.36	0.49	0.64
M+I	16,460,000	61.47	9.09	0.53	0.81
Inferred	790,000	62.50	7.68	0.43	0.81

Notes:

(1) Pit optimized using approximately $68.97/t operating costs and $157/t FOB Sept-Îles for material over 55% Fe (equivalent to approximately USD150/t benchmark price at 0.76 CAD:USD exchange rate).

(2) Within mineralized envelope and optimized pit shell, % Fe Cut-off on individual blocks.

(3) Variable Density (equation derived from core measurements), tonnes rounded to nearest 10,000.

Table 14-16 presents a calculation of the economic potential of extracting material at the selected cut-off grade of 50%. The operating margin of a theoretical product at the cut-off of 50% Fe is demonstrated to be above zero, so Mineral Resources at or above the 50% Fe cut-off have reasonable prospects for economic extraction.

Table 14-16: Reasonable prospects for economic extraction at a 50% Fe cut-off

Product composition	Value	Basis
Fe grade (%)	50.0%	Selected cut-off grade
Fe_2O_3 grade (%)	71.5%	Assuming that all Fe is present in form of hematite
Al_2O_3 grade (%)	0.6%	Empirical average of assay data
MnO grade (%)	0.7%	Empirical average of assay data
Other elements (%)	2.0%	Empirical average of assay data
SiO_2 grade (%)	25.2%	Calculated value required to reach unity
Sum	100.0%	
Price, penalties and premiums (1)		
Base price (USD/t)	$150	Price used in optimized open pit to delineate resource at 50% Fe cut-off
Fe penalty (USD/%/t)	$1.97	Three-year trailing average(2) as of March 31, 2022; Applies per percentage point below 62% Fe
Fe penalty (USD/t)	-$23.64	= (50%-62%) * 100 * $1.97
SiO_2 penalty (USD/%/t)	$1.67	Three-year trailing average(2) as of March 31, 2022; Applies per percentage point above 0% SiO_2
SiO_2 penalty (USD/t)	-$42.08	= (25.2%) * 100 * $1.67
Other elements	N/A	Product composition is below penalty thresholds for all other elements2
Selling price in China (USD/t)	$84.28	= Base price - Fe penalty - SiO_2 penalty
Ocean freight (USD/t)	$26.06	Three-year trailing average(3) as of March 31, 2022
Selling price at Sept-Îles (USD/t)	$57.28	= Selling price in China - Ocean freight
Exchange rate (USD:CAD)	0.77	Three-year trailing average(4) as of March 31, 2022
Selling price at Sept-Îles ($/t)	$74.38	= Selling price at Sept-Îles (USD/t) / Exchange rate
Operating cost ($/t)	$68.97	Sum of costs used in optimized open pit to delineate resource
Operating margin at 50% Fe ($/t)	**$5.41**	= Selling price at Sept-Îles ($/t) - Operating cost ($/t)

Notes:

(1) Assuming dry metric tonnes, all products sold as 62% Fe sinter fines, ignoring applicable lump premiums.

(2) Penalties sourced from MySteel.

(3) Ocean freight adjusted pro rata by distance (+31%) from Baltic Exchange Capesize C3 index rate as sourced from GFI Group.

(4) Exchange rate sourced from Bank of Canada.

The following table (Table 14-17) presents variation of M+I resource tonnage and % Fe resource grade compared to % Fe resource cut-off grade, within the pit constraint. At a 50% Fe cut-off the Mineral Resource potentially meets market product specifications.

Table 14-17: Resource block model sensitivity in relation to % Fe cut-off grade

Category	Cut-off Grade % Fe	Million Tonnes	% Fe	% SiO_2	% Al_2O_3	% Mn
M+I	0	32.5	55.6	17.8	0.51	0.65
M+I	45	31.1	56.1	17.0	0.52	0.66
M+I	48	26.9	57.6	14.8	0.53	0.71
M+I	50	24.0	58.6	13.2	0.54	0.75
M+I	52	20.8	59.8	11.5	0.54	0.78
M+I	53	19.2	60.4	10.6	0.54	0.79
M+I	54	17.8	60.9	9.9	0.53	0.80
M+I	55	16.5	61.5	9.1	0.53	0.81

In the opinion of the qualified person, the geological interpretation, sample location, assay intervals, drillhole spacing, QA/QC, specific gravity measurement on core, and grade continuity of the Joyce Lake DSO deposit are adequate for this resource estimation and classification.

To confirm the phosphorus content at Joyce, compilation of statistics on 3-m composites within the mineralized envelope shows an average of 0.10% P_2O_5 which is equivalent to 0.04% P. China is the intended final destination for products, for which 0.1% P is a typical threshold limit before penalties are applied. Effectively, no part of the >50% Fe grade mineralization exceeds this phosphorus limit. Some other international iron ore markets have a 0.05% P or lower penalty threshold. Further inspection of the spatial distribution of P_2O_5 grades shows that phosphorus in excess of 0.05% P is not concentrated within the deposit to an extent that would cause products to exceed specifications during expected processing and blending operations. In the event more restrictive markets are targeted, a larger surge stockpile could potentially be used for blending to meet product specifications without further rehandling. Thus, the %P content at Joyce is not an issue with respect to meeting most iron ore product specifications.

Pit Optimization Parameters

In order to meet CIM 2019 guidelines, pit optimization runs were made using parameters shown in Table 14-18. The optimized pit shell was used to constrain the Mineral Resource Estimate. Almost the entire mineralized zones fall within the pit-constrained shell.

Table 14-18: Pit optimization parameters

Item	Value	Units
Economics		
Currency	-	Canadian Dollars
Royalty	1.03	$CAD/dmt
Revenues		
Currency	-	Canadian Dollars
Selling Price for blocks >55%Fe (High-grade)	157.00	$CAD/dmt
Selling Price for blocks 50-55% Fe (Low-grade)	100.61	$CAD/dmt
Cost basis		
Mining cost – overburden	3.63	$CAD/t mined
Mining cost – ore including stockpile reclaim (0.5$)	4.13	$CAD/t mined
Mining cost – waste	3.63	$CAD/t mined
Processing and Other Costs	51.78	$/dmt
Operating parameters		
Processing Recovery	100%	
Dilution and Ore Loss Factors	-	
Cut-off for Revenue	50% Fe	
Geotechnical parameters		
Overall Pit Slope (north wall)	45	degrees
Overall Pit Slope (south wall)	47	degrees

Pit optimization was run by BBA, at the request of GMG & JDI, from the GMG resource block model in addition to verification of GMG optimization results.

Note that Measured, Indicated & Inferred material was considered in the pit optimization process.

The values were discussed and compared to what is used in the region. The commodity prices used in optimization are based on information supplied by JDI and discussions with potential buyers of product. These costs and prices are reasonable, and can be used in the definition of a pit-constrained Mineral Resource Estimate at Joyce.

The optimized pit shells were generated using the following prices, in Table 14-19, to determine sensitivity to pricing:

Table 14-19: Price sensitivity table

Case	>55% Fe FOB Sept-Îles price ($/dmt)	50-55% Fe FOB Sept-Îles price ($/dmt)
C120	$117.53	$61.14
C125	$124.11	$67.72
C150	$157.00	$100.61
C175	$189.90	$133.51
C200	$222.79	$166.40

The following table (Table 14-20) presents the mineralized material constrained by pit shells based on the above price table.

Table 14-20: Sensitivity pit shells – Base case using C150

Pit Shell	Material				Waste (tonnes)	Total Material* (tonnes)	Strip Ratio[(1)] (waste:ore)
	Measured (tonnes)	Indicated (tonnes)	Measured + Indicated (tonnes)	Inferred (tonnes)			
RF=1 C150	18,531,241	5,443,521	23,974,762	825,682	79,802,784	104,603,228	3.22
RF=1 C120	18,099,028	5,193,273	23,292,301	816,976	74,073,897	98,183,174	3.07
RF=1 C125	18,296,803	5,256,315	23,553,118	819,733	75,439,919	99,812,770	3.10
RF=1 C175	18,579,396	5,512,635	24,092,031	833,230	82,203,796	107,129,057	3.30
RF=1 C200	18,640,952	5,605,265	24,246,217	837,599	86,339,366	111,423,181	3.44

Note:
(1) Including Inferred material – Not rounded on purpose.

No significant material change is observed in mineralized material tonnage when considering its sensitivity to the average selling price.

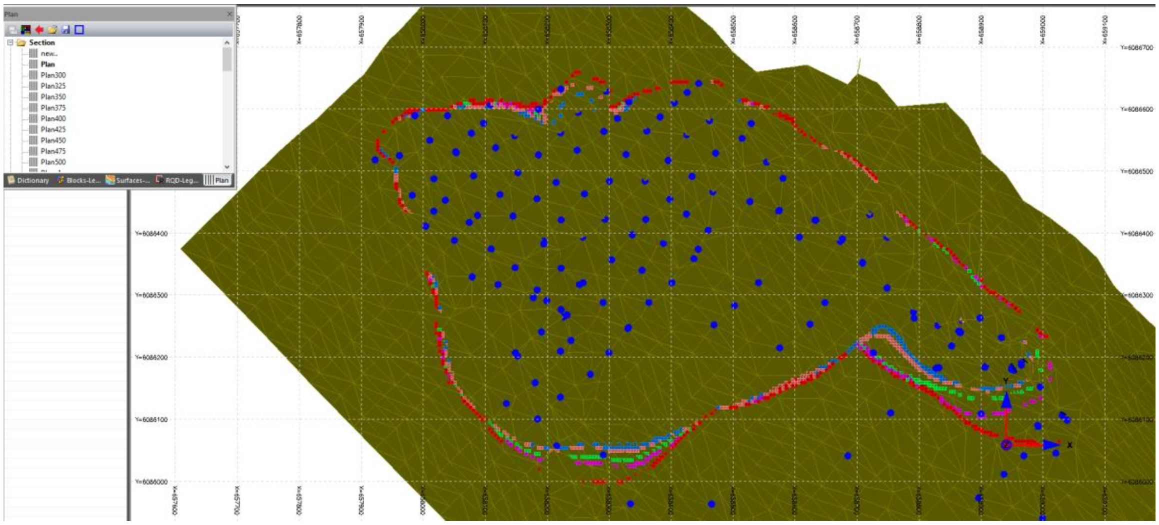


Figure 14-12: Plan view of Joyce Lake deposit with surface trace of pit shells

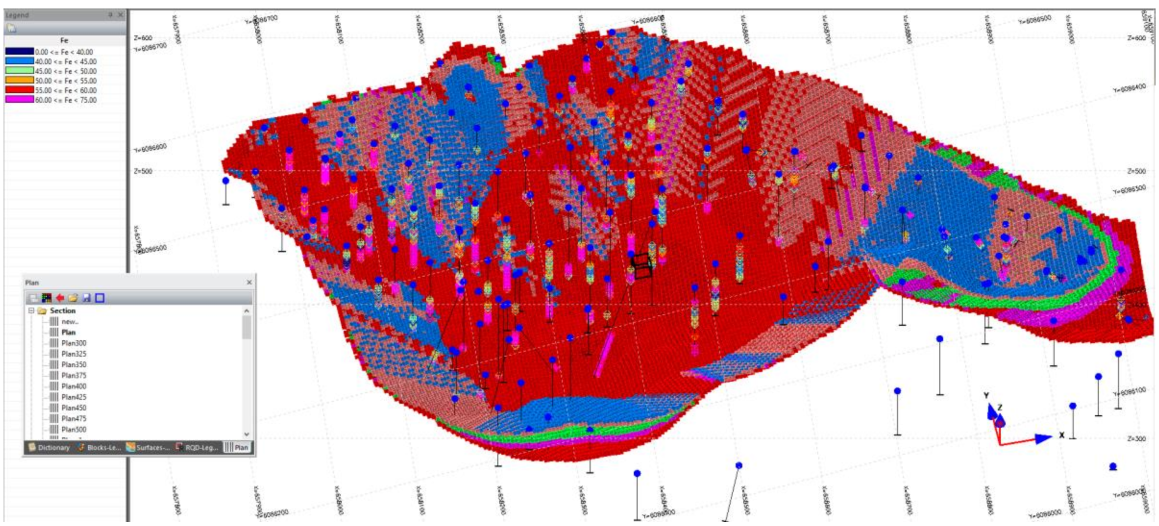


Figure 14-13: Isometric view of pit shells

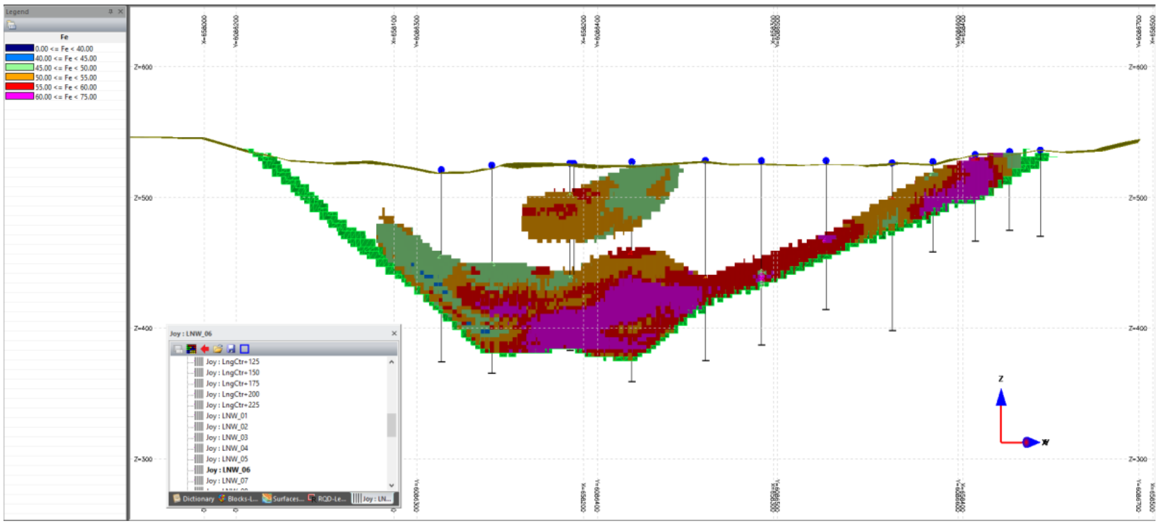


Figure 14-14: Typical section with blocks and base case pit shell - 2022

15. Mineral Reserve Estimate

This chapter presents the pit optimization and the detailed-engineered pit design carried out to convert Mineral Resources to Mineral Reserves for the Joyce Lake deposit.

15.1 Introduction

NI 43-101 defines the terms "Mineral Reserve", "Probable Mineral Reserve" and "Proven Mineral Reserve" ascribed by the Canadian Institute of Mining, Metallurgy and Petroleum, as the CIM Definition Standards on Mineral Resources and Mineral Reserves (May, 2014) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (2019).

CIM definitions have been followed in reporting Mineral Reserves. A Mineral Reserve is defined as follows:

> *"A Mineral Reserve is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Pre-Feasibility or Feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified."*

Modifying Factors are considerations used to convert Mineral Resources to Mineral Reserves. These include, but are not restricted to, mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social, and governmental factors.

A **Probable Mineral Reserve** is the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. The confidence in the Modifying Factors applying to a Probable Mineral Reserve is lower than that applying to a Proven Mineral Reserve.

A **Proven Mineral Reserve** is the economically mineable part of a Measured Mineral Resource. A Proven Mineral Reserve implies a high degree of confidence in the Modifying Factors.

Application of the Proven Mineral Reserve category implies that the Qualified Person has the highest degree of confidence in the estimate with the consequent expectation in the minds of the readers of the report.

15.2 Open Pit Mineral Reserve Estimate

This reserve statement was prepared according to the guidelines set under the requirements of the NI 43-101. The Mineral Reserves were reported within the ultimate engineered pit design produced for the Feasibility Study ("FS"), which includes all aspects of a functional pit (main haul roads, geotechnical berms, etc.). The engineered open pit was designed following the pit shell selected during the open pit optimization exercise.

Changes in the following factors and assumptions may affect the Mineral Reserve Estimate:

- Commodity prices;
- Interpretations of mineralization geometry and continuity of mineralization zones;
- Geomechanical and hydrogeological assumptions;
- Ability of the mining operation to meet the annual production rate;
- Operating cost assumptions;
- Crushing plant recoveries;
- Mining loss and dilution; and
- Ability to meet and maintain permitting and environmental license conditions.

The Mineral Reserve Estimate for the Project was prepared using a combination of Hexagon Mining's MineSight software packages for estimating the economic pit limit for the open pit and block model interrogation.

The Mineral Reserve Estimate for the deposit is based on the resource block model described in Chapter 14. The block model contained Measured, Indicated, and Inferred Mineral Resources; however, only Measured and Indicated Mineral Resources were used. Inferred Mineral Resources in the block model were not included in the Probable Mineral Reserve and remain classified as waste; Inferred Mineral Resources do not meet the standards required for inclusion in Mineral Reserves.

Mineral Reserves for the deposit incorporate mining dilution and mining loss assumptions for the open pit mining method.

The reference point at which Mineral Reserves are defined, is the point where the ore is delivered to the crushing facility, which includes the run-of-mine ("ROM") stockpile.

Table 15-1 presents the Mineral Reserves inside the design pit.

Table 15-1: Joyce Lake Mineral Reserves at 52% Fe cut-off grade

Mineral Reserves	Tonnage	Grade	Grade	Grade	Grade
Mineral Category	**(Mt)**	**(%Fe)**	**(% SiO_2)**	**(% Al_2O_3)**	**(%Mn)**
High-grade Proven (Above 55% Fe)	11.32	61.65	8.72	0.55	0.84
Low-grade Proven (52% - 55% Fe)	2.84	53.49	20.42	0.62	0.69
Total Proven (Above 52% Fe)	**14.16**	**60.01**	**11.07**	**0.56**	**0.81**
High-grade Probable (Above 55% Fe)	2.49	61.51	9.46	0.50	0.61
Low-grade Probable (52% - 55% Fe)	0.72	53.27	21.68	0.59	0.29
Total Probable (Above 52% Fe)	**3.21**	**59.65**	**12.21**	**0.52**	**0.54**
Total Reserve (Above 52% Fe)	**17.37**	**59.94**	**11.28**	**0.55**	**0.76**

Notes to accompany Joyce Lake open pit Mineral Reserves table:

1. Mineral Reserves are based on Measured and Indicated Mineral Resources with an effective date of May 6, 2022.
2. Mineral Reserves are reported based on open pit mining within designed pits and incorporate estimates for mining dilution and mining losses. As a result of regularization of the block model, an estimated 2.4% mining dilution and 2.4% mining loss were incorporated into the model.
3. Joyce Lake high-grade Mineral Reserves are reported at a diluted cut-off grade of 55% Fe. The cut-off grades and pit designs are considered appropriate for an iron ore price of $117.53/dmt for high-grade, a process recovery of 98% for crushing & screening, and estimated mining, processing, and G&A unit costs during pit operation.
4. Joyce Lake low-grade Mineral Reserves are reported at a diluted cut-off grade of 52% Fe and below the higher cut-off grades identified in Note 3. It is planned that low-grade Mineral Reserves within the designed pits will be stockpiled during pit operation and processed during pit closure. The low-grade cut-off is considered appropriate for an iron ore price of $61.14/dmt for low-grade, a process recovery of 98% and estimated ore rehandle, processing, and G&A unit costs during pit closure.
5. Proven Reserves are all blocks inside the engineered pit design in the Measured Resource category.
6. Probable Reserves are all blocks inside the engineered pit design in the Indicated Resource category.
7. Mineral Reserves were developed in accordance with CIM Definition Standards on Mineral Resources and Mineral Reserves (May 2014) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (2019).
8. Rounding may result in apparent summation differences between tonnes and grade.
9. Mineral Reserves are reported with an effective date of May 6, 2022.

The following sections outline the procedures used to estimate the Mineral Reserves. The detailed pit design is discussed in the following sections, while the production plan is discussed in Chapter 16.

15.3 Pit Limit Analysis

This section provides the background on the pit limit analysis methodology, parameters used, and the selected pit optimization shell used for the FS.

The selected shell was used as a basis for the ultimate pit design and mine planning work for the FS.

15.3.1 Methodology

In accordance with the guidelines of the NI 43-101 on Standards of Disclosure for Mineral Projects, and the CIM Definition Standards for Mineral Resources and Mineral Reserves, only those mineral blocks classified in the Measured and Indicated resource categories are allowed to drive the pit optimizer for a Feasibility Study. No economic value is attributed to Inferred blocks and, as such, these blocks are treated as waste blocks by the pit optimization routine.

Pit optimizations were carried out using the MineSight Economic Planner Module and its Pseudoflow 3D algorithm. The pit optimization algorithm is used to produce pit shells that are physical representations of an economical pit to be mined, assuming a given set of parameters and 3D block model. Using a variety of input parameters such as mining costs, processing costs, transportation costs, process recovery values and pit slopes, the algorithm outputs the pit shell that maximizes the undiscounted value of the pit shell. These shells are devoid of geotechnical and operational features such as ramps, proper benching arrangements, and minimum mining width considerations. The pit shell's purpose is to be used as a basis for establishing pit limits and guide for the design of an engineered open pit. No capital expenses, such as those required for the initial fleet purchase, are considered by the pit optimization tool.

A series of pit shells are produced using a range of revenue factors (reduction factors on selling price) from 70% to 130% to produce the industry standard pit-by-pit graph. The revenue factor ("RF") is used to measure the sensitivity of the pit optimizations to changes in mineral selling prices, as well as to evaluate the effect of the pit size and stripping ratios on the Project present value ("PV"). The analysis produces a series of nested pit shells that prioritizes the mining of the most economic material and progressively increase in size, while less profitable material is mined as the RF increases. The results of the pit optimizations are subsequently compared on the basis of the estimated PV and calculated undiscounted value and tonnes of ore and waste material. From these results, a final pit shell is selected that meets project requirements and maximizes project PV. Examples of the important project requirements include the overall pit stripping ratio, pit depth, mine life and average grade.

15.3.2 Pit Limit Analysis Inputs and Parameters

The pit optimization parameters used for the FS are based on the results of the 2015 Feasibility Study, with cost assumptions escalated.

The major costs and other parameters used for the pit optimization runs are detailed in Table 15-2.

Table 15-2: Pit optimization cost and general parameters

Parameters	Unit	Value
Exchange Rate	USD:CAD	0.76
Currency Used for Evaluation	$	CAD
Selling Price, High-grade (>=55% Fe) 35% lump + 65% fines. FOB loaded in ship in Sept-Iles	$/dmt	117.53
Selling Price, Low-grade (>=52% Fe, <55% Fe) 35% lump + 65% fines. FOB loaded in ship in Sept-Iles	$/dmt	61.14
Process Recovery	%	98
Operating Costs		
Mining – Overburden	$/t	3.63
Mining – Ore, including stockpile reclaim	S/t	4.13
Mining – Waste	$/t	3.63
Processing	$/t feed	51.78
Perimeter Dewatering and Water Management		0.39
Processing and Handling		2.59
Product Hauling Costs		4.05
Product Load-Out and Rail Siding		1.28
Site Administration and Services		2.82
FIFO and Room and Board		1.97
G&A Cost		1.21
Transportation, Port and Rail loading operating costs		37.49
Selling Cost	$/dmt	1.03
Mining Dilution & Mining Loss	%	Incorporated in Regularized Block Model ~2.4% mining loss ~2.4% mining dilution
Milling Rate (Crushing/Screening)	Mtpa	2.5
Discount Rate	%	8%
Overall Slope Angle – North Wall	°	41 - 47
Overall Slope Angle – South Wall	°	47
Cut-off Grade		
High-grade		55% Fe
Low-grade		52% Fe

15.3.2.1 Resource Block Model and Model Surfaces

The block size used in the model is X=5 m x Y=5 m x Z=3 m. The model was transferred to BBA as Comma Separated Value files ("CSV") for input into the MineSight software suite.

The following variables or attributes were provided as part of the resource block model:

- Mineralized block centers in UTM coordinates (x, y, z);
- Density of blocks (mineralized blocks only);
- Percentage of block inside mineralized envelope;
- Classification is the resource category (1=Measured, 2=Indicated, 3=Inferred);
- Grades: %Fe, %SiO_2, %Al_2O_3, %Mn.

It should be noted that the resource model, as provided to BBA, contained only mineralized blocks under the bedrock surface, thus all blocks that were not included in the resource block model were coded as being non-mineralized.

Following the transfer of the block model into MineSight, a verification of the global Mineral Resources by category was performed in order to ensure consistency with the results provided to BBA.

In addition to the block model file, three surface files were provided to BBA in the form of DXF files in the UTM coordinate system:

- Topography surface with Joyce Lake bathymetry;
- Topography surface with Joyce Lake surface; and
- Overburden surface (interface bedrock/overburden).

15.3.2.2 Model Density

The densities for mineralized blocks were provided within the resource block model. The density for material within the mineralized units changes as a function of variations in the model mineralogy. Chapter 14 of the Report presents more detail on the estimation of block densities. The density values for mineralized material ranged from 2.85 t/m^3 to 3.79 t/m^3.

The average densities for waste and overburden blocks, are 2.85 t/m^3 and 2.1 t/m^3, respectively.

15.3.2.3 Mining Dilution and Mining Loss

The mining block model imported for use in the pit limit analysis is considered a diluted block model.

For mine planning, it was decided to convert the partial percent resource model to whole blocks of regular size.

The following values, based on drillhole analysis for the material outside of the mineral envelope (within 1 block width), were used to describe the waste diluting material:

- Fe grade – 38.62%;
- SiO_2 grade – 41.42%;
- Al_2O_3 grade – 0.89%;
- Mn grade – 0.45%.

The regularization process creates blocks that cut across the mineralized-waste boundaries, thus adding dilution to the potential mill feed ("PMF") material. This also drives some of the regularized blocks below the cut-off grade and these become mining loss.

As a result of the regularization, an estimated 2.4% mining dilution and 2.4% mining loss were incorporated into the model. No additional factors were applied within the optimization software.

Table 15-3 tabulates the comparison using a preliminary pit design version.

Table 15-3: Mining dilution and loss estimation

Category	Cut-off Grade	Resource Model		Regularized Model	
		Tonnes (kt)	Fe Grade (%)	Tonnes (kt)	Fe Grade (%)
Measured	52% Fe	15,272.7	59.96	15,268.0	59.53
Indicated	52% Fe	3,431.5	59.70	3,430.2	58.86
Subtotal M&I	**52% Fe**	**18,704.2**	**59.91**	**18,698.2**	**59.41**

Category		Tonnes (kt)	Fe Grade (%)
Undiluted Resource Model		18,704.2	59.91
Mining Dilution	2.44%	0.456	38.62
Subtotal		**19,160.2**	**59.41**
Mining Loss	2.41%	0.462	59.41
Diluted Mining Model		18,698.2	59.41

15.3.2.4 Overall Slope Angle

The overall slope angle ("OSA") assumptions for the pit limit analysis were established following the geotechnical parameter recommendations presented in the report prepared by LVM (a division of Englobe Corporation), in December 2014, for the 2015 Feasibility Study (LVM, 2014a). Figure 15-1 shows the benching arrangement proposed by LVM for the 2015 FS.

The in-pit haulage roads assumed for the 2015 FS pit design were 24 m wide to accommodate double-lane width for 100 t class haul trucks. Based on the 2015 FS pit design and proposed haulage route of stacking the ramp on the North Wall, the overall slope angles were adjusted accordingly:

- South Wall Overall Slope Angle is represented by the recommended Inter-ramp Angle ("IRA") of 47°;
- North Wall Overall Slope Angle used the recommended IRA of 47° and then reduced to 41° to accommodate up to two double-lane haul ramps and represent the OSA.

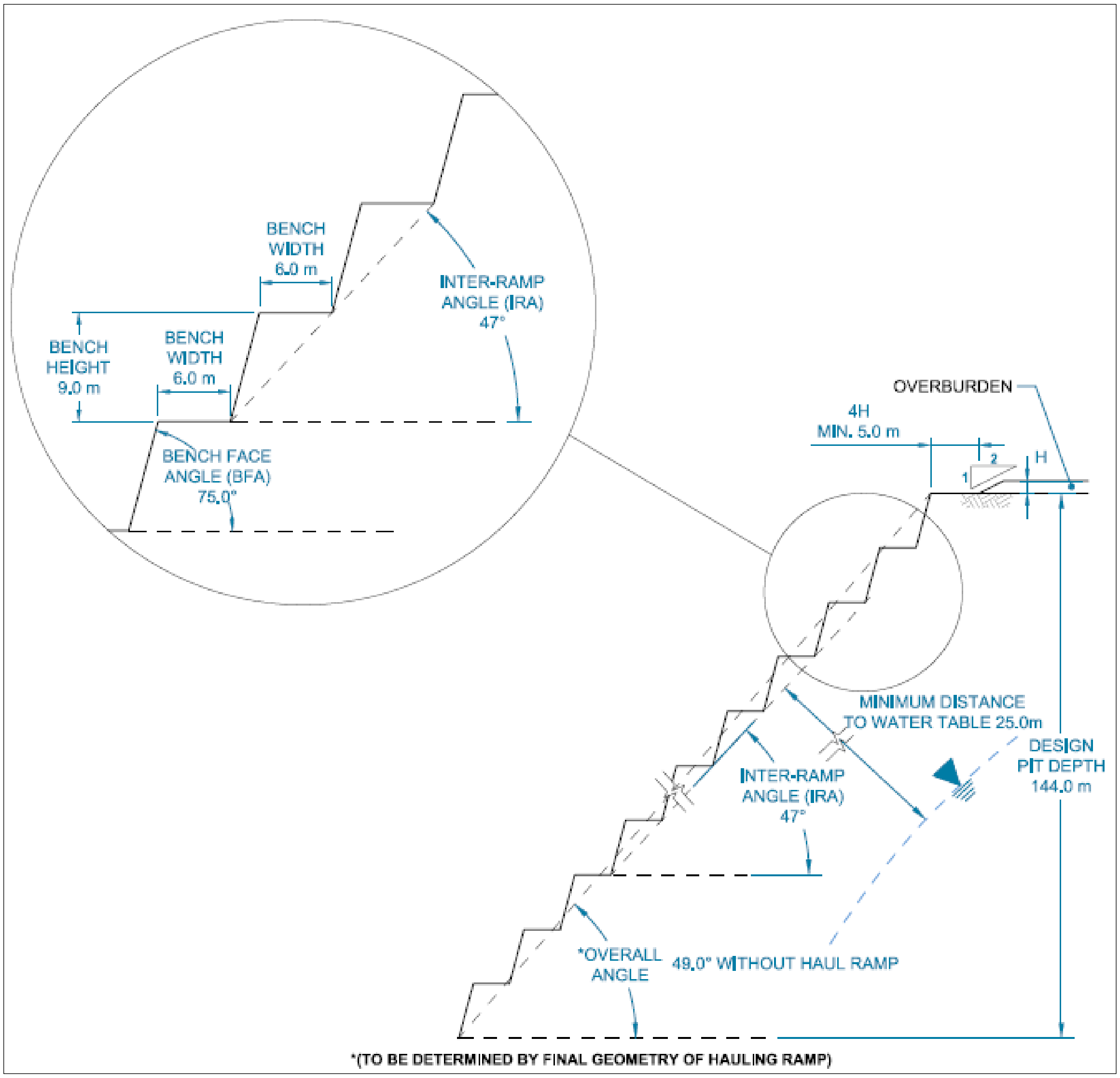


Figure 15-1: Pit design parameters (by LVM)

15.3.2.5 Operating Costs

The operating costs are preliminary and are used for pit limit analysis, mine planning, and mineral reserve estimate purposes. Detailed operating costs are developed based on a detailed mine design and plan and discussed in Chapter 21.

The basis for the operating costs for the pit limit analysis are the results of the previous FS study (BBA, 2015) and escalated for the current year.

The mining costs used the 2015 FS mining operating cost estimate with a 5% indexation per year. The mining costs used for the analysis were the average life-of-mine ("LOM") costs.

The processing costs used the 2015 FS operating cost estimates with a 15% increase.

At the time, the selling costs were provided by the Client and comprised of:

- $1.03/dmt LOM average for the sliding scale 1-2% royalty to Champion.

15.3.2.6 Selling Price

The selling price used for the pit optimization work was provided by the Client and based on preliminary FS prices for fines and lump products, FOB Sept-Îles, including estimated penalties and premiums considering production of 35% lump and 65% fines.

15.3.2.7 Cut-off Grade

For this Project, in order to achieve a product grade of 62% Fe, the ore cut-off grade was determined based on technical considerations that are more restrictive than normal economic considerations for determining the cut-off grade. Metallurgical testwork and a processing trade-off study, examining two options for ore processing, have indicated the following:

- Material having less than about 50% Fe grade is not easily (nor economically) concentrated using simple methods;
- For a DSO operation based on dry processing (simple crushing and screening), the targeted average Fe grade is 62%. At this grade, penalties relating to iron and silica are minimal. To achieve the average grade of 62% Fe, the cut-off grade for the Joyce Lake deposit is 55%;
- Considering that there is a substantial amount of mineralized material grading between 52% Fe and 55% Fe generated during the mining of >55%Fe ore, the Client will stockpile this material and process it at the end of the mine life to generate additional revenues. This cut-off was selected while keeping the average Fe at 53.3% for lump and fines products considered saleable.

The cut-off grade used for the pit limit analysis, reserve calculation, and mine planning is 52% Fe (diluted).

15.3.2.8 Boundary Constraints

There were no physical boundary constraints applied to the pit limit analysis.

15.3.2.9 Additional Assumptions

For the purposes of the pit optimization analysis, additional assumptions included:

- 98% process recovery, to account for potential rehandling losses;
- 6% moisture content; and
- 8% discount rate.

15.3.3 Pit Limit Analysis Results

The pit limit analysis process results in a series of nested pit shells, each corresponding to a revenue factor. The RF scales the metal price only, and no costs are factored by the RF. The RF 1 corresponds to an iron ore price of $117.53/dmt for high-grade and $61.14/dmt for low-grade. Table 15-4 and Figure 15-2 summarize the nested pit shell results for the Joyce Lake deposit at a selection of revenue factors.

The graph and table demonstrate that the peak NPV among the pit shells occurs at RF 0.90. The data also show that the incremental increase in NPV between the preceding pit shell (RF 0.88) and RF 0.90 is minimal.

Following the results of the discounted cash flow analysis, and incremental analysis between the various pit shells, it was decided to use the RF 0.90 pit shell to guide the ultimate pit designs.

Table 15-4: Pit optimization results

Revenue Factor	High-grade Material (Mt)	Low-grade Material (Mt)	Total ROM Material (Mt)	ROM_Material (Diluted)				Total Waste (Mt)	Financial Analysis							
				Fe (%)	SiO_2 (%)	Al_2O_3 (%)	MN (%)		Mining Cost (M$)	Processing Cost (M$)	Selling Cost (M$)	Revenue (M$)	Mine Life (y)	Un-discounted Value (M$)	NPV* (M$)	Incr. NPV (M$)
0.70	**6.2**	**1.4**	**7.6**	59.9	10.7	0.6	0.9	**14.5**	84	391	7	745	3.0	263	226	-
0.72	**6.8**	**1.5**	**8.3**	60.5	10.7	0.6	0.9	**17.8**	99	432	8	824	3.3	285	242	15.7
0.75	**13.3**	**3.2**	**16.5**	60.1	11.0	0.6	0.8	**53.7**	263	855	16	1,621	6.6	488	368	126.2
0.77	**13.6**	**3.3**	**16.8**	59.6	11.1	0.6	0.8	**55.5**	271	871	16	1,653	6.7	494	371	3.5
0.79	**13.7**	**3.3**	**17.0**	59.5	11.1	0.6	0.8	**56.7**	276	882	16	1,672	6.8	498	373	1.9
0.80	**13.8**	**3.3**	**17.1**	59.0	11.1	0.6	0.8	**57.1**	278	886	16	1,679	6.8	500	374	0.6
0.82	**13.9**	**3.4**	**17.3**	59.0	11.1	0.6	0.8	**58.1**	282	894	16	1,695	6.9	502	375	1.1
0.85	**14.1**	**3.4**	**17.5**	58.0	11.1	0.6	0.8	**59.5**	288	906	17	1,716	7.0	505	376	1.0
0.88	**14.9**	**3.6**	**18.4**	59.7	11.2	0.6	0.8	**67.9**	322	954	17	1,809	7.4	515	378	2.5
0.90	**14.9**	**3.6**	**18.5**	56.7	11.2	0.6	0.8	**68.1**	323	956	18	1,812	7.4	515	378	-0.0
0.92	**14.9**	**3.6**	**18.6**	58.8	11.2	0.6	0.8	**69.0**	327	961	18	1,821	7.4	516	378	-0.1
0.95	**15.0**	**3.6**	**18.6**	57.3	11.2	0.6	0.8	**69.7**	330	965	18	1,828	7.5	516	378	-0.2
0.97	**15.4**	**3.8**	**19.2**	57.5	11.4	0.5	0.8	**75.4**	353	996	18	1,884	7.7	517	376	-2.3
0.99	**15.4**	**3.8**	**19.3**	57.8	11.4	0.5	0.8	**75.7**	354	997	18	1,887	7.7	517	375	-0.2
1.00	**15.5**	**3.8**	**19.3**	55.3	11.4	0.5	0.8	**75.8**	355	999	18	1,889	7.7	517	375	-0.2

- The NPV calculation for the pit optimization is based on optimization parameters and does not consider capital expenditures.
- Pit shells do not constitute a pit design.

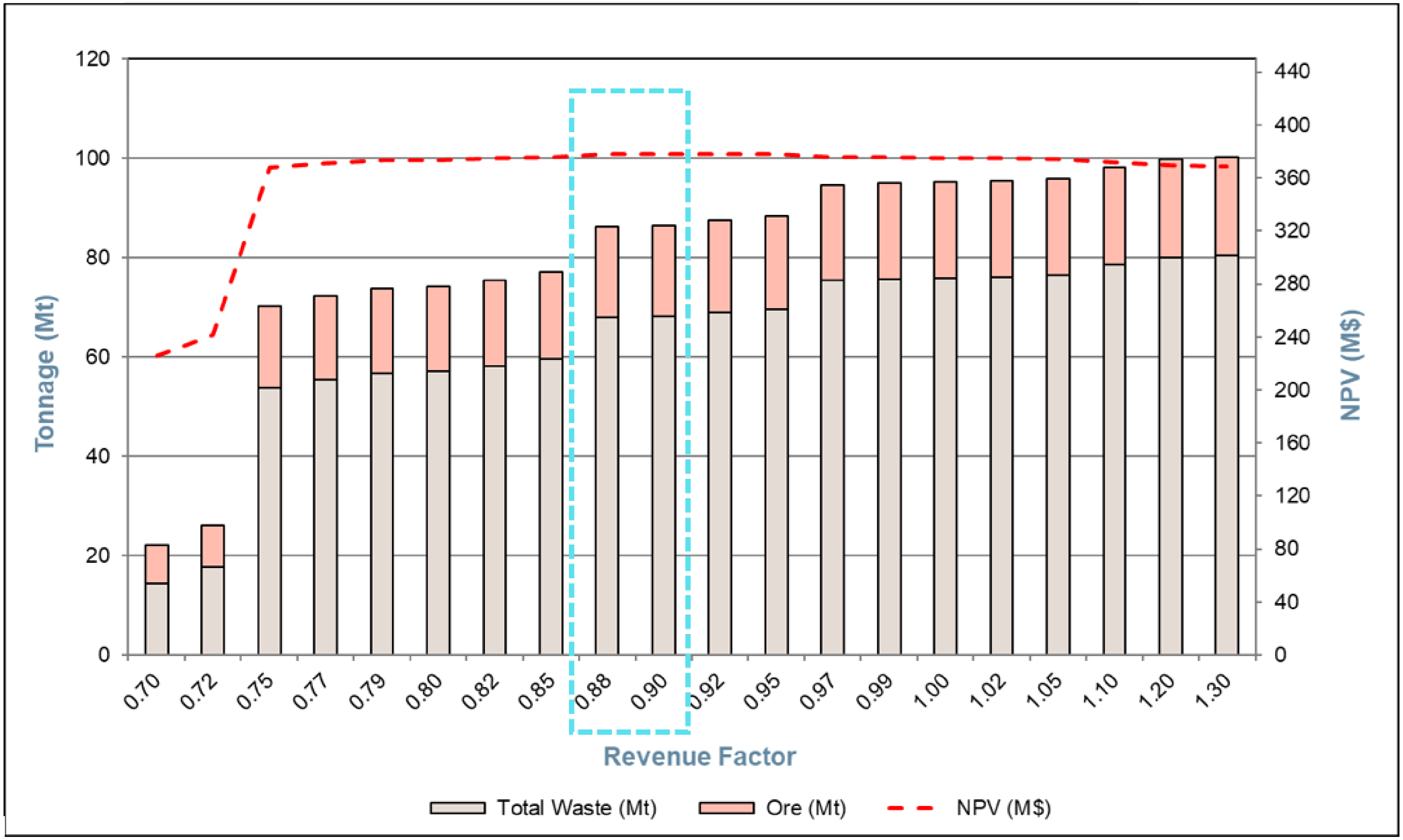


Figure 15-2: Base case FS selling price pit optimization pit-by-pit graph

15.4 Joyce Lake Open Pit Mine Design

This section describes the detailed-engineered open pit design and its bench and ramp design parameters. The mineral inventory and mining quantities are then summarized.

15.4.1 Engineered Pit Design

Joyce Lake open pit mineral reserves are founded on and are part of the Mineral Resources presented in Chapter 14 of this Report. The Mineral Reserves are reported based on open pit mining within the LOM-designed pit presented in this section and illustrated in Figure 15-3. The designed pit is approximately 1,085 m in length by 650 m wide and 230 m deep. The lowest bench is at an elevation of 309.5 m above sea level.

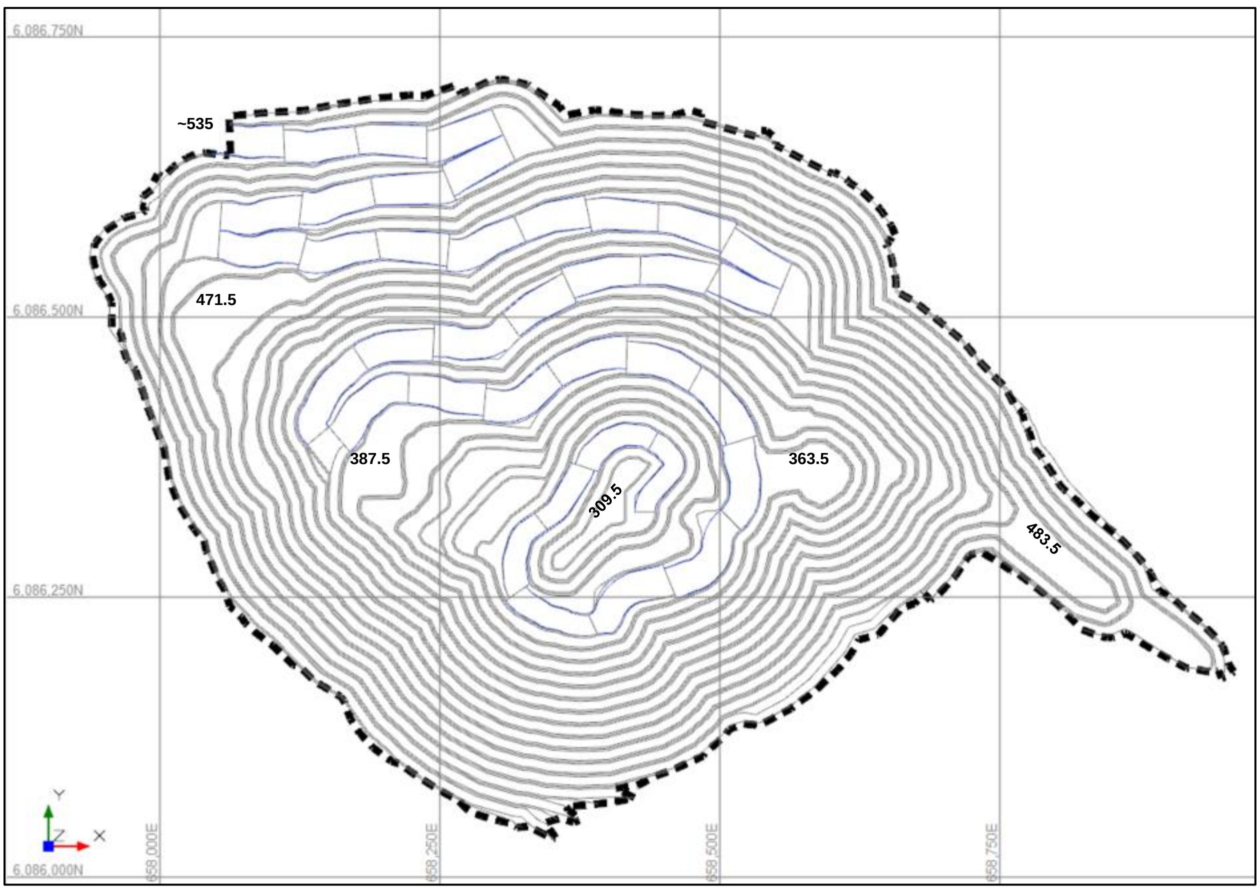


Figure 15-3: Engineered pit design – Plan view

The major design parameters used are listed in Table 15-5.

Table 15-5: Detailed open pit mine design parameters

Parameter	Value
Overall Bench Height	12.0 m
Berm Width	8.0 m
Inter-Ramp Angle (IRA)	47°
Bench Face Angle (BFA)	75°
Ramp Width (1-lane)	18 m
Ramp Width (2-lane)	24 m
Ramp Grade	10%

15.4.1.1 Bench Design

As described in the 2015 Feasibility Study, the benching arrangement proposed comprised of a 75° bench face angle, 6 m catchment berm (single benching), and 9 m bench height for an IRA of 47°.

The Newfoundland and Labrador Occupational Health and Safety Regulations (2012) indicate that, when a surface mine is worked in benches, each catchment berm shall be designed so that its final width is not less than 8 m (Item 670).

Two options were considered for the updated bench design, both with the objective of maintaining the IRA of 47°:

- Maintain the operating bench height of 9 m but with a double benching arrangement. The overall bench height would be 18 m with a 12 m catchment berm. As kinematic analyses have not been progressed as part of the pit slope stability assessment, it is uncertain whether the 18 m vertical bench height would maintain factors of safety under such analyses.
- Increase the bench height from 9 m to 12 m, increase the catchment berm from 6 m to 8 m. The overall bench height would be 12 m with an 8-m catchment berm.

The 12 m bench height with 8 m berm width was selected as the bench design for the current study. When additional geomechanical data and analysis is available during the next phases of study, the bench design should be reviewed and optimized.

15.4.1.2 Haul Ramp Design

The haul ramp design is based on the largest truck planned for the Joyce Lake pit. For the FS level study, the largest haul truck planned is a 100-tonne rigid frame truck. A Caterpillar CAT 777 or Komatsu HD785 are examples of the type of model. Table 15-6 and Figure 15-4 summarize the haul road configuration that has been used in the pit and pushback designs.

Table 15-6: Haul road configuration

Parameter	Unit	Value
Haul Truck Parameters		
Example Model		CAT 777 / HD 785
Payload (T, Heaped 2:1)	tonne	100
Operating Width, W	m	6.7 – 6.9
Width Factor (of Truck Width)		
Double-lane		3x
Single-lane		2x
Running Surface Width		
Double-lane	m	20.1
Single-lane	m	13.4
Safety Berm Parameters		
Tire Type		27.00R49
Tire Overall Diameter	m	2.6
Factor (of Tire Size)		0.5
Berm Height (Calculated)	m	1.3
Slope	degree	37
Road Berm Allowance	m	3.5
Road Drainage Ditch Parameters		
Road Drainage Allowance	m	1.2
Total Ramp Width		
Double-lane	m	25
Single-lane	m	18
Other Ramp Design Parameters		
Ramp Gradient	%	10

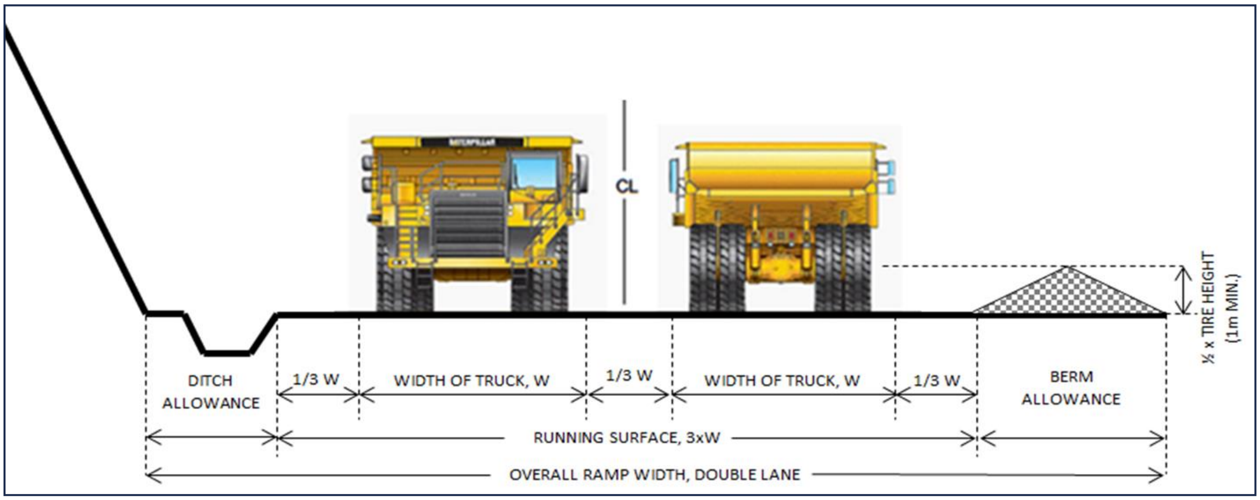


Figure 15-4: Double-lane haul ramp configuration

15.4.1.3 Minimum Mining Width

A minimum mining width of 25 m has been considered in the pit and phase designs.

15.4.1.4 Final Bench Access

To reduce the strip ratio, access ramps have not been designed to the bottom bench of each phase. When mining the final bench, the trucks are positioned on the bench crest rather than on the floor. This operating scenario is commonly referred to as a "good-bye" cut. The final ramp access is designed to 315.5 elevation with a final cut to 309.5 elevation.

Single ramp width access is utilized for the final 30 m vertical of the ramp design.

15.4.2 Open Pit Design Mineral Inventory and Mining Quantities

Table 15-7 presents the Mineral Inventory and Mining Quantities for the designed ultimate open pit. The numbers in the table consider mining dilution and ore losses.

Table 15-7: Joyce Lake ultimate pit mineral inventory and mining quantities

Mineral Reserves Mineral Category	Tonnage (Mt)	Grade (%Fe)	Grade (%SiO_2)	Grade (%Al_2O_3)	Grade (%Mn)
High-Grade Proven Mineral Reserves (Above 55% Fe)	11.32	61.65	8.72	0.55	0.84
Low-Grade Proven Mineral Reserves (52% - 55% Fe)	2.84	53.49	20.42	0.62	0.69
Total Proven Mineral Reserves (Above 52% Fe)	**14.16**	**60.01**	**11.07**	**0.56**	**0.81**
High-Grade Probable Mineral Reserves (Above 55% Fe)	2.49	61.51	9.46	0.50	0.61
Low-Grade Probable Mineral Reserves (52% - 55% Fe)	0.72	53.27	21.68	0.59	0.29
Total Probable Mineral Reserves (Above 52% Fe)	**3.21**	**59.65**	**12.21**	**0.52**	**0.54**
Total Mineral Reserve (Above 52% Fe)	**17.37**	**59.94**	**11.28**	**0.55**	**0.76**
Overburden	2.31	-	-	-	-
Waste Rock	71.55	-	-	-	-
Total Waste	**73.86**				
Total Material	**91.23**			**Strip Ratio**	**4.25**

Notes:

1. Mineral Reserves are all blocks inside the engineered pit design in the Measured and Indicated category.
2. Open pit Mineral Reserves have been estimated using a cut-off grade of 52% Fe and a process recovery of 98%.
3. Open pit Mineral Reserves have been estimated using a dilution of 2.4% at Fe grade of 38.62%, SiO_2 grade of 41.42%, Al_2O_3 grade of 0.89%, and Mn grade of 0.45% and an ore loss of 2.4%.
4. Numbers may not sum due to rounding.

15.5 Comparison to Previous Mineral Reserve Estimate

Table 15-8 provides a comparison between the current Mineral Reserve Estimate and the previous non-current Mineral Reserve Estimate (BBA, 2015c).

Table 15-8: Comparison to previous Mineral Reserve Estimate

Reserve Category	Unit	2015 Reserve Estimate	2022 Reserve Estimate
Proven Mineral Reserves			
High-grade (+55% Fe)			
Tonnage (Mt)	Mt	11.63	11.32
Fe	%	61.35	61.65
SiO_2	%	9.16	8.72
Al_2O_3	%	0.54	0.55
Mn	%	0.84	0.84

Reserve Category	Unit	2015 Reserve Estimate	2022 Reserve Estimate
Low-grade (52 - 55 % Fe)			
Tonnage (Mt)	Mt	2.89	2.84
Fe	%	53.31	53.49
SiO_2	%	20.40	20.42
Al_2O_3	%	0.60	0.62
Mn	%	0.70	0.69
Total Proven Mineral Reserves			
Tonnage (Mt)	Mt	14.52	14.16
Fe	%	59.75	60.01
SiO_2	%	11.45	11.07
Al_2O_3	%	0.55	0.56
Mn	%	0.81	0.81
Probable Mineral Reserves			
High-grade (+55% Fe)			
Tonnage (Mt)	Mt	2.45	2.49
Fe	%	61.50	61.51
SiO_2	%	9.48	9.46
Al_2O_3	%	0.50	0.50
Mn	%	0.61	0.61
Low-grade (52 - 55 % Fe)			
Tonnage (Mt)	Mt	0.75	0.72
Fe	%	53.09	53.27
SiO_2	%	21.90	21.68
Al_2O_3	%	0.58	0.59
Mn	%	0.30	0.29
Total Probable Mineral Reserves			
Tonnage (Mt)	Mt	3.20	3.21
Fe	%	59.52	59.65
SiO_2	%	12.40	12.21
Al_2O_3	%	0.52	0.52
Mn	%	0.54	0.54
Total Mineral Reserves			
Tonnage (Mt)	Mt	17.72	17.37
Fe	%	59.71	59.94
SiO_2	%	11.62	11.28
Al_2O_3	%	0.55	0.55
Mn	%	0.76	0.76

16. Mining Methods

This chapter outlines the mine plan, overburden, waste rock and low-grade ("LG") ore stockpile design, and the open pit mine equipment and operations.

16.1 Introduction

Mining of the Joyce Lake deposit will generally follow the standard practice of a conventional open pit operation, with drill and blast, load, and haul cycle using a drill/shovel/truck mining fleet. The overburden and waste rock material will be delivered to the overburden and waste disposal areas near the pit. The ROM ore will be delivered to the ore stockpile or LG ore stockpile.

Utilization of the Client's mining equipment and personnel is envisaged for the development of the open pit, as well as for the removal of overburden.

16.2 Mine Plan

The following section describes the mine production schedule and methodology from pre-construction, production, to post-production (i.e., ore stockpile reclaim).

16.2.1 Mine Production Schedule and Methodology

The overall objective of the mine scheduling and planning process is to maximize Project net present value ("NPV") while achieving the processing plant objectives and targets. Generally, this is done by delaying the overburden and waste rock removal activities, e.g. costs for as long as possible. This objective is taken into consideration during all phases of the mine design and mine planning.

The mine planning process involves the creation of a series of nested pit optimization shells within the selected final optimized pit to be used to create pit phases. From these pit shells, a starter pit phase and one transition pit phase are designed and used as guides during the detailed planning process to indicate the direction of mining. Detailed mine planning was undertaken using the MinePlan Schedule Optimizer ("MPSO") tool in the Hexagon™ MinePlan 3D software. Figure 16-1 shows a 3D view of the various pit phase designs that were used to undertake the detailed mine planning process. Yellow, green, and grey highlighted areas in Figure 16-1 are Phase 1, Phase 2, and the final phase, respectively.

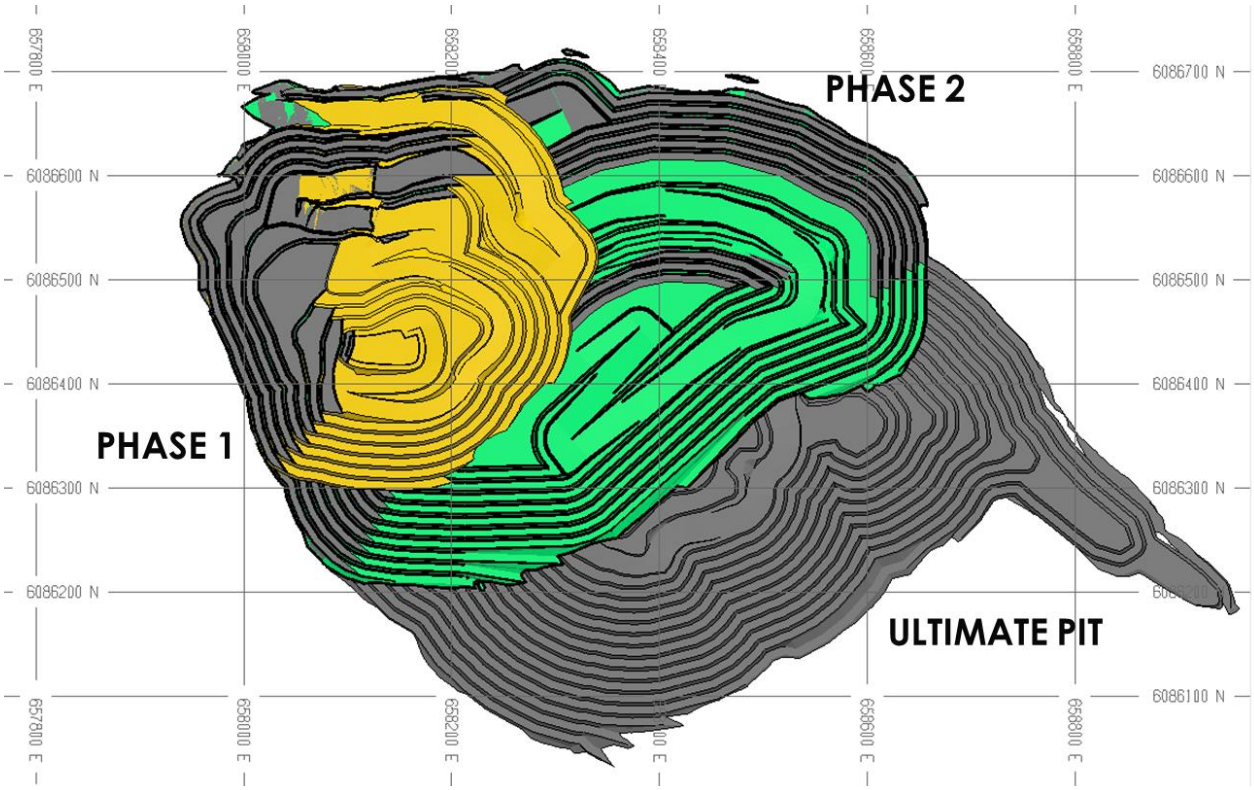


Figure 16-1: Mining phase design

The starter pit was designed to avoid excavation close to Joyce Lake during the pre-production and construction phases.

16.2.2 Scheduling Objectives and Blending

A mine production schedule was developed based on a fixed production target of 2.5 M dry tpa of iron ore lump and fines at an average grade of 60% to 62% Fe. The engineered pit phases were scheduled using Hexagon™ MineSight Schedule Optimizer. The mine plan has been developed in order to meet crushing feed requirements according to general best open pit mine practices such as equipment fleet smoothing and maximizing NPV.

16.2.3 Pre-production and Construction

Using the primary fleet, the pre-stripping of the Joyce Lake pit will occur over a period as follows:

- Year 0 (five months), a total of 5.7 Mt of overburden and waste rock is excavated and used for site construction purposes;
- Year 1 (three months), an additional pre-stripping of 3.1 Mt of overburden and waste rock is removed in order to provide access to sufficient ore material for beginning the production stage.

Due to Joyce Lake dewatering constraints, the pre-production phase is mainly carried out in the starter pit area. A buffer zone of 20 m should be left between the limits of the starter pit and Joyce Lake. In addition to the buffer zone, the excavation does not reach the Joyce Lake initial water elevation before the end of the pre-production phase. At this time, Joyce Lake is partialy dewatered and the water elevation is below the deepest pit bench. Figure 16-2 shows a plan view of the starter pit and final pit limits along with the Joyce Lake initial water surface.

The pit perimeter dewatering wells, located on the boundary of the pit are to be developed during the pre-production phase, as explained in Chapter 18.

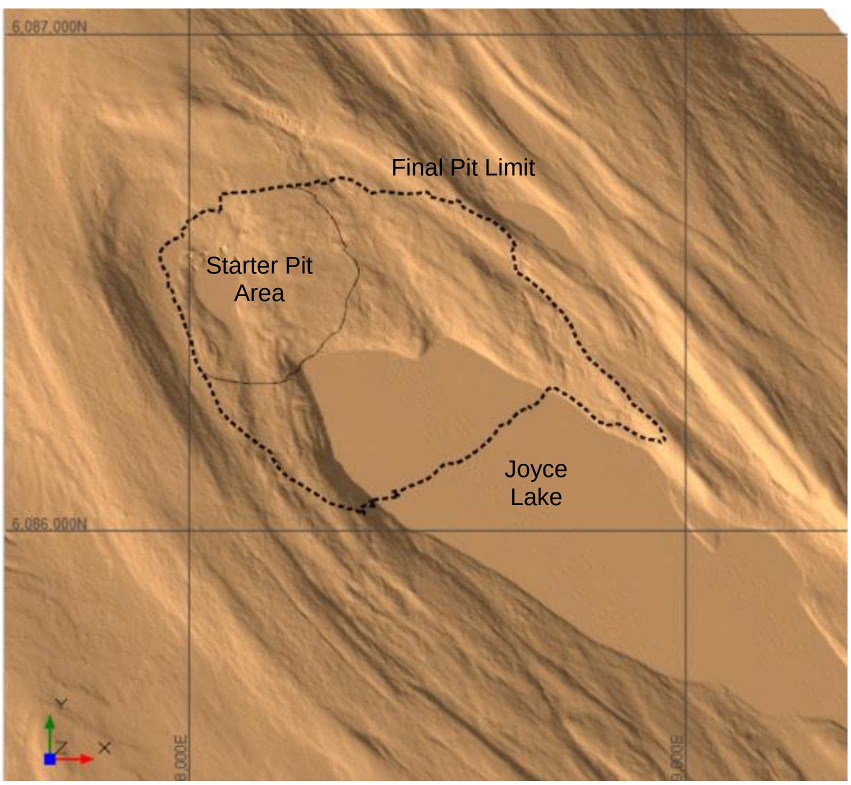


Figure 16-2: Joyce Lake vs. pit location

With the exception of a relatively small zone located under the deepest part of Joyce lake, the overburden thickness within the final pit limit varies from 0 m to 6 m, with an average of 2 m.

16.2.4 Production

Ore production will begin in April of Year 1, following the completion of the pre-stripping period. Ore will be supplied to the crushing plant at a rate of 2.5 Mt (dry basis) per annum. Mining will first occur in a small starter pit located at the North-West end of the deposit.

During production, the ore material above 55% Fe will be delivered to the high-grade ("HG") ore stockpiles near the crushing plant. The ore material between 52% Fe and 55% Fe will be delivered to the low-grade ("LG") ore stockpile and re-handled and processed at the end of the mine life.

As explained in Chapter 17, the current mine plan assumes that all ore material (HG and LG) will be re-handled from blending stockpiles, located adjacent to the crusher, by two front-end loaders to maintain a consistent feed grade.

Open pit production is expected to occur over a total of six years, with an additional two years of processing at the end of the mine life obtained from stockpiled low-grade material.

The total combined ROM ore and waste quantity is approximately 18 Mt in Year 1, and ramps up to a maximum annual production rate of approximately 21.6 Mt in Year 2. Mine production slowly decreases until the pit is depleted at the beginning of Year 6.

The open pit production schedule has been developed on a 3-month basis for the life-of-mine ("LOM"). A summary of open pit material movement over the LOM is presented in Table 16-1, Figure 16-3 and Figure 16-4. The end-of-period maps for the open pit over the LOM are shown from Figure 16-5 to Figure 16-6, while the progression of the pit elevation is shown in Table 16-2.

Mining occurs over 365 days, while crushing & screening occurs over an 8-month period.

16.2.5 Post-Mine Operation (Ore Stockpile Reclaim)

The mine will be depleted in the first quarter of Year 6. After the mine ceases operation, the HG ore material mined and stockpiled during the previous winter will be processed, for a total amount of 1.5 Mt. A portion of this material may have to be temporarily stockpiled onto the LG ore stockpile if the HG ore stockpile capacity is exceeded.

During the mine operation, a total of 3.6 Mt of LG ore (ore material between 52% Fe and 55% Fe) will be stockpiled onto the LG ore stockpile area, located near the ROM area. This material will be re-handled and processed after the HG ore stockpile is depleted.

Table 16-1: Joyce Lake mine plan summary

	Unit	Total LOM	Y0-1	Y0-2	Y0-3	Y0-4	Y1-1	Y1-2	Y1-3	Y1-4	Y2-1	Y2-2	Y2-3	Y2-4	Y3-1	Y3-2	Y3-3	Y3-4	Y4-1	Y4-2	Y4-3	Y4-4	Y5-1	Y5-2	Y5-3	Y5-4	Y6-1	Y6-2	Y6-3	Y6-4	Y7-1	Y7-2	Y7-3	Y7-4	Y8-1	Y8-2	Y8-3
# Months	-	-	0	0	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
# Days	-	-	0	0	61	92	90	91	92	92	90	91	92	92	90	91	92	92	90	91	92	92	90	91	92	92	90	91	92	92	90	91	92	92	90	91	92
HG ROM Mined	kt	13,807			4	114	293	448	841	600	234	704	938	625	95	842	1,025	844	175	478	915	625	500	438	938	1,102	1,029										
LG ROM Mined	kt	3,564			5	67	103	155	238	343	311	308	314	295	166	253	238	247	143	72	76	55	28	21	54	44	26										
Waste Rock Mined	kt	71,549			1,953	2,719	2,957	3,285	3,805	4,360	4,528	4,226	4,054	4,480	5,118	4,305	4,137	4,187	5,130	4,869	2,887	1,474	1,089	391	882	419	294										
Overburden Waste Mined	kt	2,310			805	242	186	139	146	115	388	174	94	0	21	0	0	0	0	0	0	0	0	0	0	0	0										
Total Material Mined	**kt**	**91,230**	**0**	**0**	**2,767**	**3,142**	**3,540**	**4,027**	**5,031**	**5,418**	**5,461**	**5,412**	**5,400**	**5,400**	**5,400**	**5,400**	**5,400**	**5,278**	**5,448**	**5,419**	**3,878**	**2,154**	**1,617**	**850**	**1,874**	**1,565**	**1,349**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ROM Stockpile to Crusher	kt	13,807			0	0	0	850	850	600	0	938	938	625	0	938	938	625	0	938	938	625	0	938	938	625	0	938	569								
LG Stockpile to Crusher	kt	3,564			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	368	623	0	938	938	698	0	0	
Total Material Processed	**kt**	**17,371**	**0**	**0**	**0**	**0**	**0**	**850**	**850**	**600**	**0**	**938**	**938**	**625**	**0**	**938**	**938**	**625**	**0**	**938**	**938**	**625**	**0**	**938**	**938**	**625**	**0**	**938**	**938**	**623**	**0**	**938**	**938**	**698**	**0**	**0**	**0**

Notes:

1. The high-grade ore material mined in Y6 Dec.-Mar. may be temporarily stockpiled in the low-grade ore stockpile disposal area if required.
2. Mine plan based on a dilution of 2.4% at 38.6% Fe and 41.4% SiO_2 and an ore loss of 2.4%.

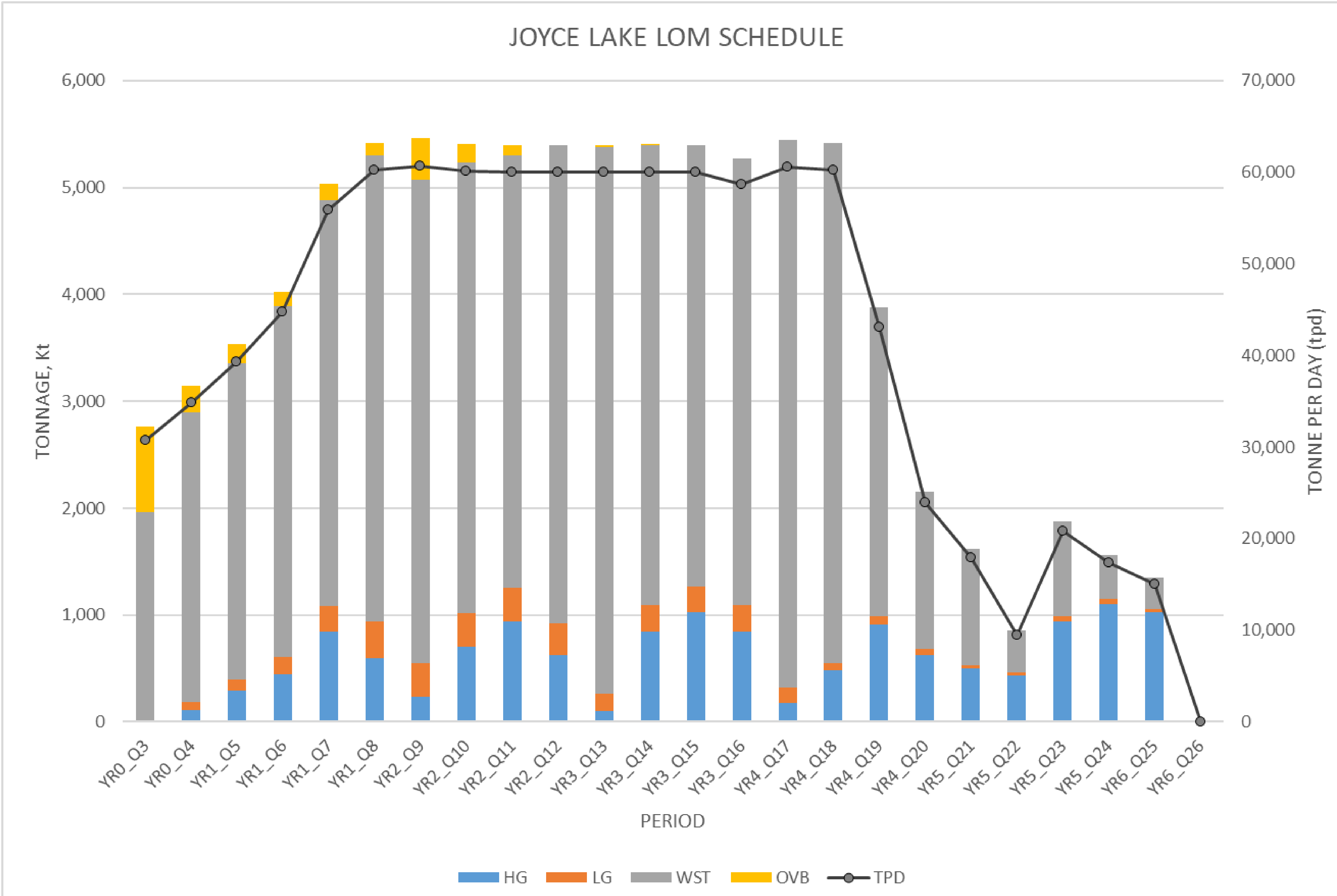


Figure 16-3: Material mined summary

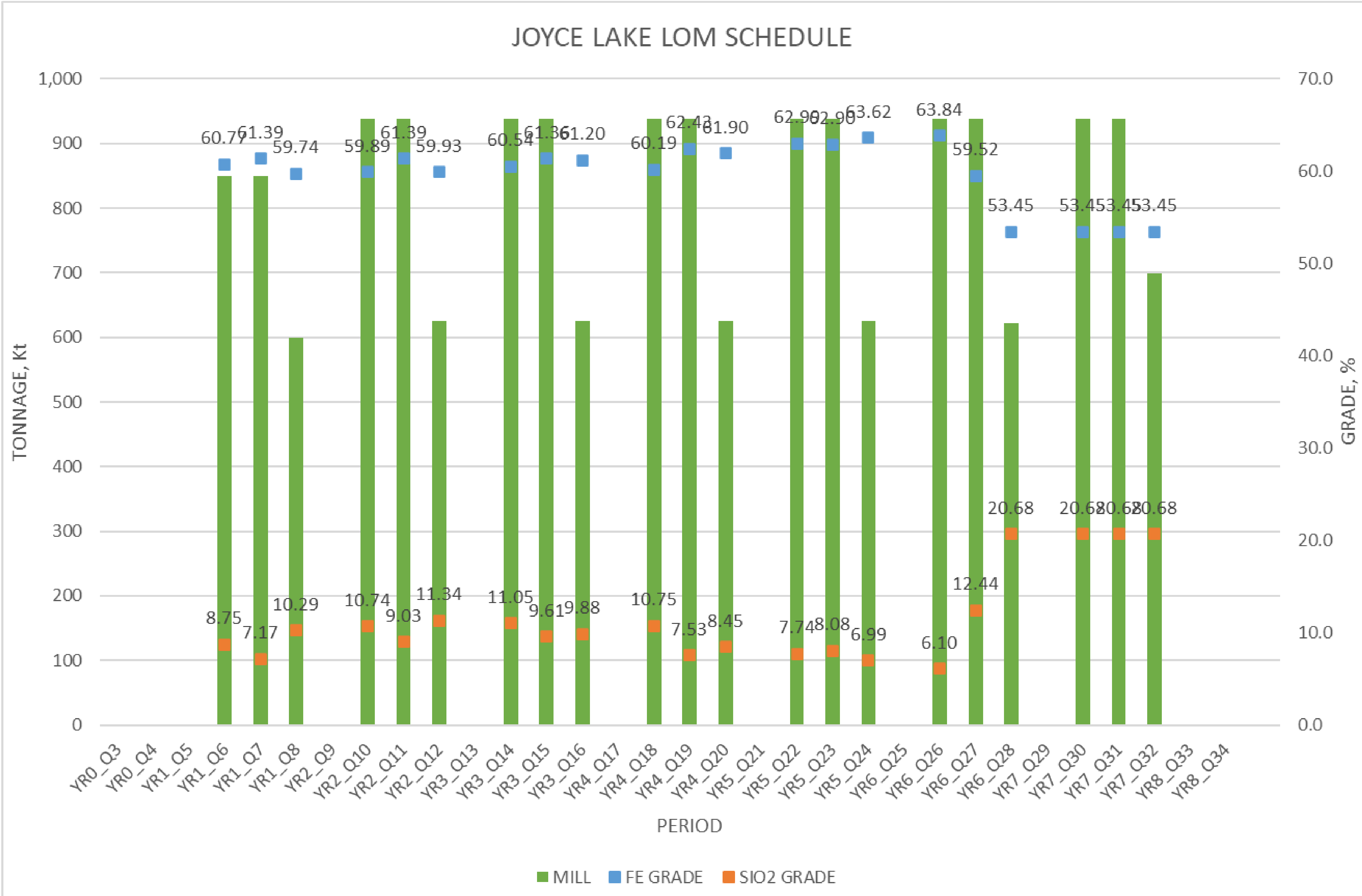


Figure 16-4: Crusher feed summary

Table 16-2: Pit elevation progression by year

	Year						
	Y0	Y1	Y2	Y3	Y4	Y5	Y6
Top Elevation of Bench							
Phase 1	549.5	519.5	483.5				
Phase 2	549.5	531.5	501.5	453.5	405.5		
Phase 3		531.5	507.5	489.5	441.5	387.5	345.5
Bottom Elevation of Bench							
Phase 1	507.5	477.5	429.5				
Phase 2	519.5	483.5	441.5	399.5	399.5		
Phase 3		501.5	465.5	429.5	375.5	339.5	309.5

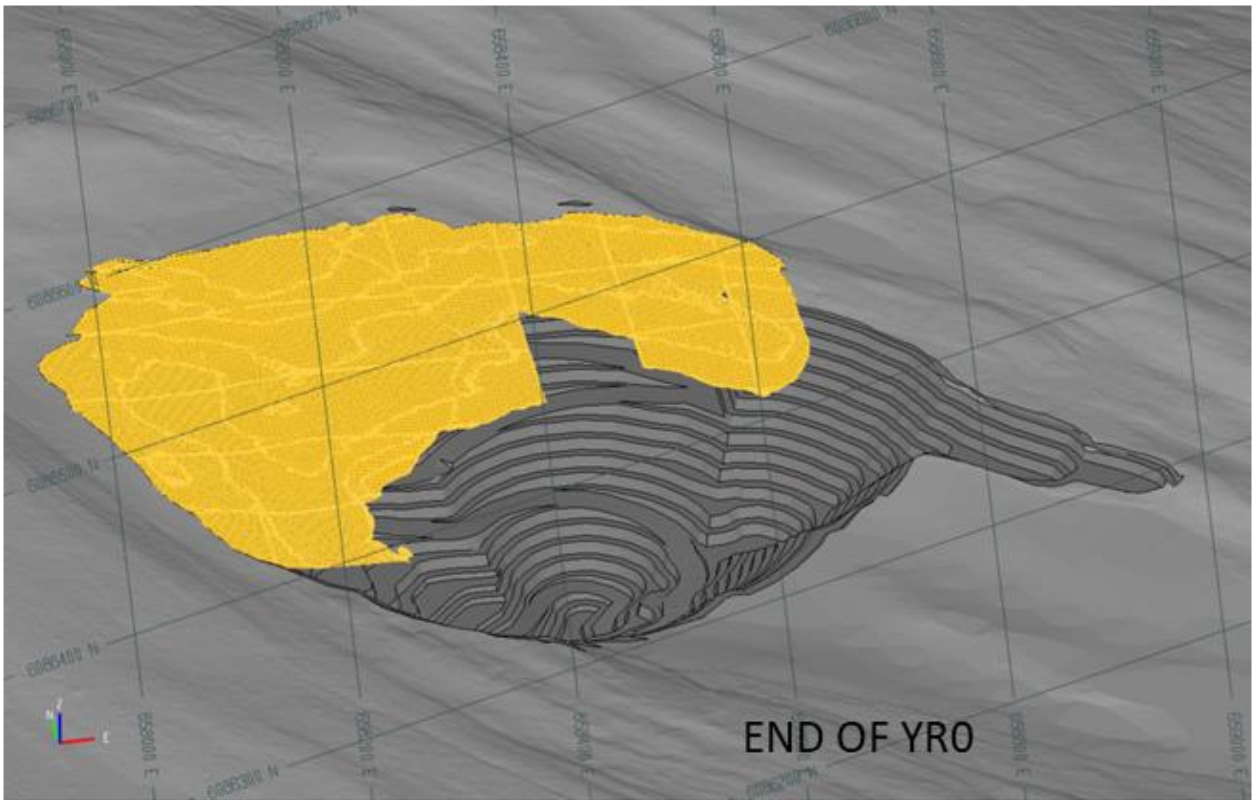


Figure 16-5: Mining area at the end of Y0 (pre-production phase)

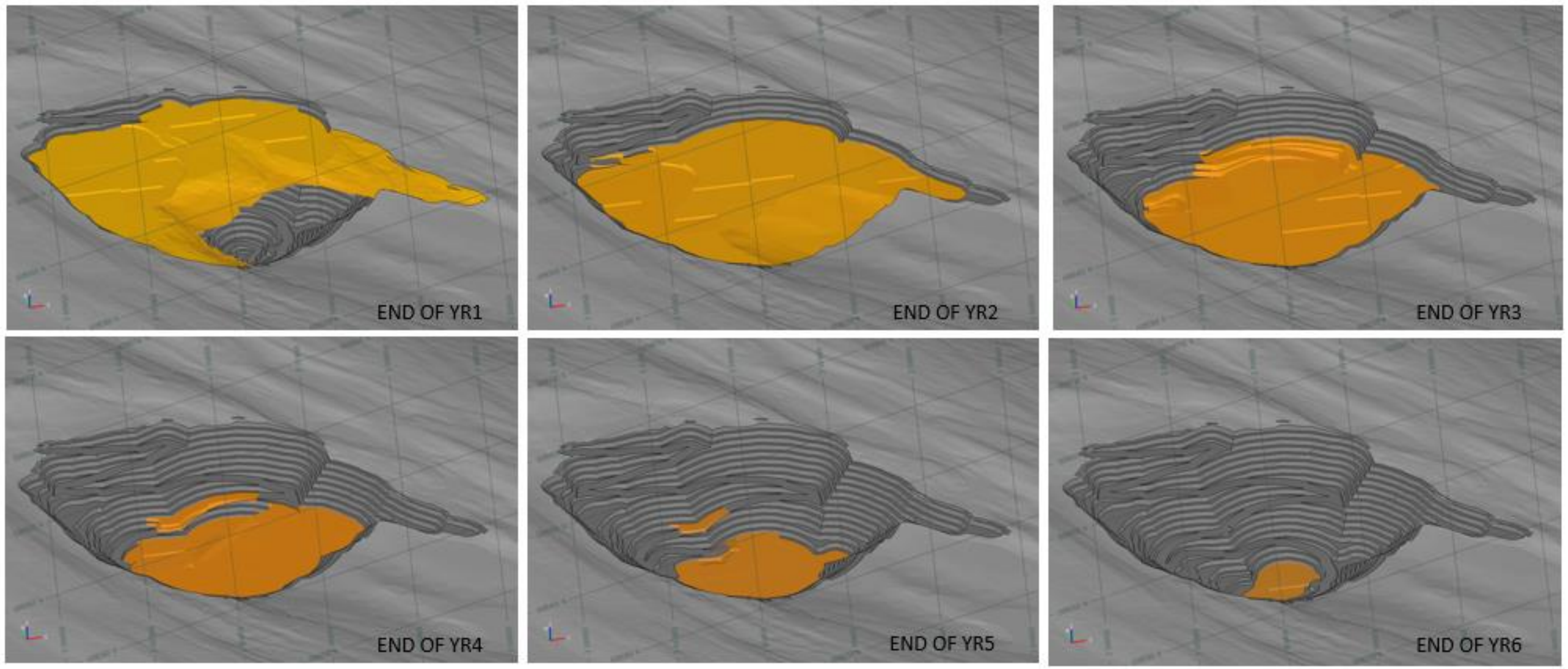


Figure 16-6: Mining area progression by year during production phase (Y1 – Y6)

16.3 Overburden, Waste Rock and Low-grade Ore Stockpile Design

Overburden and waste rock material from the Joyce Lake pit will be stored in the designated waste rock and overburden piles. The waste rock and overburden piles satisfy the required tonnages originating from the open pit, including the swell factors for each material type.

Geotechnical slope stability recommendations were provided by LVM in their report titled "Joyce Lake and Area DSO Project Geotechnical Engineering Feasibility Study – Open Pit Design" dated December 19, 2014 (LVM, 2014a). The overall slopes recommended by LVM for the different piles are summarized in Table 16-3.

When additional geotechnical data and analysis is available during the next phases of study, the overall slope angle for each disposal area should be reviewed and optimized.

Table 16-3: LVM's recommendations on overall slope angles

Disposal Area	Overall Slope Angle
Waste Rock Pile	2.5H:1V
Overburden Pile	3.0H:1V
Low-grade Ore Stockpile	2.5H:1V

LVM also recommended the placement of sub-horizontal drains, made of coarser material for drainage, to reduce the pore water pressure and ensure stability of the structures.

Based on the overall slope angles for each material, BBA proposed the pile design parameters presented in Table 16-4.

Table 16-4: Waste rock, overburden and low-grade ore piles design criteria

Overburden Disposal Area	Value	Unit
Overall Angle (from horizontal)	3.0H:1V	-
Ramp Width	26	m
Ramp Grade	10	%
Swell Factor	20	%
Waste Rock Disposal Area	**Value**	**Unit**
Bench Face Angle	34	deg
Overall Angle (from horizontal)	2.5H:1V	-
Bench Height	10	m
Ramp Width	26	m
Ramp Grade	10	%
Swell Factor	30	%
Low-grade Ore Stockpile Disposal Area Design Criteria	**Value**	**Unit**
Bench Face Angle	34	deg
Overall Angle (from horizontal)	2.5H:1V	-
Bench Height	10	m
Ramp Width	26	m
Ramp Grade	10	%
Swell Factor	30	%

A 3D view of the piles with respect to the open pit is shown in Figure 16-7. The final elevations of the piles, as well as the total capacity, can be found in Figure 16-8.

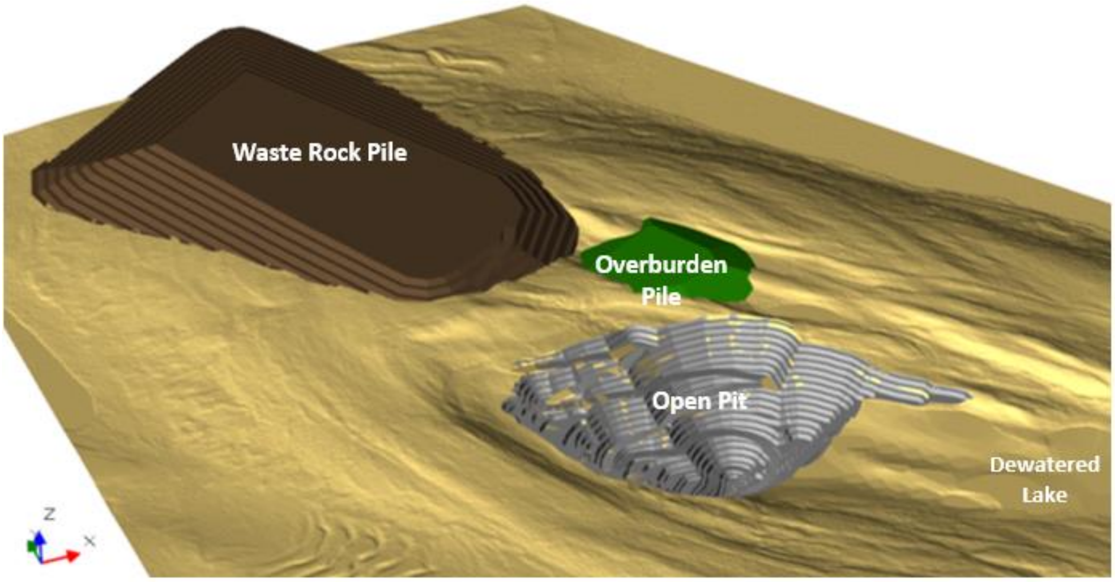


Figure 16-7: Isometric view of the waste rock and overburden piles

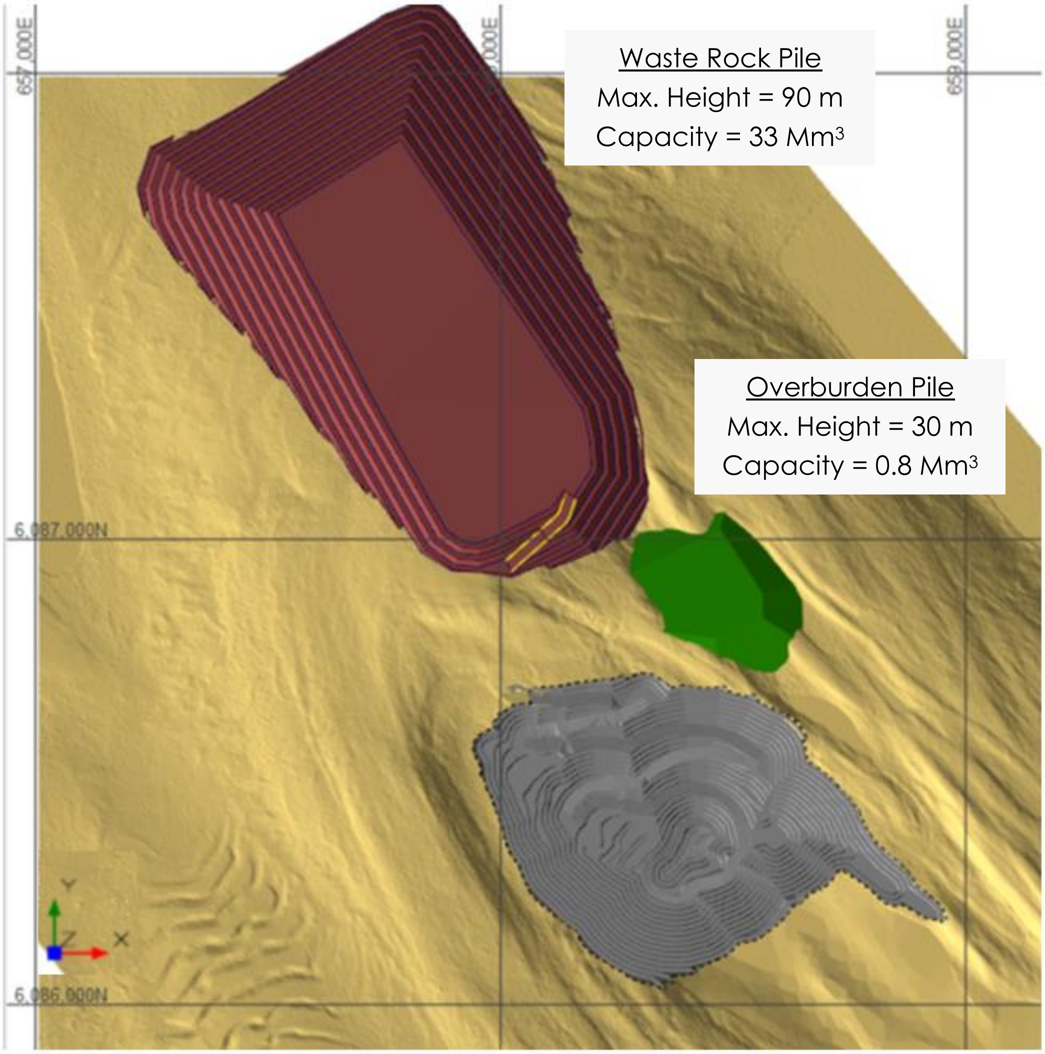


Figure 16-8: Plan view of the waste rock and overburden piles

16.4 Open Pit Mine Equipment and Operations

The Joyce Lake deposit will be mined using conventional open pit mining methods based on a truck/shovel operation. All mining equipment will be diesel-powered. Using the production schedule presented in Table 16-1, the mining fleet requirement was calculated. All equipment is assumed to be owned, operated, and maintained by the Client.

Open pit mine operations are based on 720 shifts per year, and correspond to operations running two 12-hour shifts per day, 7 days per week and 365 days per year. An assumption that ten operating days per year will be lost on average due to bad weather has been incorporated. The mining operations division will consist of the pit operations, maintenance, engineering and geology departments.

The selection of the primary fleet is based on the following parameters:

- Operating hours;
- Mechanical availability;
- Use of availability;
- Haulage distances;
- Cycle time;
- Truck speed; and
- Equipment productivity.

The primary mining fleet consists of the following:

- The primary loading equipment for overburden, waste rock, and ore consists of two diesel hydraulic shovels with a rated bucket capacity of 11 m^3. One 11.5 m^3 front-end loader will be used on an "as-needed" basis to complement the primary loading equipment fleet. The flexibility of the loader with its fast response time, justifies its use in replacing a shovel in loading support activities.
- The haul truck fleet is based on trucks with a 96-tonne payload, which is a good match with the 11 m^3 hydraulic shovels. The initial haul truck fleet consists of six trucks in the pre-production phase and will increase to 13 trucks at the end of Year 2.
- Production drilling will be accomplished using a fleet of two diesel-powered DTH blast hole rigs drilling 200 mm diameter holes.

16.4.1 Operating Time Assumptions

The productive operating time available per shift has been calculated for primary mining equipment and separately for the drills to consider the additional scheduled delays typically associated with the drills, such as additional time required for moving between drill patterns and spotting time between blast holes.

Scheduled delays for the primary equipment and drills considered operator lunch breaks, inspection and fueling, shift changes, and coffee breaks. Unscheduled delays are delays that cannot be predicted or planned, such as traffic delays, blasting, cleaning, etc. These factors were estimated based on similar operations. Table 16-5 provides details about how the net operating hours are derived from scheduled delays and unscheduled delays.

Table 16-5: Estimation of annual production hours

	Unit	Drill	Load	Haul
Calendar Days	day	365	365	365
Calendar Hours	hour	24	24	24
Calendar Time	hour	8,760	8,760	8,760
Scheduled Time	hour	8,760	8,760	8,760
Average MA%	-	87%	87%	87%
Down Time	hour	1,139	1,139	1,139
Available Time	hour	7,621	7,621	7,621
Operating Standby & No Scheduled Production	hour	240	240	240
Utilized Time	hour	7,381	7,381	7,381
Operating Delay	hour	974	974	974
Production Time	hour	6,407	6,407	6,407
Performance Loss	hour	1,230	1,230	615
Net Production Time	hour	5,177	5,177	5,792

16.4.2 Drilling and Blasting

The drill and blast design for the Study was determined by BBA, in collaboration with explosives suppliers familiar with this type of operation.

The ore zones will be drilled using 200 mm diameter holes on a drilling pattern of 6.2 m spacing x 5.4 m burden. Waste rock areas will use the same hole diameter, but a slightly larger drilling pattern of 6.9 m x 6.0 m.

Blast holes will be drilled to a total depth of 13.5 m, including 1.5 m of sub-drilling for a 12 m bench height. A stemming height of 3.9 m to 4.2 m will be used to maximize the effectiveness of the explosives column.

For estimation purposes, it was assumed that a percentage of the ore patterns will be drilled and blasted on 2 m x 6 m flitches, to account for minimizing mining dilution and losses.

Based on the production schedule, up to two drills will be required.

Blasting will be executed under contract with an explosives supplier that will supply the blasting materials and technology, as well as the equipment to store and deliver the explosives products. The explosives ingredients will be delivered to the mine site by the explosives supplier in containers.

An explosive bulk depot/transfer facility is planned for the project. The bulk depot facility will include several 25-t iso-containers (for the emulsion component), a garage/wash-bay for one MMU (mobile manufacturing unit), and containers for mixing gasser products, water evaporator for contaminated water treatment, supplies, etc. The depot should provide nine days of coverage, to accommodate the one freight train a week to Schefferville.

Blasting will be conducted using an emulsion type product. For estimating purposes, an emulsion blend type explosive (70/30 emulsion blend) with an estimated average density of 1.1 kg/m^3 was used in the calculations. An emulsion blend was selected for its water resistance and to optimize the fragmentation of ore material.

It is assumed that pre-split will be required for final walls. Pre-split holes will be drilled with a 3-inch diameter to a total depth of 12 m, using a spacing of 1.1 m. The pre-split holes will be loaded with a packaged detonator-sensitive emulsion explosive.

A summary of the drill and blast specifications can be found in Table 16-6.

Table 16-6: Drill and blast specifications

Parameter	Unit	Rock - Ore	Rock - Waste
Hole Diameter	mm	200	200
Bench Height	m	12	12
Bank Density	t/m^3	3.5	2.9
Burden	m	5.4	6.0
Spacing	m	6.2	6.9
Drillhole Length	m	13.5	13.5
Rock Mass per Hole	t/hole	1,407	1,441
Drilling Rate (overall)	m/h	25	27
Explosive density	g/cm^3	1.1	1.1
Stemming Length	m	3.9	4.2
Blasthole Length	m	13.5	13.5
Explosive Length	m	9.6	9.3
Explosive Weight	kg/hole	332.8	319.1
Powder Factor	kg/t	0.24	0.22

For the purposes of estimating the requirements it has been assumed that the overburden material will be free digging.

For blasting in rock, double priming of the blastholes has been accounted for since the explosive length is greater than 6 m.

It is estimated that, during production, approximately 1.4 M kg to 4.9 M kg of emulsion explosive product would be required for blasting every year. Assuming a working period of 365 days per year, the blasting operations will require on average 10,000 kg per day, with a peak of 13,500 kg of explosives per day, and a blast would occur every two days.

The drilling and blasting plan will be optimized during further studies.

16.4.3 Loading and Hauling

A backhoe type hydraulic excavator was envisioned for the production loading. A 11-m^3 bucket capacity was assumed when estimating the loading fleet requirements. A front-end loader type of excavator was envisioned for the Project for stockpiling handling and back-up loading. A 11.5-m^3 bucket capacity was assumed when estimating the loading fleet requirements.

Loading fleet numbers have been estimated on first principles based on the operating hours required to achieve the production schedule, calculated by cycle times, and estimates of the equipment's rated capacities and productivities. The loading unit productivity assumptions are listed in Table 16-7.

Table 16-7: Loading productivity calculations

Description	Unit	Overburden	Rock	Rock
Material Type	-	Waste	Ore	Waste
Excavator Type	-	FEL	Backhoe	Backhoe
Bucket Capacity	m^3	11.5	11	11
Bucket Fill Factor	%	90	80	95
Dry Density	t/bcm	2.10	3.50	2.90
Moisture	%	6	6	6
Swell Factor	%	40	40	40
Tonnes/Pass	wt	16.5	23.4	23.0
Haul Truck	-	Rigid Frame	Rigid Frame	Rigid Frame
	wt	96.9	96.9	96.9
Passes	#	6.0	5.0	5.0
First Bucket Cycle Time	sec	40	35	35
Subsequent Bucket Cycle Time	sec	40	35	35
Truck Spot Time	sec	45	45	45
Total Load Time	sec	285	220	220
Productivity				
Maximum Theoretical	dry t/h	1,151	1,490	1,490
Truck Availability to Shovel	%	90	90	90
Production Adjusted	dry t/h	1,036	1,341	1,341

A single type of haul truck was envisioned for the Project. A 96-t rigid frame haul truck was selected, example model includes CAT777 or HD785. Haul truck fleet numbers have been estimated on first principles based on the operating hours required to achieve the production schedule, calculated cycle times, and estimates of the equipment's rated capacities and productivities. A limited number of typical haul profiles specific to the detailed pit design were estimated.

Average annual haul profiles were created for HG ore, LG ore, waste rock, and overburden. In the MineSight software, haul routes were traced according to mining centroids for the various cuts on every bench (and material) for each 3-month period. Subsequently, with these centroid distances and the respective tonnage per cut (per material) mined, the weighted and averaged distances were calculated on a 3-month basis.

In order to optimize the waste haul cycle times, dumping has been carried out in phases to allocate shorter hauls during earlier periods of the LOM. Centroid and up-ramp distances were traced for both the waste pile locations and crusher location.

For each material type, the calculated cycle times were calculated based upon round-trip haulage profiles, the haul truck speeds, and on load/spot/dump times determined for each material. A graph showing the trend of cycle time over the LOM for each material type is shown in Figure 16-9.

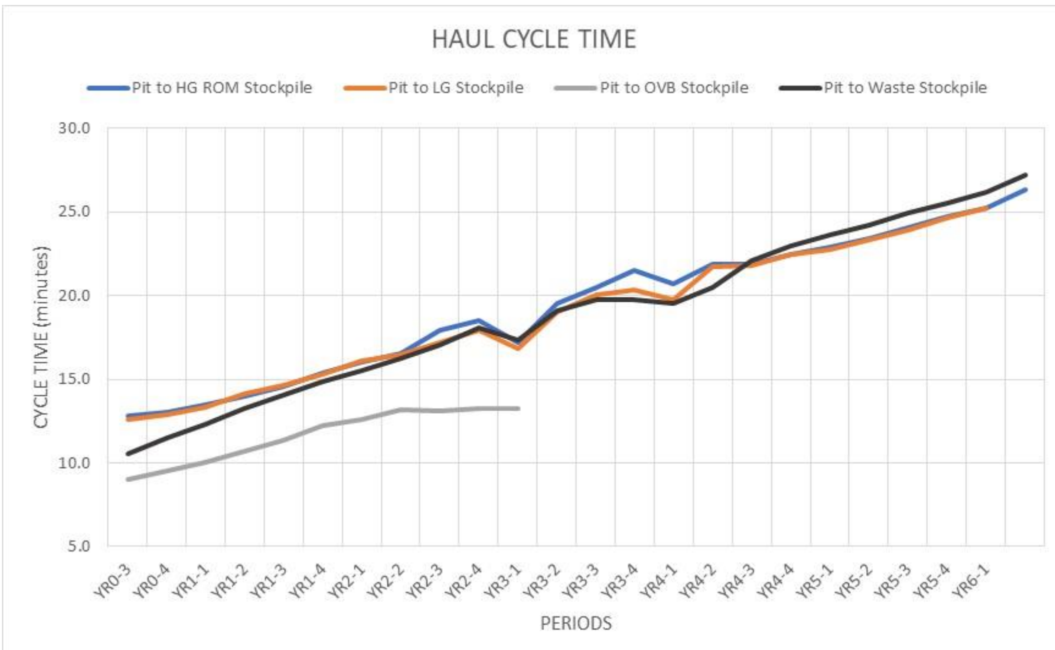


Figure 16-9: Cycle time trends on a 3-month period basis

16.4.4 Equipment Annual Fleet Requirements

The primary mining fleet was selected based on the scale of this mining operation, optimization fleet size utilization and matching of equipment, efficiency, and reliability. At the peak point in the mine life, primary equipment requirements will consist of:

- Thirteen 96-tonne diesel haul trucks;
- Two 11 m^3 diesel-hydraulic excavators;
- One 11.5 m^3 front end loader; and
- Two 200 mm DTH blast hole drills.

To complement the primary mining equipment fleet, a list of auxiliary and support equipment was developed by BBA's historical experience in similar open pit mining operations. The requirements for auxiliary support equipment were primarily based on the scale of the operation, the size and number of active waste rock piles and length of haul roads to be maintained.

Table 16-8 shows the mine equipment fleet requirements to support the mining operation in the peak years.

Table 16-8: Mine equipment list (peak years)

Equipment	Peak
Production Fleet	**Quantity**
Trucks (96 tonnes)	13
Hydraulic Excavator (11 m^3)	2
DTH drill (200 mm)	2
Support Fleet	
Wheel Loader (11.5 m^3)	1
Grader (14')	1
Track Dozer (equiv. CAT D8T)	1
Wheel Dozer	1
Auxiliary Fleet	
Water Truck / CAT740 (30 k L)	1
Fuel/Lube Truck	1
Service Truck	1
Utility Excavator	2
Utility Loader	1
Skid Steer	1
Float Truck	1
Pick-up Truck (Crew Cab)	7
Crew Bus	1
Lighting tower 4 post of 1,000 w. / Diesel Generator	4
Dewatering Pump +Booster 75 hp 500 pi Head (on skid)	3
Tire Changer (Lift Truck with TM10 Attachment)	1
Total Mining Equipment	**45**

Low-grade Ore Stockpile Re-handling

The LG ore stockpile will be situated near the ROM area. The material will be re-handled and processed at the end of the mine life. The LG ore will be loaded with a front-end loader and trammed to the crusher.

16.4.5 In-Pit Mine Dewatering

The in-pit mine dewatering pumps have been selected based on the in-pit water flow estimate in the hydrogeological report. The in-pit mine dewatering will be performed using three 75 hp dewatering pumps, including one back up unit. As the mining operation goes deeper into the pit, booster pumps will also be added to reach the required 200 m head.

Given that the pit is located within the limits of a natural lake, the mine dewatering aspect must be carefully assessed. BBA considered that two people will be assigned to mine dewatering activities and a provision for outsourced consulting was put on the estimate.

16.4.6 Mine Services

The mine services include all ancillary activities related to the operation of the pit, including outsourced consulting (geotechnical and dewatering), specialized mining software and aggregate requirements.

Due to the relatively short mine life and the limited mine equipment, no mine fleet monitoring system was envisaged.

16.4.7 Open Pit Mine Personnel Requirements

The personnel requirement for the open pit mine includes all of the hourly staff working in open pit operations that are required for the operation and maintenance of the equipment involved with or supporting mining activities, as well as the salaried engineering, geology and supervisory staff.

The maximum number of salaried employees is 27. The mine salaried staff requirements over the life of the mine are presented in Table 16-9.

The number of hourly personnel reaches a peak of 124 in Year 3. A complete list of the hourly personnel requirements is listed in Table 16-10.

The number of operators required for the major mining equipment (haul trucks, shovels, and drills) was determined according to the number of operating units and number of rotations during which the equipment is in operation. Most of the operators for the major mine equipment are based on a four-crew rotation. Hourly maintenance employee requirements were determined based on the number of equipment to maintain.

Table 16-9: Mine salaried personnel requirement

Job Title	Employees
Mine Superintendent	1
Mine Shift Foreman	4
Training Coordinator	2
Production / Maintenance / Mine Clerk	2
Maintenance	
Maintenance Superintendent	1
Maintenance Planner	1
Mine Maintenance Foreman	4
Engineering	
Chief Engineer	1
Mine Planning Engineer	2
Mine Surveyor	2
Geology	
Geologist	2
Total Salaried Staff	**22**

Table 16-10: Mine hourly personnel requirement

Year-Quarter	Y0-3	Y0-4	Y1-1	Y1-2	Y1-3	Y1-4	Y2-1	Y2-2	Y2-3	Y2-4	Y3-1	Y3-2	Y3-3	Y3-4	Y4-1	Y4-2	Y4-3	Y4-4	Y5-1	Y5-2	Y5-3	Y5-4	Y6-1
Mine Operations	**68**	**64**	**68**	**72**	**78**	**82**	**88**	**88**	**90**	**94**	**90**	**94**	**94**	**94**	**94**	**94**	**88**	**62**	**54**	**40**	**58**	**52**	**52**
Drill Operators	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4	4	4	4	4	4
Blaster	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Blast Crew	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Hydraulic Excavator Operator	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4	4	4	4	4	4
Loader Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0
Haul Truck Operator	23	19	23	27	34	38	42	42	45	49	45	49	49	49	49	49	42	23	19	12	23	19	19
Dozer Operator	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4	8	8	8
Grader Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Other Auxiliary Equipment Operator	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	2	3	3	0	3	3	3
General Labour	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Utility Labour	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2
Maintenance	**24**	**24**	**24**	**24**	**26**	**28**	**28**	**28**	**28**	**28**	**28**	**30**	**30**	**30**	**30**	**28**	**26**	**18**	**18**	**18**	**18**	**18**	**18**
Mechanics	6	6	6	6	8	10	10	10	10	10	10	12	12	12	12	10	8	6	6	6	6	6	6
Welder/Machinist	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2
Electrician	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
Apprentice	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Lube/Fuel Truck Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2
Tool Crib Attendant	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
Janitor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Tire Technician	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

17. Recovery Methods

The Joyce Lake DSO Project is based on simple dry crushing and screening of high-grade ore, as confirmed by a trade-off study ("TOS") described later in this chapter. The design basis for the dry crushing and screening plant was developed for a maximum plant throughput capacity of 3.0 Mtpa and was used to develop the process design criteria and the process flowsheet as well as the preliminary selection and sizing of major mechanical equipment. The mining operation delivers run-of-mine ("ROM") ore, at a nominal 6% moisture content, to the stockpile area ahead of the dry-processing plant. Dry processing begins with the front-end loader reclaim of ROM ore to feed the crushing circuit. Following dry crushing and screening, a lump product and a fine product are generated and directed into their respective stockpiles. Prior to stockpiling, crushed lump material is dried to 2% moisture using a rotary dryer. Dried lump is then placed into stockpiles using a radial stacker. The crushing, screen, and drying process is considered to end when a front-end loader loads the individual products into haul trucks.

The crushing and screening circuit design criteria for this feasibility study were first developed by BBA using simulation software with input test work results, as described in Chapter 13 of this Report. As part of the request for budgetary proposals, vendors performed their own analysis and proposed equipment and arrangements to meet targeted throughput with ore characteristics provided from the Client's test work.

BBA has recommended that further targeted test work be performed prior to final design, to confirm the selected crushing circuit design, as well the iron grade content of lump and fines products, over a range of ROM iron content process feed grades.

The selected flowsheet of direct shipping has several environmental advantages over wet processing. First and most obviously since the material is liberated at a coarse liberation size thus energy and water usage are minimal in the production of a saleable product. In wet processing a concentrate is typically produced with a grind size ranging between 1mm down to 20 microns, both of which would require additional energy and grinding media consumption to achieve. A second benefit is that there is no waste (tailings) created in the processing stages as all material crushed will be destined for shipment and use in steelmaking. Finally, creating lump and fines product requires less downstream treatment than a typical concentrate which would need to be pelletized. Although fines product still requires sintering before being used in blast furnaces, lump product does not require any sintering and can be directly fed to blast furnaces thus making it a more desirable product for steelmakers as well as being a more environmentally friendly product. For this reason, it will be important to optimise the crushing circuit to favorize the production of lump material.

17.1 Process Flowsheet Development

The flowsheet selected for the Joyce Lake DSO Project consists of a dry crushing and screening process to treat ROM high-grade ("HG") ore having an average grade of about 62% Fe at a 55% Fe deposit cut-off grade ("COG") and stockpiled low-grade ("LG") material included within the mineral reserves, grading between 52% and 55% Fe, which will be processed after the end of the mining operations. ROM ore is assumed to contain a nominal moisture content of 6%.

The dry processing plant produces two products classified by particle size: a lump and a fines product. All the mined ore is converted into saleable product with no generation of process rejects.

The nominal COG for the Joyce Lake deposit HG material, as derived from the mineral reserve calculation that includes mining dilution and recovery presented in Chapter 15 of this Report, was set at 55% Fe in order to provide a feed to the dry processing plant averaging about 62% Fe (excluding LG stockpiles processed towards the end of mine life). The 62% Fe iron grade corresponds to the benchmark grade where no Fe premium or penalty applies.

It was also considered that during dry processing, the lump product is expected to become slightly upgraded in iron content as finer silica should report to the fines product. The LG material, grading between 52% and 55% Fe will attract significant penalties for silica grade. Product penalties are shown in Chapter 22 of this Report. Annual product produced and sold was determined consistent with the annual open pit ROM ore release plan.

A 2014 trade-off study ("TOS") (BBA Inc., 2014b) was performed to determine if incorporation of a wet processing plant, to upgrade material having Fe grade between 50% and 55% Fe, would enhance the financial performance of the Project. This TOS is discussed in detail in a report titled "Dry versus Wet Processing", dated September 19, 2014 and summarized below.

In the wet processing plant scenario studied, the aforementioned dry plant continues to process the higher-grade ore (grade at and above 55% Fe) but is complemented by a wet plant that would process lower-grade ore between 50-55% Fe. Test work suggests that material lower than 50% Fe is difficult to concentrate and was, therefore, not considered for potential upgrading. The lump and fines produced by the wet plant are proportionally blended with the lump and fines produced by the dry plant to minimize both product variability and selling price penalties. The 2014 TOS assumed that the open-pit mining operation would be able to release 62% Fe material for dry processing and the lower-grade material for wet processing at the average proportion of the deposit. Furthermore, annual production of saleable product for both dry processing only and for dry/wet processing cases was kept at 2 Mtpa (note the TOS was performed at 2.0 Mtpa, while the Feasibility Study is based on 2.5 Mtpa).

The design of the wet plant was based on the following assumptions. Some of these assumptions were not supported by sufficient test work and would thus require significantly more test work for confirmation.

- The mine life was extended by the additional low-grade material processed in the wet plant;
- An overall iron recovery of 75% is achieved in wet processing;
- Wet scrubbing and screening is sufficient to produce a lump product (-31.5/+6 mm) grading 57% Fe from low-grade material;
- The fines from the wet process, grading 60% Fe, consist of two distinct products: a primary fines product (-6.3/+1 mm) obtained following wet scrubbing and screening and a concentrate product resulting from wet high intensity magnetic separation ("WHIMS") and de-sliming using screens and cyclones; and
- Final product combined (i.e., wet and dry) lump and fines grades of 61.7% Fe and 60.4% Fe respectively.

The TOS concluded that, despite the longer mine life and increase in saleable product resulting from the addition of a wet processing plant to the base case, the combination of higher operating costs, lower annual revenues resulting from a lower average product selling price due to increased penalties, and substantially higher capital costs required to build the wet plant, make it such that this scenario would not improve the financial performance of the Project and should not be pursued further. In effect, the Joyce Lake deposit does not contain enough material in the 50-55% Fe range to justify the addition of a wet processing plant.

Therefore, this FS pursued a simple dry processing flowsheet. Furthermore, material between 52% Fe and 55% Fe will be stockpiled in low-grade stockpiles for processing through the dry plant at the end of the mine life. Additionally, waste material grading between 50% and 52% Fe will also be segregated from other waste and stockpiled for the possibility of future processing, should market conditions favour such an initiative.

There exist dry, low intensive processing routes that can be further investigated to enrich low-grade (52-55% Fe) and below COG (<52% Fe) material. Reducing deleterious elements before shipping could open new markets previously not suitable for the low-grade material. There would also be a reduction in the amount of overall material that needs to be hauled, railed and shipped, thus reducing the carbon impact. The QP recommends that an ore sorting test work program be developed and executed during operations targeting low and below COG material. The low-grade lump product created in the crushing circuit is within an ideal range for typical ore sorting applications. This technology would not be suitable for upgrading the high-grade material as the differences between mineralogy are less prevalent than the contrast in lower-grade material.

Material produced during the first years of operation could be passed through an on-site test unit in order to assess the potential for upgrading low-grade material.

17.2 Process Description

The Joyce Lake DSO flowsheet consists of a two-stage dry crushing and screening process to produce "lump" and "fines" products. The process flowsheet is illustrated in Figure 17-1. A two-stage crushing circuit is required to produce material at the target size of 100% passing 31.5 mm.

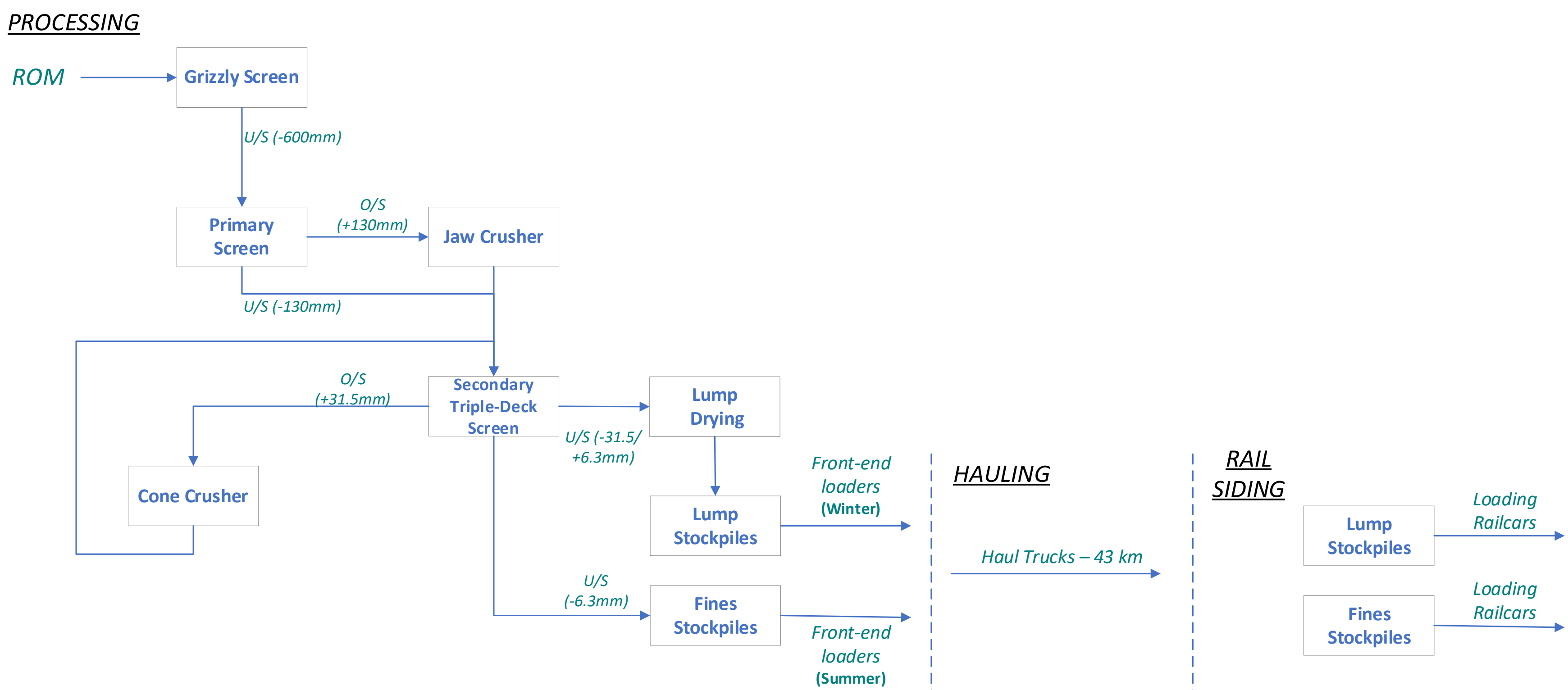


Figure 17-1: Block flow diagram for Joyce Lake dry processing, hauling and rail loading

Following a request for budgetary proposals from various equipment vendors, several options were considered including mobile and semi-mobile plants, as well as both one-line and two-line configurations. The configuration selected for this FS is based on a two-line mobile plant with each line designed to process 50% of the total process throughput, equivalent to 350 t/h. The two half-lines mobile plant design was retained for reasons of cost, flexibility and reliability; including the possibility of using the two lines at separate locations during Project construction, if necessary.

The crushing and screening design is based on CAT 777 (or equivalent) trucks delivering ore from the open pit mine to the ROM ore stockpile area ahead of the plant. Sufficient stockpiling space is provided to allow for segregating ore to allow for blending feed materials ahead of the crushing plant to minimize product grade variability. A dedicated front-end loader of 16 t capacity is used for maintaining the ROM stockpile and for feeding the plant.

The front-end loader transfers material from the ROM stockpile to a feed hopper fitted with a static grizzly screen to scalp off any oversized material (+600 mm). No rock breaker is provided as the +600 mm material will be rejected to a stockpile to be processed later. Once enough material has accumulated, a contractor will be used to break the oversize rocks for processing. The material passing the static grizzly is directed onto a vibrating grizzly feeder that serves to separate material at 130 mm prior to the primary crushing stage. The oversize material (+130 mm) is fed to a jaw crusher where it will be crushed to a top size of 225 mm. The undersize material from the static grizzly joins the jaw crusher product and the materials are combined on a common collecting conveyor. This blended material is conveyed to a triple-deck horizontal screen that separates the material into three products:

- The oversize +31.5 mm material is conveyed from the top screen deck to a cone crusher for further size reduction to a targeted top size of 32 mm;
- Lump product (-31.5/+6.3 mm); and
- Fines product (-6.3 mm).

The material discharged from the cone crusher is returned to the triple-deck screen. The cone crusher is, therefore, in closed loop with this screen, thus ensuring that no material coarser than 31.5 mm is sent with the final lump product. While a double-deck screen would normally suffice to separate the material into oversize, lump and fines products, a third deck was added to relieve the load on the 6 mm screen. This was done to alleviate excessive bed depth issues and inefficient screening that might be encountered in separating the fines and lump products. Each of the two final lump and fines products are discharged via a chute onto its respective collecting conveyor. Fines material is placed into stockpiles; lump material is fed to a rotary dryer prior which discharges onto a radial stacker, placing the dried lump into stockpiles. The fines product stockpile has a design capacity to hold 16 hours of material to allow for scheduled plant maintenance shutdowns. The lump stockpiles will reach a maximum capacity of nearly 900,000 t, representing the full year production of lump material. The stockpile will be tarped progressively throughout the year to avoid re-wetting. The pad will also be designed with drainage to avoid any pooling of rainwater. A dedicated front-end loader of 16 t capacity is used to load product from the product stockpiles into product haul trucks that deliver product to the astray load-out and rail loading area. Fines will be collected during the 214-day summer season, and the lump during the winter season.

The plant design also provides adequate room on the crushing and screening pad for emergency stockpiles for both the lump and fines products, should the need arise. The front-end loader used for product haul truck loading would also be used for emergency product stockpile management.

Operations are expected to last over a period of 214 days of the year, roughly from April through November. However, there remains a possibility that, due to inclement weather, the shipping season may be reduced to 200 days. Although annual product production and sales have been determined based on the annual mine plan of 2.5 Mtpa of ore tonnes, the plant design has been based on an annual maximum production of 3.0 Mtpa of product. This would allow for the crushing and screening plant to increase the processing rate if the previous winter was longer or had harsher conditions. For this Feasibility Study, it is considered that processing battery limits start at the ROM ore stockpile and ends with the product loaded into the product haul trucks.

17.3 Plant Feed Assumptions

The sizing of the dry crushing and screening plant for the 3.0 Mtpa capacity is highly dependent on the ROM particle size distribution being delivered to the plant from the mine. The proportion of lump and fines products can vary significantly with ore blasting practice in the harder ore areas of the mine, and the less competent ore areas of the mine.

In carrying out its crushing and grinding simulations, BBA assumed a relatively coarse ROM feed size to the plant to ensure sufficient processing capacity during extended periods of harder ore processing. The proposed ROM PSD (particle size distribution) to be used for design is provided in Table 17-1 and illustrated in Figure 17-2.

Table 17-1: Proposed ROM particle size distribution

Screen size (mm)	Cumulative Passing (%)
600	100
256	60
128	36
64	22
50	18.5
32	14
16	8
8	5
4	3
2	2
1	1

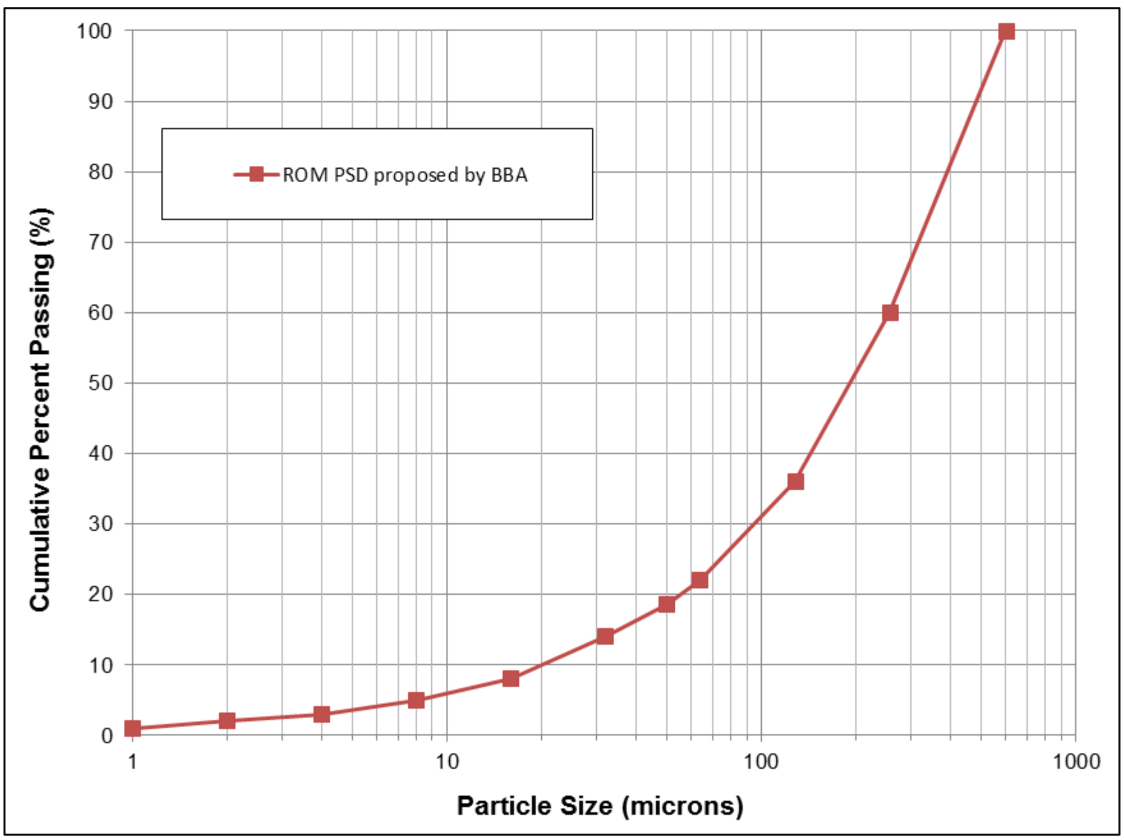


Figure 17-2: Proposed ROM PSD

The crushing circuit was sized based on 100% processing of harder ores using ore hardness data from the test work. It is understood that, during periods of mining in areas of the deposit where the ore is highly fractured, a significant amount of ore will likely bypass the jaw crusher.

17.4 Product Specifications

Two products are generated from the dry processing flowsheet: lump (-31.5/+6.3 mm) and fines (-6.3 mm). Lump product commands a premium price compared to fines and, because it does not require pelletizing or sintering before being charged to a blast furnace, has a more positive impact in terms of environmental impact compared to fines. The crushing circuit will thus be designed such that production of lump is maximized. There is also a price penalty if the fines product contains over 15% of sub 100 µm material. As such, the crushing circuit design seeks to limit the over-generation of very fine material in the fines product and, in addition, aims to preferably produce as many lumps as possible. The particle size of the fine and lump products as determined via simulation are presented in the following Table 17-2.

Table 17-2: Simulated lump and fines particle size distribution

Screen size (µm)	Cumulative Passing (%)	
	Lump	Fines
31,500	100	100
25,400	93.5	100
19,050	75.8	100
12,700	40.3	100
6,700	4.0	98.1
4,750	0.2	82.1
2,360	0	47.9
1,180	0	29.8
600	0	21.6
300	0	14.6
150	0	10.4
106	0	8.3
75	0	7.1

The particle size distributions do not account for any product degradation, neither on-site nor in transport. Due to the hard nature of the material, product degradation is assumed to be minimal. Therefore, no penalties have been accounted for in this analysis for neither the production of very fine material (-100 µm) nor the degradation of lump into fine material.

Distribution of key elements to lump and fine products (Fe, SiO_2, Al_2O_3, Mn) were established from the elemental distribution assays described in the SGS test work program and summarized in Chapter 13. The elemental recoveries were applied to quarterly mine plan grades to establish lump and fines grades as shown in Table 17-3.

Table 17-3: Annual production and products specification

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
Fines (kt)	**Wisco Ref.[2]**	**Platts Ref.**	1,495	1,625	1,625	1,625	1,625	1,623	1,673	**11,291**
% Fe	≥61%	62.00%	59.67%	59.41%	59.95%	60.39%	62.02%	58.59%	52.52%	
% SiO_2	≤10%	4.00%	9.98%	11.94%	11.91%	10.45%	8.95%	13.28%	21.99%	
% Al_2O_3	≤0.90%		0.85%	0.70%	0.66%	0.66%	0.51%	0.69%	0.76%	
% Mn	≤0.6%	2.25%	0.97%	0.63%	0.47%	0.80%	0.34%	0.46%	0.47%	
S [1]	≤0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	
P [1]	≤0.05%	0.09%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	
As [1]	≤0.005%		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	
% Moisture			7%	7%	7%	7%	7%	7%	7%	
Lump (kt)[3]	**Wisco Ref.[2]**	**Platts Ref.**	805	875	875	875	875	874	901	**6,080**
% Fe	≥62%	62.50%	62.69%	62.42%	62.99%	63.45%	65.15%	61.55%	55.17%	
% SiO_2	≤8%	3.50%	5.94%	7.10%	7.08%	6.21%	5.32%	9.94%	18.24%	
% Al_2O_3	≤0.90%		0.38%	0.31%	0.29%	0.29%	0.22%	0.30%	0.33%	
% Mn	≤0.5%	1.50%	1.81%	1.17%	0.88%	1.48%	0.63%	0.86%	0.87%	
S [1]	≤0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	
P [1]	≤0.04%	0.08%	0.035%	0.035%	0.035%	0.035%	0.035%	0.035%	0.035%	
As [1]	≤0.005%		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	
% Moisture			2%	2%	2%	2%	2%	2%	2%	

(1) Values presented are averages from test work on Bulk samples as these elements were not developed for the Mine Plan.

(2) Wisco 2014-09-04.

(3) Values shown refer to the annual production per year. Lump crushed during the summer months will be stockpiled and shipped in Q4 of that year as well as Q1 of the next year. Thus, yearly sales values are derived in part from material produced the year before.

Product moisture (after drying of lump) is expected to be 2% for lump and 7% for fines. Both values respect typical shipping liquefaction limits for iron ore. There is no specific indication that the product produced may be at risk for high moisture. However, it is understood that some producers in the area have had challenges with moisture. The rotary dryer serving for lump drying could be used as a mitigation measure in the event of higher than acceptable moisture content in the fine material.

17.5 Process Design Criteria

The process plant design criteria for the Joyce Lake DSO Project are designed to be able to produce a combined 3.0 Mt of lump and fines product per annum on a dry basis. The ROM moisture content is assumed to average 6%. It is anticipated that the processing facility will operate for a maximum of 214 days per year. It is not intended to operate the dry processing plant during the colder winter months, typically between mid-November to mid-March. It is understood that there is a risk that inclement weather could shorten the production season to as little as 200 days. The crushing and screening circuit have thus been designed to be able to produce 2.5 Mtpa within a shortened (200 days) season.

The design criteria for the Joyce Lake DSO plant are presented in Table 17-4.

Table 17-4: Process design criteria for the Joyce Lake DSO processing facility

Criteria	Unit	Value
General		
Annual plant feed (dry basis) - design	tpa	3,000,000
Annual plant feed (dry basis) - nominal	tpa	2,500,000
Operating time (days per year)	d	200-240
Operating time (nominal)	d	214
Operating time (hours per day)	h	24
Equipment utilization	%	75
Lump size	mm	6.3 - 31.5
Fines size	mm	0 – 6.3
Lump undersize tolerance (<8 mm)	%	10
Fines undersize tolerance (<100 µm)	%	15
Grizzly		
Separation size	mm	600

Criteria	Unit	Value
Primary sizing screen		
Screen aperture size	mm	130
Feed top size (F_{100})	mm	600
Jaw Crusher		
Feed top size (F_{100})	mm	600
Crusher work index	kWh/t	10.6
Abrasion work index	g	0.56
Secondary Sizing Screen		
Top deck Screen aperture size	mm	31.5
Bottom deck aperture size	mm	6.3
Cone Crusher		
Crusher work index	kWh/t	10.6
Abrasion work index	g	0.56
Lump Product Stockpile		
Lump bulk density	t/m^3	2.1
Lump angle of repose	°	33.1
Stockpile capacity (~16h)	t	900,000
Fines Product Stockpile		
Fines bulk density	t/m^3	2.3
Fines angle of repose	°	32.4
Stockpile capacity (~16h)	t	4,000
Emergency stockpile capacity	t	24,000
Lump Drying		
Lump Nominal Moisture	(%w/w)	4
Lump Design Moisture	(%w/w)	6
Dried Lump Target Moisture	(%w/w)	2
Dryer Operation	months	7
Yearly Lump Tonnage to dry (wet)	(%w/w)	892 857

17.6 Major Mechanical Equipment List

The Joyce Lake DSO flowsheet includes a static grizzly, feed hopper, vibrating grizzly feeder, jaw crusher, secondary triple-deck sizing screen and cone crusher. The design capacities and main specifications for each piece of equipment are presented in Table 17-5.

Table 17-5: Major mechanical equipment specifications

Equipment	Description	No. of Units	Size	Installed Power (kW)
Grizzly	Bar spacing – 600 mm x 600 mm	2	TBD	N/A
Feed hopper	Capacity = 35 t	2	TBD	N/A
Vibrating grizzly feeder	Bar spacing at discharge = 130 mm	2	1.3 m x 6.0 m	30
Jaw crusher	Capacity = 240-780 t/h Closed side setting = 50-175 mm	2	0.8 m x 1.4 m	132
Secondary screen	Triple-deck horizontal screen	2	2.1 m x 6.1 m	37
Cone crusher	Capacity = 150 – 470 t/h Closed side setting: 13-51 mm	2	3.2 m x 2.4 m x 2.7 m	200

17.7 Crushing and Screening Plant Power Requirements

The installed power for the process plant will be nearly 1 081kW. A breakdown of processing power demand by sector is shown in Table 17-6.

Table 17-6: Process plant power demand by area

Area	Power Demand (kW)
Portable jaw crusher plant	382
Portable screening plant	96
Portable cone crushing plant	390
Conveying	213
Total Power Demand	**1,081**

The rotary drier will be run directly on diesel fuel as it would be less efficient to use electricity from the power plant diesel generators. The yearly consumption of diesel for the rotary dryer is 1.1ML.

17.8 Crushing and Screening Plant Loader Operations

The ROM ore stockpile ahead of the process plant is fed by the CAT777 equivalent mining haul trucks. Although the mine plan aims to provide ore blending for grade right from the pit, it may be that some additional grade blending will be required. The design provides that sufficient area is available at the ROM ore stockpile pad to segregate ROM ore according to iron grade to allow for blending of feed to the process plant.

Processing requires the feeding of the plant from the ROM ore stockpile. For this, one front-end loader, having a nominal capacity of 16 t, is required. This loader would not only feed the process plant but would also manage the ROM ore stockpile and perform the required ore blending. A cycle time analysis indicated that this equipment would have a utilization rate of about 50% during the operating season.

The process plant lump and fines products will be loaded into haul trucks for transportation to the Astray rail load out area. Fines will be loaded and hauled during the summer months and lump during the winter months. Based on the requirements of the haul truck fleet operation and cycles, a haul truck loading analysis was performed. The selected truck is a 95-tonne capacity Kenworth side-dump Chassis with an additional side dump trailer attached. It was determined one dedicated front-end loader, having a nominal capacity of 16 tonnes is required to load the haul trucks and to manage the product stockpiles at the process plant, including emergency stockpiles. A cycle time analysis indicates that this equipment would have a utilization rate of about 60% during the operating season. This loader's operation would be dedicated to product manipulation and is independent from the ROM stockpile loader. Although the lump stockpile will be tarped and protected from re-wetting, there is a risk that certain portions of the stockpile could freeze into chunks not suitable for transportation. A Twin Shaft Sizer unit will be installed on-site to serve as a feed breaker to reduce frozen chunks to manageable sizes as a mitigation in the event of material freezing. This material would then be loaded onto the haul trucks.

18. Project Infrastructure

This chapter describes the major infrastructure required to support the Joyce Lake DSO Project. The Project comprises two main areas: the open pit mine site and the Astray product load-out rail siding.

The open pit mine site area, located to the north of the Iron Arm water body, incorporates the mineral deposit as well as the ore crushing, screening and lump drying facility, the permanent production camp and offices, various ore and product stockpiles as well as a power generation facility, mobile equipment shop, assay laboratory and site run-off sedimentation ponds.

The Astray product load-out and rail siding area, is approximately 20 km south of Schefferville and to the immediate east of the Schefferville to Sept-Îles rail line and incorporates product stockpiles, spur line rail and railcar loading by front-end loaders, together with a run-off sedimentation pond. There is also capability to add an emergency portable rotary dryer in the unlikely event fines drying to below ocean shipping liquification limits is necessary in summer months.

These two areas will be connected by a new single-lane 43-km product haul road, including a new 1.2-km rock causeway across the Iron Arm waterway, and will be used for year-round product haulage from the mine site to the Astray rail load out.

The mine site access from the town of Schefferville, Québec will be by the existing Iron Arm Road that will be improved and extended to connect with the product haul road. The product haul road will be used specifically for product haulage and the upgraded Iron Arm Road and, 4.2-km extension, will be used only for construction and for personnel and supplies access during production. The Client will not build, own or operate any other facility outside of the aforementioned Project areas. Product rail transportation services from the Astray rail siding, which connects to the Tshiuetin Rail Transportation portion of the Schefferville to Sept-Îles railway, will be contracted from service providers, as will product rail car unloading at Société Ferroviaire et Portuaire de Pointe-Noire ("SFPPN") facility and ship loading at the Pointe Noire, multi-user port.

Mining operations during the life-of-mine ("LOM") are to take place year-round whereas crushing and screening (including lump drying and stockpiling at the mine site) will occur during the summer period (214 days). Product hauling, rail transportation and shipping will be done year-round. Fines will be truck-hauled and rail-transported during the summer period and lump reclaimed from the mine site stockpile during the winter period.

18.1 Project General Arrangement and Site Plan

Figure 18-1, Figure 18-2, and Figure 18-3, present the Project's general arrangement, including a more definitive plan of both the open pit mine area and the Astray product load-out rail siding area.

The following approach was taken to develop the mine site and Astray product load-out and rail siding area plans:

- Major mine site infrastructure, and waste and overburden stockpiles were located outside of mineralized areas. While JDI has not done condemnation drilling, local geology and mineralization trends indicate minable mineralization outside of the estimated Mineral Resources is not present.
- For the mine site and Astray area a geotechnical survey was performed by LVM Inc., a division of Englobe. Geomorphological analyses supported by limited geotechnical drilling data which were used to optimize the location of roads, pads, the rail siding and water crossings. The geotechnical survey also identified the location of possible borrow materials for construction. This was captured in the proposed mine site and Astray area, as well as the haul road general arrangements.
- The haul road is kept within the Labrador provincial boundaries and avoids routing over claims held by others, as based on information provided to BBA by the Client.
- The ultimate open pit mine footprint has been determined from the mineral reserve calculations based on the Mineral Reserve Estimate, as presented in Chapter 15 of this Study.
- The open pit infringes on the footprint of Joyce Lake and, therefore, the lake must be drained.
- To minimize impact on the environment and to facilitate permitting, the following measures and design features have been considered during the mine site, haul road and Astray load out area plans development:
  - Major stream crossings were identified by Stantec and appropriate culvert and bridge design has been adopted;
  - All new project infrastructure is located within Labrador. No new roads or other new infrastructure are being considered within Québec;
  - The existing Iron Arm access road from Schefferville to the existing Client exploration camp will be upgraded and extended to facilitate personnel, equipment and supplies access to the Project for construction and during production and will continue to benefit local communities both during and after operations cease.
- During construction two existing roads: the Iron Arm Road to access the mine site and a previous mining access road to the east of and parallel to the Schefferville to Sept-Îles rail

line to access the Astray product load-out area. A second previous mine access road, also parallel to and to the west of the Schefferville to Sept-Îles railroad, may also be used to access the Astray product load out area.

  - The Project design incorporates components for easy relocation to other iron ore DSO projects and to facilitate site restoration, including the mobile dry crushing and screening plant, the modular permanent production camp, the centralized diesel power generation plant and other modular buildings;
  - The Joyce Lake DSO Project incorporates 100% recovery of processed material with no rejects, so no storage of wet or dry rejected material is required;
  - Crossing of the Iron Arm waterway is by a 1.2-km rock causeway. Design provides for two bridges within the causeway allowing adequate water flow, fish passage and passage for leisure boaters;
  - Roads and the rock causeway across Iron Arm are designed to facilitate remaining in place after mine closure for the benefit of local communities, if they elect to retain them, closure costs, however, include removal of the causeway and reclamation of roads.

- The Project is not connected to an electric power utility grid and generates its own power using diesel generator sets. Electric power is provided to the mine site area infrastructure by a centralized diesel power generation station through a local power distribution grid. More remote mine site infrastructure like the deep well dewatering system and powder, as well as the Astray load out area magazine, will have local generators for their specific power requirements.

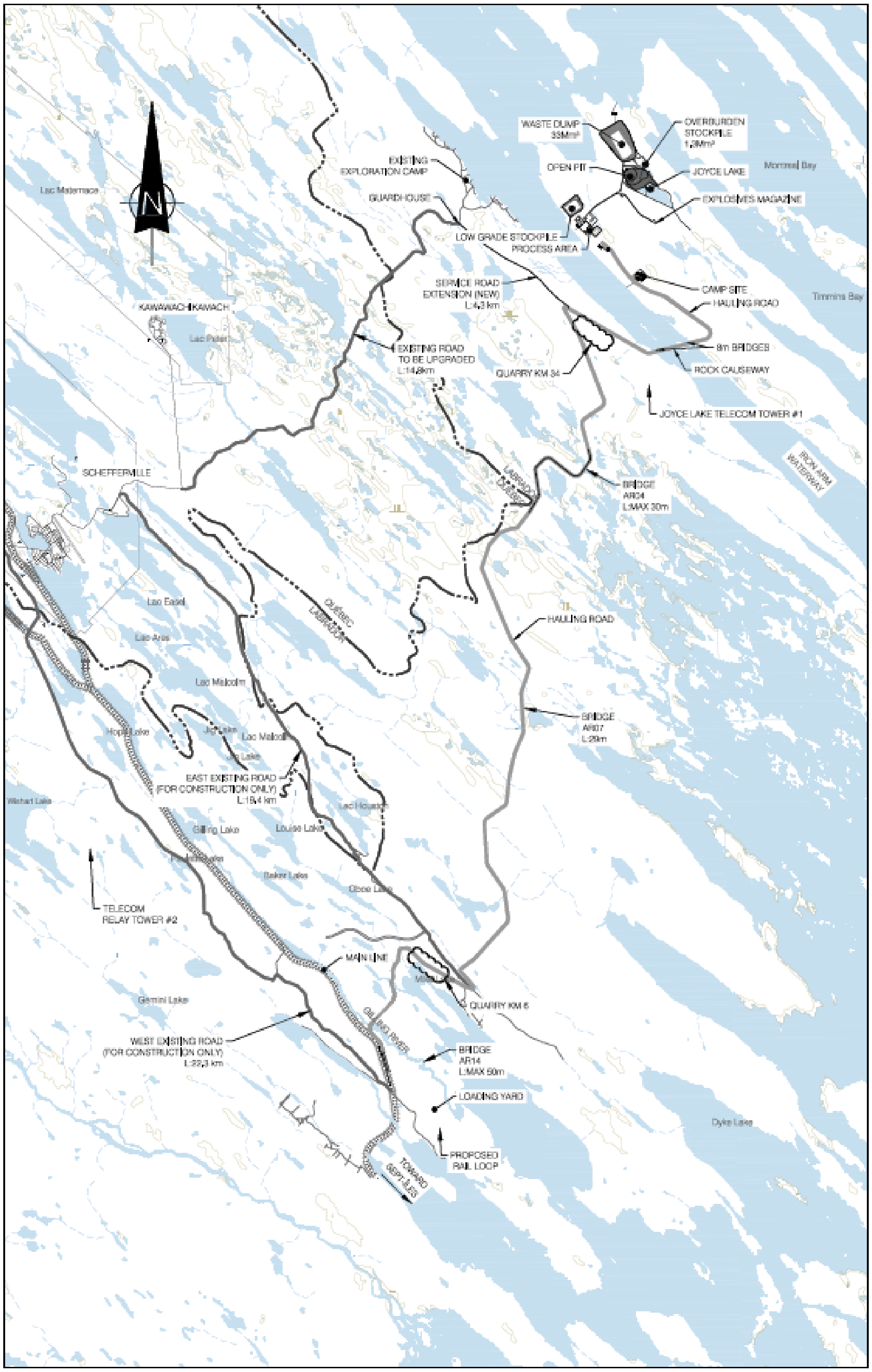


Figure 18-1: Project and surrounding area

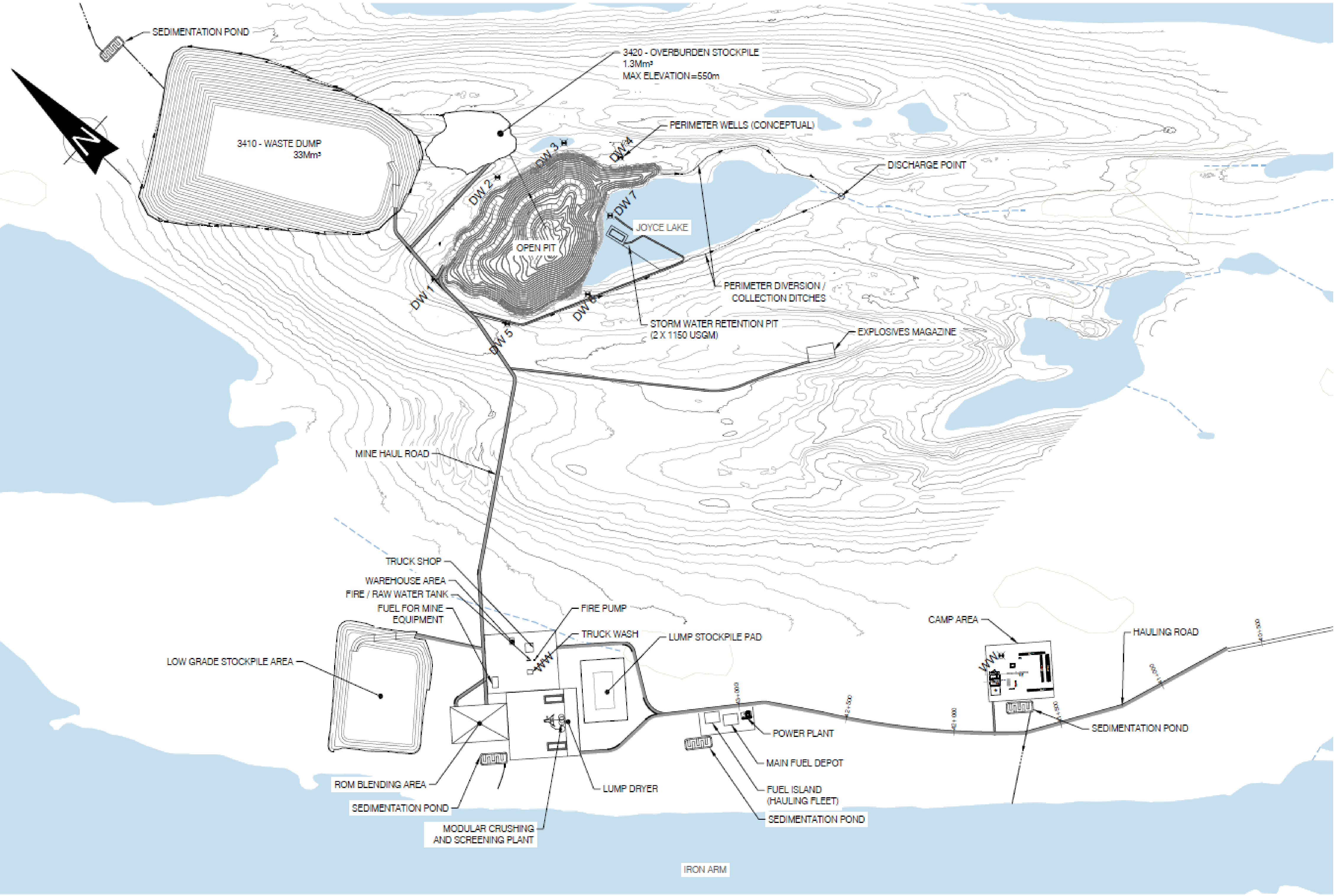


Figure 18-2: Sketch of open pit mine area

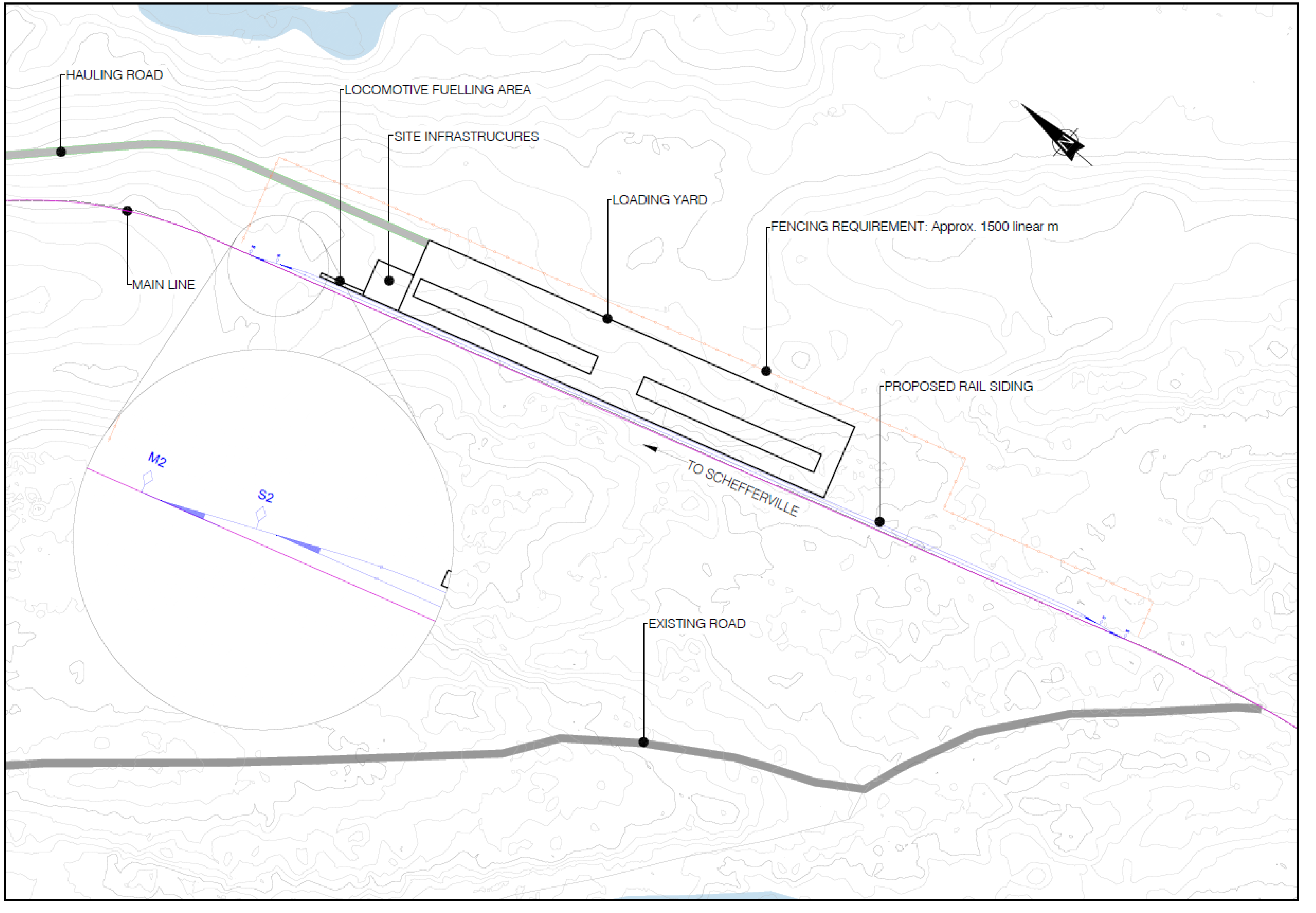


Figure 18-3: Project load-out and rail loading area

18.2 Description of Major Project Infrastructure and Activities

The city of Schefferville, Québec is about 20 km to the southwest of the Joyce Lake deposit, which is located in Labrador. Existing project infrastructure is currently limited to a 20-bed camp used by the Client for staging its exploration activities in the area. This exploration camp is located to the west of the Joyce Lake deposit. The Iron Arm waterway separates the exploration camp from the Project mine site area. This camp site includes two helicopter pads. A modular barge having a capacity of about 20 t is also stored at the camp site. Past activity on the Project has been limited to exploration and environmental assessment ("EA") baseline data collection. An existing 21.4 km access road via Iron Arm road, connects Schefferville to the exploration camp. This road is frequently used by the Client personnel to access the camp, and also by local residents to access their cottages on the south side of Iron Arm waterway.

18.2.1 Access to Project Areas During Construction

The Joyce Lake Project comprises two areas; the open pit mine site area where mining, ore crushing, screening and lump drying and stockpiling and haul-truck loading take place, and the Astray product rail load-out area where product is loaded into railcars and transported to port at Pointe Noire. Mining takes place year-round, and ore crushing, screening and lump drying and stockpiling over 214 summer days.

During construction, access to the open pit mine site area from Schefferville will be from the existing Iron Arm Road running to the existing Client exploration camp. This road is in relatively good condition but requires some upgrading for it to serve adequately for the construction phase of the Project. A new road extension of the Iron Arm Road of about 4.2 km, located entirely within Labrador, will be constructed along the south side of Iron Arm to connect the existing Iron Arm Road to the planned haul truck road which, in turn, will connect to the mine site by means of the new rock causeway. Construction of the Iron Arm extension access road, including the rock causeway, is planned to take place early in the Project development once permits are obtained. This will allow unhindered access from Schefferville to the open pit mine area and will allow pre-stripping mining operations to begin, as well as construction of mine site infrastructure according to the construction schedule. This approach will allow for haul road construction from east to west and simultaneously from west to east.

The Project construction would benefit from having a well-situated staging area for storage and assembly of equipment and materials. The existing old Schefferville airport clearing, located about 9.3 km from Schefferville, within the province of Québec, is well situated to serve this purpose. This area is relatively flat, clear, and ideal for use during the Project construction phase as a staging area to store materials and preassemble smaller sections of project equipment.

Project construction is planned to take place simultaneously at the open pit mine site area and at the Astray rail load out area. To access the Astray rail load-out area, there are two existing roads available. One of these roads, located to the east of the main line railroad and currently used by Labrador Iron Mines ("LIM") to access the Houston deposit, is planned to be used as an access during construction of the Gilling River bridge crossing from the east. The other road, to the west of the main line railroad, is planned to be used to access the Astray rail load-out area located to the west of the Gilling River. These two roads provide all the access required to allow for optimal construction planning of the Astray rail load-out area infrastructure. These roads will also allow personnel working at the Astray load-out area during both construction and production to access the site from Schefferville without having to use the haul road.

To construct the various pads and roads at the mine site, the haul road and the Astray load out area, borrow material will need to be sourced from various locations. Backfill material will primarily be taken from:

- The open pit mine;
- Cut-and-fill from road construction;
- Cut-and-fill from the Astray rail siding construction;
- Quarries located 6 and 34 km along the haul road measured from the rail siding.

Construction of the haul road can take place simultaneously from both ends, greatly benefiting the overall Project construction schedule. The haul road bridge over the Gilling River can be built from both sides and, once complete will provide unhindered access to and from the rail load out area along the haul road. Material sourced from the open pit mine will serve for construction of the mining roads and mine area pads but will not be used for causeway or haul road construction, unless it is free of iron mineralization.

18.2.2 Main Access Road to Project Areas During Production

The Iron Arm Road from Schefferville to the existing Client exploration camp at Iron Arm will be used for regular access for personnel and supplies to the mine site area and the haul road on a year-round basis during production. The existing road (about 5.1 km) from Schefferville to the Kawawachikamach First Nations reserve cut-off is in excellent shape and is maintained by the Québec provincial government. The existing Iron Arm Road from the Kawawachikamach cut-off to the Clients exploration camp will be used during Project construction and production to transport personnel, goods, equipment, fuel, etc. between the Project areas and the local communities. As such, this 14.8-km stretch of Iron Arm road will require upgrading to allow for the increased traffic and to make it useable and maintainable during the winter. This upgrade will also benefit local communities during construction, production and following mine closure.

A 4.2-km extension to the existing and upgraded Iron Arm Road will be required to connect to the new product haul road.

18.2.3 Product Hauling and Loading Operation

An analysis was performed to evaluate technically robust and proven strategies and equipment selection for product hauling from the mine site to the Astray rail load out are. In 2014, a trade-off study ("TOS") titled "Haul Road vs Rail", dated October 6, 2014 (BBA Inc., 2014d), compared hauling by truck versus extending a rail line from the main Schefferville railway to a location in proximity of the mine. The TOS determined that road haulage is more cost-effective. This strategy was retained for the current 2022 Feasibility Study.

For this Study, product truck haulage is considered as a separate activity from ore crushing, screening and lump product drying, which will be done over the summer season only of 214 days on average ranging to 244 days in a warm year. Product truck hauling will take place over the entire year and trucks will haul fines products over an average 214 summer days and dried lump reclaimed from the lump stockpile over the average 151 days (less holidays) winter period. Fines and lump products will be railed to the Pointe Noire multi-user port continuously throughout the year.

An analysis of various trucking equipment options was conducted in consultation with vendors. The retained solution was a Dramis/Kenworth C500 chassis 8x6 (semi-active hydraulic suspensions) equipped with a SmithCo Side Dump trailer. The truck fleet requirements were estimated using the design parameters indicated in Table 18-1. Note that the ROM moisture is 6% while 5.26% moisture is used for 2% lump and 7% fines.

Table 18-1: Haul truck fleet design parameters

Criterion	Unit	Value
Hauling Distance (Plant to Rail)	km	43
Annual Production	Mtpa (dry)	2.50
Annual Tonnage for Material Handling	Mtpa (wet @ 5.26%)	2.64
Days per Year	d	360
Truck Utilization	h/d	20
Truck Hauling Capacity	t/trip	95
# of Hauls per Day for Fleet	Loads/d	77
Haul Truck Average Cycle Time	minutes	147
Trucks Required in Fleet	# purchased	12

This analysis concludes that a fleet of 12 product haul trucks will be required based on an annual nominal production of 2.5M DMT/a. Haul trucks will dump either fine or lump product at the Astray load out rail siding where loaders will manipulate the product into stockpiles and later directly into railcars. It was determined that two high-lift front-end loaders ("FEL"), having a nominal capacity of 21 t is required to load the trains and to manage the product stockpiles.

The Astray rail load-out area infrastructure includes three trailers housing a dispatch office, a dry room and a lunchroom; each able to receive up to six workers. Potable water for these facilities will be supplied in bottles and a provision for chemical, maintenance-free toilets have been made to avoid the installation of sewage containment units. The loaders for product-loading (i.e., FELs) will have a designated area on an open pad for light maintenance and oil changes.

The Astray product load-out and rail area is located south of the mine site at the end of the 43-km product haul road. The rail siding will comprise 2.4 km of track constructed parallel with the existing Schefferville to Sept-Îles railway line from the Tshiuetin Rail Transportation Inc. ("TRT") owned rail section at approximately 20 km from Schefferville. The product haul trucks arriving from the mine site will dump the lump and fines products on two stockpiles built on a 600-m x 100-m pad. The stockpiles each have a capacity of 24,000 t. Front-end loaders will load the product into railcars. Each railcar is weighed to make sure that weights are optimized without exceeding limits. Rail transport calculations are based on 360 days per year in two train sets with 164 rail cars per train set for a total of 328 client owned rail cars. Each train set will be powered by two head end locomotives, provided as part of the rail haulage contract with Québec North Shore & Labrador Railway ("QNSL").

18.2.4 Product Haul Road

The dedicated product haul road connects the mine site to the Astray rail load out area, a distance of 43 km. This road is engineered based on specific topographical and geotechnical features over its length. To reduce the Project footprint and construction activities, the road has been designed as a single-lane with a width of 6 m. Certain portions of the road that have sharp turns and/or low visibility were designed with two lanes (10 m wide) to ensure safe operation. For long stretches of single-lane road pull-outs were designed every 1,000 m to allow for empty trucks on their return trip to pull-over and allow loaded trucks to pass unhindered. The road width at pullouts is approximately 12 m. Allowances for waiting times in pull-outs were calculated in truck cycle estimates. Figure 18-4 provides a typical X-cut of the layers of materials used for construction of the single-lane portions of the haul road. The thickness of the lower structural layers can vary according to specific local geotechnical characteristics. Similar drawings for the double-lane and the single-lane with pull-out road are shown in Figure 18-5 and Figure 18-6, respectively.

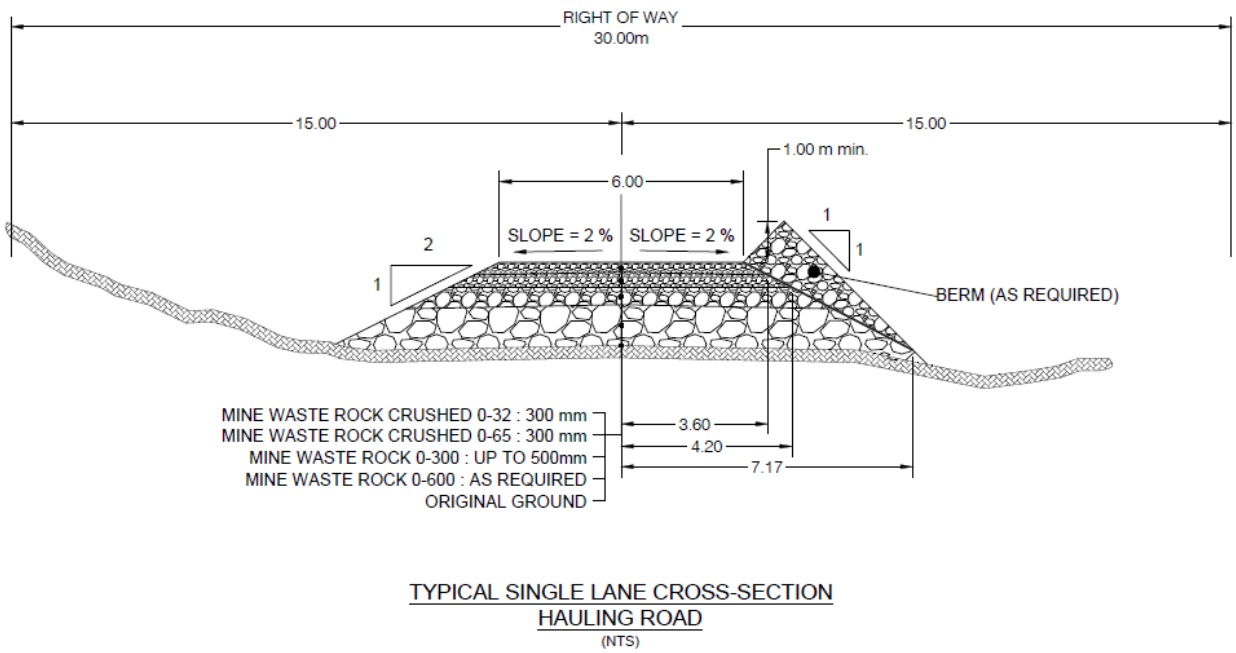


Figure 18-4: Typical product haul road profile (single-lane)

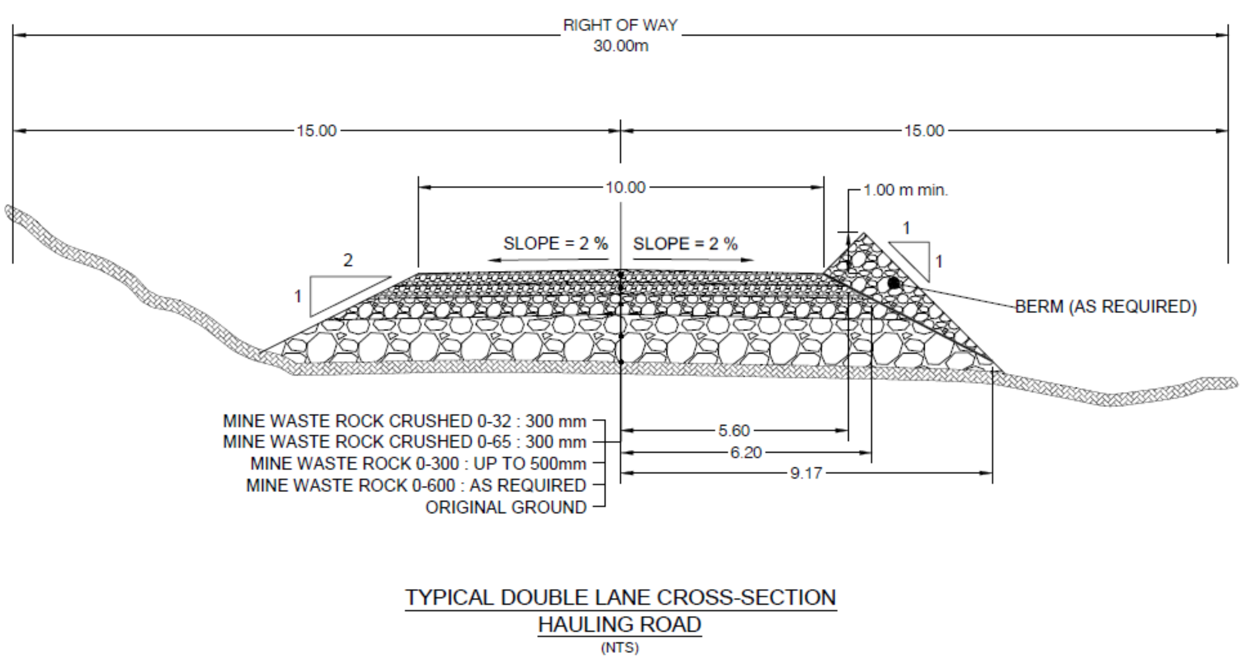


Figure 18-5: Typical product haul road profile (double-lane)

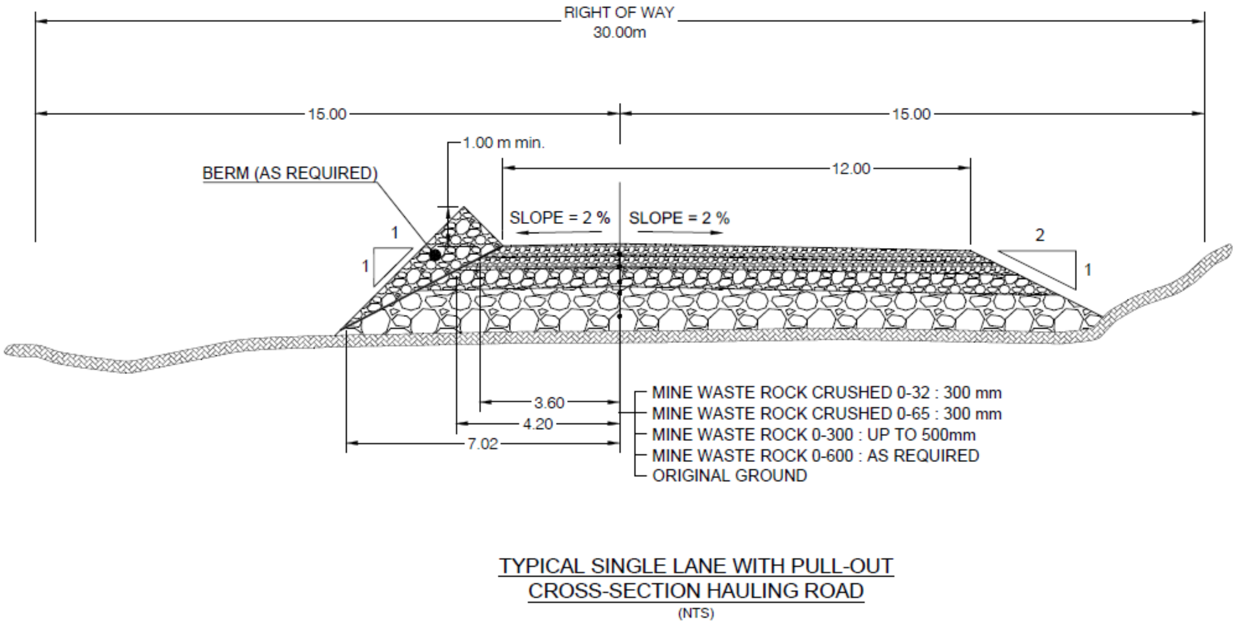


Figure 18-6: Typical product haul road profile (single-lane with pull-out)

Haul road water crossings have been designed based on Stantec's recommendations from historical and recently collected data. Crossing of the Iron Arm waterway to access the mine site area was the subject of a TOS performed by BBA in 2014 (BBA Inc., 2014c). This study compared various means of crossing the waterway for product haulage, as well as for personnel, materials and equipment. The TOS concluded that the construction of a rock causeway would be the safest, most practical, flexible, and cost-effective method of crossing the Iron Arm waterway and was retained for this 2022 Feasibility Study. The proposed rock causeway was in an area of favorable bathymetry, requiring minimal fill material for construction. The causeway length is 1.2 km from shore to shore. Design provides for two 8 m span bridges within the length of the causeway allowing for fish movement as well as for leisure boating activities. Mine waste rock will not be used for causeway construction; instead, construction aggregate will be non-deleterious, non-reactive and inert quarry rock. By not using mine waste rock an amendment to Schedule 2 of the Metal and Diamond Mining Effluent Regulations under the federal *Fisheries Act* will not be required. Design is such that the causeway can remain for the benefit of the community after mining activities are concluded, if desired by local communities.

A typical cross-section of the causeway and a schematic of a bridge span are presented in Figure 18-7 and Figure 18-8 respectively.

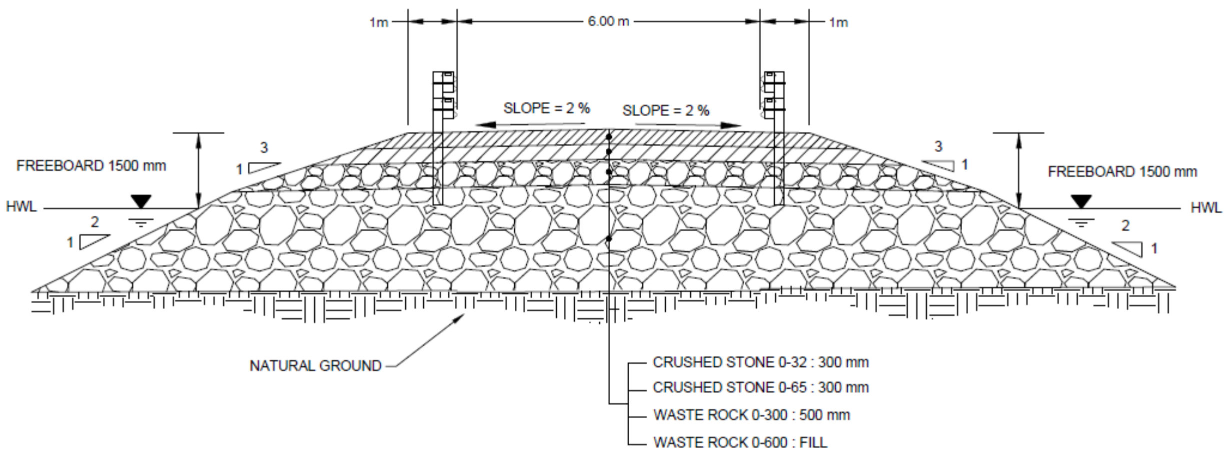


Figure 18-7: Typical cross-section view of the causeway

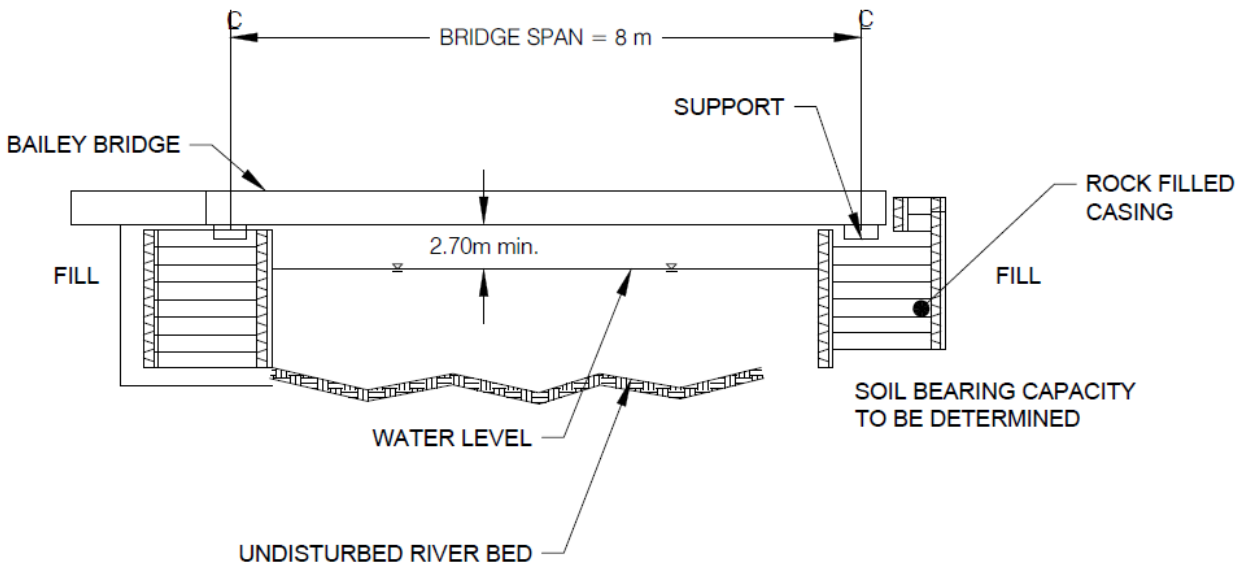


Figure 18-8: Schematic causeway bridge span

18.2.5 Mine Site Roads

The mine haul roads were designed to accommodate the selected mining truck fleet, as described in Chapter 16. The mine site roads connect the open pit to the waste rock and overburden piles, as well as to the lower grade ore stockpile, the ore crushing, screening and lump drying plant, mine garage and permanent production camp. Secondary roads are provided in the area to access the explosives magazine and the open pit perimeter deep well dewatering stations. Details on the dimensions and source of construction material for the mine site roads as well as other project roads can be found in Table 18-2.

Table 18-2: Summary of Project roads dimensions and source of material

Road Name	Length (m)	Width (m)	Material Sourcing
Haul Road	43 000	6-12*	Mine Waste Rock (north of iron arm causeway **only**), Quarry at km 34 Cut-and-fill from haul road and rail area, Additional quarries along haul road (km 6) as needed
New Iron Arm Road Extension	4 300	8	Cut-and-fill along road
Rehab of Existing Iron Arm Road	14 800	8	Cut-and-fill along road
Mine Road 1	537	25	Cut-and-fill along road, Mine Waste Rock for additional fill
Mine Road 2	3 117	25	Cut-and-fill along road, Mine Waste Rock for additional fill
Mine Service Road to Explosives	1 310	10	Cut-and-fill along road, Mine Waste Rock for additional fill
Road to Well No. 2 & 4	661	5	Cut-and-fill along road, Mine Waste Rock for additional fill
Road to Well No. 6	270	5	Cut-and-fill along road, Mine Waste Rock for additional fill
Dike Road	1 420	22	Cut-and-fill along road, Mine Waste Rock for additional fill
Road A Sedimentation Pond	1 074	3	Cut-and-fill along road, Mine Waste Rock for additional fill
Road B Sedimentation Pond	650	3	Cut-and-fill along road, Mine Waste Rock for additional fill

18.2.6 Site Infrastructure Drainage

The stormwater and contact surface runoff management design uses diversion ditches, culverts, and sedimentation ponds. Pads underlying surface infrastructure and stockpiles are drained and water is collected in peripheral ditches and directed into sedimentation ponds. Six sedimentation ponds are proposed for the Project, with five located in the open pit, crushing and screening plant area, waste, ore and product stockpiles, the accommodations area and one at the Astray product rail load out yard. Open pit contact water from the open pit excavation, while expected to be minimal, will be pumped into open pit perimeter ditching draining to one of the sedimentation ponds. The following are the design criteria for the sedimentation ponds:

- Settle particles greater than 5 microns in size during the 10-year return period storm event;
- Contain and store runoff from the Project infrastructure areas for up to the 100-year return period storm event;
- Use a primarily subsurface, reverse slope low-level outlet to act as hydrocarbon and Light Non-Aqueous Phase Liquids ("LNAPL") containment feature and mitigate thermal effects on discharge;
- An emergency spillway will be required to convey flows larger than the 100-year return period event; and
- The water management design of contact water treatment focuses on sedimentation. As sedimentation will reduce TSS concentrations and the particulate fraction of metals. Runoff from the water quality design storm event will be detained in the sedimentation pond for a minimum of 24 hours.

Culverts are designed with a minimum diameter of 600 mm to reduce the potential for blockage from ice, sediment, beaver activities, and vegetation. Access roads and rail tracks will require side ditches and culverts to convey cross-drainage. Intermittent and perennial watercourse crossings will require steel pipe or arch-type culverts. The 100-year return period flow will be used to size culvert conveyance capacity without access roads and rail track inundation. Rail track drainage works will be designed in accordance with the American Railway Engineering and Maintenance-of-Way Association ("AREMA") guidelines.

Two perimeter non-contact water diversion ditches will be constructed around the shoreline of Joyce Lake and the open pit to be used for the following:

- Collection and diversion of Joyce Lake catchment area runoff around the open pit and the shoreline of Joyce Lake;
- Collection and diversion of Joyce Lake initial dewatering;

- Collection and diversion of groundwater intercepted from the open pit perimeter dewatering wells; and
- Collection and diversion of Joyce Lake footprint dewatering during production.

Collected non-contact water in the perimeter ditches will be discharged to Stream T3 downstream of the existing Joyce Lake outlet (which currently drains via Hollinger Lake) and which will discharge north to Timmins Bay in Attikamagen Lake.

18.2.7 Mine Operations and Maintenance

Truck Shop

The truck shop building consists of a structure supported on a series of functional containers. The steel truss roofing system is covered by a fabric membrane. Inside, the rig-mat type flooring system is assembled on-site and eliminates the need for a poured concrete pad.

The truck maintenance shop consists of six identically sized garage bays in a back-to-back configuration sized to accommodate CAT 777 or equivalent mine trucks, as well as other mobile mining equipment. The product haul trucks will also be serviced in this facility. Mine truck tire changing will require coordination with adjacent bays in the garage or can be performed outside, weather permitting. The mine truck dump boxes can only be removed outside using a mobile crane. A 15-tonne gantry crane is provided in the garage bays for heavy lifting duties. A sketch of the truck shop is presented in Figure 18-9.

Oils, coolant, and windshield water solution used for truck oil changes and maintenance will be stored in interchangeable totes. Used oils, lubricants, and coolants will be collected and stored in interchangeable totes (bins) and appropriately disposed of through a third-party service provider.

Potable water will be supplied to the building in water bottles. Raw water will be stored in a 5,700 L tank for use in the garage bays and sourced from a nearby well.

Sewage will be collected in a 5,700 L tank and transported to the sewage treatment system located near the permanent camp.

The aforementioned pre-assembled containers, acting as supports for the roof system, will incorporate four office spaces for maintenance mine management personnel, a 30-person lunch room, washrooms, a mechanical room, an electrical room, oil storage, and small parts storage.

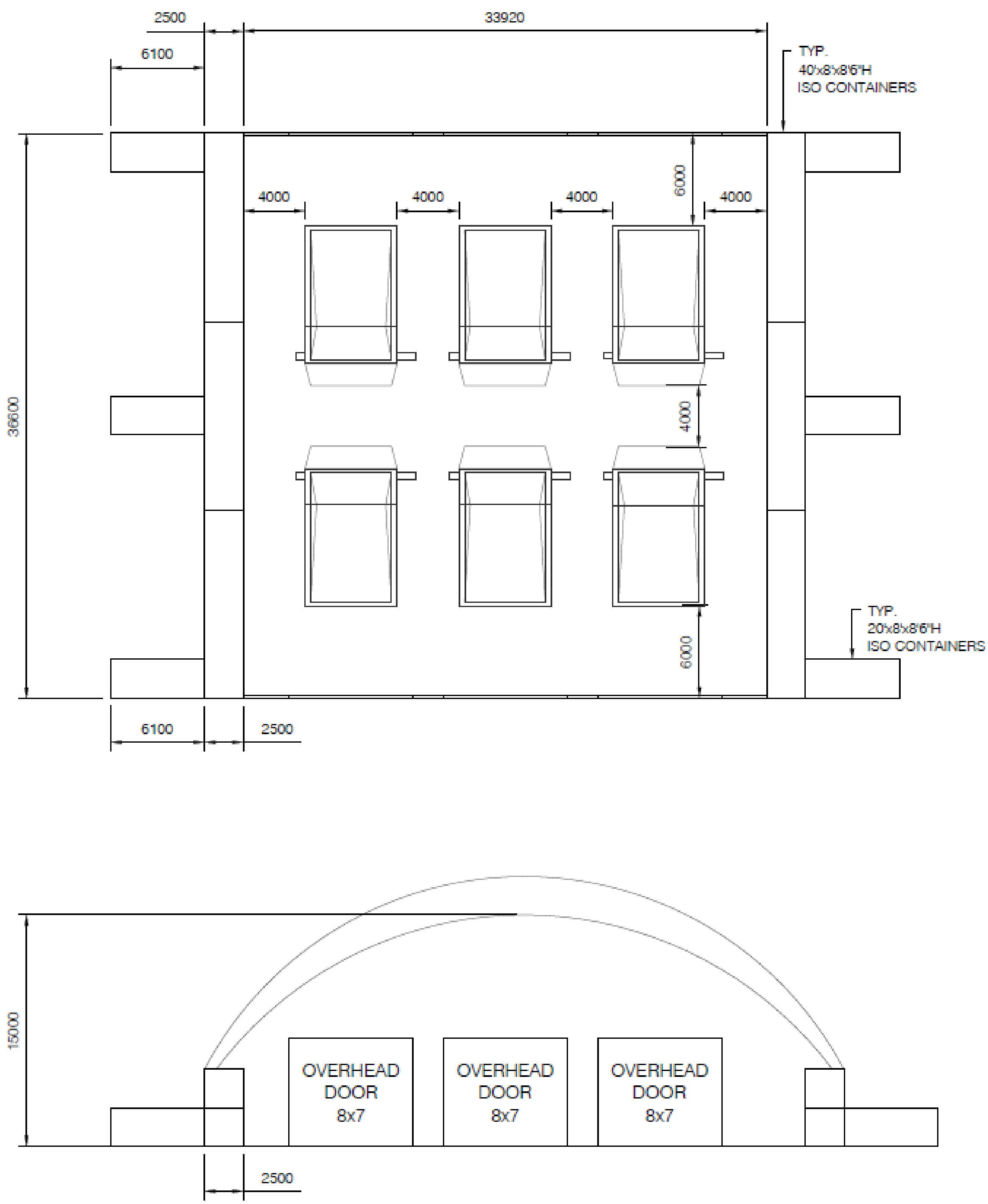


Figure 18-9: Truck shop overhead and cross-section views

Truck Wash

The truck wash building consists of a structure, built in the same configuration as the garage, using containers as part of the structure.

The truck washing package system includes two hoses for high flow/low-pressure water and two hoses for low flow/high-pressure water for finishing. Flooring in the truck wash bay consists of a steel hydropad that drains into a system designed to separate large solids and a filtering system that recycles the water. Raw water is used as make-up water, which is supplied from a nearby well.

Warehouse

The warehouse consists of a dome structure supported by prefabricated concrete blocks sitting on a gravel pad. The warehouse will include racking and open space for larger pieces of equipment. It is not planned to heat the warehouse. Should heating be required, space heaters can be used.

18.2.8 Dry Processing Plant

The dry ore crushing and screening dual-line plant, located approximately 2 km southwest of the open pit, consists of mobile jaw crushing, screening, cone crushing, conveyor systems and a rotary dryer for lump drying. A detailed description of these facilities is provided in Chapter 17.

18.2.9 Site Power

18.2.9.1 Electrical Grid

Discussions were held with Nalcor to investigate the potential of replacing the diesel generators with a tap-off of the electrical grid which currently provides power to the city of Schefferville. From the discussions it was understood that providing power to the city of Schefferville was a priority and that, if power demands peak, power might not be available for use at the site as it will be reserved for city use. Nalcor representatives seemed confident that power would be readily available during summer; however, outside of this time it was a certainty that there would be moments where power would not be available. This would imply that, further to the capital costs and materials required to bring an electrical line from the old Labrador Iron Mines facilities to the Joyce Lake site, generators would still be required on-site to supply energy when power was not available (assumed to be 30-40% of the time). To guarantee energy availability, an expansion of the Menihek hydro generating station would be required (new turbine and dam adjustments). This would be a very costly upgrade and it does not seem likely that a project requiring 1.5-3 MW, with a LOM of only seven years, would justify Nalcor to proceed with such an upgrade. For this study, stand-alone generators have been retained as a base case analysis as it seems the only reasonable solution, given the lack of reliable power in the area.

18.2.9.2 Central Power Plant and Stand-Alone Generator Sets

All electric power for the Project will be generated using diesel powered generators. Overall, the Project power requirements have been estimated monthly, giving due consideration to the fact that some areas are not operated during the winter months. Design provides that the aforementioned, diesel generators are in two configurations:

- A centralized power plant with generator sets ("genset") will produce electric power that will be distributed through a local grid to the permanent production camp including offices, mine maintenance area, service areas and the crushing and screening plant. A central power plant offers the advantage of load sharing between the generators, as well as shared redundancy, thus less installed power is required.
- Stand-alone local generators will be installed for more remote areas such as the Astray rail load out area, telecom, mine site guardhouse, mine site perimeter and open pit mine dewatering well pumps, etc.

The centralized power plant design consists of five 600 V, 818 kW prime-rated generator sets, each complemented by a step-up transformer (0.6-13.8 kV) delivering power to the crushing and screening plant, the mine infrastructure facilities (mine offices, truck shop, wash bay and warehouse), the permanent camp and the administrative buildings via 13.8 kV overhead lines. When the crushing and screening plant is in operation (8 months out of 12), the centralized power plant will operate with four generator sets running and one generator set in standby mode. During the winter months, when crushing and screening is curtailed and only mining operations are carried out, three-generator sets will be running and two will be in standby mode.

Remote areas (Astray rail load out area, explosives magazine area, telecom towers, guardhouse, pit perimeter dewatering pumps) will be fed by independent, stand-alone 600 V diesel generator sets.

The estimated power demand used for design of the central power plant is 2.4 MW. Due to the crushing and screening plant operating only eight months of the year, power requirements vary from month to month and from season to season. Average annual power consumption for the central power plant is estimated at 14.1 GWh. A single-line diagram for the centralized power plant is presented in Figure 18-10. A general power demand profile, as well as average annual diesel consumption by area, is presented in Table 18-3. An estimate of the annual fuel consumption for the stand-alone diesel generator stations is presented in Table 18-4.

Table 18-3: Joyce Lake site power demand – Centralized power plant

Area	Power Demand (kW)	Annual Diesel Consumption (L)
Permanent camp	470 – 750	1,287,000
Administration buildings	79 – 125	215,000
Mine infrastructure (mine office, truck shop, wash bay, warehouse, etc.)	450	950,000
Crushing/screening plant[1]	933	1,313,000
Network losses (2%)	27-44	Incl.
Design margin (10%)	214	Incl.
Total	**1,500 – 2,400**	**3,765,000**

(1) Crushing and screening plant will be operational during the summer season only

Table 18-4: Joyce Lake site power demand – Stand-alone generators

Area		Annual Diesel Fuel Consumption (L)
Stand-Alone Generators	Explosives Magazine	27,000
	Rail Siding	48,200
	Guardhouse	14,600
	Telecom Towers	11,400
	Mine Perimeter Wells	803,300
Total		**904,500**

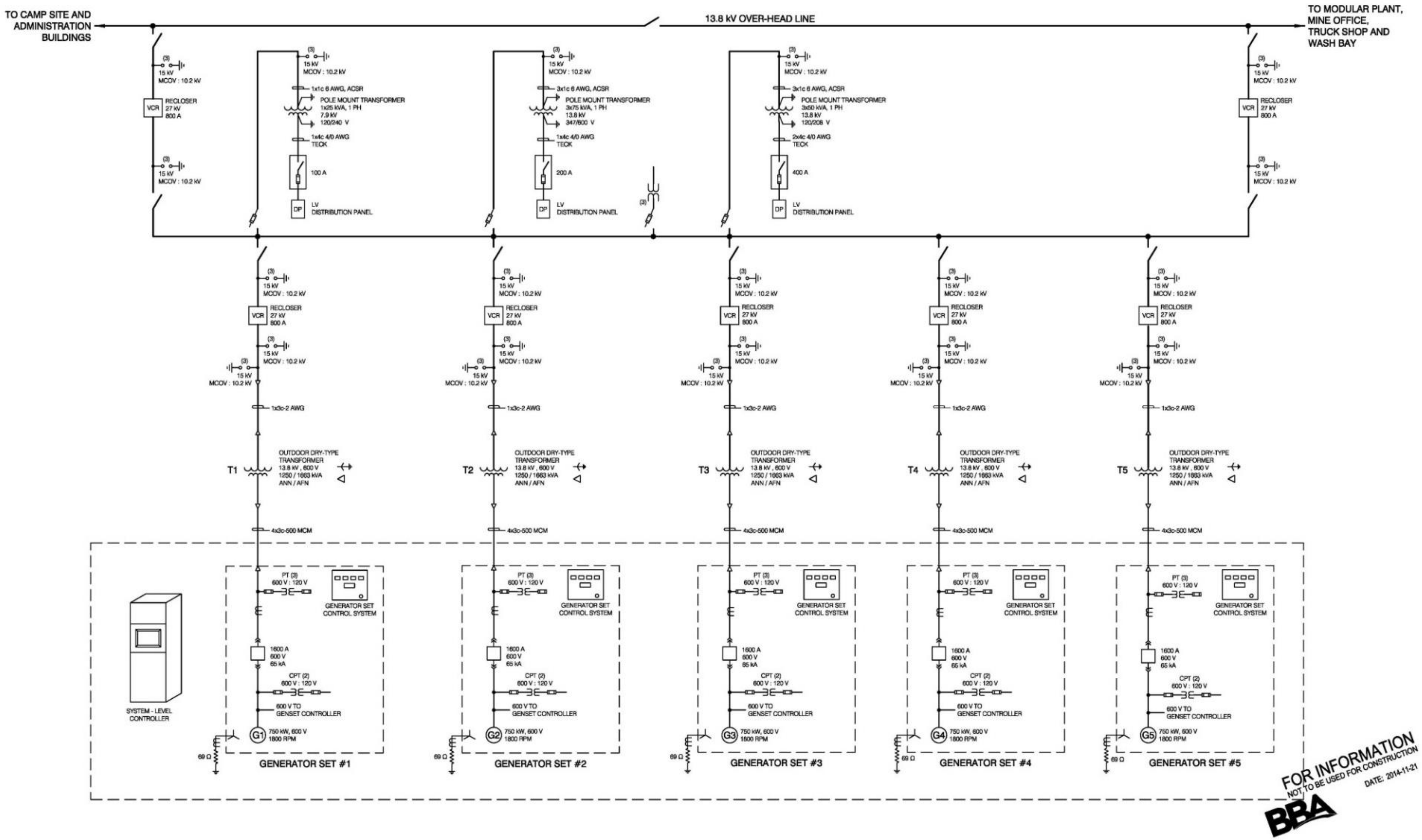


Figure 18-10: Single-line diagram

18.2.10 Fuel Storage and Management

Fuel for mining equipment, product haul trucks, wheel loaders, auxiliary equipment and for the diesel generators will be railed in from Sept-Îles. Total diesel fuel consumption at the peak years of operation has been estimated at 1.40 M litres per month in the winter months and 1.55 M litres per month during the summer months. A breakdown of monthly diesel consumptions per project area can be found in Table 18-6.

To handle this volume, six rail tanker cars, each having a capacity of 96,000 litres, will be required to deliver fuel from the Sept-Îles terminal to Schefferville rail terminal at a rate of once per week. Fuel is stored in the tanker railcars and a local service provider will transport fuel from the tanker cars to the site. These logistics require that two sets of three railcar tankers will be needed to deliver the fuel to meet the required cycle time. The local service provider will transport fuel to site using 20,000 litre capacity tanker trucks. At peak consumption during summer months, three tanker trucks per day would need to be delivered to site.

Fuel is stored on-site in different areas in proximity of its end users, as shown in the general site plan. Fuel storage is done in skid type, double-walled horizontal tanks each having a 50,000-litre capacity, with integrated containment and overfill protection. Each of the fuel storage areas, with the exception of the central power plant, is equipped with a fueling station with metering. A dedicated small capacity fuel truck will be part of the site infrastructure mobile fleet and will distribute fuel to remote stations and users such as in-pit mining equipment, dewatering pumping stations, telecom towers, etc. Gasoline for light vehicles will be purchased directly from a distributor in the nearby communities and delivered to site. Table 18-5 outlines the various fuel storage areas and holding capacities and Table 18-6 details diesel consumption per month.

Table 18-5: Joyce Lake fuel storage stations

Fuelling Station	Fuel Type	Tank Capacity (L)	Equipment Serviced
Mine Equipment Station	Diesel	1 X 50,000	Mine trucks and auxiliary mining equipment
Power Plant Station	Diesel	2 X 50,000	Central power plant and stand-alone generators
Power Plant Station	Diesel	1 X 50,000	Lump material dryer
Product Haul Truck Station	Diesel	1 X 50,000	Product haul trucks
Pickup Truck Station	Gasoline	1 X 5,000	Site pick-up trucks
Rail Station	Diesel	1 X 50,000	Loaders and local generator

Table 18-6: Monthly Diesel Consumption (L) per Area

	Monthly Diesel Consumption (L)											
Area	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Dewatering	0.12	0.11	0.12	0.11	0.12	0.11	0.12	0.12	0.11	0.12	0.11	0.12
Offices and Administration	0.13	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.12	0.13	0.13
Camp	0.17	0.15	0.13	0.13	0.10	0.10	0.10	0.10	0.13	0.13	0.16	0.17
Astray Rail Siding	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Mining (fleet and explosives)	0.77	0.77	0.77	0.82	0.82	0.82	0.83	0.83	0.83	0.83	0.83	0.83
Crushing and Screening	0.00	0.00	0.22	0.21	0.22	0.21	0.22	0.22	0.21	0.22	0.00	0.00
Lump Drying	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
TOTAL	1.35	1.31	1.53	1.55	1.54	1.52	1.55	1.55	1.57	1.58	1.39	1.41

Site Services

18.2.10.1 Potable water

Potable water is supplied to the permanent production camp from a water treatment system located nearby that will treat fresh water supplied from a water well. The treatment facility will be sized for a 144-person camp.

Water lines connected to the camp will be contained inside a heated utility tunnel to prevent freezing during winter months. Potable water for the other buildings and areas on-site will be supplied with water bottles.

18.2.10.2 Raw Water

Raw water will be supplied by three water wells, one for the truck shop and truck wash bay, one for the permanent camp and one for the load-out and rail area. Each well will be in the vicinity of the buildings for nearby water supply. The raw water wells will also be used to fill the fire water tanks on-site.

18.2.10.3 Fire Water

Fire water will be stored and supplied to the permanent production camp and to the truck shop according to NFPA requirements. Dedicated 200,000 litre tanks will supply fire water sourced from the raw water wells, as previously described.

18.2.10.4 Sewage Treatment

A centralized sewage treatment facility for the entire site will be located at the permanent production camp. Sewage collected from the truck shop and rail areas will be transported to the workers camp treatment system using a septic tanker truck or totes. The sewage treatment system will develop quantities of solid waste that will be disposed of through a contracted service in Schefferville.

18.2.10.5 Permanent Production Camp

The permanent production camp is located about 2 km from the crushing and screening plant. The modular, trailer-type camp contains a total of 144 single-beds rooms and ancillary facilities. The design provides that two dormitory wings, each having two floors, are connected by a central core area. The central core will include a reception, offices, kitchen and dining area, and laundry room. The reception area, used to control arrivals and departures of workers, will consist of a waiting area, temporary luggage storage, washrooms, and camp management offices. The plant administration office is located within the camp facility and consists of five offices and twenty workstations, intended mainly for operations management. The kitchen and dining area, serving breakfast and dinner, will accommodate 80 people at a time.

Laundry facilities will be available for personal laundry, while work clothes and bed linens will be washed in the central core.

18.2.11 Telecom

The Telecom, IT, and networking systems designed for the Joyce Lake DSO Project include:

- UHF/VHF mobile radio;
- Telephony services;
- Internet access;
- Engineering IT Services (hardware and software for engineering applications);
- Corporate IT services (hardware and software for corporate applications);
- Process Control Networking (links between parts of the process);
- Wide Area Networking (link to the Internet and external phone lines);
- Campus Area Networking (wired and wireless links between facilities);
- Local Area Networking (wired and wireless links within facilities);
- Network Security;
- Emergency backup communications;
- Two installed relay towers, one at the mine site and one at the rail load-out.

These services will be installed progressively when needed during the Early Works, Construction and Production phases of the Project.

18.2.12 Waste and Overburden Stockpiles

An area is designated for waste rock, topsoil, and mineralized material at sub-ore grade. Design of the waste stockpiles is discussed in Chapter 16 of this Report.

18.2.13 Low-grade Stockpiles

During mining operations, low-grade materials grading 52-55% Fe will be stockpiled for processing at the end of open pit mine life. The stockpile located next to the crushing and screening facility, will be constructed on a levelled pad made of appropriate mine waste materials. The proximity of the stockpile to the crushing system will allow front-end loaders to reclaim the stockpile for direct crusher feed.

18.2.14 Other Site Infrastructure

18.2.14.1 Laboratory

An on-site laboratory is provided for sample preparation and chemical analysis for samples collected from the mining operation, process and product stockpiles. The laboratory is housed within three modular trailers. The sample preparation area contains crushers, pulverizers, and sieves. The analytical area contains an XRF machine for chemical analysis and all required auxiliaries including a fluxer, furnace and an assortment of labware. Each area will be equipped with appropriate safety equipment.

18.2.14.2 Explosives Magazine

Explosives will not be produced or stored on-site. Explosive accessories will be stored in a magazine located near the mine and will be managed by the retained blasting contractor. An area for locating an explosives magazine has been provided on the mine site.

18.2.14.3 Guardhouse

The guardhouse consists of a trailer located ahead of the junction where the new access road extension of Iron Arm Road joins the new product haul road. The guard is there to monitor and control traffic and access. The trailer will be complete with two workstations, a lunchroom and self-contained washroom facilities.

18.3 Non-Contact Surface Water Management

The design provides that perimeter trenches be constructed along the north and south of the open pit and Joyce Lake, as recommended by Stantec. The catchment trench system collects surface run-off water that normally drains into Joyce Lake and discharges it into the watershed where Joyce Lake naturally drains. These trenches are also used to collect water pumped from the open pit perimeter wells and water pumped from the trench system at the bottom of Joyce Lake. This system is designed to collect surface water and precipitation inside the Joyce Lake footprint to avoid draining into the open pit.

18.3.1 Joyce Lake Initial Drainage and Dewatering During Operations

Initial drainage

Joyce Lake is of variable depth, from a couple of metres near its existing discharge point to about 20 m at its intersection with the open pit. The total water volume contained is estimated at approximately 3 Mm^3. The mine plan requires that Joyce Lake be drained by the end of the first year of mining production; however, the construction and water management strategy requires that the lake be drained during the construction period. Stantec provided rates and volumes for draining the lake. Water will be pumped using a floating barge and a series of pumps sized to provide the required flowrates to allow for draining.

Draining will occur over a period of four to six months during the first year of construction, July 1 to November 30, then dewatering will continue in the summer of construction Year 2 and is expected to be completed 592 days after the start of construction in the summer of Construction Year 2.

The maximum initial lake dewatering rate is estimated to be 260 L/s. Dewatering discharge will continue until freeze up and then continue for the majority of the following summer. The dewatering flows will be discharged to Stream T3, which is downstream of the existing Joyce Lake outlet (which drains into Hollinger Lake) and eventually discharges to Timmins Bay which is part of Attikamagen Lake. Consideration was given to constrain pumping rates to not exceed actual maximum rates for flowing from Joyce Lake into the watershed.

Joyce Lake Dewatering

Once emptied, any water from surface drainage and from direct precipitation into Joyce Lake would naturally drain into the open pit. In order to minimize such water flowing into the pit, Stantec has proposed, at a conceptual level, a trench system within Joyce Lake, allowing for this water to be collected within a basin excavated in the overburden at the bottom of the lake and to then be pumped directly into the perimeter ditches. This system is proposed to be constructed during the first year of mining production and is accounted for as part of sustaining capital.

18.3.2 Open Pit

Open pit contact water dewatering parameters were provided by Stantec. The maximum pumping rate is indicated to be in the order of 17 L/sec. Water is pumped from the open pit into the same settling basin that is treating water from the overburden and waste rock stockpiles. Mine dewatering is part of the open pit mine operations.

18.3.3 Pit Perimeter Deep Well Dewatering

Following its conceptual level hydrogeological study, WESA (a division of BluMetric Environmental Inc.) recommended that a perimeter deep well dewatering strategy be adopted as part of the mine dewatering strategy. Perimeter dewatering is expected to control the level of the water table to keep the open pit dry and to support pit slope design parameters developed by LVM in its pit stability geotechnical study.

WESA recommended the number of perimeter wells, their depths, and the flowrates from each of the wells. At least seven wells, having diameters of 203 mm (8 inches), will be required to a maximum depth of 220 m. One well will be drilled pre-construction and the remaining six will be installed during the construction period. Each well will have a dedicated pumping station consisting of a 152 mm (6" inch) submersible turbine pump (i.e., specialized pumps) with an electric motor and a local diesel generator to provide the required electric power.

The deep-wells will discharge on average between 377 to 816 m^3/day per well, depending on the phase of the pit as mine life progresses (Table 18-7). A total of 2,642 to 5,714 m^3/day is assumed for all wells combined, depending on the phase of the pit. Water will be pumped into the Joyce Lake perimeter ditches (north and south).

Deep-well drainage during pre-production starts in month six of construction and lasts for five months. Deep-well drainage water is considered non-contact background concentration groundwater, suitable for discharge to the environment. It is expected that the water pumped from each well will be relatively clean and can be directed straight into the surrounding watershed via the north/south perimeter trenches. Access to the wells is by a road constructed adjacent to the trenches.

Table 18-7. Average pumping rate per dewatering well ("DW")

Dewatering Well	Pumping Rate (IGPM)
DW1	720
DW2	720
DW3	720
DW4	720
DW5	720
DW6	720
DW7	720

18.4 Transportation Logistics (Rail and Port)

Astray Load Out Site Rail Operations

A rail siding will be constructed along-side the existing TRT main line (Menihek subdivision) to process loading of rail cars with fine and lump product as well as to receive shipment of maintenance parts and diesel fuel. A standard rail car side loading arrangement, seen in Figure 18-11, is proposed to limit the footprint of the rail loadout.

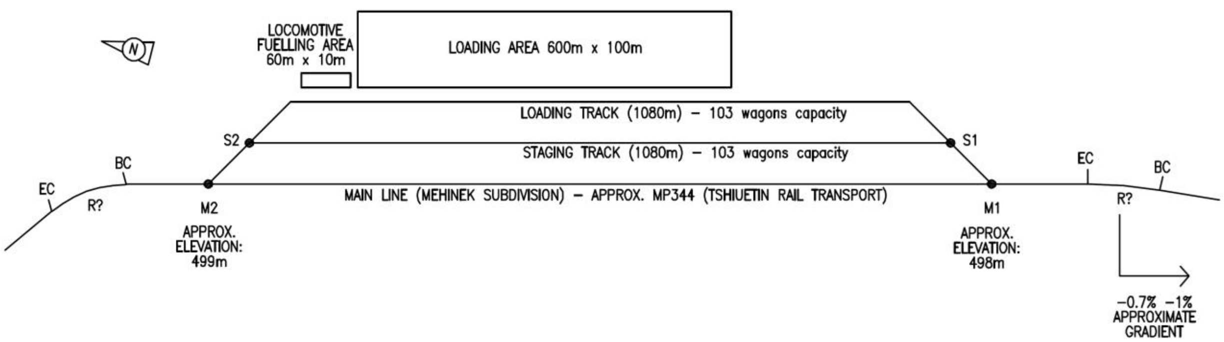


Figure 18-11: Proposed rail siding configuration

The total track length required for this option is roughly 2.4 km with 4.6 m (15 ft) track spacing. The siding configuration shown above requires approximately 30 shunting maneuvers to be performed during the train loading sequence.

Off-site Rail and Port Operations

Rail transportation of products will be a contracted service provided by the operators of the railway network connecting Schefferville to the multi-user ocean port at Pointe-Noire. As such, the Client will not build and/or directly own infrastructure outside of the rail siding area provided in the Project, excluding the product and fuel railcars. All other support rail transportation equipment and services will be part of various transportation agreements that the Client will put in place with railway and other transportation service providers.

The Client has performed an in-house train logistics study and provided design parameters to BBA for this Feasibility Study. Based on an 88-hour cycle time, for production of 2.5 Mtpa (dry) of product, railway transportation logistics dictate that two train sets, each composed of 164 railcars (total 328 railcars), and two locomotives per train set, are required.

The Client has informed BBA that product from the Joyce Lake DSO Project will be transported to the multi-user port facility at Pointe Noire close to Sept-Îles, Québec for overseas shipping to China or elsewhere. The Client will arrange rail car offloading and stockpiling at the SFPPN facility at Pointe Noire and contract the Port of Sept-Îles ("POS") to receive the products by conveyor from SFPPN at its Pointe Noire Central Conveyor Tower, where the products will then be transferred to the multi-user wharf and ship loading services. The Client will not own or operate any infrastructure at the port terminal.

The five transport service providers required for the Project are listed in Table 18-8.

Table 18-8: Transport service providers

Rail and Other Transport Service Providers	Destination Route	General Description of Service Provided
Tshiuetin Rail Transportation ("TRT")	Astray product load out area	Railcar loading shunting and spur track maintenance
TRT	Rail haulage from Astray product loadout to Emeril Junction	Rail car haulage and train operation between Astray product loadout and Emeril Junction
Québec North Shore and Labrador ("QNS&L")	Rail haulage from Emeril Junction, Newfoundland to Arnaud Junction Québec	Railcar haulage and supply/maintain locomotives
Société ferroviaire et portuaire de Pointe-Noire ("SFPPN")	Rail haulage from Arnaud Junction to SFPPN's Pointe Noire facility	Railcar haulage, unloading, laydown, reclaim, and conveyor product transfer to Port of Sept-Îles Central Tower at Pointe Noire
Port of Sept-Îles ("POS") at Pointe Noire	Central Conveyor Tower to Pointe Noire Multiuser Wharf and Ship Loading	Conveyor transfer of the product to POS Pointe-Noire multi-user wharf and ship loading
Ocean Shipping	Primarily to China or other seaborne destination	Shipping to China or other seaborne destination

19. Market Studies

Mysteel was contracted by the Client to evaluate the Chinese market demand, premiums and penalties and estimated net realized pricing for the Joyce Lake high-grade ("HG") and low-grade ("LG") lump and fines products to be sold in China. Mysteel was provided the Joyce Lake Product Specifications to determine the proper iron ore indexes by which the Joyce Lake selling price would be established. These indices are based upon similar products currently in use in the Chinese market.

19.1 Overview of Iron Ore Supply

The top five seaborne suppliers of iron ore are Australia, Brazil, South Africa, Canada, and Ukraine; Australia and Brazil, predominantly, exporting at nearly 88.6% of the seaborne supply at more than 100 Mt of iron ore in 2021. China's run-of-mine ("ROM") production capacity reached 1.18 billion tonnes in 2021, an increase of 10.2 Mt from 2020. During this time, China's mining sector has undergone regulatory reforms that favour large state-owned firms over private firms, as well as underground mining over open pit sites. As a result, the ROM capacity of state-owned mines rose by 3.4% between 2019 and 2020 while capacity of private mines fell by 1.9%.

Global steel production increased by 3.8% compared to China's decreased production of 3.0% in 2021. China's decreased production can be attributed to the global pandemic and policies shifting towards higher quality feed materials and products. In 2021, the global crude steel output (excluding China) increased by 12.92% year-on-year, exceeding the level of production and consumption before the pandemic with the rapid recovery of the manufacturing industry.

China's steel production growth will be challenged until 2030, after which a decline is expected until 2060 due to falling demand. China's 14th Five-Year Plan calls for a decline in annual crude steel capacity by 2025 as part of efforts to reduce carbon emissions. Mysteel assumes that the capacity replacement program will occur at an average ratio of 1.25:1 during the current Five-Year Plan, with total capacity down some 100-150 Mt during this period as a result. Despite this planned reduction in its crude steel manufacturing sector, China's capacity will remain the world's largest by 2025 and still be importing approximately 1 billion tonnes of iron ore in 2030.

19.1.1 Iron Ore Supply and Demand Balance

The iron ore market has been experiencing three stages of supply-demand balance over the past decade. Between 2010 and 2016, driven by the uptrend of global crude steel production and pig iron production, especially from China, global iron ore miners have been actively expanding their production capacity with Fortescue Metals Group Ltd. ("FMG") taking the lead for fast expansion, resulting in an overcapacity, and driving the average iron ore price down to below USD60/t in 2015. After that, the narrowing profit margin caused by the dropping iron ore price has forced some marginal miners to shut down production. As a result, there was a tight supply and demand balance during 2016 and 2019. In 2019, a supply shortage occurred until 2021 due to the dam accident of Vale, which affected production significantly, while other new mine projects cannot offset the supply loss.

Vale is expected to resume its full capacity by 2022; combined with the commission of the Gudai-Darri project owned by Rio Tinto, iron ore supply-demand scope is expected to see a new cycle of movements as a result.

China has been the single most important driver of global seaborne iron ore prices for almost the last two decades due to its size as the biggest iron ore consumer by far. With over 1 billion tonnes of crude steel output and over 1 billion tonnes of iron ore imports a year, China now buys up about 70% of the total seaborne iron ore supply which represents over 80% of its total domestic iron ore consumption coming from import.

During the early 2000's, China's iron ore demand began growing, making China a dominant global consumer of iron ore, driving the Super Cycle to its peak first in about 2006 and then in 2011. Consequently, the sector saw some massive expansions by existing miners and developments by aspiring producers. Fortescue was a very successful and new world-class player comparable with the Big Three of the time (Vale, Rio Tinto, and BHP) and thus creating an oligopoly of the Big Four. It took a few years, up to about 2015, for the Big Four to complete their expansions to a total production of over a billion tonnes, driving down their cost of production and iron ore prices and squeezing out marginal producers. The Super Cycle, therefore, ended upon the cumulative impact of concurrent expansions of major producers collapsing iron ore price to below USD50/t by 2015. As China started to resume steel demand growth, and therefore iron ore consumption, iron ore price started to recover to the levels of today.

In the meantime, physical/spot and futures markets were created, providing liquidity for efficient iron ore trading. In 2019, the accident of the Brumadinho tailings dam collapse in Brazil resulted in a supply shortage and boosted the iron ore price during the year, providing a catalyst for the market to realize the subtle fundamental dynamic changes since the bottom of the market. Since 2020, a new cycle of recovery has begun. Helped by expectations of global fiscal stimuli by major countries post-COVID-19 disruptions, strong iron ore price performance has been seen in addition to already favourable fundamental factors.

Over the cycles of the last decades, the global iron ore market underwent historic fundamental changes in supply and demand with price fluctuating to peaks over USD200/t and a bottom below USD50/t. Nevertheless, the market has returned to its status quo of an oligopolistic market of supply dominated by the Big Four. This condition provides a certain stability to the market, supported by the stable demand from China consuming most of the market supply.

19.2 Potential Markets for Joyce Lake Products

Mysteel concluded that iron ore with the mineral composition of Joyce Lake HG and LG products is in high demand among China's steel mills and beneficiation plants, however some products will require blending due to high-silica contents.

19.2.1 Potential Demand Among Steel Mills

Mysteel survey results indicate a generally positive demand for the Joyce Lake HG iron ore at steel mills. Moreover, they found the HG high-silica ore can be used in most Chinese steel mills by blending with low-silica products, particularly in the Hebei province, a region with an abundance of HG concentrates with low-alumina and silica contents that can be easily blended.

Currently, the region's steel mills are a major consumer of Brazilian high-silica fines. The silica contents of the Joyce Lake HG lump and fines is comparable and offer lower alumina and phosphorus in comparison with the Brazilian fines. For the Joyce Lake LG iron ore, blending with high-grade, low-silica varieties such as the Brazilian or Chinese concentrates would be necessary. The Joyce Lake LG fines compare favourably to the Indian fines in terms of alumina content while the Joyce Lake lump compares favourably to Hainan lump in terms of lower phosphorus and alumina content.

19.2.2 Potential Demand Among Beneficiation Plants

China is home to 56 beneficiation plants with a current annual capacity of 80 Mt, the majority located near seaports in coastal provinces (Mysteel, 2022). These beneficiation plants are able to remove the silica content of LG hematite iron ores from Joyce Lake to produce HG concentrates.

In 2021, China imported 1.12 billion tonnes of iron ore, of which only 52 Mt was used at beneficiation plants. Market participants are likely to see significant potential in this trade moving forward, as concentrate production grows more profitable amid rising demand and prices. These plants are increasingly using higher grade iron ore to reduce carbon emissions and improve efficiency.

Joyce Lake low-grade lump and fines may be an attractive product for steel mills but would require extensive blending with high-grade iron, low-grade silica product. According to Mysteel's research, the Joyce Lake low-grade products would more easily be sold to iron ore beneficiation plants typically located on the Chinese coast, for which there is a strong demand for imported ore. A Mysteel survey finds that iron ore procurement in steel mills and beneficiation plants are basically the same. These plants would purchase the product for upgrading the iron content and reducing the silica content before selling to steel mills.

19.3 Iron Ore Index Pricing

Comparisons were made between Joyce Lake products and comparable indices available in the market to develop a recommended index for pricing purposes. Iron ore indices are developed by combining the spot prices with financial instruments such as futures contracts to create models. Three-year trailing averages of the relative iron ore indices, premiums and penalties provide the basis for the assumed base price to be used in the current Study. Penalties and premiums are based upon ranges of elemental grades based off a 62% Fe benchmark as is the standard for the Chinese market. Table 19-1 details the four products from the Joyce Lake deposit (HG Lump, HG Fines, LG Lump, LG Fines) as well as the index selected as a relative basis.

Table 19-1: Realized price calculations for the four Joyce Lake deposit products (categorized by HG, LG, lump and fines)

Joyce Lake Specifications – Selling to Steel Mills (for LG Fines: Selling to Steel Mills/Beneficiation Plant)						
Products	Fe (%)	SiO_2 (%)	Al_2O_3 (%)	P (%)	S (%)	Moisture (%)
HG Fines						
Joyce HG Fines	60.31	10.73	0.72	0.02	0.05	7.04
Crude Brazilian Fines	61.90	8.14	0.81	0.04	-	6.80
HG Lump						
Joyce HG Lump	63.36	6.38	0.32	0.02	0.05	4.00
South African Lump	64.49	5.13	1.17	0.05	0.02	1.34
LG Fines						
Joyce LG Fines	52.34	22.27	0.80	0.02	0.05	7.04
Indian Fines	51.88	8.60	6.48	0.06	0.02	8.72
LG Lump						
Joyce LG Lump	54.98	18.47	0.35	0.02	0.05	4.00
Hainan Lump	55.00	17.50	1.50	0.08	0.90	1.00

19.3.1 Crude Brazilian Fines

The iron grade of Brazilian crude fines ranges from 58%-65% and those produced in the south of Brazil primarily have high-silica and low-alumina content. The Joyce Lake HG fines have comparable silica content; however, offer greater benefits since they have lower alumina and phosphorus content.

19.3.2 South African Lump

South African iron ore varieties tend to be high-grade with few impurities; however, contain high-alkali metals that have a negative impact on the metallurgical properties of coke. They are favourable in terms of silica and iron content; however, the Joyce Lake HG lump compares favourably in terms of alumina and phosphorus content.

19.3.3 Low-grade Indian Fines

Indian fines have an Fe grade that ranges between 50% to 63%, though the alumina content can be prohibitively high for many steel mills. Joyce Lake's LG product has an advantage given its lower alumina content, whether it's being sold to a steel mill directly or to a beneficiation plant. Though Joyce Lake fines contain lower alumina, the silica content will require blending with high-grade, low-silica varieties.

19.3.4 Hainan Lump

Hainan lump is mainly produced by China's Hainan Mining Co., Ltd., whose main business sectors include iron ore mining, beneficiation plants and sales. Its main products include iron ore lump, fines, and concentrates. Hainan lump is derived from a sedimentary metamorphic iron ore deposit and their typical values are as follows: Fe: 53% - 57%, SiO_2: 15.5% - 19.5%, Al_2O_3 <1.5%, S<0.9%, P<0.08%, particle size between 8 mm and 40 mm, and moisture <1%. Hainan lump is high in silica and low in alumina and phosphorus. They are the primary choice for acidic components to charge burdens.

The Joyce Lake LG lump compares very well to the Hainan lump in terms of its iron and silica contents with a slight advantage of having a lower alumina content. The higher moisture of the low-grade lump should not entail major penalties, especially since the lump product will likely be sold to a beneficiation plant where moisture content has less, or no, impact on the process.

19.3.5 Iron Ore Pricing for Project Financial Evaluation

It is expected that Joyce Lake HG products above 60% Fe with silica content between 6.4% to 10.7% will be in demand by steel mills, especially those that have access to low-silica blending products, such as in the Hebei region. The demand will be limited partially by the rate at which the steel mill can blend down the high-silica contents.

Joyce Lake LG lump and fines less than 55% Fe with silica between 18.5% to 22.3% will require extensive blending with higher grade and low-silica iron ore. These products may be more easily sold to iron ore beneficiation plants with a capacity to process 80-90 Mtpa of low-grade ore, that would upgrade the iron content and reduce the silica content to then sell to steel mills.

19.3.6 Selling Price, Premiums and Penalties

Mysteel has provided the price, premium and penalty for each index comparator on a three-year and look-back monthly average. Mysteel uses its seaborne and portside spot price indices (converted to USD/dmt) and the cost and freight ("CFR") China port price as the benchmark for the calculations (Table 19-2).

Table 19-2: Mysteel index summary (as of March 31, 2022) (Mysteel, 2022)

Mysteel Index (Summary)	3-year look-back (USD/dmt)	5-year look-back (USD/dmt)
62% Fe Australian Fines (SEADEX)	124.95	103.03
62% Fe Low Alumina Fines	126.72	104.87
Crude Brazilian High-silica Fines	122.82	100.38
South African Fines	165.03	141.31
Hainan Lump	72.83	58.29
52% Fe Indian Fines	71.43	57.49
57% Fe Indian Fines	84.34	67.64

The price, premium, and penalties used in the summary below are all based on Mysteel indices (Table 19-3). The adjustment of premiums and penalties is based on the principle of proximity. The pricing of low-grade iron ore, which may otherwise be outside of applicable grade ranges, is still primarily based on a 62% Fe benchmark index with applicable discounts.

Table 19-3: Premiums and penalties (Mysteel, 2022)

Specifications	Range	3-year Premiums and Penalties (USD/dmt)	5-year Premiums and Penalties (USD/dmt)
Per 1% Fe	Fe: 60% to 63.5%	1.97	1.70
Per 1% SiO_2	SiO_2 : <4.5%	0.79	0.77
	SiO_2 : 4.5% to 6.5%	1.44	1.53
	SiO_2 : 6.5% to >9%	1.91	2.63
Per 1% Al_2O_3	Al_2O_3: <1% to 2%	3.44	3.52
	Al_2O_3: 2% to 3%	1.48	1.34
Per 0.01% P	P: 0.1% to 0.12%	2.01	1.90

19.4 Currency Exchange Rate

The CAD to USD exchange rate used in the Project economic evaluation analysis is a ratio of 1:0.77. This exchange rate represents a three-year look-back average as of March 2022, based on Bank of Canada data.

19.5 Rail Transportation, Port Handling and Ship Loading Services

The Client expects to enter contractual arrangements with three entities for the transportation and handling of iron ore products, these entities are as follows:

- Tshiuetin Rail Transportation Inc. ("TRT") railway for rail services between the Client's rail siding and Ross Bay Junction;
- Quebec North Shore and Labrador Railway ("QNS&L") between Ross Bay Junction and the port facilities;
- SFPPN railway and port hub at Pointe Noire and Port of Sept-Îles rail car dumping, stockpiling and ship loading services.

The Client has not yet entered into formal negotiations or agreements with any of the service providers. Furthermore, the Client has not confirmed costs of a capital, or of an operational, nature related to these service providers. Any future agreements with service providers will likely be confidential. The Client has, however, determined that the capacity at TRT and QNS&L, as well as the port facility, is sufficient to handle its products, even when considering the production plans of other iron ore producers.

Typical rail transportation service agreements in the Labrador Trough have historically involved take or pay contracts with the user supplying its own rail cars. Locomotives are usually supplied by the service provider possibly through a leasing arrangement. The Client has assumed that an agreement with QNS&L will also provide the required locomotives that will run through for use on both the TRT and QNS&L railroads.

19.6 Ocean Freight Costs to China

For the economic analysis of the Joyce Lake DSO Project, ocean freight costs from the port in Sept-Îles to a China port are assumed to be USD26.06/dmt shipped. This rate is based on loading vessels of greater than 150,000 tonne capacity (Cape Size Vessels).

20. Environmental Studies, Permitting and Social or Community Impact

Stassinu Stantec Limited Partnership (Stassinu Stantec) of Stantec, and Genivar (now WSP) were retained as the environmental consultants for the Joyce Lake DSO Project. Under their joint mandate, the following baseline environmental studies were conducted in support of the Environmental Assessment ("EA") and the Feasibility Study:

- Fish and Fish Habitat Baseline Study (Genivar, 2013);
- Fish and Fish Habitat Baseline Study Complementary Report (WSP, 2014a);
- Avifauna Baseline Study (Genivar, 2013); updated (WSP, 2021a);
- Mammal and Herpetofauna Baseline Study (Genivar, 2013);
- Vegetation Baseline Study (Genivar, 2013);
- Rare Plant Survey (WSP, 2014b);
- Air Quality Modelling (WSP, 2015a); updated (WSP, 2021b);
- Noise Modelling Study (WSP, 2015b);
- Phase 1 Assessment for Acid Rock Drainage and Metal Leaching (ARD/ML) (Stassinu Stantec, 2013); ARD/ML Assessment Update (Stantec 2021);
- Baseline Hydrogeology Scoping Study (Stantec, 2013);
- Characterization and Preliminary Treatability Testing of Tailings Effluent (Stassinu Stantec, 2013);
- Surface Water Baseline Study (Stassinu Stantec, 2014) in EIS Chapter 11 (Stassinu Stantec, 2021);
- Water and Sediment Quality Baseline Study (Genivar, 2013);
- Historic and Heritage Resources Baseline Study (Stassinu Stantec, 2014);
- Contemporary Aboriginal Use of Lands and Resources for Traditional Purposes – Baseline Study (Stassinu Stantec, 2014);
- Socio-Economic Baseline Study. Economy, Employment and Business (Stassinu Stantec, 2015);
- Sediment Pond Design (Stassinu Stantec, 2013);
- Closure and Reclamation Plan (WSP, 2015c);
- Bird and Bat Surveys (Groupe Hémisphères, 2022a); and
- Fish and Fish Habitat Survey Along the Projected Haul Road Crossings (Groupe Hémisphères, 2022b).

The following additional studies were conducted by other consultants in support of the EA and Feasibility Study.

- Joyce Lake and Area DSO Project – Hydrogeological Study (BluMetric Environmental, 2015);
- Joyce Lake and Area DSO Project Geotechnical Engineering Feasibility Study – Open Pit Design. (LVM, 2014);
- Joyce Lake and Area DSO Project Geotechnical Feasibility Study – Surrounding Areas (LVM, 2014).

In 2012, the EA process for the Project was initiated with the filing of a Project Description with the CEA Agency and with the filing of a Provincial Registration Document with the Government of Newfoundland and Labrador, Department of Environment and Climate Change ("NL-ECC"). Updated Project information was also provided in a Supplemental Information Package to government authorities in Q1 2013 and an additional Project Update was submitted in Q4 2014. The Project was paused in 2015 and was also placed on care and maintenance until late 2020. On May 21, 2021, an updated Environmental Impact Statement ("EIS") (addressing guidelines originally issued in 2012) was submitted to the federal government and was submitted as a new Registration document to the provincial government as the original Registration expired in November 2016. The federal conformity review of the updated EIS resulted in a number of Information Requirements to be addressed before the document could be released for technical and public review. The provincial Registration resulted in the requirement for a new EIS, with new guidelines issued in August 2022. At the recommendation of the federal government, one common EIS will be submitted to satisfy the requirements of both the federal and provincial EA processes.

On July 28, 2022, the Project received an extension to the time limit for the ongoing EA under federal legislation CEAA 2012. The deadline to submit the required information or studies in the Final Environmental Impact Statement Guidelines is December 31, 2025. A combined EIS is currently being prepared for filing with provincial and federal authorities as a requirement under the extension. The combined EIS will be a public document and will undergo a review in accordance with provincial and federal assessment processes.

In the meantime, in a letter dated November 7, 2022, the Impact Assessment Agency of Canada ("the Agency") has advised the outcome of a conformity review of the draft EIS for the Joyce Lake DSO Project, has determined that the draft EIS and the associated English EIS summary for the Project from Joyce Direct Iron (the Project "Proponent"), submitted on October 1, 2022, is sufficient to proceed to technical review by the Agency, federal authorities and Indigenous groups that have requested to participate in the review.

20.1 Environmental Setting

The Joyce Lake Property is located within an area of rolling hills and valleys reflecting the structure of the underlying bedrock. Elevation in the DSO Project area can vary from approximately 470 masl on the shores of Iron Arm up to approximately 560 masl at the high point on the Iron Arm peninsula. Figure 18-1 shows the environmental features in the area including, watercourses and water bodies, wetlands, seasonal camps, existing roads, and planned infrastructure layout.

There is no industrial activity within 25 km of the Project area and, as a result, regional and Project area baseline air quality is very clean and existing noise is reflective of natural conditions in the area. There are seasonal cabins along Iron Arm and also by Astray Lake; hence, modeling for noise and air quality was conducted to determine the potential for interaction with the occupants of these cabins and other receptors. The direction of the prevailing winds is from northwest to southwest.

As previously noted, a range of surveys were carried out within the proposed Project footprint and larger region to characterize the existing environmental conditions.

There are no designated sensitive areas or special areas in the Project footprint, including designated wildlife areas, stewardship zones, parks, and natural areas. Non-designated sensitive areas can include areas of importance to species of conservation concern, such as wetlands, which are located throughout the Project area. These and other potentially non-designated sensitive areas are documented and evaluated in the EIS.

The biophysical environment in which the Project lies is within the Mid-Subarctic Forest Ecoregion and the High Subarctic Tundra Ecoregion of Western Labrador. Habitat types common to Western Labrador are found throughout the Project area. These habitat types potentially support a range of wildlife species that are common throughout the region such as migratory caribou, moose, black bear, grey wolf, Canada lynx, and a variety of small mammals.

There were no observations of any vascular plant species listed under Schedule 1 of the *Species at Risk Act* (SARA) or the *Newfoundland and Labrador Endangered Species Act* (NLESA) during surveys of the PDA. In general, the examination of existing information and the results of field studies indicates that habitats in the region support a diversity of flora species common to Labrador. There are eight species of conservation concern known, or thought to be present, within (or in close proximity to) the Project area. Several bird species that may occur in the region are listed as species at risk or of conservation concern, such as Olive-sided Flycatcher (*Contopus cooperi*), Grey-cheeked Thrush (*Catharus minimus*), and Rusty Blackbird (*Euphagus carolinus*). A bird study conducted in 2021 identified Barrow's Goldeneye (*Bucephala islandica*; probably in migration between their breeding and molting grounds), Bank Swallow (*Riparia riparia*; colony identified on the sandy bank of a river but preferred breeding habitat is scarce), and Rusty

Blackbird (relatively common with numerous wetlands suitable as breeding habitat) (Groupe Hémisphères, 2022a).

A total of seven species were observed during the short transects conducted during the 2021 spring migration survey; Rusty Blackbird was the only species at risk observed. Four passerine species and one shorebird species were identified during the wetland survey component of the 2021 spring migration survey; Rusty Blackbird was the only species at risk observed (Groupe Hémisphères, 2022a).

A total of 21 bird species were observed during the 2021 spring migration survey, including one species at risk (Rusty Blackbird). In total, seven species of waterfowl and two species of birds of prey were observed during the overland flights of the 2021 spring migration survey (Groupe Hémisphères, 2022a).

In total, 59 avian species were observed during the 2021 breeding bird survey, including three species at risk (Barrow's Goldeneye, Bank Swallow, and Rusty Blackbird). In total, 15 different species were observed during the overland flights conducted during the 2021 breeding bird survey; Barrow's Goldeneye was the only species at risk detected. Wetland surveys conducted during the 2021 breeding bird survey confirmed the presence of 47 species, which includes landbirds, waterfowl, gulls, terns, shorebirds, and birds of prey (Groupe Hémisphères, 2022a).

In total, 11 different species were observed during the overland flights of the 2021 fall migration survey; Barrow's Goldeneye was the only species at risk detected. In total, 15 different species were identified during the short transects of the 2021 fall migration survey; no species at risk were observed during these surveys (Groupe Hémisphères, 2022a).

It is possible that two species of bat – Little Brown Myotis (*Myotis lucifugus*) and Northern Myotis (*Myotis septentrionalis*) are present within the Local Study Area. A survey conducted in 2021 identified Little Brown Myotis from recorded vocalizations during the reproduction and migration periods. Although the Northern Myotis could potentially be present in the study area, its presence is less likely (Groupe Hémisphères, 2022a).

Project Area

A number of environmental baseline studies have been undertaken in support of the EA. At least two mammal species of conservation concern may occur in the Project area: Pygmy Shrew (*Sorex hoyi*) and Least Weasel (*Mustela nivalis*); both are considered rare by the Atlantic Canada Conservation Data Centre and vulnerable to extirpation from the province.

Following possible changes to the proposed haul road that connects the processing plant at the mine site to the Astray rail yard, seven potential water crossings had remained unassessed for fish and fish habitat in previous baseline studies carried out to support the environmental assessment process. Of the seven potential streams located at the crossings, only four were present within the projected haul road limits. The other streams were either too small or were isolated by a permanent obstacle to fish migration. Most streams intersecting the projected haul road limits were smaller than anticipated and are run-off from wetlands. Only one of the water crossings presented characteristics suitable for fish habitat and fishing caught White Sucker (*Catostomus commersonii*), Longnose Sucker (*Catostomus catostomus*), and Brook Trout (*Salvelinus fontinalis*) using minnow traps and Lake Chub (*Couesius plumbeus*) was collected using a seine net in proximity to the mouth of the lake located upstream of the stream (Groupe Hémisphères, 2022b). There are no known fish species at risk within the Regional Study Area.

Baseline water quality and sediment quality results show that existing surface water and sediment quality is good, with several parameters occasionally, and slightly, exceeding ecological water and sediment quality guidelines. The aquatic environment includes a number of large lakes, ponds, and streams in the Project area that ultimately drain into the Smallwood Reservoir and down into the Churchill River to the Atlantic Ocean. Based on surveys conducted in 2012 and 2013, fish species and habitat in the Project area are common to western Labrador and none are considered to be of conservation concern. Indigenous and recreational fisheries lie in close proximity to the Project and interactions with these fisheries are assessed in the EIS.

In terms of the socio-economic environment, the areas most likely to interact with the DSO Project are the nearby community of Schefferville, the Innu community of Matimekush-Lac John, and Naskapi community of Kawawachikamach. These communities are located in Québec near the provincial border. In addition, the Project will interact with the primary places of residence for the labour force in western Labrador (e.g., Labrador City, Wabush, Churchill Falls) as well as with the Innu Nation of Labrador, the NunatuKavut Community Council and the Innu First Nation of Uashat mak Mnai-Utenam. The Project will interact with land and resource use by Indigenous peoples and the general public, and will also interact with historic and cultural resources. These interactions are assessed in the EIS.

The EIS provides detailed descriptions of the existing biophysical and socio-economic environments that could be affected by the Project for each Valued Component ("VC").

20.2 Jurisdiction, Applicable Laws and Regulation

The infrastructure for the Project is located wholly on provincial Crown Land. The surface rights belong to the Government of Newfoundland and Labrador, with the exception of a small area of land at the intersection of the Project's new Astray rail siding with the Tshiuetin Rail Transportation ("TRT") railway. The Client will submit an application to the Province for a mining lease on Crown Land, and will enter into an agreement with TRT for use of their land to connect the new rail siding. Iron ore products will be shipped on an existing rail to Point Noire in the Sept-Îles area of Québec and no changes to Port Authority or adjacent lands in Québec are required for this Project to proceed.

The Project is subject to an EA in accordance with provincial and federal requirements. Mining projects in the Province of Newfoundland and Labrador are subject to EA under the Newfoundland and Labrador *Environmental Protection Act*, and associated *Environmental Assessment Regulations*. The Project is also subject to a Federal EA under the *Canadian Environmental Assessment Act*, 2012. As projects currently undergoing assessment under CEAA 2012 must receive release from CEAA 2012 by August 22, 2022, the Project received, on July 28, 2022, an extension from the Agency to continue the federal EA under the CEAA 2012 process until December 31, 2025.

The provincial and federal EA processes are public and work in parallel. An overview of the EA processes is provided in the sections below.

Federal EA is required because the Project triggered CEAA 2012 since it involves the construction, operation, decommissioning and abandonment of a metal mine, other than a gold mine, with an ore production capacity greater than 3,000 t/d. Designated Projects require a "screening" by the Agency to determine whether an EA is required. The federal decision-making and coordinating authority is the Impact Assessment Agency of Canada (. Other federal departments may also provide specialized knowledge or expert advice through both the federal and provincial EA processes.

To initiate the federal process, a Project Description document was submitted to the Agency in November 2012 along with a Summary Document that was provided in both official languages. The Summary Document was distributed by the Agency to federal departments, as appropriate, and is posted on the Agency website for access by the general public. A Supplemental Information Package was provided to the federal Agency and the NL-ECC in February 2013. Final EIS Guidelines were issued by the Agency in March 2013. These guidelines were used to prepare an update of the EIS, which was submitted to the Agency for a conformity review in May 2021. Information Requirements resulting from the federal conformity review were provided to the Client in July 2021.

The provincial environmental assessment process is initiated by submitting a formal registration of the Project to NL-ECC for review. At the conclusion of the review period, the Minister advises the proponent whether the Project will require an Environmental Preview Report ("EPR"), an EIS, or if the Project has been released or rejected. The provincial process was initiated in November 2012 with submission of the Project Description document, which served as the registration. The Minister of NL-ECC informed the Client in December 2012 that an EIS is required for the Project. A Supplemental Information Package was provided to the NL-ECC in February 2013 and Final EIS Guidelines were issued in December 2013. The original EA process expired in 2016 and these guidelines were used to prepare an update of the EIS, which was submitted in May 2021 to fulfil the requirements of a new Registration. The NL-ECC determined that a new EIS was required and issued final EIS Guidelines on August 12, 2022. The EIS Guidelines establish the nature, scope and minimum information and analysis required in preparing the provincial requirements for inclusion in the EIS including the requirement for limited new baseline studies. The new baseline studies are underway and are expected to be complete in 2023.

Based on recommendation from the Agency, the Client will be combining the federal and provincial EIS's to submit identical EISs to both processes. With the new studies requested by the Province, the results are expected to be available in 2023. The Client also submitted a request to the Agency for extension of the EA process under CEAA , which was granted by the Agency on July 28, 2022.

The final EIS, targeted for submission in 2023, is expected to be reviewed by the separate provincial and federal committees, including subject area experts, identified Indigenous Groups and will also be available for public review and comment. Review comments from the committees, Indigenous Groups and from the public will be considered when a determination of the environmental implications and significance of adverse environmental effects of the Project is made by the federal and provincial governments.

At the completion of the EIS review period, the responsible provincial and federal Ministers will each decide if additional information is required. Upon a determination of sufficient EIS information, the two levels of government will each decide if the Project may proceed and will issue their decisions separately. The provincial and federal governments will each determine if permits/authorizations may be issued, and conditions that may apply. A list of permits that may apply to the Project is provided in Section 20.4.

The Project will require an Authorization from DFO under the *Fisheries Act*, an Application to Transport Canada to construct a major work (causeway) under the *Canadian Navigable Waters Act* and Environment and Climate Change Canada ("ECCC") will require aquatic Environmental Effects Monitoring ("EEM") (as per MDMER) under the *Fisheries Act*.

20.3 Environmental Studies

The draft EIS submitted to the Agency on May 21, 2021 was prepared based on the guidelines issued by the federal government, and also based on the provincial government EIS Guidelines issued in 2013. A conformity review of the submitted draft EIS was completed by the Agency on July 05, 2021 and the proponent subsequently revised the draft EIS and resubmitted it to the

Agency on October 13, 2022, who then determined on November 07, 2022 that it conformed with requirements and that the Agency was continuing with a technical review of the draft EIS,

Joyce Direct Iron, in compliance with the Agency and NL-ECC final guidelines, is targeting completion of additional baseline data collection and other studies, receive and include feedback from the Agency on the draft EIS technical review and do further consultation with designated Indigenous Groups so as to submit a single final EIS to both the Agency and NL-ECC in 2023.

The assessment methods used in the preparation of the draft EIS included an evaluation of the potential environmental effects for each VC that may arise during the Project as well as from accidental effects. VCs are environmental attributes with which the Project may interact, and are of value or interest to Indigenous groups, regulatory agencies, the Client, scientists, and/or other stakeholders. VCs specified in the EIS Guidelines and assessed in this EIS are:

- Atmospheric Environment and Climate;
- Water Resources;
- Groundwater Resources;
- Terrain and Acid Rock Drainage/Metal Leaching;
- Wetlands;
- Fish and Fish Habitat;
- Birds, Wildlife, and their Habitats;
- Species at Risk and Species of Conservation Concern;
- Historic and Cultural Resources;
- Current Use of Land and Resources for Traditional Purposes by Indigenous Persons;
- Other Contemporary Land and Resource Use;
- Community Services and Infrastructure;
- Economy, Employment and Business;
- 2021 Bird and Bat Surveys;
- 2021 Fish and Fish Habitat Survey along the Projected Haul Road Crossings.

The Client has actively engaged with a variety of stakeholders, including Indigenous groups, members of the public, and regulatory agencies throughout the Project design and EA processes. Indigenous groups designated by the Agency, and consulted in preparation of the Project assessment, include:

- Innu Nation of Labrador;

- Naskapi Nation of Kawawachikamach;
- Innu First Nation of Matimekush-Lac John;
- Innu First Nation of Uashat mak Mani-Utenam;
- NunatuKavut Community Council.

Issues and responses have been documented and incorporated throughout the EA, including through Project design and effects management procedures. Indigenous groups and other stakeholders have expressed considerable interest in the Project throughout the engagement process.

The potential interactions of Project features and activities with the existing environment were identified and potential effects were assessed for the Construction, Operation and Maintenance, and Closure and Decommissioning phases. The activities reflect the scope of the Project as prescribed in the EIS Guidelines and form the basis of the effects assessment. Accidental events were also assessed, including train derailment, forest fire, hydrocarbon spill, settling / sedimentation pond overflow, and premature or permanent shutdown. The probability of an accidental event is low.

Mitigation measures are proposed to reduce or avoid adverse environmental effects. With the implementation of the mitigation measures, adverse residual environmental effects resulting from Project activities are predicted to be not significant for all VCs and project phases.

The evaluation of potential cumulative effects considered whether there was a residual environmental effect of the Project that would interact cumulatively with the residual environmental effects of other past, present, or future (i.e., certain or reasonably foreseeable) physical activities in the vicinity of the Project. Cumulative effects of ten other projects or activities in combination with the Project were assessed.

There are no likely significant residual effects or cumulative environmental effects predicted for any of the VCs. Monitoring programs will be implemented where warranted to verify the effectiveness of mitigation measures and the accuracy of effects predictions. As discussed in the relevant sub-sections of each VC, although significant effects could occur to several VCs as a result of accidental events, the likelihood of occurrence is low.

The Project will result in community and social benefits through direct and indirect economic effects including wages, salaries, government revenues and capital and operating expenditures.

As noted in Section 20, a number of environmental baseline studies have been undertaken in support of both the EA and the Feasibility Study. Details of the environmental studies and the results are presented in Appendices to the EIS (not all studies listed in Section 20 were included in the draft EIS submission). An analysis of the Project environmental effects will be presented for each VC in the final EIS.

20.4 Environmental Permitting

Following release from the federal and provincial EA processes, the Project will require a number of approvals, permits and authorizations. The proponent will also be required to comply with any other terms and conditions associated with the EIS release issued by the provincial and federal regulators. A preliminary list of permits, approvals, and authorizations that may be required for the Project are listed in Table 20-1, which are subject to confirmation with the responsible agencies following the completion of the EA process. Permits and authorizations may also be required from other jurisdictions, such as municipalities, if any are affected.

These permits, approvals, and authorizations will be required at various stages throughout the mine life.

Table 20-1: Potential environmental permits, approvals and authorizations anticipated to be required

Permit, Approval or Authorization	Issuing Agency
Provincial	
Release from EA Process Approval of Environmental Protection Plan Monitoring Plan for Certificate of Approval	NL-ECC Minister
Permit to Occupy Crown Land	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Crown Lands Division
Permit to Construct a Non-Domestic Well Water Use License Water & Sewage Works Water Resources Real-Time Monitoring Certificate of Environmental Approval to Alter a: body of water; culvert installation;fording; bridge; stream modification or diversion; and other work within 15 m of a body of water (site drainage,dewater pit, settling ponds) pipe crossing - water intake	NL-ECC – Water Resources ManagementDivision

Permit, Approval or Authorization	Issuing Agency
Certificate of Approval for Construction Certificate of Approval for Construction and Operation (Industrial Processing Works) Certificate of Approval for Generators Approval of Emergency Response Plan Approval of Environmental Contingency Plan Approval of Emergency Spill Response	NL-ECC – Pollution Prevention Division
Permit to Control Nuisance Animals	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Forestry and Wildlife
Approval of Development Plan, Rehabilitation and Closure Plan, and Financial Assurance Mining Lease Surface Rights Lease Quarry Development Permit	Newfoundland and Labrador Department of Industry, Energy and Technology – Mining and Mineral Development
Blasters Safety Certificate Magazine Licence Approval for Storage and Handling Gasoline and Associated Products Approval for Temporary Fuel Cache Fuel Tank Registration Approval for Used Oil Storage Tank System (Oil / Water Separator) Certificate of Approval for Waste Management System Permit to Construct Drinking Water and Wastewater Infrastructure Building Accessibility Registration and Permit Food Establishment Licence National Building Code – Fire, Life Safety, and Building Safety	Service NL
Operating Permit to Carry Out an Industrial Operation during Forest Fire Season on Crown Land Permit to Cut Crown Timber Permit to Burn	Newfoundland and Labrador Department of Fisheries, Forestry and Agriculture – Forestry and Wildlife
Approval to Construct and Operate a Railway in Newfoundland and Labrador	Newfoundland and Labrador Department ofTransportation and Infrastructure
Federal	
Release from EA Process	Agency
Fisheries Act Authorization for harmful alteration, disruption or destruction of fish habitat	Fisheries and Oceans Canada (DFO)
Approval to Interfere with Navigation	Transport Canada

Permit, Approval or Authorization	Issuing Agency
Designation of a Tailings Impoundment Area Effluent Monitoring and Aquatic Environmental Effects Monitoring in accordance with the *Metal and Diamond Mining Effluent Regulations* under the *Fisheries Act* (including notification, identification of final discharge point, and all required components of effluent monitoring, and environmental effects monitoring) Approval of MDMER Emergency Response Plan	Environment and Climate Change Canada (ECCC)
Licence to Store, Manufacture or Handle Explosives (Magazine License)	Natural Resources Canada
Approval to Construct a Railway	Canadian Transportation Agency

20.5 Geotechnical

The open-pit geotechnical site investigation was performed to gather rock mass characteristics for the preparation of a preliminary Engineering Geology Model.

The stratigraphic conditions encountered within boreholes consist typically of a downward sequence of overburden or highly weathered bedrock followed by bedrock.

Table 20-2 illustrates the stratigraphy encountered at each borehole location in terms of depth and elevation.

Table 20-2: Subsoil stratigraphy observed in boreholes

Borehole Elevation (m)	Length Geodesic Elevation (m)			
	Overburden or Highly Weathered Bedrock[(1)]	Iron Formation	Shale	Sandstone
BH-P-01 [527.85]	0.00 – 7.00 [527,85 – 520,85]	7.00 – 118.90 [520,85 – 416.12]	118.90 – 134.10 [416,12 – 401,84]	134.10 - ≥160.00 [401.84 - ≤377,50]
BH-P-02 [522,18]	0.00 – 3.00 [522,18 – 519,18]	3.00 – ≥173.00 [519,18 – ≤372.36]	---	---
BH-P-03 [526,33]	0.00 – 9.00 [526,33 – 517,87]	9.00 – 78.00 [517,87 – 453.03]	78.00 – 108.50 [453,03 – 424,37]	108.50 - ≥160.70 [424.37 - ≤375,32]
BH-P-04 [519,26]	0.00 – 1.50 [519,26 – 517,85]	1.50 – ≥160.00 [517,85 – ≤368.91]		

(1) Thickness of overburden may be lower than indicated since it was impossible to collect samples

From a thickness of 3 m to 9 m, either overburden or highly weathered rock was found at the surface within boreholes BH-P-01 to BH-P-04.

It should be noted that in all borehole locations, visual observations showed that overburden seems to be thin and that rock outcrops are frequent. No recovery was possible down to a certain depth when initiating the boreholes. It is therefore impossible to assess if the first runs are in highly weathered bedrock or in overburden.

Iron Formation (Rock Types A and B and Group I)

The Iron Formation consists of iron oxide with white and red chert, fine- to medium-grained, dark grey, with centimetric bands of white to reddish medium-grained chert and millimetric bands of fine-grained red chert. We note the presence of nodules of white chert and pockets of iron oxide.

This formation is highly fractured with limonite in most fractures. Mostly non-magnetic with few weakly magnetic zones were observed. This formation is also highly weathered with very low RQD values. Two main lithologies have been identified within Iron Formation:

- Massive, weakly to highly hydroxidized (limonite, goethite) Iron Oxide (Hematite) with chert (white, gray or red) - rock type A;
- Mainly massive, weakly to highly hydroxidized (limonite, goethite) Iron Oxide (Hematite) – rock type B.

No thicknesses of more than 5 m have been identified for rock types A and B from a geomechanical point of view, these two lithologies were grouped (Group I).

In the PEA, three members of units have been identified within the Iron Formation from a geological point of view. From a geomechanical point of view, all these members were grouped in one lithology (Group I).

Shale (Rock Type C and Group II) from Ruth Formation

This rock unit was only intercepted in BH-P-01 and BH-P-03. The shale unit consists generally of black shale with a zone of interbedded siltstone. This formation is not weathered and medium to high RQD values were measured.

Sandstone (Rock Type D and Group III) from Wishart Formation

As mentioned in the PEA document, the lithology was described as a sedimentary quartzite (metamorphic sandstone) and arkose, a quartz and feldspar clastic deposit. For the purpose of this study, this unit was described as grey sandstone from on-site geologists since no petrographic analysis has been performed on the sample.

Similar to shale rock unit, the sandstone was only intercepted by BH-P-01 and BH-P-03. Grey sandstone, fine to medium grain centimetric interbedded with black shale. This formation is not weathered and high RQD values were measured.

Classification of Rock Units

Arising from the previous section, three principal lithologies have been identified in the Pit area:

- Banded Iron Formation (Group I);
- Shale (Group II);
- Sandstone (Group III).

An essential part of a rock mass characterization program is the evaluation of intact rock strength for the various geological units. Laboratory testing of selected rock samples was carried out to measure the intact rock properties.

Intact Rock Strength Material Properties

Rock laboratory testing was performed on the selected samples obtained from iron oxide (Group I), shale (Group II) and sandstone (Group III) rock units of the site under investigation in the Project. The samples were selected to cover all major rock units at the site. The samples were sent to the Rock Mechanics Laboratory of Laval University. Overall, 66 samples were strength tested. In addition to the samples tested at Laval University, one batch of rock samples was sent to the LVM's rock and soil laboratory in Boucherville. Among the total samples that were sent to Boucherville, 31 samples were subjected to strength tests.

Of the 66 tested rock samples at Laval University, 27 rock samples were tested for uniaxial compressive strength ("UCS"), 33 samples for Brazilian Indirect Tensile Strength and six samples for triaxial compressive strength. Of the 31 samples tested at the Boucherville laboratory, three rock samples were tested for UCS, nine samples for Brazilian Indirect Tensile Strength and 19 samples for point load test.

The UCS, triaxial and Brazilian testing data for rock types A and B (hematite with white chert and mainly iron oxide) were used to develop the strength envelopes for the iron oxide rock units.

Investigations by the four geotechnical drillholes indicate that, at present stage of the Project, it is not possible to clearly delineate the spatial distribution of rock types A and B. The iron oxide with cherts (rock type A) is randomly intercepted along the geotechnical boreholes similar to the iron oxide with limonite alteration or hematite with hydroxide (rock type B); resulting in an extremely heterogeneous rock mass. This complexity needs to be addressed in the future geotechnical investigations. Due to the lack of information regarding the approximate distribution of the rock type A and B in the iron oxide zone, for this study, it was decided to combine the laboratory strength results for the rock types A and B and to deal with a broader range of rock matrix properties. It is recognized that the average values obtained by combining the test results for the rock type A and B would be more influenced by the results of rock type B, due to the greater number of tests available for this rock type.

Table 20-3 summarizes the lab testing results for the main rock units in the pit area.

Table 20-3: Intact rock strength material properties

Properties		Lithology		
Parameter	**Value**	**Iron Formation**	**Shale**	**Sandstone**
Unconfined Compressive Strength, σ_{ci} (MPa)	***Mean***	***60***	***96***	***195***
	Min	25	44	104
	Max	105	138	256
Brazilian Test, σ_T (MPa)	***Mean***	***7***	***10***	***14***
	Min	3	4	10
	Max	14	17	19
Unit Weight, γ (kN/m^3)	***Mean***	***32.5***	***27.6***	***26.4***
	Min	23.9	25.9	25.3
	Max	48.8	30.7	27.7
m_i		**8**	**9**	**14**

The mi values of the Hoek-Brown failure criterion of intact rock obtained for the shale and sandstone rock units (rock type C and D) were found to be characteristic when compared to typical values usually encountered for similar rock types. Typical mi values reported for the shale and sandstone rock units range between 4-8 and 13-21, respectively. The derived mi value for the iron oxide rock unit (rock type A+B) is relatively in the range of the mi values typically reported for fine to very fine grain sedimentary rocks.

The value of σ_{ci} obtained from the combination of all testing results for iron oxide samples (combination of rock type A and B), including UCS, triaxial and Brazilian test data, is slightly lower than the corresponding average UCS value of all tested samples. Therefore, at this stage, the average UCS value of all tested samples for rock types A and B (~ 60 MPa), was used to represent the intact rock strength of the iron oxide rock unit in the geomechanical pit design procedure.

Rock Mass Model

The rock mass strength is estimated using the Hoek-Brown failure criterion, which is expressed by:

$$\sigma_1 = \sigma_3 + \sigma_{ci}\left(m_b \frac{\sigma_3}{\sigma_{ci}} + s\right)^a$$

Where:

> m_b is the value of the constant m for the rock mass;
>
> s and a are constants that depend upon the characteristics of the rock mass;
>
> σ_{ci} is the uniaxial compressive strength (UCS) of the intact rock; and
>
> σ_1 and σ_3 are the axial and confining principal stresses, respectively.

Table 20-4 presents the Hoek-Brown parameters obtained for the different rock masses at the project area. The same table shows the equivalent Mohr-Coulomb cohesion and friction angle for the same rock masses.

It should be noted that the influence of blast damage on the near surface rock mass properties has been taken into account using D factor, which depends upon the degree of disturbance due to blast-induced damage and stress relaxation. Based on the evaluation of excavation method, this factor is considered equal to 0.7 corresponding to good quality blasting and mechanical excavation for the final pit wall profile.

Hoek Brown Failure Envelopes for iron oxide rock mass yields a rock mass strength of 3.5 MPa.

Table 20-4: Summary of Inferred rock mass strength parameters

Property		Value	Comments
Intact Rock Properties –Iron Formation			
Unit Weight (kN/m³)		32.5	Average Lab Test
Intact Uniaxial Compressive Strength, σ_c (MPa)		60	Average Lab Test
mi		8	Calculated
Rock Mass Properties –Iron Formation			
Geological Strength Index (GSI)		35	Evaluated Based on Observation
Disturbance factor D		0.7	Mechanical Excavation [1]
Generalized Hoek-Brown failurecriterion	a	0.516	Estimated with RocData
	m_b	0.225	
	s	1.00E-04	

Property		Value	Comments
Mohr-Coulomb	c, (MPa)	0.35	Estimated with RocData
	ϕ (°)	30.3	
Intact Rock Properties – Shale			
Unit Weight (kN/m^3)		27.6	Average Lab Test
Intact Uniaxial Compressive Strength, σ_c (MPa)		96	Average Lab Test
mi		9	Calculated
Rock Mass Properties – Shale			
Geological Strength Index (GSI)		50	Evaluated Based on Observation
Disturbance factor D		0	No effect
Generalized Hoek-Brown failurecriterion	a	0.506	Estimated with RocData
	m_b	1.509	
	s	0.0039	
Mohr-Coulomb	c, (MPa)	1.45	Estimated with RocData
	ϕ (°)	45.6	

Rock Mass Stability Assessment

Based on the preliminary Engineering Geological Model developed for the rock masses encountered in the Joyce Lake pit area, the iron oxide rock mass quality is considered as "weak". Kinematic failure modes in rock slopes typically include planar, wedge and toppling failures. These failure modes can be identified by using stereographic analysis of peak pole concentrations of the discontinuity data. The highly fractured rock mass and the variability of the banding direction with depth does not allow assessment of the stability with kinematic analyses at this stage. Consequently, the potential instability mode in the pit slopes is likely to be controlled by rock mass strength rather than structure, even at bench scale. For this reason, the slope design process was performed with analyses of the overall and inter-ramp slope angles, to determine a slope angle that meets the stability acceptance criteria presented in Table 20-5.

Table 20-5: Acceptance criteria for the pit slope design

Slope Scale	Consequences of Failure	Acceptance Criteria		
		FOS (min)(Static)	FOS (min) (Dynamic)	POF (max) P[FOS≤1]
Bench	Low to High	1.1	N/A	25%-50%
Inter-ramp	Low	1.15-1.2	1.0	25%
	Medium	1.2	1.0	20%
	High	1.2-1.3	1.1	10%
Overall	Low	1.2-1.3	1.0	15%-20%
	Medium	1.3	1.05	5%-10%
	High	1.3-1.5	1.1	≤5%

Conventional Limit Equilibrium Analyses ("LEA") are often conducted to evaluate the maximum overall slope angle for pit walls with an acceptable factor of safety. Slope stability assessment was performed using limited equilibrium analysis according to the Morgenstern-Price solution for circular slip surfaces.

The inputs for the LEA analysis are listed below:

- Slope configuration, defined by the slope height and inter-ramp slope angle;
- Material properties, assigned to the entire slope based on the dominant rock type (weighted density, cohesion and friction angle, obtained from the rock mass properties);
- Water Table, coinciding with the surface of the pit, to simulate the worst-case scenario;
- Seismic loading, simulated by an application of static forces, that represent seismic inertial forces resulting from potential ground accelerations caused by an earthquake (pseudo-static method).

The seismic loading requires the input of seismic parameters such as peak ground acceleration ("PGA") and the seismic coefficient (k). The PGA value was determined from Natural Resources Canada – Earthquakes Canada, 2013 based on the interpolation using the Shepard's method from a 10 km spaced grid of points. The value of PGA in the area of the proposed pit is 0.036 g, determined for a 2% in 50 years (0.000404) probability of exceedance according to Canadian National Building Code 2010 and 0.033 g, determined for a 2% in 50 years (0.000404) probability of exceedance according to Canadian National Building Code 2015

A series of multiple analyses was conducted to assess the influence of the underground water table position with regard to the pit slope surface. A distance of 15 metres was set as a minimum distance to avoid frost penetration to mitigate icing damage in the rock mass and also to avoid water pressure buildup in the slope wall due to icing restricting seepage flow. At the present stage of the hydrogeological study, a peripheral system of deep wells is considered for the underground water table control. Therefore, respecting a distance of 25 metres between the slope and the water table was considered feasible and was retained for the base case. Figure 20-1 presents the plotted curves where safety factors are plotted for 15 m and 25 m distances and different Inter Ramp Angles ("IRA") for the pit slope. It can be seen that for the last case, an IRA of 47° is acceptable and is retained as the design value. Based on the assumptions of using good controlled production blasting practices and trimming and forming of the final benches with mechanical excavation (D=0.7), the minimum safety factor of 1.3 obtained from the analyses is found to meet the required minimum safety factor of 1.2 based on common engineering practice for static loading conditions. For dynamic loading conditions, a safety factor of 1.27 was obtained.

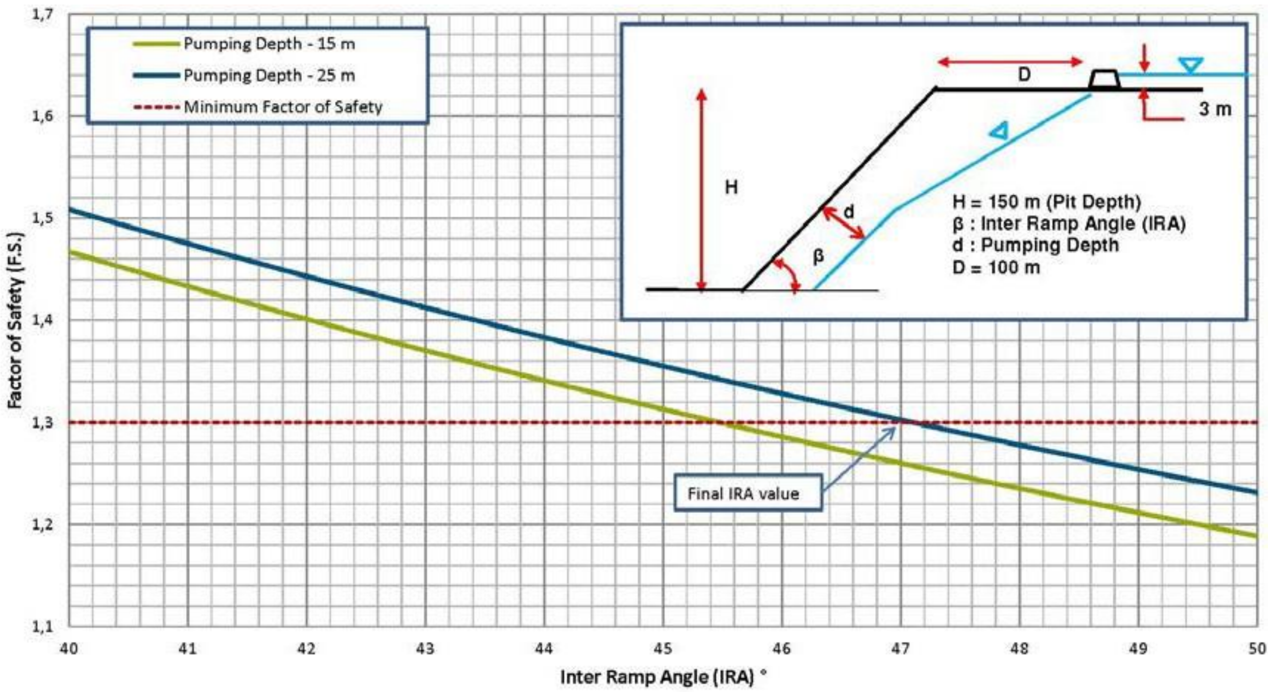


Figure 20-1: Safety factor vs. inter-ramp angle, depending on distance (15 m and 25 m) between slope and water table

20.6 Hydrogeology

For the dewatering of Joyce Lake and planning for general site water management, hydrogeological studies were undertaken in 2014 to determine the connectivity of groundwater in the target rock to surface water in Joyce Lake and to the water table for the surrounding watershed. Hydrogeological information will be used along with the pit construction design to develop a dewatering plan for Joyce Lake.

The hydrogeological study for the Project was completed by WESA, a division of BluMetric Environmental Inc. The work included four vertical boreholes that were drilled in order to conduct packer testing to obtain hydraulic conductivity information. Additionally, monitoring wells were installed to determine bulk hydraulic properties, and three-dimensional groundwater flow modeling was completed to assess drawdown effects in the pit area.

From the 2015 Joyce Lake Hydrogeological Study performed by BluMetric Environmental:

The main aquifers appear to be found in fractured bedrock. Under the current study, distinctive local groundwater flow systems of fractured rock systems are identifiable. The drilling campaign from the current study produced boreholes along the eastern and western limbs of the syncline. These boreholes intercepted several fracture zones over the length of the borehole. An attempt to correlate packer test results and interpretations with stratigraphy revealed both closed fracture zones interpreted as areas with limited groundwater flow and other zones where the fracture density in the rock mass is observed to be high and which is associated with regions in bedrock where groundwater flow could be high. Stratigraphic interpretations were drawn from correlations using current and the Client's core log reports.

The contours in the vicinity of the proposed pit are based on groundwater elevations measured on October 13, 2014 at five of the six installed monitoring wells. The sixth monitoring well, BH-P-04, had not yet been constructed on that date and the groundwater elevation was measured on October 18, 2014. These 2014 elevations were combined with groundwater elevations measured in October 2012 (Stassinu Stantec, 2013a) to determine groundwater flow directions in the vicinity of the proposed pit. Groundwater elevations range from approximately 505 masl near Joyce Lake, which correspondingly has an elevation range of approximately 505 - 511 masl northwest of Joyce Lake on the southwest flank of the syncline. Groundwater flows toward Joyce Lake. The groundwater flow velocity (*v*) in the area of the pit can be calculated using the following equation:

$$v = K/ne$$

Where:

K = hydraulic conductivity (m/s)

i = hydraulic gradient (dimensionless)

ne = effective porosity (dimensionless)

Horizontal hydraulic gradients in the pit area range from approximately 0.014 to 0.039. The bulk hydraulic conductivity in the pit area ranges from 10^{-7} to 10^{-6} m/s. Effective porosity in the study area has not been measured, and is not easily determined. The effective porosity is estimated to be 0.005. Based on these values, groundwater flow velocities in the pit area are estimated to range from 9 to 200 m/y.

Due to the need to use HQ-coring equipment for drilling and the limited time available, it was not possible to install nested monitoring wells to assess vertical gradients.

Beyond the immediate area of the pit, groundwater is inferred to flow toward Joyce Lake from a catchment area of approximately 1.82 km^2 (Stassinu Stantec, 2013a). Groundwater elsewhere on the peninsula reports directly to Attikamagen Lake or other smaller surface-water features.

Table C-1 in Appendix C of the Hydrogeological Study Report (BluMetric Environmental, 2015) summarizes the chemical results for the collected groundwater. The results were compared to Schedule 4 of the Metals and Diamond Mining Effluent Regulations ("MDMER"), the Canadian Water Quality Guidelines for Aquatic Protection, and Schedule A of Newfoundland and Labrador Regulation 65/03 (NL 65/03). All of the results were well below Schedule 4 MDMER and Schedule A of NL 65/03. Copper concentrations were above the WQI criterion for samples taken from monitoring wells JGW-1, JGW-3, and BH4 at 7.5, 9.9, and 4.7 µg/L respectively, while the zinc concentration was above the CWQG criterion for the sample collected from monitoring well JGW-1 (69.2 µg/L versus 30 µg/L).

Hardness concentrations ranged from 7.9 mg/L to 61.8 mg/L, alkalinity ranged between 14.9 mg/L and 53.1 mg/L (as $CaCO_3$) total dissolved solids ("TDS") ranged from 40 to 130 mg/L, and acidity results were between 11.6 mg/L and 15 mg/L.

Iron results were variable, from a low of <20 to 929 µg/L, which are still more than one order of magnitude less than the NL 65-03 criterion of 10,000 µg/L. Manganese concentrations were quite elevated, from a low of 414 to a high of 5,140 µg/L, these concentrations are of less concern because there are no standards for manganese.

Pit dewatering will be accomplished using large diameter dewatering wells that will be constructed with well screens surrounded by sand filter packs that will be thoroughly developed. It is expected that the dewatering wells will show improved water quality over the groundwater quality from samples already taken from the monitoring wells because of the filter pack and well development. This improvement of water quality has been our experience with another project in the Schefferville area. The water quality of the groundwater extracted from the dewatering wells is expected to be suitable for direct discharge to receiving water bodies given the groundwater results reported above. Water samples should be analyzed from each dewatering well after development to ensure the water is suitable for discharge.

Operation of the open pit mine will require dewatering to ensure that the water table is maintained below the bottom of the pit and more than 25 m from the pit walls. The most effective pit dewatering approach is considered to be a pit perimeter dewatering well system. Given the numerical model uncertainties reported in WESA (BluMetric Environmental, 2015), in 2022 Pinchin Ltd. ("Pinchin") compared the numerical groundwater model simulation results for the dewatering system to analytical estimates. The analytical estimates resulted in larger estimated inflow rates ranging from 8,200 m³/day to 27,000 m³/day (1,500 to 5,000 US gpm) based on the geomean and maximum measured bedrock hydraulic conductivities (K), respectively.

The preliminary dewatering design based on these higher inflow rates is described below.

- The optimum distance between dewatering wells to achieve the required drawdown is usually calculated from the results of aquifer tests performed during hydrogeologic investigations. Without larger scale hydraulic information for the Joyce Lake Project a Theis drawdown estimate using an assumed storativity (S) for fissured jointed rock of 1.1E-02 was evaluated by Pinchin (2022) and resulted in seven perimeter dewatering wells spaced 300 m apart at pumping rates ranging from 14 L/s (geomean K) to 45 L/s (maximum K) to achieve 135 m drawdown.
- The dewatering wells will be installed using an air rotary drill rig to depths of 250 masl, between 240 and 290 mbgs (the actual depth to be used for dewatering wells would be verified during future field tests but is assumed to be 220 m for the purposes of this FS). The well installations will be required to intersect productive fracture systems and be functional. Steel well screens will be installed upon completion with a minimum diameter of 8". The drilling and development of successful and useful dewatering wells can be highly variable in bedrock and wells with insufficient yield will need to be replaced. If unfavorable ground conditions are encountered, adjustments to the dewatering system may also be required to achieve the design objectives.
- The perimeter wells will have 6" submersible turbine pumps, or specialized pumps installed that are individually rated for flow rates of between 14 L/s to 45 L/s (210 to 720 US gpm).
- The perimeter trenches recommended by Stantec, to be constructed along the north and south of the open pit to collect surface run-off water, will also be used to collect water pumped from the open pit perimeter wells. Water collected in the perimeter trenches is expected to be discharged into Attikamagen Lake, contingent that the required water quality standards are met.
- Staged installation of pumping wells will provide additional data on aquifer characteristics and will enable a more efficient dewatering system design.
- Based on the preliminary analytical calculations conducted, the target drawdown of 135 m for the fully developed Joyce Pit would require 365 days of pumping at a rate of 14 L/s (210 US gpm), therefore dewatering well installations should be scheduled accordingly. This installation schedule will also allow time for pumping rates to be optimized to field conditions.
- Pump and well failures can lead to a rise in groundwater levels, which may affect mining operations. Pump replacement can be easily completed but the lag time for repairing a well failure can be a concern because it could take more than several months for drilling, installing and commissioning a new well. The installation time would be affected by site

accessibility, rig availability, installation time, and the time it takes to re-establish steady-state pumping conditions. For these reasons, well redundancy is recommended.

- Initially, a minimum of nine observation wells (MW1-MW9) should be installed around the pit perimeter down to 250 masl to monitor groundwater elevations around the open pit perimeter.

WESA (BluMetric Environmental, 2015) reported that surface water features in the vicinity of the pit will be affected by the pit dewatering system. These impacts will range from complete dewatering at Pond A to minimal impacts at Attikamagen Lake. Mitigative measures will be required for surface-water bodies that contain fish or are fish habitat. Mitigative measures could include diverting water from the pit dewatering system to the surface-water bodies that are affected by the dewatering system. Based on ongoing groundwater testing, dewatering flows should be continuously monitored; for example, dewater requirements for flood control and water quality for future stages in detailed engineering.

20.7 Hydrology

Baseline local hydrology studies for the Project were conducted by Stantec from August 2012 to July 2013 (Stassinu Stantec, 2014; Stassinu Stantec, 2021).

The Project area (open pit, stockpiles, processing plant, accommodations camp) is located within a peninsula in Attikamagen Lake and the Attikamagen Lake watershed. Attikamagen Lake drains into Petitsikapau Lake via Iron Arm, which is part of the larger Churchill River watershed. The rail yard works are located in the Gilling River watershed, which is a sub-watershed of the Churchill River.

The open pit is located within the Joyce Lake watershed, which regularly discharges to a wetland bog channel via groundwater flow. The remaining watersheds within the stockpile, processing plant and accommodations camp area consist of small watercourse features.

The Project site is located within the Interior Labrador climate zone. The Interior of Labrador has a continental climate with lengthy, very cold winters with deep snow cover, but relatively more settled weather patterns. The average daily temperatures typically drop below freezing by the end of October and remain below zero until April. Monthly mean temperature extremes in the area can range from -29 °C in the winter to 17 °C in the summer, with a mean annual temperature of -5.3 °C. Average annual precipitation is approximately 780 mm based on period of record 1948 to 2010 and 823 mm based on period of record 1971 to 2000 (climate normal). The Project site is located within the zone of 'isolated patches of permafrost', near the southern extremity of the 'sporadic discontinuous permafrost' zone. The mean monthly snow cover peaks in February, March and April. The snow cover is usually melted by the end of May and returns in October with a mean monthly value of 7 cm.

A regional hydrological assessment was conducted using the Water Survey of Canada hydrometric monitoring stations flow data from the region. Rivers typically enter their baseflow recession in the fall, which lasts as long as May. The spring freshet typically occurs in May – June and accounts for most of the annual flow. During the subsequent summer and early fall, attenuated storage contributes to the falling limb of the annual hydrograph. The mean annual flow per unit area was 0.0205 $m^3/s/km^2$ with standard deviation of 0.0042 $m^3/s/km^2$ and ranged from 0.0122 $m^3/s/km^2$ to 0.0289 $m^3/s/km^2$. Low flow occurs from January to April. Streamflows peak in May or June due to spring freshet and then gradually decrease until August or September and remain uniform for most of the remainder of the year.

Local hydrologic conditions are assessed using continuous water level data collected at four hydrometric monitoring stations for watercourses and four water level stations for lakes. Stream flow and rating curves were developed for the four watercourse hydrometric stations.

20.8 Surface Water Quality

Water quality sampling studies were completed by Genivar (2013e) (now WSP) in August 2012 in waterbodies in the Project area to characterize baseline conditions in watersheds potentially affected by the Project.

The water samples were analyzed for a wide range of parameters, including conductivity, pH, hardness, apparent colour, turbidity, total dissolved solids, total suspended solids, dissolved inorganic carbon, dissolved organic carbon, total organic carbon, alkalinity, as well as other general chemistry and total metal parameters.

The main results were:

- In general, the waterbodies are characterized by good quality water and results are typical of low-productivity waters;
- Joyce Lake is sensitive to acidification due to low pH (less than or equal to 6.6) and low total alkalinity (less than 5 mg/L as $CaCO_3$);
- Hardness is generally low (less than or equal to 62 mg/L as $CaCO_3$) and therefore some heavy metals have lower concentration toxicity thresholds; and
- The Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life were exceeded for aluminum, cadmium, copper and iron in some waterbodies in the Project area.

20.9 Water Management

Stormwater management facilities consisting of sedimentation ponds, berms, drainage ditches, and pumps will be used to collect and contain surface water run-off from the low-grade ore, run-of-mine, waste rock and overburden stockpiles, open pit (surface water run-off and groundwater seepage), processing plant pad, main fuel depot and power plant pad, rail yard, mining office, truck shop and wash bay pad, and accommodation camp pad. Sediment ponds will be designed to provide on-site storage of local run-off, with slow, controlled releases permitted after appropriate settling and water quality sampling indicates the water is suitable for release with respect to regulated discharge limits. No additional water treatment to sedimentation of suspended solids in the sedimentation ponds is anticipated for the Project.

In the pit, drainage and terracing will be implemented such that surface water and groundwater seepage can be collected within sumps that will be pumped to a perimeter ditch that conveys water to a sedimentation pond for treatment prior to release to the environment. There will be perimeter dewatering wells installed around the pit that will be pumped into perimeter ditches around the open pit and shoreline of Joyce Lake that collect and divert mine non-contact surface water run-off away from mine contact areas.

20.9.1 Water Balance

A dry processing plant is used to dry crush and screen high-grade ore. Processed ore will be direct shipped off-site with no tailings by-product produced. The mine water demand for this process is relatively very low and a water balance is not required to demonstrate a sustainable processing water supply is available.

20.9.2 Acid Rock Drainage/Metal Leaching

The acid rock drainage ("ARD") / metal leaching ("ML") methodology is consistent with the approach recommended by the EIS guidelines outlined in the Mine Environment Neutral Drainage ("MEND") Report 1.20.1 and the Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, Version 0 – December 2009, produced by the MEND (Price, 2009). The geochemistry testing program classified that overburden, waste rock, ore and iron ore ARD to be low. Low percentages of uncertain and potential acid generating waste rock were estimated for the Project. The estimated volume of uncertain and potential acid generating waste rock ranges between 0.9% and 5.5% of total rock volume. The metal leaching of the overburden, waste rock, ore and iron ore is considered to be low, based on compliance with concentrations from Shake Flask Extraction ("SFE") and leachates from kinetic tests with the MDMER discharge limits.

20.9.3 Tailings Management

Tailings will not be produced by this Project. Therefore, there is no need for tailings management.

20.9.4 Low-grade Ore, Waste Rock and Overburden Stockpiles

A ditch system will be established around the footprint of the low-grade ore, waste rock and overburden stockpile areas. Water collected in these ditches will be directed to settling ponds. Water that is collected in the ditches and sumps will be treated as necessary prior to discharge into the environment

20.9.5 Red Water

Red water is a tailings effluent condition associated with iron ore mining and processing. When iron ore tailings come in contact with water, the iron precipitation and staining processes occur and result in the red discoloration of water due to very fine particulate suspension. At other iron ore mining operations in the Labrador City, Wabush, NL and Fermont, QC area, the red water condition is associated with tailings effluent and is not an issue associated with waste rock or open pit run-off. The red water condition is not associated with ARD and is associated with very fine colloidal reddish iron mineral or iron-stained quartz / silica particles in suspension (Canada Gazette, Part II, Vol. 143). Treatment for the suspended ferric iron minerals, including the colloidal forms, is primarily accomplished by control of pH and/or dissolved oxygen concentration, settling and addition of flocculating polymers to aggregate precipitated particles into settable flocs. As tailings will not be produced by the Project, red water is not considered to be a potential concern at the open pit mine.

20.10 Rehabilitation and Closure

A Rehabilitation and Closure Plan will be developed for the Joyce Lake DSO Project as required under the Newfoundland and Labrador *Mining Act*, and in consultation with federal and provincial government agencies. Section 10.1 of the Newfoundland and Labrador *Mining Act* and Section 8.2 of the *Mining Regulations* under the *Mining Act* require that the lessee provide financial assurance to be included in the Rehabilitation and Closure Plan and, as part of the plan, provide an estimate of the cost of completing the work set out in the plan. This Plan will address the requirements set under the Newfoundland and Labrador *Mining Act*, Guidelines to the *Mining Act*, Part I, Sections 10, 12 and 13, and the 2021 Rehabilitation and Closure Plan Guidance Document released by the Government of Newfoundland and Labrador, Mineral Development Division on March 9, 2021. There are three stages of rehabilitation activities that will occur over the life span of the mine, which include: progressive rehabilitation, closure rehabilitation and post-closure monitoring and treatment.

The Client retained the professional services of WSP to develop a conceptual Rehabilitation and Closure plan for the Project, which was subsequently reviewed and costs updated by Stantec in 2022. The objective of the Rehabilitation and Closure Plan is to return the Project site to pre-development conditions as soon as possible.

Specifically, the Rehabilitation and Closure Plan will describe how:

- The mine site will be progressively restored; The site (e.g., the open pit) will be secured with barricades and signage as necessary;
- The infrastructure not required post-closure will be dismantled and removed;
- Equipment or machinery will be recovered and sold on recovery and used markets;
- Hazardous materials and waste will be managed safely and removed;
- Any buried pipelines will be removed or filled with a filler concrete or cement grout upon receiving approval from the minister;
- The footprints of all dismantled sites will be leveled for appropriate drainage, and covered in soil to promote re-vegetation;
- The overburden stockpile will be completely utilized to rehabilitate the mine site;
- The overburden and run-of-mill stockpile footprints will be scarified and re-vegetated.

The estimated cost for the rehabilitation and closure work is $6.4M, and this includes the cost of post- closure monitoring.

20.11 Consultation and Engagement

The Client is committed to engaging relevant Indigenous and non-Indigenous communities and stakeholder groups throughout the development and operation of the Project. The Client continues to engage Indigenous groups with established or asserted rights for the purpose of sharing information on the Project, and addressing questions, issues, or concerns with regard to the Project and its potential effects. These ongoing Indigenous and stakeholder engagement processes have been a vital and integral input to Project planning and design, and to the EIS. Indigenous and non-Indigenous community and stakeholder engagement will continue over the life of the Project.

Consultation and engagement with Indigenous groups began in 2010 and is ongoing. Since the initiation of engagement activities, the Client has held more than 30 meetings and phone calls with the Innu Nation of Labrador, Naskapi Nation of Kawawachikamach, Innu of Matimekush-Lac John, and Innu of Uashat mak Mani-Utenam.

The Century website (https://centuryglobal.ca/) contains publicly-available information on its current projects, including the Attikamagen property and the Project. The website contains information about the Project, as well as a number of Project-related documents:

- NI 43-101 Technical Report - Feasibility Study, Joyce Lake Direct Shipping Iron Ore (DSO) Project Attikamagen Property, Labrador, March 2, 2015
- Preliminary Economic Assessment (PEA) Study Report for the Joyce Lake DSO Project, May 8th, 2013;
- Mineral Resource Update, Joyce Lake DSO Iron Project, Newfoundland & Labrador, March 3, 2014
- NI 43-101 Technical Report Joyce Lake DSO Iron Project Newfoundland & Labrador, April 18, 2013;
- NI 43-101 Technical Report on the Mineral Resources of the Hayot Lake Taconite Iron Project, November 9, 2012; and
- Independent Technical Report, Attikamagen Iron Project, Schefferville Area, Québec, January 21, 2011

The Client has also given numerous presentations to industry and the public regarding the Project and its overall activities.

Issues and concerns raised during consultation and engagement with stakeholders, regulators and Indigenous groups regarding effects of the Project include:

- Wildlife;
- Fisheries and Fish Habitat;
- Consultation;
- Employment;
- Impact Benefits Agreements;
- Water Quality;
- Waste Management;
- Noise;
- Fuel Storage; and
- Transportation.

21. Capital and Operating Costs

The FS Project scope is based on the construction of a greenfield facility having a nominal annual production capacity of 2.5M Mtpa, dry basis of combined lump and sinter fines products. The capital and operating cost estimates related to the mine, process plant and site and Astray rail loading infrastructure have been developed by BBA. Costs related to the railway transportation, port handling, ship loading at the port terminal and ocean shipping have been provided by the Client. WESA (now WSP) and Stantec have provided designs for the basis of cost estimating for the Joyce Lake drainage and the open pit deep-well groundwater dewatering system and surface water management plan. Table 21-1 presents a summary of the Project total estimated initial capital costs.

Table 21-1: Summary of the capital cost estimate

Initial Capital Costs	$M
Mining (Capitalized Pre-Stripping)	$20.7
Mining Equipment (Initial Owner Fleet)	$26.3
Infrastructure Direct Costs	$143.1
Infrastructure Indirect and Owners Costs	$42.8
Railcars Lease Down Payment	$9.2
Other Mobile Equipment Lease Down Payment	$10.0
Contingency	$18.4
Total	**$270.4**

The total initial capital cost, including indirect costs and contingency was estimated to be $270.4M. This capital cost estimate is expressed in constant Q2-2022 CAD and excludes sustaining capital (capital required to support operations starting in the first year of operation) and salvage value. Also excluded are government's mandated assurance payments for closure and rehabilitation; provisions for deposit payments typically required to secure third party services and capacity. These costs and credits are treated separately within the Project economic analysis and are discussed in Chapter 22 of this Study.

Table 21-2 presents a summary of estimated average life-of-mine ("LOM") operating costs per dry tonne of combined lump and fines products.

Table 21-2: Estimated average LOM operating cost ($/t dry product)

Cost Area	LOM Average Cost per tonne ($/dmt)
Mining	$15.46
Pit Perimeter Dewatering and Water Management	$0.70
Crushing and Screening and Product Handling	$3.02
Product Truck Haulage to Astray Lake Rail Loading	$6.71
Load-out and Rail Siding Operation at Astray Lake	$1.81
Site Administration	$4.52
Site Services (Room & Board and FIFO Air Tickets)	$3.15
Lump Drying	$0.89
Total operating costs excluding Royalties	**$36.26**

The total estimated operating costs are $36.26/t of dry product loaded in rail car at Astray rail load out. Royalties and working capital are not included in the operating cost estimate but are included in the economic analysis in Chapter 22 of this Study.

21.1 Basis of Estimate and Assumptions

The capital cost estimate pertaining to the mine site, the crushing, screening and lump drying area, the Astray load-out rail area and other site infrastructure was performed by a professional estimator on BBA's estimation team. Operating costs were estimated by BBA's process and engineering department.

21.1.1 Type and Class of Estimate

The capital cost estimate for this FS is designed to be the basis for a Project budget authorization and funding and, as such, forms the "Control Estimate" against which subsequent phases of the Project will be compared and monitored. The accuracy of the capital cost estimate and the operating cost estimate developed in this Study is qualified as -10% / +15%. All estimates exclude taxes and duties.

21.1.2 Dates, Currency and Exchange Rates

These operating and capital cost estimates are calculated and presented in constant Q2-2022, Canadian Dollars (CAD). The exchange rate used was USD0.77 = CAD1.00 and escalation and inflation were not included in the estimates.

21.1.3 Construction Labour Rates and Labour Productivity Factors

The hourly crew rates used in the estimate were developed by BBA and are based on current applicable construction collective bargaining agreements and on BBA's experience on other projects in the region. Crew rates include direct, indirect, and construction equipment. The rates were developed as "all-in" rates. These rates are applicable to the labour strategy implemented during construction and are not applicable to the production labour strategy.

Direct rates include a mix of skilled, semi-skilled and unskilled labours for each trade as well as the fringe benefits on top of gross wages. Direct supervision by the foremen and surveyors is built into the direct costs. For the purpose of defining the "work week", all estimated costs for labour are based on ten hours per day, seven days per week, for a 70-hour "work week". Work will be performed on a fly-in fly-out ("FIFO") basis, respectively of four weeks of work followed by two weeks rest. The average crew rate considers 40 hours at the base rate coupled with 30 hours overtime at a multiplier of two times the base rate.

The indirect cost component consists of allowances for small tools, consumables, supervision by the general foremen, management team, contractor's on-site temporary construction facilities, mobilization / demobilization, contractor's overhead and profit. It also includes the costs related to the transportation of the FIFO employees.

The construction equipment rates were developed by BBA for each discipline (by speciality). Rates proposed by "La Direction Générale des Acquisitions du Centre de Services Partagés du Québec" were considered. Labour rates are based on "Construction Labour Relation Association of Newfoundland and Labrador". Table 21-3 presents the average all-in crew rates for the various disciplines.

Table 21-3: Labour rates used for cost estimation in capital construction phase

Discipline	Average Hourly Rate
Civil	$227.85
Architectural	$168.55
Mechanical	$191.25
Piping	$182.05
Electrical	$173.90

Project construction performance is an important concern of project owners, constructors, and cost management professionals. Project cost performance depends largely on the quality of project planning, work area readiness, preparation and the resulting productivity of the work process made possible in project execution. Labour productivity factors have been developed for each discipline and applied as a productivity loss factor to the base man-hours developed for each discipline. Factors accounted for include, but are not limited to, the following:

- Site location;
- Weather conditions (winter conditions are expected to dominate from November 16th to April 15th);
- Extended overtime;
- Work over several distant staging areas;
- Accessibility to work area;
- Overcrowded tight work areas;
- Height, scaffolding;
- Work complexity;
- Availability of skilled workers;
- Labour turnover;
- Health and Safety considerations;
- Supervision;
- Fast-track requirements; and
- Materials and equipment over-handling.

Given the considerations listed above. the productivity factors were established based on BBA's experience as well as the following reference books:

- Global Construction Cost and Reference Yearbook;
- Association for the Advance of Cost Engineering (AACE);
- RS Means Construction Cost Data;

- Richardson Cost Data;
- Estimator's Piping Man-Hour Manual;
- National Electrical Association Manual of Labour Units;
- Estimator General Experience and Logic

Table 21-4 presents the labour productivity factors applied in the capital cost estimate.

Table 21-4: Productivity factors used for cost estimation

Discipline	Productivity Factor
Earthworks	1.481
Architectural / Building	1.391
Mechanical Works	1.406
Piping Works	1.449
Electrical Works	1.434

In parallel with the estimating process, budgetary quotation requests were sent to heavy civil / earthworks contractors familiar with work in the Schefferville and Northern Labrador area. Two budgetary proposals were received and are based on open shop labour executing the work and yielding comparable results to BBA's estimate developed with its internal database.

21.1.4 General Direct Capital Costs

This Capital Cost Estimate is based on the construction of a greenfield facility having a nominal production capacity of 2.5 Mtpa, dry basis of lump and sinter fines products. The design of the ore crushing, screening and lump drying plant area, consisting of the run-of-mine ("ROM") stockpile, a two-line crushing and screening plant, a rotary dryer for lump product and the product stockpiles has been based on process design testwork and on material handling logistics.

The general site plan developed in the Feasibility Study has been used to estimate engineering quantities and generate material take-offs ("MTO"s). Equipment costs and major buildings and other infrastructure components have been estimated using budgetary proposals obtained from vendors. Labour rates have been estimated as previously described.

BBA has developed its capital cost estimate on the following assumptions and estimation methodology:

- Mining equipment quantities and costs have been developed by BBA's mining group based on the mine plan developed in the Study. Mining equipment costs were estimated from BBA's recently updated database of vendor pricing.

- Mine pre-stripping costs incurred in the pre-production ("PP") period have been capitalized.
- Waste materials from the mining operation, used for construction of roads and pads, are assumed to be delivered by the Owner's mining fleet and personnel to specifically defined locations.
- Civil earthwork quantities for construction of roads and pads have been estimated by BBA's civil engineering team based on drawings, detailed topographical data and site geomorphological and geotechnical studies performed by LVM. It is assumed that the site geotechnical studies are reasonably representative of actual soil conditions.
- It is assumed that heavy civil work is awarded to reputable contractors familiar with local conditions on a unit cost basis.
- Borrow materials, other than waste material coming from the open pit mining operation, originate from the Astray area rail cut and fill quantities, as well as from local quarries on the south side of the rock causeway and along the haul road, as identified in the LVM site geotechnical study.
- Bridges and culverts have been engineered and estimated by BBA based on recommendations from the Stantec water management team.
- Capital costs for the main service buildings such as mine garage, truck wash, warehouse and offices have been estimated based on vendor budget proposals. These are generally prefabricated, or pre-engineered structures built directly on leveled pads.
- The permanent production accommodation camp and supporting infrastructure were defined and estimated by BBA with a detailed functional specification based on an estimated number of rooms. BBA obtained budget proposals from vendors.
- Mechanical, electrical and process equipment capital costs were estimated by BBA engineering disciplines based on the defined design criteria.
- Mobile equipment fleet for ore and product handling such as wheel loaders and haul trucks were sized by BBA based on material handling logistics. Budget prices were obtained from vendors.
- The railcar fleet was determined by the Client based on cycle times derived from an internal study. BBA obtained budget unit pricing for railcars from vendors.
- Diesel fuel storage capacity and capital cost estimate were based on monthly and seasonal fuel requirements for mobile equipment and power generation.
- The central electric power generating station and the stand-alone generator set capacities were estimated by BBA based on estimated power requirements. A motor list and a single-line diagram were developed, and budget prices were obtained from vendors or were derived from BBA's current updated database.

- Telecommunication capital and operating costs were based on a design developed by BBA and vendor budget proposals.
- The operating cost fuel component for mining and power generation was based on a diesel fuel price of $1.45 per litre delivered to the mine site. This price was derived from a three-year average of crude oil as of March 2022, from which the diesel price was calculated.

21.1.5 Indirect Costs

Indirect costs included in the capital cost estimate include the following items:

- Owner's costs were provided by the Client based on the owner's team that will be in place during the engineering and construction phase of the Project. These costs include items such as executive management, corporate support for engineering, procurement and contract administration, construction, Health, Safety & Environment ("HSE") and community affairs management. Also included are costs for permits, legal fees and insurance.
- Engineering, procurement and construction management ("EPCM") services costs were developed by BBA and were based on the Project schedule and scope of work. Construction management takes into consideration that the Project is staged over several areas simultaneously over a relatively long distance as the mine site and rail are connected by over 43 km of road.
- Temporary construction facilities include construction trailers, generators and other such items and were estimated by BBA based on vendor prices for major items. The Client also has provided access to its exploration camp south of Iron Arm and to housing in Schefferville to satisfy the peak labour force of roughly 325 people.
- Construction operation and maintenance include costs such as room and board for complete construction crews.
- Third party services include services such as security guards, nurse, Owner's surveyors and other such services.
- Overhead expenses include mainly umbrella insurance for construction.
- Common and distributable costs include costs such as freight of all imported equipment and materials from point of origin to the site, first fills, spare parts and vendor reps.

Indirect costs are based on a specific project execution schedule, as presented in Chapter 24, which assumes construction begins in the month of March of any given year and production starts in the month of March of the following year.

21.1.6 Contingency

Contingency provides an allowance to the capital cost estimate for undeveloped engineering detail within the scope of work covered by the estimate. Contingency is not intended to consider items such as labour disruptions, weather-related impediments, changes in Study Project scope, nor does it take into account price escalation or currency fluctuations. A contingency of 10% of the sum of direct and indirect costs has been attributed to the Study capital cost estimate. The contingency allowance is not applied to mining or other site mobile equipment or to railcars.

21.1.7 Exclusions

The following items are not included in this capital cost estimate:

- Inflation and escalation. The estimate is in constant Q2-2022 Canadian Dollars;
- Costs associated with hedging against currency fluctuations;
- All taxes and duties;
- Working capital (this is included in the financial analysis but not in the capital or operating costs);
- Project financing costs including, but not limited to, interest expense, fees and commissions; and
- Costs incurred prior to project approval and start of detailed engineering are considered as sunk costs and are not part of this capital cost estimate or project economic analysis.

21.2 Estimated Capital Costs

Project initial capital costs were estimated at $270.4M, as shown in Table 21-1 details provided in Sections 21.2.1 through 21.2.5. All capital costs i in this Study are in Q2--2022 CAD.

21.2.1 Mining Capital Costs

Mining capital costs are comprised of pre-stripping (pre-production) mining costs and mine equipment costs. Pre-stripping costs are incurred from preparing the open pit for ore production and are estimated based on the mine plan presented in Chapter 16 and consist of the costs for removal of overburden and waste rock by an owner-operated equipment fleet. Based on the Project implementation schedule, mining pre-stripping begins in the month of July and ends in December (6 months). Ore mining begin in January of the following year, with ore crushing and screening beginning at the end March. Mine pre-stripping costs (July to December) have been estimated at $20.7M.

A mining equipment list and schedule were developed to implement the mine plan, as presented in Chapter 16. A breakdown of mining equipment and costs by year is shown in Table 21-5.

The initial mobile equipment fleet will be leased, with the exception of auxiliary service equipment which will be purchased. The leasing terms are a 'lease-to-buy' option wherein the operator will retain the equipment rights at the end of the lease. The total pre-production payments are $26.3M which include leasing down payments. Pre-production leasing payments in the order of $22.0M are required and are described under leasing later in this section. Subsequent leasing payments during production total $87.9M over the LOM. An additional sustaining capital of $18.3M will be required for equipment additions and replacements over the first, second, and third years of operation and is not included in the initial capital estimate.

Table 21-5: Schedule of mining equipment purchase

Equipment	Initial Capital	Sustaining Capital		
	PP-1	Y1	Y2	Y3
	No. units	No. units	No. units	No. units
Trucks (96 tonnes)	7	4	2	-
Hydraulic Excavator (11 m^3)	2	-	-	-
DTH drill (8'')	2	-	-	-
Wheel Loader (11.5 m^3)	1	-	-	-
Grader (16')	1	-	-	-
Track Dozer	1	-	-	-
Wheel Dozer	1	-	-	-
Water Truck	1	-	-	-
Fuel/Lube Truck	1	-	-	-
Service Truck	1	-	-	-
Skid Steer	1	-	-	-
Pick-up Truck	7	-	-	7
Crew Bus	1	-	-	-
Lighting tower w/ diesel generator	4	-	-	-
Dewatering Pump + Booster	2	-	-	2
Tire Changer	1	-	-	-
Utility Loader	1	-	-	-
Utility Excavator	2	-	-	-
Float Truck	1	-	-	-
Blast Support Vehicles	1	-	-	-

21.2.2 Project Infrastructure Capital Costs

The initial infrastructure capital cost to develop the Project is estimated to be $204.3M, including direct, indirect, and contingency, is shown in Table 21-6.

Table 21-6: Project infrastructure capital costs

Cost Area	Capital Cost ($M)
Project Infrastructure Direct Costs	$143.1
Indirect Costs	$42.8
Contingency	$18.4
Total	**$204.3**

A breakdown of the Project infrastructure direct capital costs, estimated at $143.1M, are presented in Table 21-7.

Table 21-7: Breakdown of Project infrastructure direct costs

Area	Direct Cost ($M)
Roads, Bridges and Causeway	$53.3
Permanent Production Camp (144 beds)	$7.6
Telecom	$4.6
Astray Rail Siding and Stockpile Area	$14.4
Crushing and Screening Area	$8.5
Power Plant and Electrical Distribution	$12.1
Open Pit Perimeter Dewatering System	$1.9
Mine Truck Shop, Wash Bay and Warehouse, Infrastructure	$11.6
Laboratory Facilities	$1.7
Mine Waste Stockpile Site Preparation and Sedimentation Ponds	$1.6
Other Site Prep and Infrastructure	$11.0
Dryer and Lump Stockpile	$14.9
Total Directs	**$143.1**

21.2.2.1 Roads, Bridges and Causeway

This item comprises mainly of civil works components listed below. The total direct cost was estimated at $53.3M and are described in Chapter 18.

- Repair and upgrade of the existing 14.8-km Iron Arm Road from the Kawawachikamach turn-off to the Client's exploration camp, located to the south of the Iron Arm waterway;
- Construction of a new 4.3-km service road connecting Iron Arm Road to the Project product haul road;
- Construction of a new 43-km product haul road from the product storage pad at the mine site to the product storage pad at the Astray rail loadout;
- Construction of three bridges along the product haul road;
- As part of the haul road construction of the 1.2-km rock causeway, including two causeway bridges.

21.2.2.2 Permanent Worker Camp

Costs include mobilization of a 144-bed permanent production camp equipped with a kitchen and dining hall, laundry facilities and administrative offices. Costs also include site preparation, electrical rooms, water facilities for potable water, water treatment and fire protection water. The permanent production camp is planned to be rented, including services. One year of pre-production rentals and services is included in the permanent production camp area costs, estimated at $7.6M.

21.2.2.3 Telecom

The purchase, delivery, and installation of the telecommunications network, including two trailer-mounted telecom towers and local antennas located at the Astray rail loadout area, mine site truck wash facility, mine crushing and screening and guard house areas. The direct capital costs for all telecom equipment and infrastructure were estimated at $4.6M.

21.2.2.4 Astray Rail Siding and Stockpile Area

Direct capital costs for construction of the Astray rail siding and stockpile area were estimated at $14.4M, including 2.4 km of rail track connecting to the existing Schefferville to Sept-Iles rail line, a 600 m x 100 m pad for lump and fines product stockpiles, as well as an equipment maintenance area and rail office. Included in the price are sedimentation ponds to treat run-off water in the area.

21.2.2.5 Processing Plant Area

The direct capital costs associated with the crushing and screening plant area were estimated at $8.5M. The two-line modular plant consists of primary and secondary crushing along with vibrating grizzly, product screening equipment and conveyors. Costs were based on budget proposals from vendors supplying a complete package.

21.2.2.6 Power Plant and Electrical Distribution

Direct capital costs for the central power generation plant, the supporting fuel dispensing system and the electrical distribution system to the various areas supplied with electrical power were estimated at $12.1M. The power plant is described in Chapter 18.

21.2.2.7 Open Pit Perimeter Dewatering System

The six open pit perimeter deep well system, including drilling of seven boreholes, electric pumps powered by local generators, and piping for water discharge were estimated at a direct capital cost of $1.9M.

21.2.2.8 Mine Truck Shop, Wash Bay and Warehouse, Infrastructure

The mine truck shop, wash bay and warehouse facility were estimated at a capital cost of $11.6M, based on vendor budget proposals.

21.2.2.9 Laboratory Facilities

A modular laboratory, comprised of a sample preparation area, limited sample storage, and analytical equipment, has been included and the cost was based on vendor budget proposals. The estimated direct capital cost is $1.7M. Lump and fines products, as well as open pit ore samples, will be assayed in this facility.

21.2.2.10 Mine Waste Stockpile Site Preparation and Sedimentation Ponds

The mine waste stockpile area will be prepared via tree cutting and shrubbing activities. Various sedimentation ponds will also be constructed to treat run-off water from the mine site and have been sized and direct capital costs were estimated at $1.6M.

21.2.2.11 Other Site Preparation and Infrastructure

At a capital cost estimate of $11.0M, this item includes miscellaneous activities such as clearing of mine site small areas, the explosives magazine pad, the guardhouse and mine site fuel storage areas and equipment.

21.2.2.12 Dryer and Lump Stockpile

The dryer and lump stockpile area will include a feed system connected to a rotary dryer designed to dry lump product during the summer months. The dried lump product will be placed on a stockpile and covered by tarpaulin throughout the year. This area also includes a crushing unit designed to break up frozen chunks of lumps as a mitigation in the event tarping and drainage efforts are insufficient to avoid moisture gain by the stockpile. The total area capital cost is estimated at $14.9M.

21.2.2.13 Indirect Capital Costs

Project indirect costs were estimated at $42.8M, based on the Project scope and construction schedule as shown in Table 21-8. Owner's costs have been provided by the Client based on the corporate and support personnel required during the construction period. EPCM has been estimated by BBA based on a defined construction management plan. Temporary construction facilities and their operations have been estimated in detail by BBA. Other indirect costs were factored based on similar projects.

Table 21-8: Indirect costs

Cost Area	Indirect Costs ($ M)
Owner's Costs	$3.0
EPCM Services	$15.0
Temporary Construction Facilities and Utilities	$6.5
Construction – Operation and Maintenance	$9.2
Other Indirects	$9.2
Total	**$42.8**

21.2.3 Capital Cost Contingency

Contingency provides an allowance for undeveloped engineering detail within the scope of work of the Project. It does not account for labour disruptions, weather-related impediments, changes to Project scope, price escalation or currency fluctuations. The value of the contingency, $18.4M, represents 10% of direct and indirect Project infrastructure capital costs.

21.2.4 Railcars and Other Site Mobile Equipment

The Project requires the purchase of 328 iron ore railcars based on Client cycle time calculations. Additional major site mobile equipment will be required such as:

- Fuel tanker cars for transportation of diesel to site;
- Product haul trucks for transportation of lump and fines material from the mine site to the rail siding;
- Front-end loaders for loading of ROM material into the crushing system, lump stockpile manipulation, haul truck loading and railcar loading.

Other auxiliary equipment will be required such as graders for snow clearing, pickups, back hoes, a bus for transportation of workers, etc. Major equipment will be purchased on a lease-to-buy basis whereas auxiliary equipment will be purchased outright. Pre-production costs for the down payment of major equipment, as well as the full purchase price of auxiliary equipment, amounts to $9.2M for railcars and $10.0M for other equipment for a total of $19.2M.

21.2.5 Sustaining Capital, Salvage Value and Other Costs

Sustaining Capital

Sustaining capital costs include ongoing capital costs for additions and modifications of a capital nature during the life of the operation. The sustaining costs consist of mining equipment required during the LOM.

Salvage Value

The salvage value represents the residual saleable value of equipment at the end of the operation. A salvage value was assigned to the product railcars, fuel tanker railcars, and major plant and site mobile equipment such as loaders. It should be noted that the product haul trucks are not expected to have any salvage value as they will likely be at or close to the end of their useful life. Salvage value was assigned to the sale of the diesel generators and crushing and screening equipment which will still have useful life left at the end of operations.

Closure Costs

Closure costs have been calculated for site remediation at the end of operations. These costs include remediation of site ponds, waste piles, open pit and post closure monitoring. The costs do not include reclamation of the process plant and administrative areas. It is assumed that the salvage value of the infrastructures (garage, administration offices etc.) will offset the demobilization and remediation costs; hence no infrastructure salvage values were accounted for in the financial model. Closure costs are incurred upon approval of project construction permits (50%) with two anniversary payments over the next two years (25% each).

Leasing

Initial mining equipment purchases, railcars, haul trucks and front-end loaders will be purchased on a lease-to-buy option wherein equipment ownership will be transferred to the Client. Leasing terms were obtained from mining equipment suppliers for the Project and were compared to quotes received on other recent projects. The leasing terms used for the Project are a 20% down payment, interest of LIBOR + 5% with a 5-year repayment term.

Pre-Payments

To secure access to port and rail services a buy-in, or pre-payment, will be required prior to the start of operations. This will allow the Client a certain capacity of the installations/services over the LOM. These payments will either be paid back to the Client on a per tonne basis or reclaimed by selling the acquired capacity to a third-party at the end of operations.

A breakdown of the sustaining capital, salvage value and other costs are summarized in

Table 21-9: Estimated sustaining capital costs, salvage value and other costs. These values have been included in the Project economic analysis in Chapter 22.

Table 21-9: Estimated sustaining capital costs, salvage value and other costs

Description	Sustaining Capital Costs ($M)
Mining Equipment Sustaining Capital	**$18.3**
Closure Costs	**$6.4**
Leasing payments in pre-production	**$22.0**
LOM Leasing payments during production	**$87.9**
Pre-payments	**$62.4**
Salvage Value	
Project Infrastructure	($3.0)
Rail cars	($23.0)
Other mobile equipment	($5.9)
Total Salvage Value	**($31.8)**

21.3 Operating Cost Estimate

Mine site operating costs to product loaded into rail cars were estimated at $36.26/dmt as shown in Table 21-10, with more details provided in the following sections.

Table 21-10: LOM operating cost to rail car loading, summary

Cost Area	LOM Cost ($M)	LOM Average Cost per tonne ($/dmt)
Mining	$268.5	$15.46
Perimeter Dewatering and Water Management	$12.1	$0.70
Processing and Handling	$52.5	$3.02
Product Hauling	$116.5	$6.71
Load-out and Rail Siding	$31.5	$1.81
Site Administration & Services (Site)	$78.5	$4.52
Site Administration (Room & Board and FIFO Air Tickets)	$54.7	$3.15
Lump Drying	$15.5	$0.89
Total	**$629.8**	**$36.26**

21.3.1 Operations Labour Force

The LOM production labour force will comprise 1/3 local workers who as necessary, will participate in training programs and fly-in/out (FIFO) workers who will be accommodated at site.

For determination of operating costs, all-in (including benefits, insurance etc.) annual labour rates for salaried and hourly personnel were estimated by BBA based on benchmarking against similar projects and Canadian Salary Guides.

During lower-grade stockpile reclaim during approximately the last 1.5 years of the LOM, the site will be operated with minimal crews for crushing, screening and lump drying, hauling products and loading rail cars. Operating costs reflect reduced staff during this period, including administrative and managerial roles, with daily direction by area foremen.

Table 21-11: Employees during production (on site and off site)

Site Personnel	Peak Number of Employees
Mining Employees	146
Crushing, Screening, Drying and Handling Employees	40
Product Hauling Employees	50
Product Load-out and Rail Siding Employees	16
Site Administration and Services Employees	25
Total	**277**

Workers will be employed throughout each LOM year except for 17 hourly workers operating the crushing, screening, drying and product handling who will be employed on a seasonal basis for eight summer months of the year as this function will not operate during the winter. The production work force was estimated assuming a 14 day-on/14 day-off rotation with 168 working hours per rotation. Salaries include benefits, overtime (5-10%), vacations and bonuses for a total fringe/burden of 35-40% of the base salary.

21.3.2 Mining Costs

Mining operating costs have been developed based on the mining plan and year-round operation of the open pit mine. Mining operating costs averaged over the LOM were estimated at $15.46/dmt of combined lump and fines products, including the low-grade product generated at the end of the mine life. The cost estimate is $3.15/t mined, includes pre-production stripping, ore production and includes low-grade ore stockpile reclaim. A breakdown of mining operating costs is provided in Table 21-12.

Table 21-12: Breakdown of average LOM mining operating costs

Cost Area	LOM OPEX ($/t mined)
Equipment Maintenance Cost	$0.86
Equipment Fuel	$0.72
Blasting	$0.57
Mine Labour	$0.94
Services and Miscellaneous	$0.06
Total	**$3.15**

21.3.2.1 Equipment Maintenance Cost

These costs primarily consist of maintenance costs estimated by BBA based on experience and historical data from similar projects, as well as vendor information. Maintenance costs include costs of repairs, spare parts, consumables, etc., and are compiled on a maintenance operating cost per hour basis for each equipment type. Equipment maintenance costs per operating hour exclude costs of maintenance personnel, fuel and electricity, which are accounted separately.

21.3.2.2 Equipment Fuel Cost

Fuel consumption was estimated for each LOM year based on equipment specifications and utilization. The price of diesel fuel was assumed to be $1.45 per litre delivered to site, based on information obtained from the Supplier and third-party service suppliers for fuel delivery to site in conjunction with a 3-year average price for crude oil.

21.3.2.3 Blasting Cost

Blasting costs for ore and waste rock were estimated based on parameters and powder factors shown in Chapter 16. Blasting unit costs were estimated at $0.57/t for ore and waste rock, based on an emulsion unit cost of $118.60 per 100 kg and include accessories, contractor costs for storing, mixing and delivering explosives to the blast hole.

21.3.2.4 Labour

Labour requirements were estimated to support the Study mine plan. Mine salaried and hourly personnel and headcounts are presented in Section 16.4.9.

Table 21-13: Mining personnel

Salaried Personnel		Peak Count
Operations	Mine Superintendent	1
	Mine Crew Supervisor	4
	Mine Clerk	2
	Training Coordinator	2
Maintenance	Maintenance Superintendent	1
	Maintenance Crew Supervisor	4
	Maintenance Planner	1
Engineering	Chief Engineer	1
	Mine Planning Engineer	2
	Mine Surveyor	2
Geologist		2
Subtotal Salaried Personnel		**22**
Hourly Personnel		**Peak Count**
Operations	Hydraulic Excavator Operators	8
	Loader Operators	4
	Haul Truck Operators	49
	Drill Operators	8
	Dozer Operators	8
	Grader Operators	4
	Auxiliary Equipment	1
	General Labour	4
	Utility Labour	4
Hourly Personnel		**Peak Count**
Maintenance	Field Mechanics	4
	Field Welder	2
	Shop Mechanics	8
	Electrician	2
	Mechanic Apprentice	2
	Welder-machinist	2
	Lube/Fuel Truck Operator	4
	Tool Crib Attendant	2
	Tire Technician	2
	Janitor	2
Subtotal Hourly Personnel		**120**
Contractor, Blasting Services		4
Total Peak		**146**

21.3.2.5 Services and Miscellaneous Costs

This element includes costs for items such as mine engineering software licenses, consulting services and production of aggregates for mine road maintenance.

21.3.3 Perimeter Dewatering and Water Management

Open pit perimeter deep well dewatering is carried out year-round and will be complete by Q1 of the sixth production year when activity in the open pit ceases. Perimeter dewatering in seven wells contributes $0.70/dmt to mining operating costs and consists of labour, fuel for generating pumping electricity, and pump maintenance.

21.3.4 Processing and Handling

Crushing and screening and lump product drying and related ore and product handling in the area account for $3.02/dmt. A description of each cost component is discussed in the sections following. Crushing, screening and lump product drying, and stockpiling occurs in summer months while lump reclaim occurs in winter months.

21.3.4.1 Labour

The processing area accounts for a total of 40 employees of which 17 hourly workers operating the crushing and screening plant will be employed eight summer months as the plant will not operate in the winter.

Table 21-14: Process plant labour

Salaried Personnel	Number of Employees
Processing Manager	1
Process Engineer	1
Lab Manager	1
Area Foreman	4
Subtotal Salaried Personnel	**7**
Hourly Personnel	**Number of Employees**
Process Plant Operator	8
Area General Labour	4
Area Millwrights	3
Area Electricians	2
Laboratory Attendants	4
Loader Operators	12
Subtotal Hourly Personnel	**33**
Total	**40**

Maintenance personnel for loaders are shared services and are included in product hauling labour estimates.

21.3.4.2 Front-end Loader Costs

Two 16-tonne capacity front-end loaders are used to feed ROM ore to the crushing plant and also used to load lump and fines products from plant stockpiles onto haul trucks. Loader operating costs include operator costs, fuel and parts and maintenance. Diesel fuel consumption was estimated based on material handling logistics, loader cycle times, and fuel consumption, maintenance requirements and spare parts estimated from vendor data.

21.3.4.3 Electricity

The site electricity is generated at the central power plant using diesel fuel, with consumption prorated to each consuming area. Power generating cost is allocated based on use of the power used and a diesel price of $1.45 per litre.

21.3.4.4 Maintenance and Consumables

Maintenance costs for the crushing and screening plant were estimated at 5% per annum of the plants initial capital cost. Cost of consumables, including crusher liners and screens, were provided by the vendor.

21.3.4.5 Laboratory

The laboratory provides sample preparation and assaying for the crushing plant, and for open pit ore grade control. The laboratory operating costs, including electricity and workforce, are included in the general process plant costs presented earlier. The laboratory equipment vendor provided a budget cost on a per sample basis for consumables and equipment maintenance. Laboratory consumable costs were estimated at $3.00 per sample processed.

21.3.5 Product Haulage Costs

The costs of product haulage from the mine site to the Astray rail loading area are estimated at $6.71/dmt, which includes operation and maintenance of the haul truck fleet.

21.3.5.1 Labour

A total of 50 workers, including the haul truck drivers and maintenance personnel, are required in the product hauling operation. A breakdown of hourly personnel is presented in Table 21-15.

Table 21-15: Product hauling operating labour

Hourly Personnel	Number of Employees
Haul Truck Operators	44
Haul Truck and Loader Maintenance Mechanics	6
Total	**50**

21.3.5.2 Fuel

The annual fuel requirement for the fleet of ten trucks was estimated based on vendor data. Total fuel usage was calculated assuming an average hourly consumption of 50 l/h and cycle time of 147 minutes (round trip).

21.3.5.3 Tires and Maintenance

Tire wear data and unit costs were provided by the vendor. Tire costs were based on a 4,000-hour tire life. Maintenance expenses for the haul fleet are presented in the form of an allowance for small parts, lubricants and major parts.

21.3.6 Astray Product Load-out and Rail Siding

Astray load-out and rail siding operating costs were estimated at $1.81/dmt and are shown in Table 21-16. They include product stockpile management, loading of product into railcars and operating and maintaining the area infrastructure.

21.3.6.1 Labour

Labour associated with operations in the load-out and rail area is mainly related to loader operators and supervision and are presented in Table 21-16.

Table 21-16: Operating labour at the load-out and rail

Salaried Personnel	Number of Employees
Area foreman	4
Hourly Personnel	**Number of Employees**
Railcar loading/Stacking loader operators	12
Total	**16**

21.3.6.2 Astray Front-end Loader Costs

Three 21-tonne capacity front-end loaders are used at Astray to manage the lump and fines product stockpiles and to load railcars. Loader operating costs include labour costs for operators, fuel and parts and maintenance. Diesel fuel consumption was estimated based on material handling logistics and loader cycle times and the fuel consumption rate provided by the equipment vendor together with maintenance and spare parts cost data.

21.3.6.3 Astray Area Infrastructure

There is minimal infrastructure in the load-out and rail area and costs are limited to operating a diesel generator for electrical requirements in the trailer office and an allowance for inspecting and maintaining the rails.

21.3.7 Site Administration and Services

Site administration and services are comprised of shared and common services provided to all areas of the Project, including the general mine area, access and haul roads and remote areas such as the load out and rail area. Site administration and services were estimated at $4.52/dmt. Table 21-17 provides details of these costs. Site administration services are generally considered fixed costs and are provided year-round.

21.3.7.1 Labour

A list of personnel assigned to site administration and services is shown in Table 21-17. Personnel consists of resident general operations management and support, as well as personnel for assuring the maintenance and upkeep of site infrastructure, including road maintenance.

Table 21-17: Site administration and service personnel

Salaried Personnel	Number of Employees
Resident General Manager	1
Human Resources	1
Accounting/Payroll	1
Health & Safety	1
Purchasing	1
IT Technician	1
Environmental Engineer	1
First aid	2
Subtotal Salaried Personnel	**9**

Hourly Personnel	Number of Employees
Security Guard	4
Warehouse Attendants	2
Fuel Distribution and Dewatering Systems	2
Site Mechanical Maintenance	2
Road Maintenance – General Labour	3
Road Maintenance – Light Mobile Equipment Operator	3
Subtotal Hourly Personnel	**16**
Total	**25**

21.3.7.2 Electricity

Electricity generated by the mine site central power plant is distributed as discussed in Chapter 18. The cost of diesel fuel to generate electricity is distributed proportionally to the crushing and screening plant and to site infrastructure including permanent production camp, offices, garage and warehouse based on annual power consumption. Of the annual central plant electricity produced 15% is used by the crushing and screening plant and 65% by other site infrastructure. Based on a diesel price of $1.45 per litre, electricity production cost is $0.39 per kWh (excluding power plant labour and maintenance costs).

Local generators provide power to areas not connected to the central power plant and these costs are accounted for separately.

21.3.7.3 Site Infrastructure Maintenance

Site infrastructure maintenance costs include the upkeep of equipment used for site and road maintenance, excluding labour, which is accounted for separately.

21.3.7.4 Telecom

Telecom service costs were estimated based on service provider proposals that were, in turn, based on specific telecom requirements for the site. They are presented as a monthly all-in cost that is considered fixed and applicable year-round.

21.3.7.5 Other (Expense Allowance)

A general expense allowance was provided for site administration office operations.

21.3.8 FIFO and Room and Board

Fly-in-fly-out ("FIFO") airline tickets and room and board (camp catering services) were estimated to average $3.15/dmt over the LOM. These are shown in Table 21-18 and further details provided in the following sections.

Table 21-18: FIFO and room & board costs

Cost Item	LOM Average Cost per tonne ($/dmt)
Camp Operations	$1.58
FIFO Air Tickets	$1.57
Total	**$3.15**

In the Study, personnel counts were developed for all areas based on activity and requirements. In general, mine personnel varies based on the mine plan while personnel count in other areas stays relatively stable. An analysis was performed of the general labour force requirements and personnel were first classified based on FIFO and local residents (roughly 1/3 of workers). A further classification was made based on personnel working year-round and seasonal personnel required only during the 8-month period when processing, product hauling and rail transportation takes place.

In developing the staffing plan, it was assumed that certain employees (mainly of a non-specialized nature) would be from local communities, thus there is no consideration for these employees in the FIFO or in the camp accommodations.

21.3.9 Lump Drying

Lump product will be dried during the summer months to be reclaimed and hauled during the winter months when the process plant is closed during winter. The lump stockpiles will be tarped to avoid re-wetting. The cost of drying the lump product and provision for anti-freezing agent in rail cars is $0.89/dmt.

21.3.10 Rail Transportation, Port and Ship Loading

Once the products are loaded into railcars at the Astray loading areal, the Client will subcontract rail transportation from Astray area ~20 km south of Schefferville to SFPPN off-loading and stockpiling facility at Pointe Noire before transfer by conveyor to the Pointe-Noire multiuser port terminal for cape-size ocean ship loading, which is part of the Port of Sept-Îles (POS). The Client has performed its own analysis based on confidential discussions with the various third-party service providers that would be involved in product transportation from the Astray railcar loading area to the multi-user port at Pointe Noire for ship loading. The Client has estimated an average operating cost of $25.06/dmt for railing from Astray loadout, railcar off-loading, stockpiling, reclaim and ship loading over the LOM.

22. Economic Analysis

The economic evaluation of the Joyce Lake DSO Project was done using a discounted cash flow model on both a pre-tax and after-tax basis. The capital and operating cost estimates presented in Chapter 21 of this Report were based on the mining and processing plan developed in this Study to produce a nominal 2.5 Mt of combined lump and fines products annually over the life of the mine ("LOM"). The internal rate of return ("IRR") on total investment was calculated based on 100% equity financing. The net present value ("NPV") was calculated for discounting rates of 0%, 4% and 8%, resulting from the net cash flow generated by the Project. The Project base case NPV was calculated based on a discounting rate of 8%. The payback period based on the undiscounted annual cash flow of the Project is also indicated as a financial measure. Furthermore, a sensitivity analysis was also performed for the pre-tax and post-tax base cases to assess the impact of a +/-20% variation of the Project initial capital costs and operating costs. Sensitivity to the price of iron ore was analyzed between -20% and +80% of the benchmark projected price.

The financial analysis was done using the following assumptions and procedures:

- The project execution schedule including key project milestones;
- The entire LOM for the mineral reserve estimated in this Study. LOM production is expected for approximately 7 years;
- A benchmark sinter fines price of USD124.95/dmt CFR China port for 62% Fe content with applicable premiums and penalties applied as described in Chapter 19;
- Ocean freight from Sept-Îles to China port at USD24.67 per wet tonne over the LOM;
- Fines product is sold in the same quarter as production while Lump product is stockpiled at site during the summer, and shipped in the winter months (Q4 of the production year and Q1 of the subsequent year);
- During the first 5-6 years of the LOM l process and transportation will be of higher-grade ore. Once higher-grade ore is exhausted, the lower-grade stockpile will be crushed, screened and transported;
- Capital and operating costs are in constant Q2-2022 dollars with no escalation or inflation applied;
- Working capital required to meet expenses after production start and before revenue becomes available, is included;
- Inclusion of a royalty payable to royalty holders as outlined in Chapter 4 of this Study;
- An exchange rate of CAD 1.00 = USD 0.77;
- Calculation of production, sales and key financial metrics on a quarterly basis;

- Inclusion of pre-payments for buy-in for rail and port capacity totaling $58.4M, which is disbursed during pre-production and reclaimed either annually by railing operating cost reduction or by the Client selling capacity rights to another producer, at the end of mine life;
- A 20% discount of railing and port operating cost for lower grade products which is to be negotiated with the rail and port service providers;
- Payback periods, unless otherwise stated, are the years required to reach a break-even cashflow from the start of production (not accounting for pre-production).

This financial analysis was done by BBA on a pre-tax basis. The Client provided applicable annual taxation which BBA incorporated into its cash flow model to also provide results on an after-tax basis. All values are expressed in Canadian Dollars (CAD) unless otherwise stated.

Table 22-1 presents the annual revenues derived from the higher grade and lower grade selling prices based on 62% Fe iron content adjusted for applicable premiums and penalties, as described in Chapter 19.

Both lump and fines products are produced during the summer (i.e., non-winter days) of each production year, which is expected to last 214 days, from April 16th to November 15th. Tables 221 & 222 show lump and fines LOM annual production tonnage and grades. Lump product is dried, stockpiled and tarped for shipment during the subsequent winter months, with lump sales shown in the following winter months with all lump products produced in a summer season transported and sold by the end of the following winter season. Compared to shipping all products in the summer, delaying shipment of lump to the winter months has the benefit of producing a more stable cash flow throughout the year, providing a consistent employee work schedule and reduces the number of haul trucks, rail cars and port annual capacity required.

Table 22-2 presents the undiscounted cash flow projection for the Project based on the following:

- The aforementioned annual revenues;
- Operating costs;
- Royalties;
- Capital cost disbursements;
- Other costs including rehabilitation and closure costs, and pre- payments.

Table 22-1: Joyce Lake DSO Project revenue

Year	1	2	3	4	5	6	7	8	Total
Fines Production (kt)	1,495	1,625	1,625	1,625	1,625	1,623	1,673	-	**11,291**
Fines Fe Grade (%Fe)	59.7%	59.4%	60.0%	60.4%	62.0%	62.6%	52.5%	-	-
Fines SiO_2 Grade (%SiO_2)	10.0%	11.9%	11.9%	10.5%	8.9%	7.6%	22.0%	-	-
Lump Al2O3 Grade (%Al_2O_3)	0.8%	0.7%	0.67%	0.7%	0.5%	0.6%	0.8%	-	-
Fines Mn Grade (%Mn)	1.0%	0.6%	0.5%	0.8%	0.3%	0.5%	0.5%	-	-
Lump Production (kt)	805	875	875	875	875	874	901	-	**6,080**
Lump Fe Grade (%Fe)	62.7%	62.4%	63.0%	63.4%	65.2%	61.6%	55.2%	-	-
Lump SiO_2 Grade (%SiO_2)	5.9%	7.1%	7.1%	6.2%	5.3%	4.5%	18.2%	-	-
Lump Al2O3 Grade (%Al_2O_3)	0.4%	0.3%	0.3%	0.3%	0.2%	0.3%	0.3%	-	-
Fines Mn Grade (%Mn)	1.8%	1.2%	0.9%	1.5%	0.6%	0.9%	0.9%	-	-
Premium/Penalty Adjusted Joyce Lake Selling Prices ($/dmt)									
HG Fines Selling Price (USD)	$117.11	$113.36	$114.65	$118.28	$124.88	$128.20	-	-	-
HG Fines Selling Price (CAD)	**$152.48**	**$147.60**	**$149.27**	**$154.00**	**$162.60**	**$166.92**	**-**	**-**	**-**
LG Fines Selling Price (USD)	-	-	-	-	-	$57.97	$57.97	-	-
LG Fines Selling Price (CAD)	**-**	**-**	**-**	**-**	**-**	**$75.48**	**$75.48**	-	-
HG Lump Selling Price (USD$)	$162.71	$159.71	$161.14	$163.72	$169.28	$170.89	-	-	-
HG Lump Selling Price (CAD)	**$211.85**	**$207.94**	**$209.81**	**$213.16**	**$220.41**	**$222.51**	**-**	-	-
LG Lump Selling Price (USD$)	-	-	-	-	-	$75.74	$75.74	-	-
LG Lump Selling Price (CAD)	**-**	**-**	**-**	**-**	**-**	**$98.61**	**$98.61**	**-**	**-**
Sales Revenue (CAD) *									
Fines Shipments (kt)	1,495	1,625	1,625	1,625	1,625	1,623	1,673	-	**11,291**
Lump Shipments (kt)	235	820	875	875	875	877	825	698	**6,080**
Sales Revenue from Fines	$228.0M	$239.9M	$242.6M	$250.3M	$264.2M	$212.1M	$126.3M	-	$1,563.2M
Sales Revenue from Lump	$49.8M	$172.0M	$182.2M	$183.6M	$190.0M	$193.9M	$115.4M	$70.3M	$1,157.2M
Gross Revenue from Sales	**$277.8M**	**$411.8M**	**$424.8M**	**$433.8M**	**$454.2M**	**$406.0M**	**$241.7M**	**$70.3M**	**$2,720.4M**

*Lump product mined and processed in any given year are sold in Q4 of the same year and in Q1 of the following year. Sales Revenue of any given year accounts for some lump product produced the prior year

Table 22-2: Joyce Lake DSO Project undiscounted cash flow (million $)

Year		PP (-1 and 0)	1	2	3	4	5	6	7	8	Total
Lump Production (kt)		-	805	875	875	875	875	874	901	-	**6,080**
Fines Production (kt)		-	1,495	1,625	1,625	1,625	1,625	1,623	1,673	-	**11,291**
Lump Shipments (kt)		-	235	820	875	875	875	877	825	698	**6,080**
Fines Shipments (kt)		-	1,495	1,625	1,625	1,625	1,625	1,623	1,673	-	**11,291**
Lump Average Selling Price ($/dmt)		-	**211.85**	**207.94**	**209.81**	**213.16**	**220.41**	**173.35**	**98.61**	-	-
Fines Average Selling Price ($/dmt)		-	**152.48**	**147.60**	**149.27**	**154.00**	**162.60**	**130.64**	**75.48**	-	-
Gross Revenue from Sales ($M) *		-	**$277.8**	**$411.8**	**$424.8**	**$433.8**	**$454.2**	**$406.0**	**$241.7**	**$70.3**	**$2,720.4**
Operating Expenses	LOM average ($/dmt product)	Capitalized PP Costs									
Mining ($M)	**$15.46**	$17.7	$50.7	$59.9	$62.2	$54.9	$32.7	$8.1	-	-	**$268.5**
Perimeter Dewatering and Water Management ($M)	**$0.70**		$1.7	$1.7	$1.7	$1.7	$1.7	$1.7	$1.7	$0.4	**$12.1**
Processing and Handling ($M)	**$3.02**		$7.8	$8.0	$8.0	$8.0	$8.0	$8.0	$4.4	$0.4	**$52.5**
Product Hauling ($M)	**$6.71**		$15.8	$16.5	$16.5	$16.5	$16.5	$16.5	$16.5	$1.7	**$116.5**
Load-out and Rail loading operating costs ($M)	**$1.81**		$4.4	$4.5	$4.5	$4.5	$4.5	$4.5	$4.1	$0.4	**$31.5**
Site Administration & Services ($M)	**$4.52**		$10.9	$10.9	$10.9	$10.9	$10.9	$10.9	$10.6	$2.8	**$78.5**
Site Administration & Services (FIFO, room + board) ($M)	**$3.15**	$3.0	$9.0	$9.9	$10.0	$9.5	$7.6	$5.0	$3.8	-	**$54.7**
Lump Drying ($M)	**$0.89**		$2.1	$2.2	$2.2	$2.2	$2.2	$2.2	$2.3	$0.1	**$15.5**
Total Annual Operating Expenses ($M)	-	**$20.7**	**$102.1**	**$113.6**	**$116.0**	**$108.2**	**$84.0**	**$56.8**	**$43.3**	**$5.8**	**$629.8**
$/dmt Product sold	**$36.26**		**$44.40**	**$45.44**	**$46.41**	**$43.28**	**$33.60**	**$22.75**	**$16.81**	-	**$36.26**
Royalties	LOM average ($/dmt product)										
Total Royalties ($M)	**$1.86**	-	**$3.4**	**$5.1**	**$5.3**	**$5.3**	**$5.7**	**$4.8**	**$1.6**	**$1.2**	**$32.3**
Rail Transportation											
Rail Transportation and Prepayments ($M)		**$58.4**	**$100.6**	**$134.1**	**$138.9**	**$150.1**	**$150.1**	**$145.7**	**$138.7**	**$8.3**	**$1,024.8**
Capital Costs (1)											Total CAPEX
Mining (Capitalized Pre-Stripping) ($M)		$20.7	-	-	-	-	-	-	-	-	**$20.7**
Mining Equipment (Initial Owner Fleet) ($M)		$26.3	-	-	-	-	-	-	-	-	**$26.3**
Mining Equipment Sustaining ($M)			$12.0	$5.0	$1.3	-	-	-	-	-	**$18.3**
Project Infrastructure – Direct Costs ($M)		$143.1	-	-	-	-	-	-	-	-	**$143.1**
Project Infrastructure – Indirect Costs ($M)		$42.8	-	-	-	-	-	-	-	-	**$42.8**
Project Infrastructure – Contingency ($M)		$18.4	-	-	-	-	-	-	-	-	**$18.4**
Railcars ($M)		$9.2		-	-	-	-	-	-	-	**$9.2**
Other mobile equipment ($M)		$10.0		-	-	-	-	-	-	-	**$10.0**
Salvage Value ($M)		-	-	-	-	-	-	-	-	($31.8)	**($31.8)**
Closure and Rehab Assurance Payment ($M)		$4.8	$1.6	-	-	-	-	-	-	-	**$6.4**
Leasing ($M)		$22.0	$22.0	$22.0	$22.0	$22.0	-	-	-	-	**$109.9**
Total Capital Costs ($M)		**$297.2**	**$35.6**	**$26.9**	**$23.3**	**$22.0**	-	-	-	**($31.8)**	**$373.2**
Cash Flow (Undiscounted) (2)											
Net Change in Working Capital ($M)		$38.0	($38.3)	$0.6	($0.2)	($3.6)	($4.8)	$3.3	$6.6	($1.5)	$0.0
Annual Cash Flow ($M)		**($317.7)**	**($2.2)**	**$132.7**	**$141.1**	**$144.7**	**$209.7**	**$202.1**	**$64.6**	**$85.3**	**$660.2**
Cumulative Cash Flow ($M)	-	**($317.7)**	**($319.9)**	**($187.2)**	**($46.1)**	**$98.5**	**$308.2**	**$510.3**	**$574.9**	**$660.2**	-

(1) Negative values represent a capital gain for the Client; other values are expenditures, (2) Positive values represent gains whereas negative values represent expenditures

Figure 22-1 presents the undiscounted cash flows for the Project as derived from the spreadsheet format presented earlier.

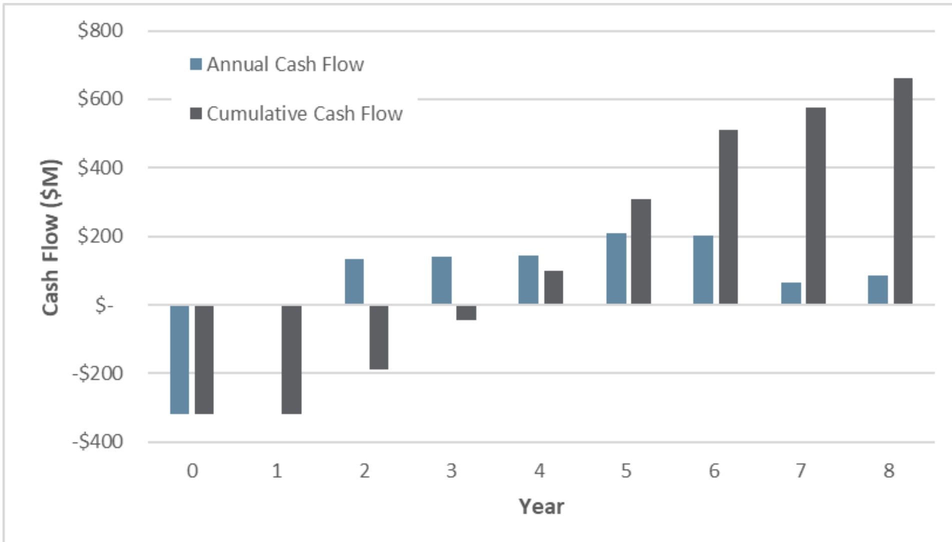


Figure 22-1: Joyce Lake DSO Project cash flow

A discount rate is applied to the cash flow to derive the NPV for each discount rate. The payback period is presented for the undiscounted cumulative NPV. The NPV calculation was done at 0%, 4% and 8%. The base case NPV was assumed at a discount rate of 8% following discussions with the Client. Table 22-3 presents the results of the financial analysis for the Project, based on the assumptions and cash flow projections.

Table 22-3: Before tax financial analysis results

IRR = 27.72%	NPV ($M)	Payback (years)
Discount Rate		
0%	$660.2M	3.2
4%	$489.4M	-
8%	$357.2M	-

At a benchmark selling price for 62%Fe sinter fines of USD124.95/dmt, CFR China and an exchange rate of CAD1.00 = USD0.77, the Project is forecasted to provide a before-tax IRR of 27.72%. At the base case discount rate of 8% the NPV is $357.2M and the payback period is 3.2 years after the start of production.

22.1 Taxation

The Project will fall under the tax jurisdiction of the federal income tax, provincial income tax and provincial mining taxes.

- A federal income tax rate of 15%, payable to the Federal Government of Canada under the *Income Tax Act* (Canada).
- A provincial income tax rate of 15%, payable to the Government of Newfoundland and Labrador under the *Income Tax Act, 2000* (Newfoundland and Labrador).
- Under the *Revenue Administration Act* (Newfoundland and Labrador) the operator of mines will be subject to:
  - 15% tax on taxable income ("Taxable Income"):
    - Taxable Income is calculated as net income, less the greater of 20% of the net income (if positive) and amounts paid to a person who receives royalties subject to the mineral rights tax.
    - Net income is gross revenue of tax payer less all expenses, with certain exceptions such as interest and impact benefit payment, reasonably incurred in mining operations, processing, and smelting.
    - Operators can claim allowances for depreciation and processing:
      - The depreciation on processing or smelting assets (Class 1 assets) and mining assets that are not Class 3 assets (Class 2 assets) cannot exceed 25 percent of the undepreciated capital costs. The depreciation on mining assets acquired for and used in a new mining operation (Class 3 assets) can be up to 100% of the undepreciated capital cost.
      - Processing allowance is the minimum of 8% of the cost of the processing facility and 65% of income before the processing allowance. JDI's operation does not involve processing, as defined under *Mining and Mineral Rights Regulations 2003 (Amendment)*. Therefore, no processing allowance is considered in this Study.
    - Credit against tax on Taxable Income:
      - Credit amount for a year is lesser of $2 million and corporate income tax payable under *Income Tax Act, 2000* (Newfoundland and Labrador) for the year.
      - Cumulative credit amount cannot exceed $20 million.
  - 20% tax on amounts taxable:
    - A 20% tax applies to amounts taxable, which are calculated as 20% of the net income (as determined above under "Tax on Taxable Income"), if positive, minus amounts paid to a person who receives royalties subject to the mineral rights tax.
  - 20% mineral rights tax:

- Under the *Mineral Act* (Newfoundland and Labrador) the mineral rights tax will be applied where a person receives consideration, including rent and royalties that are contingent upon production of a mine, or computed by reference to the production from a mine, for the grant or assignment of any right issued. JDI does not expect to receive such royalties, and therefore, JDI is not liable to the mineral rights tax.

After tax project financial performance is presented in Table 22-4.

Table 22-4: After tax financial analysis results

IRR = 20.01% Discount Rate	NPV ($M)	Payback (years)
0%	$394.7M	3.7
4%	$276.4M	-
8%	$184.6M	-

On an after-tax basis, the Project is forecasted to provide an IRR of 20.01%. At the base case discount rate of 8%, NPV is $184.6M. The payback period is 3.7 years after the start of production.

22.2 Sensitivity Analysis

NPV and IRR sensitivity to key variable ranges, before and after –tax, was determined from the financial model base case, for the following ranges.

- Initial capital costs +/-20%;
- Operating costs +/-20%;
- Products selling price -20%/+80%.

Results are shown in Table 22-5, and graphically in Figure 22-2 and Figure 22-3.

Table 22-5: Sensitivity analysis table (before tax)

Variation	-20%	-10%	-5%	0	+5%	+10%	+20%	+30%	+40%	+50%	+80%
Selling Price											
Base Price for 62% Fe, CFR China ($/dmt)	99.96	112.46	118.70	124.95	131.20	137.45	149.94	162.44	174.93	187.43	224.91
IRR	6.55%	17.95%	23.09%	27.72%	30.92%	35.08%	42.96%	50.31%	57.32%	63.95%	82.44%
NPV (8%)	-$18.9 M	$171.5 M	$266.8 M	$357.2 M	$421.0 M	$508.5 M	$683.6 M	$857.4 M	$1,032.5 M	$1,206.3 M	$1,730.3 M
Payback (y)	5.41	4.21	3.78	3.21	3.04	2.74	2.24	2.04	1.83	1.64	1.27
CAPEX											
CAPEX (million $)	212.1	241.0	255.6	270.4	285.3	300.3	330.8	-	-	-	-
IRR	34.81%	31.08%	29.35%	27.72%	26.16%	24.68%	21.92%	-	-	-	-
NPV (8%)	$430.5 M	$394.1M	$375.7M	$357.2 M	$338.6M	$319.8M	$282.0M	-	-	-	-
Payback (y)	2.76	3.03	3.12	3.21	3.34	3.52	3.90	-	-	-	-
OPEX											
OPEX (million $)	503.9	566.9	598.4	629.8	661.3	692.8	755.8	-	-	-	-
IRR	32.65%	30.20%	28.96%	27.72%	26.47%	25.21%	22.68%	-	-	-	-
NPV (8%)	$450.5 M	$403.8 M	$380.5 M	$357.2 M	$333.9 M	$310.6 M	$264.0 M	-	-	-	-
Payback (y)	2.88	3.06	3.13	3.21	3.32	3.49	3.90	-	-	-	-

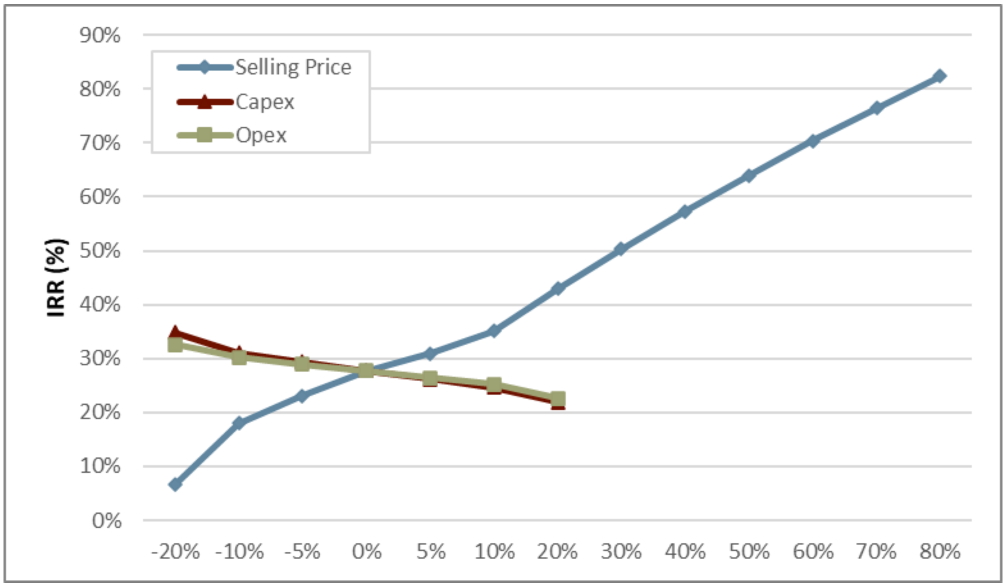


Figure 22-2: Before-tax sensitivity analysis for IRR

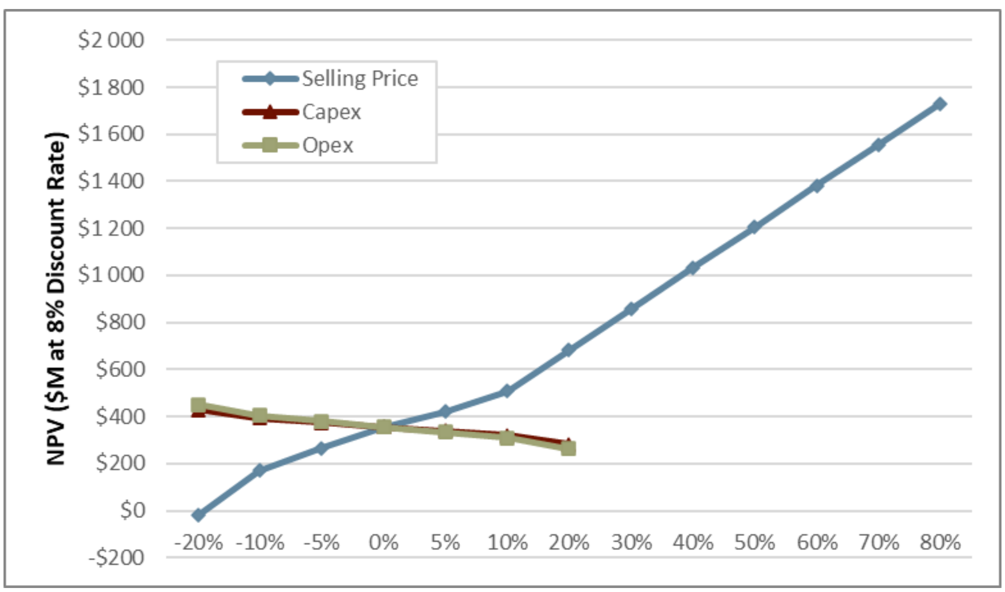


Figure 22-3: Before-tax sensitivity analysis for NPV

Table 22-6: Sensitivity Analysis Table (after-tax)

Variation	-20%	-10%	-5%	0	+5%	+10%	+20%	+30%	+40%	+50%	+80%
Selling Price											
Base Price for 62% Fe, CFR China ($/dmt)	99.96	112.46	118.70	124.95	131.20	137.45	149.94	162.44	174.93	187.43	224.91
IRR	4.24%	12.58%	16.41%	20.01%	22.42%	25.56%	31.64%	37.43%	42.87%	47.97%	62.38%
NPV (8%)	-$50.9 M	$70.8 M	$128.6 M	$184.6 M	$223.2 M	$275.5 M	$380.1 M	$484.9 M	$588.9 M	$691.8 M	$1,002.1 M
Payback (y)	5.51	4.42	4.05	3.69	3.34	2.95	2.49	2.23	1.86	1.71	1.38
CAPEX											
CAPEX (million $)	212.1	241.0	255.7	270.4	285.3	300.4	330.8				
IRR	25.69%	22.69%	21.31%	20.01%	18.70%	17.48%	15.26%				
NPV (8%)	$237.6 M	$211.3M	$198.0M	$184.6 M	$170.2M	$155.8M	$127.5M				
Payback (y)	2.93	3.31	3.47	3.69	3.83	3.95	4.19				
OPEX											
OPEX (million $)	503.9	566.9	598.4	629.8	661.3	692.8	755.8				
IRR	23.62%	21.81%	20.91%	20.01%	19.02%	18.05%	16.15%				
NPV (8%)	$240.2 M	$212.4 M	$198.5 M	$184.6 M	$169.7 M	$155.1 M	$126.7 M				
Payback (y)	3.15	3.40	3.52	3.69	3.81	3.91	4.11				

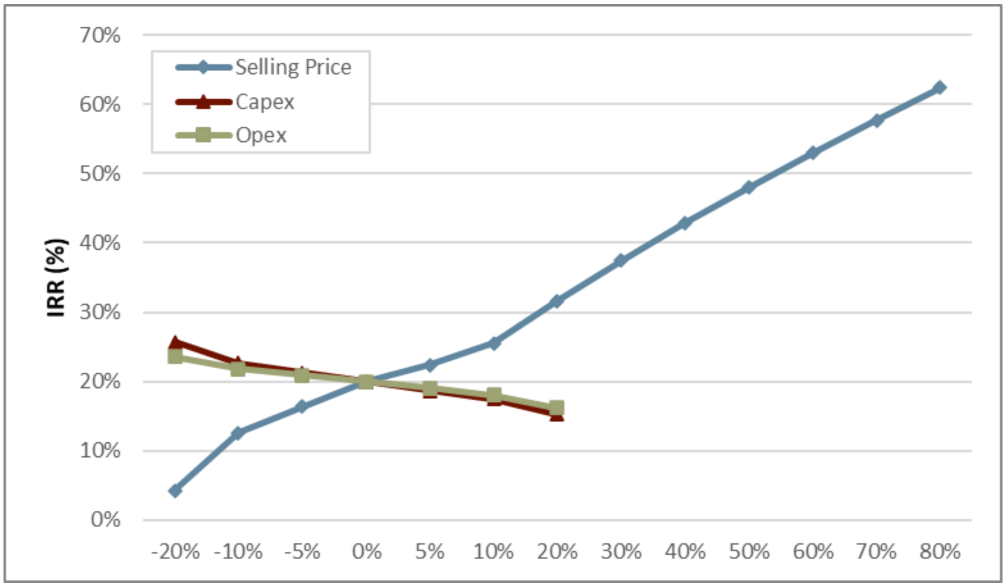


Figure 22-4: After-tax sensitivity analysis for IRR

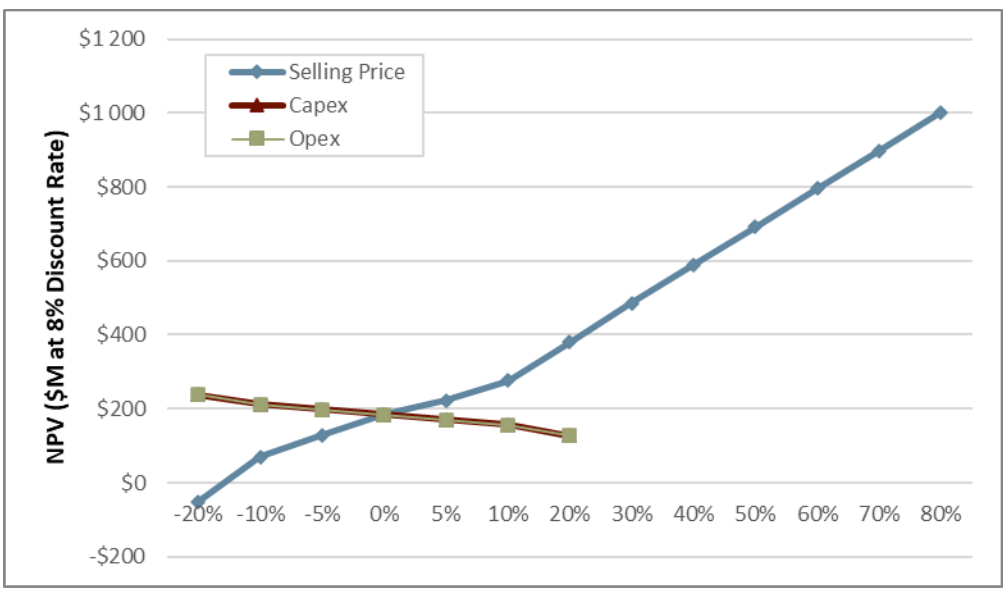


Figure 22-5: After-tax sensitivity analysis for NPV

23. Adjacent Properties

The Joyce Lake Project is located in the western central part of the iron-rich Labrador Trough which contains a number of large iron-rich deposits and exploration properties. Only Direct Shipping Iron Ore ("DSO") properties adjacent (regionally) to the Project are described here.

The following companies have regionally adjacent DSO projects currently under development or investigation:

- Labrador Iron Mine Holdings Limited ("LIM");
- Tata Steel Minerals Canada Limited ("TSMC"); and
- Black Bird DSO Deposit (Century Global Commodities Corporation).

The following information has been publicly disclosed by the companies identified, as of July 2021, and has not been verified by the qualified person ("QP").

Information on regionally adjacent properties contained in this Report is not indicative of mineralization at the Joyce Lake project.

23.1 Labrador Iron Mine Holdings Limited (LIM)

LIM, through its majority-owned subsidiary Labrador Iron Mines Ltd., operated the James Mine and the associated Silver Yards processing plant near Schefferville from 2011 through 2013. During operation, LIM sold 3.55 million tonnes of iron ore products to China before placing production and shipping on hold in 2014 due to declining prices. LIM ultimately closed the James Mine and Silver Yards processing plant, and rehabilitated the sites, between 2016 and 2020.

Subsequently LIM advanced the Houston DSO project, near Schefferville, and adjacent to the planned Joyce Lake project product haul road, to a Preliminary Economic Assessment ("PEA") in March 2021. The Houston DSO project is expected to produce 2 million tonnes of DSO products annually over a project life of 12 years, producing a total of 23.4 million tonnes of iron ore products at an average grade of 62.2% Fe.

23.2 Tata Steel Minerals Canada Limited (TSMC)

TSMC is a joint venture between Tata Steel of India and Investissement Québec. TSMC is currently developing the DSO project, located approximately 10 km northwest of Schefferville. The site was previously mined and consists of approximately ten iron ore deposits.

The project has a production capacity of 4.2 million tonnes of high-grade concentrate per annum over a 12-year mine life. The majority of ore will be trucked to a processing complex and concentrated to high-grade sinter fines. High-grade iron ore is also expected to be crushed to produce a DSO product.

The project started construction in 2012 and produced DSO products from an external plant, on a seasonal basis, starting in 2013. Commissioning of the concentrator was placed on hold in 2016 due to declining ore prices and resumed in 2019. The Howse DSO deposit is a project 25 km northwest of Schefferville in Labrador, held by TSMC, containing approximately 46 million tonnes of DSO iron ore. The project is anticipated to produce between 1.3 and 3.0 million tonnes of DSO products per annum over a 15-year mine life. Ore from the Howse deposit may be crushed and screened to produce DSO products or treated and upgraded in the processing complex to produce concentrate.

23.3 Black Bird DSO

The Black Bird DSO Deposit is part of the Sunny Lake property held by Century Global Commodities Corporation through its wholly owned subsidiary, Century Sunny Lake. This deposit is located approximately 65 km northwest of Schefferville. The 2015 mineral resource estimate contains an Indicated mineral resource of 1.55 million tonnes at 59.9% Fe and an Inferred mineral resource of 8.6 million tonnes at 57% Fe.

24. Other Relevant Data and Information

24.1 Project Implementation Schedule and Execution Plan

This Chapter provides a summary and general description of the project implementation and construction execution plan upon which the Project construction schedule and the capital cost estimate were developed. A more detailed construction plan than can be shown in this Chapter was developed and used during the feasibility study ("FS").

The Project schedule and execution plan are dependent on the start date due to the seasonal temperature and other weather impacts associated with developing this Project in Labrador. The on-site construction schedule is based on a start in March with commercial production beginning in March of the following year. The schedule is dependent on the pre-ordering of equipment and supplies prior to start of on-site construction. It is assumed that all studies and other work will have been completed and the Client will have all permits in hand prior to the on-site construction start date.

The major Project milestones are listed in Table 24-1. The two monthly columns show the time of occurrence in months relative to the start of construction and to the start of commercial production.

Table 24-1: Key project milestones

Major Milestones	Month vs Start Construction
Award EPCM mandate	-8
Award Mobile Crushing/ Screening Plant Order	-7
Award Mining Equipment Order	-7
Environmental Permit Approval(1)	-3
Start Construction	0
Telecommunication available across site	5
Causeway completed	5
Start pumping Joyce lake	5
Haul Road and Astray Rail Siding Completed	7
Export Infrastructure Completed	9
Power Available at site	9
Truck shop dome completed	9
Permanent camp available (144 rooms)	10
Mechanical Completion (Construction Complete)	10

Notes:

(1) Environmental permit approval shown in month –3 of on-site construction start is a placeholder and the Client may elect to not pre-award EPCM and equipment delivery until environmental permits are in place. Such an election will not impact elapsed time of construction.

(2) Production (crushing and screening) commences mid-April in the spring season following the completion of construction.

24.1.1 Schedule Basis

The Project execution schedule developed in the feasibility study and described herein covers the period from the start of the EPCM contract award to the start of commercial production. The major assumptions driving key milestones in the preliminary project execution schedule are as follows:

- The provincial and federal environmental assessment and subsequent permits requests are issued in time to allow on-site construction to proceed and, if appropriate, for pre-order of equipment and construction services;
- The Project EPCM services contract will be awarded in July of the year prior to the year of on-site start of construction;

- Major construction is planned to be done over ten months, starting in the month of March of the Project implementation year;
- During the summer of the year prior to the start of on-site construction, work will be done on refurbishment of the 14-km Iron Arm road from the Kawawachikamach turn-off to the existing Joyce Lake exploration camp to prepare the road for construction traffic;
- The product haul road construction will be built from four points:
  - from km 7 towards the rail siding;
  - From km 7 eastwards;
  - From km 34 going towards the causeway and the mine;
  - From km 34 going westwards.
- Construction work shifts are based on ten hours per day and seven days a week with a rotation of 28 days of work and 14 days of rest on a fly-in-fly-out ("FIFO") basis;
- The construction of the rock causeway will be done as early as possible in the construction schedule from the South side of Iron Arm waterway;
- The draining of Joyce Lake will take start towards the end of summer during construction. Draining of Joyce Lake needs to be complete during Year 1 of production to ensure no impact on the open pit excavation plan.

24.1.2 EPCM Services

24.1.2.1 Engineering

To support the construction schedule, EPCM activities will be split into two mandates:

- The first mandate will define the requirements and prepare the specifications, drawings, and request for quotations ("RFQ") for the rehabilitation of the existing Iron Arm road from Kawawachikamach turn-off to the Joyce Lake exploration camp and the 4.2-km road extension to the southern access to the rock causeway. Completion of this mandate will allow immediate start of the causeway construction across Iron Arm waterway and a start of driving the west to east section of the 43-km product haul road. The mandate for Iron Arm road will be awarded about one year prior to the start of on-site construction to ensure that the mine site is accessible early in the project construction schedule. It is understood that the Client will have secured all required permits to undertake this work.
- The second mandate will cover the balance of the work and will complete the definition of requirements and prepare specifications, drawings and RFQs for the product haul road, causeway, mine garage and other site infrastructure, processing facility, permanent camp,

power plant and rail siding infrastructure, as well as the mine pre-stripping, Joyce Lake dewatering, deep-well drainage system and related fixed and mobile equipment.

It is planned that the Project processing plant will be ordered and delivered early in the schedule as it may be used during construction to provide crushed materials for the construction of the site road and pads in the mine area. The EPCM mandate will be awarded and mobilized about eight months prior to on-site construction start.

24.1.2.2 Procurement

Procurement for the first mandate will be only for the rehabilitation of the Iron Arm road from Kawawachikamach turn-off to the Joyce Lake exploration camp and the 4.2-km road extension to the causeway south access point.

Procurement activities in the second mandate will be prioritized based on delivery of longer lead items such as the mining fleet, the mobile crushing and screening equipment, the modular operations camp, and the power plant generators. In budgetary quotes received during the FS, the longest lead times near or on the critical path are in the order of eight months. Some equipment, such as the rail cars, will potentially have longer lead times, but have no significant impact on the critical path of the Project. They will, however, impact the Client’s cash disbursement schedule. It is recommended that the EPCM contractor confirm this early in their mandate. Apart from flight, Schefferville is accessible by rail only. Equipment selection in this study considers that equipment and spare parts must be shipped to site by rail.

24.1.2.3 Construction Management

The construction management team will be split into two locations. At first, the majority of the team will be located near the existing Client exploration camp while the Iron Arm road and causeway are under construction, and relocated to the modular offices on the mine side of Iron Arm once they are operational. This portion of the team will manage the work at the mine site as well as the construction of the eastern segment of the product haul road.

A smaller portion of the team will be located at the rail siding and will be managing the western segment of the product haul road and the rail siding construction from the construction office located at the rail siding. The entire construction management team will be composed of up to 16 personnel with between 12 to 15 on a two weeks in / one week out rotation.

Figure 24-1 shows the construction management workforce curve.

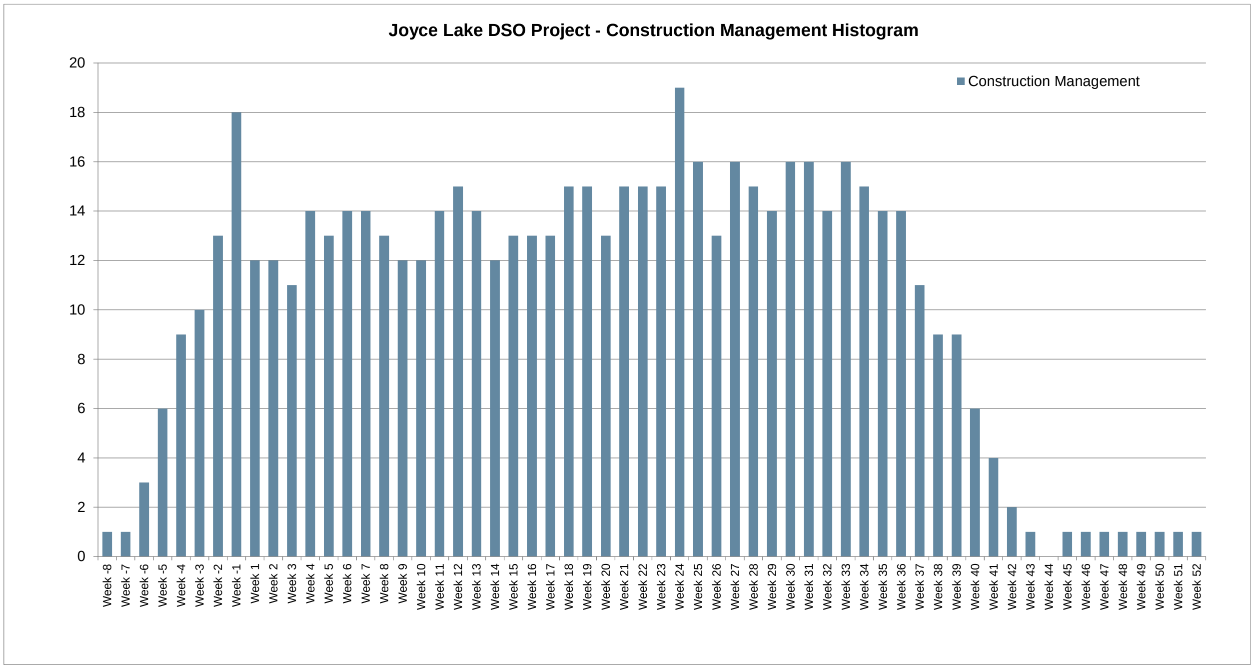


Figure 24-1: Joyce Lake construction management histogram

24.1.3 Construction

The mine site sits on the north side of the Iron Arm waterway approximately 28 km from Schefferville. An existing 14-km stretch of Iron Arm road will be rehabilitated (including a 4.2-km extension) to accommodate the traffic required for mine construction and services during mine operation. To take advantage of the short summer months the existing Iron Arm road will be rehabilitated over the summer preceding the start of construction. It is assumed that construction permits for this work will be in hand.

It is expected that all required permits, including the construction permits, shall be issued to allow start of construction in the first week of March of the Project implementation year.

The existing paved airport in Schefferville will serve as the initial key laydown area of the project. After the causeway construction is complete the construction team will begin preparation of the crusher and stockpile pads. Preliminary pads in these areas will serve as a laydown area for major equipment.

The work is split into three major areas, the rail siding, the product haul road and the mine.

Construction will begin simultaneously on two work fronts: the product haul road from the rail siding end and the extension of the Iron Arm Road 4.2-km towards the causeway. Mobile crushers destined for future operation shall be requisitioned early to supply the backfill material required for the construction phase.

A number of borrow material deposits have been identified by geotechnical work performed during the FS. Nevertheless, the majority of the road and pad construction material shall be retrieved from the footprint reserved to accommodate the rail loading pad (approx. 600 m x 100 m), the mine pit, and a quarry developed along the hauling road corridor, approximately 34 km north of the rail siding.

During the last three months of the ten month construction period, winter weather conditions will prevail. By this point dewatering activities will cease, and civil works will be ramping down and demobilising. Construction activities will be focused on installation of modular buildings and key equipment such as the crushers and dryer. As the winter season progresses activities will be limited to work within enclosed buildings, commissioning of production equipment, waste rock stripping and other activities relatively unaffected by winter conditions.

24.1.3.1 Rail Siding

A heavy civil contractor shall execute all earth and rock excavation and backfill except for the rail ballast. Material required for the ballast construction will be crushed by the earthwork contractor and piled for use by the rail contractor. All work related to the rails, including the tie-in to the existing rails, shall be accomplished by a specialized rail turnkey contractor. Rail construction will be completed by month 8 of the implementation year.

24.1.3.2 Product Haul Road and Causeway

The product haul road spans approximately 43 km in total length and crosses four important waterways, including Iron Arm which will be crossed using a rock causeway. A total of five bridges will be erected. Three bridges, a 50-m, a 31-m and 40-m, will be erected along the road between km 1 and 34 (km increases from the rail siding going eastward towards the mine). Two, 8-m long bridges will be installed in the 1.2-km rock causeway across the Iron Arm waterway.

Two of the bridges, including the 50-m bridge located between the rail siding and km 7, must be erected rapidly to provide access to the rail siding area from east and west. Near the rail siding area, crews will work on each side of the 50-m bridge crossing where one team will work from the rail siding to lay down the haul road foundation, working west to east, while a second team will start at km 7 to lay down the road foundations from east to west, toward the rail siding. Once the bridges are installed, crushed material from the rock excavation at the rail siding will be used to complete the upper layers of the road. Two rented 20-person fly camps will be located on each side of the 50-m bridge crossing to accommodate the work crews.

At the other end of the product haul road sits the causeway. With a 1.2-km length, the causeway will have two 8-m bridges that will serve to maintain water circulation and allow access for leisure boats. The foundation layer of the causeway is first built to allow access to the mine site. Crossing the causeway marks the start of construction of the mine area. Consequently, the ability to cross the causeway with heavy machinery is a major milestone in the critical path of the Project. The schedule foresees five months of work prior to the initial crossing expected mid-July. A 4.2-km section of new road from the end of Iron Arm road must be completed between the causeway and the existing Iron Arm Road to be rehabilitated the previous summer. It is assumed that the material for this 4.2-km section of Iron Arm road extension shall be supplied by a quarry in Kawawachikamach, roughly 14 km away. The material for the sub-foundation of the causeway will be produced at the km 34 quarry.

24.1.3.3 Mine Area

The mine area civil work will be executed with the Client's mining team and equipment fleet. Wood clearing, where required, will be done by a local contractor. This work will begin as soon as the crossing of the Iron Arm is completed.

The mine pit will produce extensive backfill material from both the overburden and the waste rock. This material will be used as raw material for the construction of the mine roads and the mine area pads.

In the construction year, the excavated material from the mine shall be used to build the pads for the explosive magazine area, truck shop, crushing plant, permanent camp, the fuel bay, and power plant along with mine and service roads. The initial pads shall be built so that they can be expanded, should operations require.

Civil works are expected to be completed by mid-October. Taking advantage of the extended daylight hours in the region, work on the critical path, such has the causeway, shall be accomplished on two shifts. Construction power, where required, shall be provided by contractors using temporary generators.

The permanent production accommodations camp and truck shop will both be supply and install contracts. Work will start as soon as sufficient pad space is prepared and be completed and turned over in December, at the latest. In parallel to the camp and truck shop construction, a third contractor will be responsible for the mechanical and electrical installation of the power plant and fuel storage and dispensing facilities.

24.1.3.4 Construction Camp

Facilities for room and board for construction workers will be done within the Schefferville municipality. Lodging of workers is assumed to be as follows:

- 144 rooms facility, location to be determined;
- Exploration camp, 30 rooms available;
- Schefferville hotels and rooms in private residences;
- Two small 20-room fly camps for the rail siding area rented from a Third Party.

This puts the total number of confirmed rooms available during construction 214.

The peak labour force on-site during construction is estimated at 325 as demonstrated in Figure 24-2. For a period of approximately two months, an additional 115 rooms will be required and will be sourced prior to a construction commitment. During the EPCM phase, it will also be possible to optimize the construction plan to smooth out the personnel peak.

At the end of Month 10, the permanent camp will be completely operational and ready to receive Mining and Operations personnel.

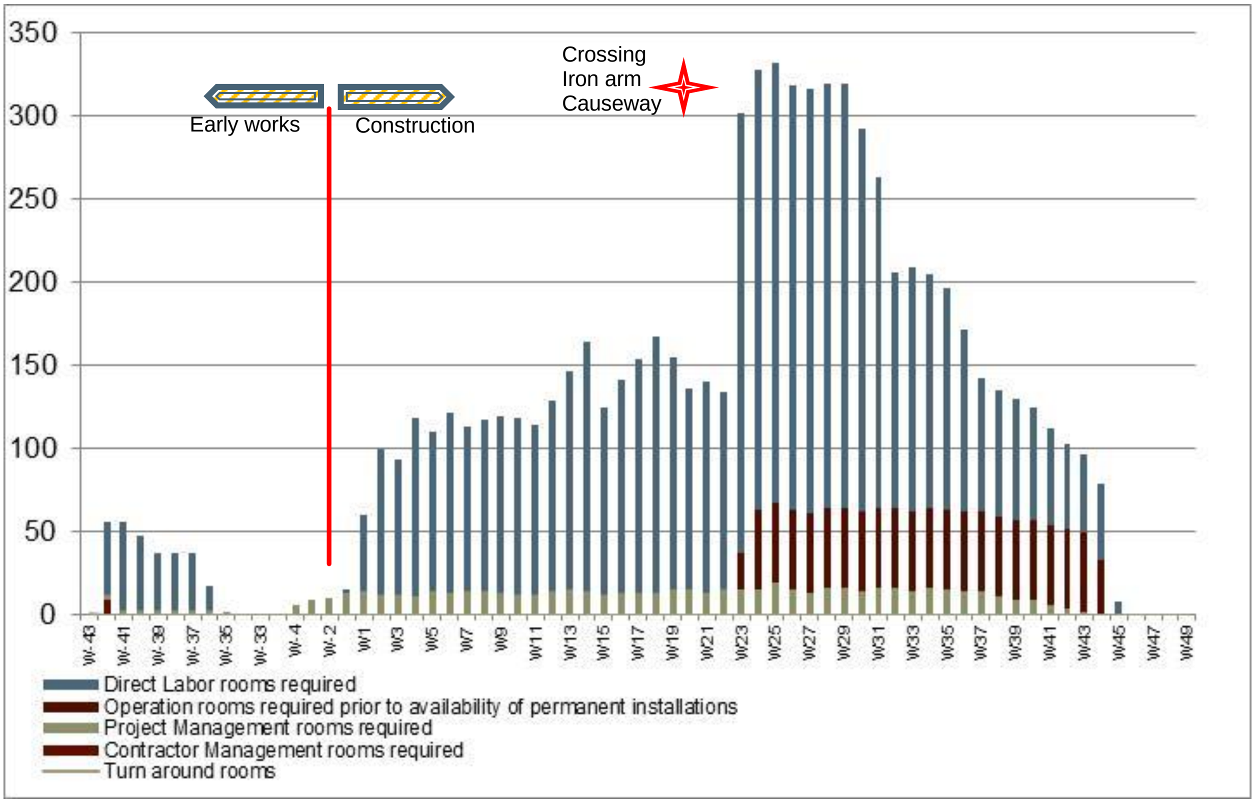


Figure 24-2: Preliminary construction workforce curve

24.1.4 Pre-Operational Verifications and Commissioning

The bulk of the POV activities are concentrated in the process plant, truck shop, camp, and power plant areas. It starts during October, to be completed in December. Production will start at the end of Q1 of the year following construction.

24.1.5 Project Execution Schedule

For the feasibility study, a Level 3 project execution schedule was developed as part of the construction plan. Figure 24-3 presents a simplified project execution schedule summary of the more detailed schedule developed.

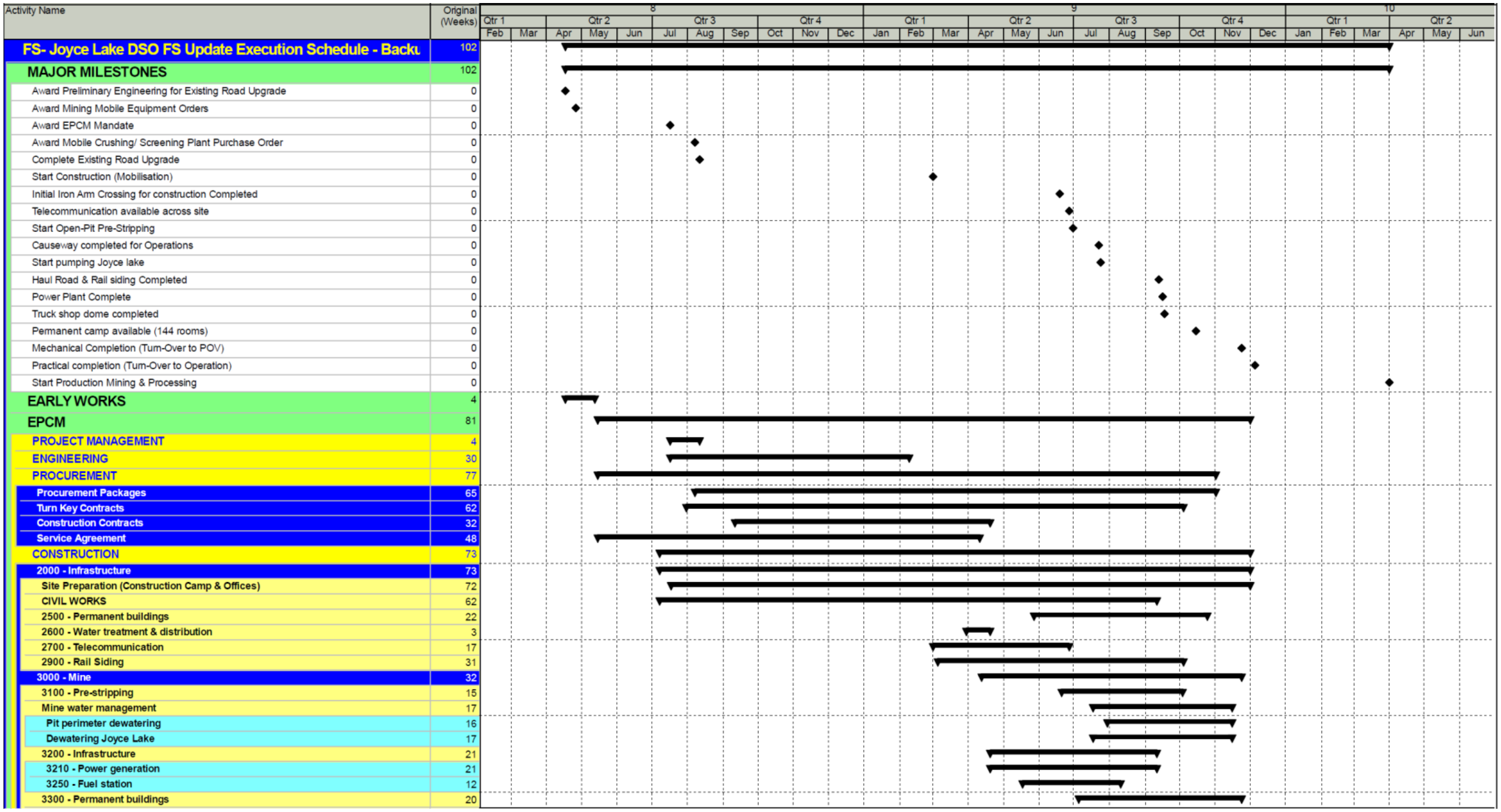


Figure 24-3: Summary – Project master schedule (page 1 of 2)

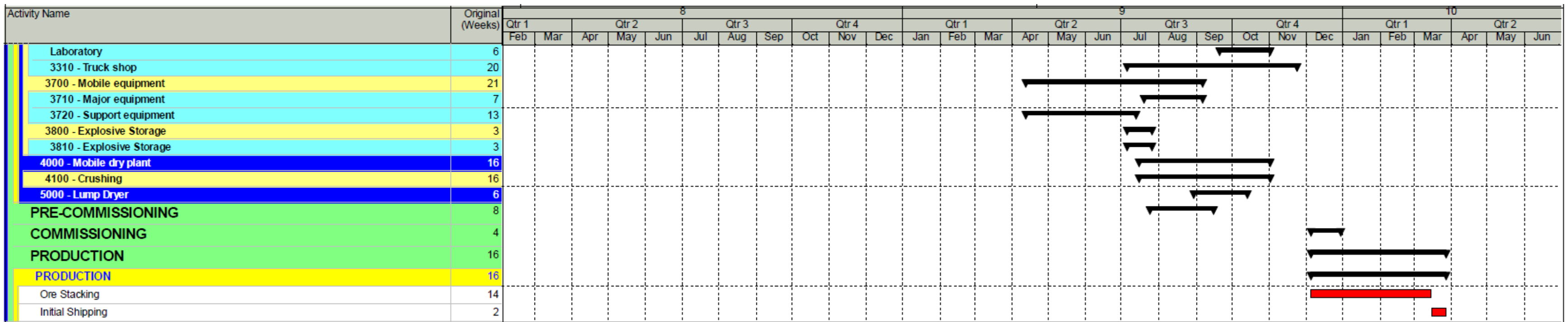


Figure 24-3: Summary – Project master schedule (page 2 of 2)

25 Interpretation and Conclusions

A non-current feasibility study ("FS") was completed in March 2015, and filed as a Canadian NI 43-101 Technical Report in April 2015. This report is an update of the non-current 2015 FS and includes Project optimization to minimize capital and operating costs.

An Environmental Impact Statement ("EIS") was also compiled in 2015 to advance the Project Environmental Assessment ("EA"). Due to the global collapse of the iron ore market, the federal and provincial EA processes were paused in 2015 while the Project was placed on care and maintenance until late 2020 when the market started to recover. In May 2021, the Client filed an updated EIS with the federal IAAC Agency for conformity review and, subsequently, filed a further updated conforming (draft) version to commence the technical review by IAAC. Concurrently, the Client also received from NL-ECC new provincial EIS guidelines upon registration of the Project with the province in 2021, which is substantially similar to the previous guidelines issued. As required by IAAC, only one single combined EIS, compliant to both the federal and provincial guidelines, will be necessary.

The Client discussed with GlobalMinds Geoservices Inc. ("GMG") its intention to advance the Joyce Lake Project to a production decision as quickly as possible, with the use of the current May 2022 Mineral Resource Estimate ("MRE"). The qualified person ("QP") is of the opinion that the extent and quality of the work completed to date in relation to the May 2022 MRE is robust and satisfactory.

The Joyce Lake deposit is well-defined, with an exceedingly high percentage of Mineral Resource in the Measured and Indicated categories in the current May 2022 pit-constrained resource; significant additional exploration on the deposit is not planned.

The proposed exploration and development plan is sufficient to cover the Client's key expenditures work program through to a production decision based on the existing MRE. Preproduction expenditures will also include cost to advance the federal and provincial EA processes to completion, the costing of which is not included in this FS.

The Project can be advanced rapidly for a production decision as previous data collection and supporting studies were completed, along with the 2015 FS. These non-current technical reports contain extensive data and analysis, including modelling and designs. As the Project progresses, future studies are projected along with an estimated budget, briefly explained in Chapter 26.

Over approximately the next 12 months, the Client expects to negotiate Impact Benefit Agreements ("IBAs") with up to five Indigenous Nations in the Project area, as well as a Benefits Agreement with the province of Newfoundland and Labrador.

25.1 Mineral Resources

The current MRE, effective date of May 6, 2022, was in conformity with generally accepted CIM Estimation of Mineral Resource and Mineral Reserve Best Practices Guidelines.

The Joyce Lake DSO Project and surrounding properties have a rich mining heritage. Recent drilling and 3D modelling has shown that the DSO iron deposit located on the Property has a predictable geometry and potential for tonnage additions, within both the known extents and extrapolations. The mineralized structures have been confirmed and improved with the 2013 drilling program, providing a much better understanding of the geological context and interrelationship between structures.

In 2013, Century proceeded with core drilling to take advantage of its higher drilling speed compared to RC drilling and to obtain accurate density measurements used to convert volume to tonnes. In the opinion of GMG: the geological interpretation, sample locations, assay intervals, drillhole spacing, QA/QC and grade continuity of the Joyce Lake DSO deposit are adequate for this current May 2022 resource estimation and classification. The resource estimate is produced by GoldMinds Geoservices Inc. and was performed with a cut-off grade of 50% Fe and a 55% Fe sensitivity. The Joyce Lake deposit is 23.97 Mt of Measured and Indicated Mineral Resource at an average grade of 58.63% total Iron (Fe) and 0.83 million tonnes of Inferred Mineral Resource at an average grade of 62.10% Fe.

It is important to mention that a technical risk regarding the estimation of Mineral Resources still resides in the varying density used to convert volume to tonnage, as the DSO material is difficult to recover in-situ at depth under the water table. Market conditions for iron demand, permitting, and railroad availability remain the other major risks associated with the Project.

In the opinion of the QP, the geological interpretation, sample location, assay intervals, drillhole spacing, QA/QC, specific gravity measurement of core and grade continuity of the Joyce Lake DSO deposit are adequate for this resource estimation and classification.

25.2 Mineral Reserves

The Joyce Lake open pit mine contains 17.37 Mt of iron ore reserves in the Proven and Probable categories at an average grade of 59.94% Fe, 11.28% SiO_2, 0.55% Al_2O_3 and 0.76% Mn. Total waste material amounts to 71.55 Mt of waste rock and 2.31 Mt of overburden, resulting in an overall open pit strip ratio of 4.25 (tonnes of waste rock and overburden per tonne of ore). Table 15-1 presents the final open pit Mineral Reserves for the Joyce Lake DSO pit.

25.3 Mining

Mining of the Joyce Lake deposit will generally follow the standard practice of a conventional open pit operation, with drill and blast, load and haul cycles using a drill/shovel/truck mining fleet. The overburden and waste rock material will be delivered to the overburden and waste disposal areas near the pit. The run-of-mine ore will be delivered to the ore stockpile or low-grade stockpile ahead of the processing plant. Mining operations are planned to take place year-round.

A three-phase mine plan was developed to support a mining operation targeting a saleable product production rate of 2.5 Mtpa of lump and fines products over the LOM. Mine pre-stripping takes place over an approximate nine-month period and mining operations will take place over an additional five years. Low-grade stockpile reclaim will occur over, approximately, two years following the end of mining operations.

The 12-m bench height with 8-m berm width was selected as the bench design for the current study. When additional geomechanical data and analysis for rock mass is available during the next phases of study, the bench design should be reviewed and optimized.

The more prominent risks identified that are related to the mining operation are as follows:

- Risks related to pit dewatering and water management (including perimeter well pumping, Joyce Lake drainage and surface water management and open pit water from surface water and ground water). If the hydrogeology is not adequately understood, and higher volumes of water need to be pumped, this could have an impact on capital and operating costs.
- Risks related to ore moisture content (assumed to be 6% but can vary depending on pit water management plan). Excess humidity in the ore can impact processing efficiency, as well as product transportation costs.
- Risks related to pit slope stability. Pit slope design is dependent on rock mechanics and hydrogeology. LVM has identified certain geotechnical complexities that should be further studied.
- Operation of the open pit mine will require dewatering to ensure that the water table is maintained below the bottom of the pit and more than 25 m from the pit walls. Perimeter dewatering was proposed by BluMetric Environmental to achieve this, based on groundwater modeling. If shallower pit slopes are required this could impact the size of the Mineral Reserve, stripping ratios and overall mining costs.
- Risks related to the estimate of the density of waste rock. If the density is significantly higher than estimated, there will be an impact on mining fleet requirements and cycle times, thus on overall mining operating costs.

25.4 Processing

The Joyce Lake process consists of a two-stage dry crushing and screening process to produce "lump" and "fines" products. This process route does not require any grinding to liberate the material for subsequent physical or chemical separation. The result is a process which creates no material waste and is much more energy-efficient in comparison to coarse and fine beneficiation circuits. Lump material also has the added benefit of not requiring sintering or pelletizing prior to being introduced to a steelmaking furnace.

Each of the crushed products, lump and fines, are delivered to their dedicated stockpiles. Lump product is first dried to 2% moisture prior to being stockpiled. The lump stockpile is progressively tarped to prevent re-wetting and is later reclaimed for shipment during the winter season. Loaders transfer the lump and fine products from the stockpiles into haul trucks for transport to the rail connecting to the existing Tshiuetin rail line, located 43 km away.

25.5 Risks and Opportunities

The possible risks and opportunities have been identified based on the present information known and are summarized in Table 25-1 (excluding those typical to all mining projects, such as changes in metal prices, exchange rates, etc.). Further information and assessments are needed before these opportunities should be included in the Project economics.

Table 25-1: Project risks (preliminary risk assessment)

Area	Risk Description	Opportunities for Mitigation
Geotechnical and hydrogeology	1. FS Excavation slope considered 1V:1H for the haul road being a temporary road. As the Project progresses to detailed engineering geotechnical input is required as a steeper slope may be required where there is rock excavation.	1. Latest geotechnical information or confirmation for the excavation slope is required for precise quarry and borrow pit location and rock quantity. The quarry 6 km can also be investigated further depending on material availability which can be confirmed upon geotechnical assessment.
Construction Plan	1. At the peak of construction, it is assumed that sufficient capacity will be available in the area via a 144-person camp. There is risk that this capacity is not available at the time the project proceeds.	1. This can be resolved via mobilization and demobilization of an additional temporary camp prior to the installation of the permanent camp. Operating costs, not including mobilization and

Area	Risk Description	Opportunities for Mitigation
		demobilization of the camp, are already accounted for in the current estimate.
Mineral Processing and Metallurgy	1. Assumptions were made about distribution of key elements to lump and fine products which could have an impact on the assumed selling prices. 2. Moisture content of the ROM could be more elevated than expected. Risk that fines product could exceed liquefaction (shipping) limits.	1. Confirmatory metallurgical test work is suggested to be performed. 2. Confirmatory test work should be performed to better understand potential moisture of ROM. Lumps dryer should be able to handle some excess capacity of fines if limits are surpassed, however this needs to be confirmed with dryer vendors.
Site Infrastructure	1. The current FS study was based on an older LIDAR, seemingly less accurate due to missing LIDAR info on the causeway area. Haul road layout also needs to be revisited after the latest LIDAR info (in detailed engineering) because the road width design was reduced to a single lane and gradient has been restricted by 7%. 2. Outdated geotechnical assessment of the site infrastructure include the road layout and its surroundings.	1. During the next Project phase, the latest LIDAR survey is required. 2. Future geotechnical assessment of the field area (e.g., test pit, geotechnical boreholes, field technical assistance, reporting, geotechnical laboratory), and surroundings.
Transportation	1. Operationally rolling stock is maneuvered by making use of the main line. This can be an operating risk because of the existing main line traffic (3 loaded trains port-bound / 3 empty trains for mine or siding loading areas). No contingency for emergency tracks, or a maintenance facility to service bad order wagons or provide light	1. In discussions with the rail provider, no issues were raised concerning shunting maneuvers on the main line. This will be re-evaluated with the service provider in more detail if the Project moves to higher and more definitive study. If necessary, the design can be modified to allow for emergency work and simplify shunting activities.

Area	Risk Description	Opportunities for Mitigation
	maintenance for locomotives.	
Environmental	1. Predicted water discharge quality does not meet regulatory requirements/limits (both federally and provincially). 2. Flooding risk to the open pit which may affect the roads. Note that the Project is designed under design storm weather conditions (rainfall intensity basis). 3. Dewatering rates for the open pit in Joyce Lake may exceed predictions.	1. Could detain water in sedimentation ponds for longer to increase the sedimentation of suspended particles; OR add reagents such as flocculants/coagulants to enhance sedimentation. 2. Plan for weather station on-site and include an emergency preparedness plan that provides actions and contingency in the event of a short-term and localized flooding that could be a result of high-intensity storm events or extended storm durations. 3. Continuous evaluation of groundwater flow conditions in the area of the open pit in Joyce Lake and incorporate contingencies in the emergency response plan in the event that the Project experiences elevated groundwater flows. Examples of mitigative contingencies could include: – Increasing pumping capacity in deep wells and/or adding in-pit pumps; and – Grouting highly producing fractures and having access to additional pumping capacity (an option that is less likely).

26. Recommendations

The following pre-construction recommendations are made so as to de-risk the Project and also to reduce the timeline for a Client construction decision.

While BBA has made these recommendations to facilitate de-risking and expediting the Project, the results of this Feasibility Study ("FS") are not dependent on execution of these recommendations prior to a Project construction decision by the Client.

26.1 Environmental Assessment and Permitting

It is recommended to continue to advance the federal and provincial Environmental Assessment ("EA") process so as to obtain permits prior to a Client construction decision. BBA has not estimated the pre-production EA Client cost or schedule.

26.2 Further Technical Studies before Construction

- Confirmatory metallurgical test work is suggested to be performed on core samples representative of the Mineral Resources estimated for this FS pit design to:
  - Confirm lump (35%) to sinter fines (65%) crushing ratio assumed in this FS;
  - Confirm distribution of key elements (Fe, SiO_2, Al_2O_3, etc.) in lump compared to fines products used in this FS and derived from prior metallurgical test work; and
  - Develop a better understanding of run-of-mine ("ROM") ore moisture used in this FS and impacts on process flowsheet, product particle size distribution and lump drying requirements as well as fines product transportation moistures.

  An estimate of $200,000 to $400,000 is recommended for the above items.
- Further to metallurgical testwork, a more detailed geotechnical study could be performed to confirm pit slope and bench configuration. To do so, the following work is recommended:
  - Complete the six oriented drill boreholes and do optical and acoustic tele-viewer surveys, a laboratory testing program, and a study of the final geotechnical pit slope design. Structural data of rock joints orientation should also be collected to perform kinematics analysis for the bench configuration; and
  - Do a geotechnical investigation to determine gap data on the ROM ore and product stockpiles, and also perform a stability analysis for the construction sequence of the waste stockpile.

  An estimate of $1-2 million is recommended for the above items.

- A more detailed hydrogeological study to confirm perimeter dewatering parameters and design.
  - The FS of open pit perimeter dewatering requirements (number of wells and dewatering rates) was partially based on the results of testing from 50-mm monitoring wells. It is recommended that further pumping tests be done in test wells of a minimum 200 mm diameter.

  An estimate of $1.5 to 2 million is recommended for the above item.

- It is also recommended to perform further evaluation for in-situ resource density confirmation.
  - Two sets of drill hole core samples were used to determine the mineralized density for the FS. To confirm the densities used it is recommended that bulk density, dry density and moisture content be determined from available drill core from triple tube and sonic drilling.

  An estimate of $100,000 to 200,000 is recommended for the above item.

26.3 Exploration of DSO Targets in Immediate Joyce Area

This FS mines only the Joyce Lake deposit. The Joyce Project economics could be enhanced by mining additional DSO deposits from discoveries on nearby Client-owned claims and/or acquired claims.

- It is recommended that the Client considers exploring other DSO exploration targets in the immediate vicinity of the Project, specifically Joyce South, Lac Sans Chef and Jennie Lake.
- New DSO exploration discoveries in the immediate area of Joyce Lake could have significant positive economic impact on the Project; however, as this FS excludes new DSO discoveries, BBA has not provided an exploration expenditure recommendation.

26.4 Detailed Engineering and Construction Decision by the Client

BBA recommends a production decision is taken by the Client when market conditions or outlook are compliant with key market condition parameters used in this FS, including product selling prices.

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