NI 43-101 TECHNICAL REPORT

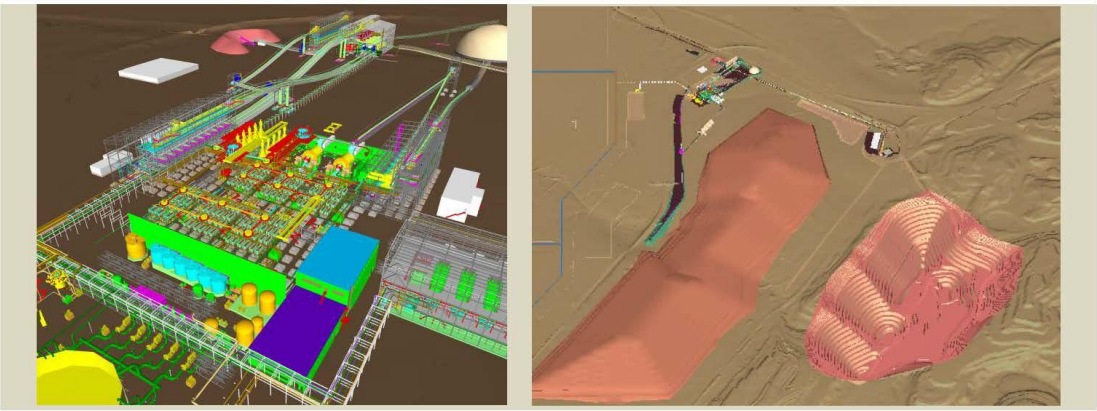
FEASIBILITY STUDY

of the

SHYMANIVSKE IRON ORE DEPOSIT

for

Black Iron Inc.



DATE AND SIGNATURE PAGE

Date: December 17, 2012

PREPARED BY THE FOLLOWING QUALIFIED PERSONS:

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PREPARED BY:

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P&E MINING CONSULTANTS INC. Geologists and Mining Engineers

Watts, Griffis and McOuat Since 1962 CONSULTING GEOLOGISTS AND ENGINEERS

This report is effective as of 17th day of December 2012

[Signed]	December 17, 2012
R.M Spiering. P.Eng., WorleyParsons Canada Services Limited	**Date**
[Signed]	December 17, 2012
Masoud Gorjian, P.Eng., WorleyParsons Canada Services Limited	**Date**
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Reza Ehsani, P.Eng., PMP, WorleyParsons Canada Services Limited	**Date**
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Philip Burris, C.Geol., Eur. Geol., WorleyParsons UK Limited	**Date**
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Richard W. Risto, M.Sc., P.Geo., Watts, Griffis and McOuat Limited	**Date**
[Signed]	December 17, 2012
Michael Koclumbas, B.Sc., P.Geo., Watt, Griffis and McOuat Limited	**Date**

CERTIFICATE OF QUALIFICATION

I, Rob Spiering, P. Eng., do hereby certify that:

1 I am currently employed as Manager of Projects / Project Manager in the consulting firm WorleyParsons Canada Limited at 2645 Skymark Avenue, Mississauga, Ontario, L4W 4H2, Canada.

2 This certificate accompanies the report, dated December 17, 2012, and titled “Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.”

3 I graduated from University of Calgary with a B.Sc. in Mechanical Engineering in 1980.

4 I am in good standing as a member of the Professional Engineers Ontario (#100122103).

5 I have practiced my profession continuously since my graduation.

6 I have read the definition of "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that as a result of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI43-101.

7 I have visited the project site on January 24th, 2012 and September 9th, 2012.

8 I am responsible for the coordination, consolidation and review of Sections 1, 2, 3, 4, 5, 19, 21, 23, 24, 25, 26 and 27, and I was involved in the preparation of this Technical Report Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.

9 I am independent of the issuer as described in Section 1.5 of National Instrument 43-101.

10 I have not had any prior involvement with the Shymanivske property.

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

12 As of the effective date of the technical report, to the best of my knowledge, information and belief, the technical report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Prepared in Toronto, Ontario, December 17, 2012

{SIGNED AND SEALED}

_____

Signed
R.M. Spiering, P. Eng.

CERTIFICATE OF QUALIFICATION

I, Masoud Gorjian, P. Eng., do hereby certify that:

1 I am currently employed as Process Engineering Manager in the consulting firm of WorleyParsons Canada Limited at 2645 Skymark Avenue, Mississauga, Ontario, L4W 4H2, Canada.

2 This certificate accompanies the report, dated December 17, 2012, and titled “Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.”

3 I graduated from Isfahan university of Technology in Esfahan, Iran with a B.Sc. in Metallurgical Engineering in 1993.

4 I am in good standing as a member of the Professional Engineers Ontario (#100126162) and a member of the Canadian Institute of Mining Metallurgy and Petroleum.

5 I have practiced my profession in metallurgy and mineral processing continuously since my graduation.

6 I have read the definition of "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that as a result of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI43-101.

7 I have visited the project site on May, 2012, for 7 days.

8 I am responsible for the coordination, consolidation and review of Sections 13 and 17, based on my knowledge on iron ore process design.

9 I am independent of the issuer as described in Section 1.5 of National Instrument 43-101.

10 I have not had any prior involvement with the Shymanivske property.

11 I have read National Instrument 43-101 and Form 43-101 F1, and the part of the Technical Report that I am responsible for, has been prepared in compliance with that instrument; and

12 As of the effective date of the technical report, to the best of my knowledge, information and belief, the technical report and parts that I am responsible for, contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Prepared in Toronto, Ontario, December 17, 2012

{SIGNED AND SEALED}

_____

Signed

Masoud Gorjian, P. Eng.

CERTIFICATE OF QUALIFICATION

I, Reza Ehsani, P. Eng., do hereby certify that:

1 I am currently employed as Project Engineering Manager in the consulting firm WorleyParsons Canada Services Limited at 2645 Skymark Avenue, Mississauga, Ontario, Canada, L4W 4H2:

2 This certificate accompanies the report, dated December 17, 2012, and titled “Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.”

3 I graduated from Sharif University of Technology in Tehran with a B. Eng. in Civil Engineering in 1997.

4 I am in good standing as a member of the Professional Engineers Ontario (#100075237).

5 I have practiced my profession continuously since my graduation.

6 I have read the definition of "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that as a result of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI43-101.

7 I am responsible for the coordination, consolidation and review of Sections 18 and 22 and co-author of section 21, based on my knowledge on iron ore process design.

8 I am independent of the issuer as described in Section 1.5 of National Instrument 43-101.

9 I have not had any prior involvement with the Shymanivske property.

10 I have read national Instrument 43-101 and Form 43-101 F1, and the part of the Technical Report that I am responsible for, has been prepared in compliance with that instrument; and

11 As of the effective date of the technical report, to the best of my knowledge, information and belief, the technical report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Prepared in Toronto, Ontario, December 17, 2012

{SIGNED AND SEALED}

_____

Signed

Reza Ehsani, P. Eng., PMP

CERTIFICATE OF QUALIFICATION

I, Philip Burris, C.Geol., Eur. Geol., do hereby certify that:

1 I am currently employed as the European Regional Director for the Water Consulting Practice within the firm:

Company Name: WorleyParsons Europe Limited
Address: Parkview, Level 1,
London
United Kingdom
TW8 9AZ

2 This certificate accompanies the report, dated December 17, 2012, and titled “Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.”

3 I graduated from Leeds University in the UK with a BSc (Hons) in Geology in 1991 and then went on to complete a MApp Sc in Ground water Studies at the University of NSW in Sydney, Australia in 1999.

4 I am in good standing as a Charted Geologist and Fellow of the Geological Society of London (#1001558) and an accredited European Geologist with 20 years of experience in environmental geology and water studies.

5 I have practiced my profession in environmental assessment and hydrogeology continuously since my graduation.

6 I have read the definition of "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that as a result of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI43-101.

7 I have visited the project site and environ in Feb, 2012 for 6 days.

8 I am responsible for the coordination, consolidation and review of Section 20 and co-author of Sections 1, 25 and 26.

9 I am independent of the issuer as described in Section 1.5 of National Instrument 43-101.

10 I have not had any prior involvement with the Shymanivske property.

11 I have read national Instrument 43-101 and Form 43-101 F1, and the part of the Technical Report that I am responsible for, has been prepared in compliance with that instrument; and

12 As of the effective date of the technical report, to the best of my knowledge, information and belief, the technical report and parts that I am responsible for, contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.

Prepared in London, England, December 17, 2012

{SIGNED AND SEALED}

_____

Signed

Philip Burris C.Geol., Eur Geol.

CERTIFICATE OF QUALIFIED PERSON

I, Eugene J. Puritch, P. Eng., residing at 44 Turtlecreek Blvd., Brampton, Ontario, L6W 3X7, do hereby certify that:

1. I am an independent mining consultant and President of P&E Mining Consultants Inc.
2. This certificate applies to the technical report titled "Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc" (the "Technical Report"), with an effective date of December 17, 2012.
3. I am a graduate of The Haileybury School of Mines, with a Technologist Diploma in Mining, as well as obtaining an additional year of undergraduate education in Mine Engineering at Queen's University. In addition I have also met the Professional Engineers of Ontario Academic Requirement Committee's Examination requirement for Bachelor's Degree in Engineering Equivalency. I am a mining consultant currently licensed by the Professional Engineers of Ontario (License No. 100014010), Association of Professional Engineers and Geoscientists Saskatchewan, Association of Professional Engineers and Geoscientists Newfoundland and Labrador, Association of Professional Engineers and Geoscientists New Brunswick and registered with the Ontario Association of Certified Engineering Technicians and Technologists as a Senior Engineering Technologist. I am also a member of the National Canadian Institute of Mining and Metallurgy.

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

   I have practiced my profession continuously since 1978. My summarized career experience is as follows:
   - Mining Technologist - H.B.M.& S. and Inco Ltd., ... 1978-1980
   - Open Pit Mine Engineer – Cassiar Asbestos/Brinco Ltd., ... 1981-1983
   - Pit Engineer/Drill & Blast Supervisor – Detour Lake Mine, ... 1984-1986
   - Self-Employed Mining Consultant – Timmins Area, ... 1987-1988
   - Mine Designer/Resource Estimator – Dynatec/CMD/Bharti, ... 1989-1995
   - Self-Employed Mining Consultant/Resource-Reserve Estimator 1995-2004
   - President – P&E Mining Consultants Inc 2004-Present
4. I visited the Shymanivske Property that is the subject of this report on Feb 27, 2012.
5. I am responsible for authoring Sections 15 and 16 and co-authoring portions of section 1 and 21of the Technical Report.
6. I am independent of the Issuer applying the test in Section 1.5 of NI 43-101.
7. I have had no prior involvement with the project that is the subject of this Technical Report.
8. I have read NI 43-101 and Form 43-101F1. This Technical Report has been prepared in compliance therewith.
9. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading insofar as my contribution is concerned.

Effective Date: November 15, 2012
Signed Date: December 17, 2012

{SIGNED AND SEALED}

Signed
Eugene J. Puritch, P. Eng.

CERTIFICATE OF QUALIFICATION

I, Richard W. Risto, do hereby certify that:

1. I reside at 22 Northridge Ave, Toronto, Ontario, Canada, M4J 4P2.
2. I am a Senior Associate Geologist with Watts, Griffis and McOuat Limited, a firm of consulting engineers and geologists, which has been authorized to practice professional engineering by Professional Engineers Ontario since 1969, and professional geoscience by the Association of Professional Geoscientists of Ontario.
3. This certificate accompany the report titled "Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.", dated December 17, 2012.
4. I am a graduate from the Brock University, St. Catherines, Ontario with an Honours B.Sc. Degree in Geology (1977); Queens University, Kingston, Ontario with a M.Sc. Degree in Mineral Exploration (1983), and I have practised my profession for over 20 years. My relevant experience includes: extensive experience with iron deposits, a variety of other deposit types and the preparation of technical reports.
5. I am a licensed Professional Geoscientist of the Association of Professional Geoscientists of Ontario (Membership # 276); Association of Applied Geochemists; and, Prospectors and Developers Association of Canada.
6. I have read the definition of "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
7. I visited the Property from April 11 to April 18; May 22 to May 29; June 27 to July 3 and from December 12 to 17.
8. I am solely responsible for Sections 6 to 12 and jointly responsible with co-authors of this report for Sections 1 and 27.
9. I am independent of the issuer as described in Section 1.5 of NI 43-101.
10. My relevant experience includes 30 years of field exploration and project evaluation for both precious and base metal projects including a number of iron deposits both in Canada and internationally. I have had prior involvement with the Property that is the subject of this technical report, including acting as co-author of the following report: *"Preliminary Economic Assessment Report of the Shymanivske Iron Ore Deposit for Black Iron Inc.",* dated December 14, 2011.
11. I have read NI 43-101, Form 43-101F1 and the technical report and have prepared the technical report in compliance with NI 43-101, Form 43-101F1 and generally accepted Canadian mining industry practice.
12. As of the date of the technical report, to the best of my knowledge, information and belief, the technical report contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.

{SIGNED AND SEALED}

Signed
Richard W. Risto, M.Sc., P.Geo.

CERTIFICATE OF QUALIFICATION

I, Michael W. Kociumbas, do hereby certify that:

1. I reside at 420 Searles Court, Mississauga, Ontario, Canada, L5R 2C6.
2. I am a Senior Geologist and Vice-President with Watts, Griffis and McOuat Limited, a firm of consulting geologists and engineers, which has been authorized to practice professional engineering by Professional Engineers Ontario since 1969, and professional geoscience by the Association of Professional Geoscientists of Ontario.
3. This certificate accompanies the report titled "*Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc.*", dated December 17, 2012.
4. I am a graduate from the University of Waterloo, Waterloo, Ontario with an Honours B.Sc. Degree in Applied Earth Sciences, Geology Option (1985), and I have practised my profession continuously since that time.
5. I am a licensed Professional Geoscientist of the Association of Professional Geoscientists of Ontario (Membership # 0417). I am Member of: Canadian Institute of Mining, Metallurgy and Petroleum (Membership #94100); Prospectors and Developers Association of Canada (Membership #10463). I am an Associate of Geological Association of Canada.
6. I have read the definition of "qualified person" set out in the National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
7. I have not visited the Property.
8. I am solely responsible for Section 14 and jointly responsible with co-authors of this report for Sections 1, 25 and 26.
9. I am independent of the issuer as described in Section 1.5 of NI 43-101.
10. My relevant experience includes 25 years of field exploration and project management for both gold and base metal projects, including a number of iron deposits both in Canada and internationally. I have extensive experience with Mineral Resource estimation techniques and the preparation of technical reports. I have had no prior involvement with the Property that is the subject of this technical report.
11. I have read NI 43-101, Form 43-101F1 and the technical report and have prepared the technical report in compliance with NI 43-101, Form 43-101F1 and generally accepted Canadian mining industry practice.
12. As of the date of the technical report, to the best of my knowledge, information and belief, the technical report contains all scientific and technical information that is required to be disclosed to make the technical report not misleading.

{SIGNED AND SEALED}

Signed
Michael Kociumbas, P.Geo.

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LIST OF ABBREVIATIONS

Above Sea Level	ASL
Banded Iron Formation	BIF
Basic Oxygen Furnace	BOF
Bench Face Angle	BFA
Black Iron Inc.	Black Iron, BKI
Bond Work Index	BWI
Breton, Banville and Associates	BBA
Capital Expenditure	CAPEX
Comma Separated Value	CSV
Cost and Freight	CFR
Council of the Canadian Institute of Mining Metallurgy and Petroleum	CIM
Crusher work index	CWI
Cut-Off Grade	COG
Database	DB
Davis Tube	DT, DTT
Diameter	dia
Diamond Drillhole	DDH
Digital Elevation Model	DEM
Drop-Weight Test	DWT
Electric Arc Furnace	EAF
Engineering, Procurement, and Construction Management	EPCM
Environmental Assessment	EA
Environmental Impact Assessment	EIA
Environmental Impact Statement	EIS
Environmental Preview Report	EPR
European Bank for Reconstruction and Development	EBRD

Evapotranspiration ..... ET

Feasibility Study ..... FS

Financial Analysis ..... FA

Free on Board ..... FOB

General and Administration ..... G&A

General Arrangement ..... GA

Geographic Information System ..... GIS

Global Positioning System ..... GPS

Government Service Centre ..... GSC

Gravity Gradient Instruments ..... GGI

Heavy Liquid Separation ..... HLS

Hematite ..... Fe_2O_3

Internal Rate of Return ..... IRR

International Finance Corporation ..... IFC

Interpajp ..... NPIG

Inter-ramp Angles ..... IRA

Inverse Squared Distance ..... ID^2

Iron Formation ..... IF

Length L

Lerchs-Grossman 3-D ..... LG 3-D

Life of Mine ..... LOM

Loss on Ignition ..... LOI

Low Intensity Magnetic Separation ..... LIMS

Magnetite Iron ..... Fe_{mag}

Magnetite ..... Fe_3O_4

Major Resource Project ..... MRP

Mekhanobrchermet ..... MCM

Memorandum of Understanding ..... MOU

MineSight Economical Planner ..... MSEP

Net Present Value ..... NPV

Operating Expenditure ..... OPEX

Ore Dressing and Processing Plant ..... GOK

Overburden ..... OB

Otsinka Vplyvu na Navkolyshne Seredovysce ..... OVNS

Oxide Iron Formation ..... OIF

P&E Mining Consultants Inc. ..... P&E

Pellet Feed ..... PF

Power Factor ..... Cosφ

Process Flowsheet ..... PFS

Project Control File ..... PCF

Qualified Person ..... QP

Quality Assurance ..... QA

Quality Control ..... QC

Quantitative Evaluation of Minerals by Scanning Electron Microscopy ..... QEMSCAN™

Rod Work Index ..... RWI

Run-of-Mine ..... ROM

Safety, Health, Environment and Community ..... SHEC

SAG Mill Comminution ..... SMC

SAG Power Index ..... SPI

Sales, General, and Administrative Expenses ..... SG&A

Satmagan ..... Sat

Semi Autogenous Grinding ..... SAG

SGS Lakefield Research ..... SGS Lakefield

Silicate Iron Formation ..... SIF

Silicate-Carbonate Iron Formation ..... SCIF

Single Line Diagram ..... SLD

Specific Gravity ..... SG

Stakeholder Engagement Plan ..... SEP

Stripping Ratio ..... S/R

Tailings Storage Facility ..... TSF

Three-Dimensional 3D

Toronto Stock Exchange ..... TSX

Total Iron Content ..... Fe_{tot}

Total Pinion Energy ..... Wtot

Topographic, Geodetic and Navigation Technologies ..... TNT TPI, TNT TPI LLC

Two-Dimensional 2D

United States Dollars ..... USD

Work Breakdown Structure ..... WBS

Waste Management Plan ..... WMP

Watts, Griffis and McOuat ..... WGM

Weight Recovery ..... wt. rec.

Weight ..... wt

Wilfley Table ..... WT

Work Index ..... WI

Work Index of Coarse Particle ..... Mia

Work Index of the Fine Particle ..... Mib

Yuzhny GOK ..... YUGOK

UNITS OF MEASURE

Above Sea Level	ASL
miliGal	mGal
Foot	',ft
Inches	″,in
Dollar	$
Dollar per tonne	$/t
Degree	°
Micron (Micro Meter)	µm
Centimeter	cm
Canadian Dollars	CAD
Feet per minute	fpm
Gram	g
Gram per cubic centimeter	g/cc, g/cm^3
Gallons per minute	GPM
Giga watt hour	GWh
Hectare	ha
Horsepower	hp
Kilogram	kg
Kilometer	km
Square kilometer	km^2
Kilotonne	kt
Kilovolt	kV
Kilovolt-Ampere	kVA
Kilo Pascals	kPa
Kilowatt	kW
Kilowatt-hours per tonne	kWh/t
Pounds per hour	lb/h

Meter	m
Million	M
Million tonnes per year	Mtpa; M t/y
Cubic metre per hour	m^3/h
Mile	mi
Millimeter	mm
Million tonnes	Mt
Metric tonnes per hour	mt/h
Mega Volt Amps	MVA
Mega Watt	MW
Motor Control Centre	MCC
Standard cubic feet per minute	scfm
Tonnes	t
tonnes per hour	t/h
tonnes per cubic meter	t/m^3
tonnes per year	t/y
metric tons	tonnes or t
short tons	tons
Weight	wt

1 SUMMARY

1.1 Introduction

The following Technical Report (The Report) presents the results of the Feasibility Study ("FS") for Black Iron's Shymanivske Iron Ore deposit located in the KrivBass iron ore basin of the Dnepropetrovsk region of Ukraine. The Shymanivske subsurface usage permit for the extraction of iron ore, registered as "Special Permit No. 4537", is 100% owned by Shymanivske Steel LLC which is a wholly owned subsidiary of Black Iron Inc. The deposit area covers 256 hectares and is located approximately 330 km south-east of Kiev and 150 km north of the Black Sea in Ukraine.

This project contains as NI 43-101 compliant resource, with 645.8 Mt Measured and Indicated Mineral Resources, consisting of 355.1 Mt Measured Mineral Resources grading 32.0% Total iron and 19.5% Magnetite iron, and Indicated Mineral Resources of 290.7 Mt grading 31.1% Total iron and 17.9% Magnetite iron, using a cut-off grade of 10% Magnetite iron. Additionally, the project contains 188.3 Mt of Inferred Mineral Resources grading 30.1% Total iron and 18.4% Magnetite iron. The project is surrounded by five other operating mines, including ArcelorMittal's iron ore complex.

The Feasibility Study (FS) was completed by:

- WorleyParsons Canada Services Ltd. ("WorleyParsons") for the process plant and infrastructure,
- Watts, Griffis and McOuat Limited ("WGM"), Consulting Geologists and Engineers of Toronto, for the Mineral Resources and
- P&E Mining Consultants Inc. ("P&E") for the mine design.

The FS began in December, 2011. WorleyParsons, WGM and P&E have conducted multiple visits between January 2011 and September 2012.

A Preliminary Economic Assessment (PEA) was prepared by engineering consulting group BBA Inc. and issued in December 2011. The PEA was based on the development of 7.3 Mtpa of 67% Iron Ore Concentrate with an alternative to produce 7.6 Mtpa of 65% Iron Ore Pellets.

During the FS the process was optimized. This was achieved by reviewing the available comminution and recovery data and comparing alternative comminution flowsheets for seven options, including High Pressure Grinding Rolls (HPGR), Autogenous Grinding mill (AG mill) or Semi-Autogenous Grinding mill (SAG mill) circuits. The HPGR flowsheet option had a lower operating cost than the other options. The resulting project NPV for this option represented the best case going forward and the FS study was completed on this basis. The outcome of this study has been confirmed by the results of the testwork that showed Shymanivske ore to be hard and competent, which is more suitable for HPGR crushing than SAG milling.

As a result of the process optimization, the plant capacity increased by 26% and the operating cost was reduced by 16%. The FS outlines an operation producing 9.2Mtpa of high-grade 68% iron ore

concentrate, projecting a pretax but post-royalty 45.9% internal rate of return (IRR) and a U.S. $3.5 billion net present value (NPV) at an 8% discount rate.

1.2 Mineral Resource Estimates

Following the completion of additional drilling in December 2011, Black Iron prepared an updated Mineral Resource estimate for the Shymanivske Deposit. WGM was retained by Black Iron to audit this in-house estimate. The resources are reported above a -440m ASL (about 500m from surface), which is the same pit shell depth used in the previous PEA.

A summary of the NI 43-101-compliant Mineral Resources is provided in the table below.

Table 1.1: Categorized Mineral Resource Estimate for the Shymanivske Iron Ore Deposit

(Cut-off Grade of 10% Fe_{mag})

Category	Tonnes (Million)	Fe_{tot} %	Fe_{mag} %
Measured	355.1	32.0	19.5
Indicated	290.7	31.1	17.9
Total M&I	**645.8**	**31.6**	**18.8**
Inferred	188.3	30.1	18.4

Mineral Resources that are not Mineral Reserves do not have a demonstrated economic viability. Given the uncertainty that may be attached to Inferred Mineral Resources, it cannot be assumed that continued exploration will lead to the upgrading of all or any part of an Inferred Mineral Resource to an Indicated or Measured Mineral Resource.

The Mineral Resource estimate for the Shymanivske Deposit was completed using block sizes of 10m x 20m x 15m and is based on 215 historical diamond drillholes, new drilling from Black Iron's twin-hole program (22 holes), and its definition-drilling program (41 holes). The drillholes are dispersed along the Banded Iron Formation horizons for approximately 2,150m of strike length and 900m of width of the Shymanivske Deposit. The drilling was done on sections perpendicular to the strike of the formations, with spacing varying from 30m to 130m along sections, and from 80m to 300m along the strike with vertical depths of 250m to 550m.

Three major mineralized domains (SX1F, SX2F and SX4F) and one Oxide Domain (SX5F) were defined using a cut-off grade of 10% Fe_{mag} for the block model resource estimate. Alteration products in the form of martite, hematite, limonite and goethite are dominant features in the Oxide Domain. This domain was treated as waste in the Mineral Resource estimate because the iron contained in this zone cannot be recovered using the process designed to maximize iron recovery from the non-oxidized zones in which the bulk of the resource is contained. The ID^2 grade interpolation used 5m equal-length composites generated from the raw assays and statistical analysis completed for the domains. The interpolation

showed good normal distributions for both the composites and the raw assays, and it was determined that capping was not required for the Shymanivske Deposit.

WGM conducted specific gravity (SG) measurements using bulk density and pycnometer data at both the MCM laboratory in Ukraine and, for validation purposes, at SGS-Lakefield in Canada. The results from both labs showed that the SG, when measured by pycnometer correlates strongly with $\%Fe_{mag}$ on the selected samples, except in the Oxide Zone where alteration has occurred. Using the variable density model, a 20% Fe_{mag} gives a SG of approximately 3.49.

A four-step approach based on search ellipse size and number of samples was used to generate the Fe_{tot} and Fe_{mag} grade models; however, the classification of the Mineral Resources was also based on drillhole density (or drilling pattern); geological knowledge/interpretation of the geology; and some other constraints, such as the presence of alteration (Oxide Zone). A Distance Model was generated and the estimated Mineral Resources were reported by distances that represented the category or classification: Measured blocks were less than 100m distance (average approx. 60m), Indicated blocks were 60m to 150m (average approx. 100m) and Inferred blocks were greater than 150m (average approx. 200m). The drilling density was lower in the deeper parts of the deposits, hence the drillhole spacing was taken into consideration when classifying the Mineral Resources and these areas were given a lower confidence category.

Geology and Mineralization

The Property is situated in the Kryvyi Rih Basin ("Krivbass"), a Paleoproterozoic synclinorium structure in the Archean Ukrainian Shield. The Krivbass lies along the western edge of the Middle Dnieper Block of the Shield, adjacent to the Inhul-Inhulets, or Kirovograd Block. Krivbass is one of several Ukrainian iron formation-hosting basins on micro-plate boundaries.

The iron formation on the Property is of the Lake Superior-type. This type of iron formation consists of banded sedimentary rocks composed principally of bands of iron oxides, magnetite and hematite within quartz or chert-rich rock, and contains variable amounts of silicate, carbonate and sulphide lithofacies. Such iron formations have been the principal sources of iron throughout the world.

Mineralization of economic interest on the Property is the oxide facies iron formation (OIF) or oxide facies banded-iron formation, which is magnetite-rich taconite that contains minor hematite throughout. The Soviet literature commonly refers to this mineralization as "un-oxidized ferriferous quartzite". Supergene iron mineralization is also present on the Property. It is commonly associated with the faults and fault zones that may be coincident with an unconformity occuring along the western margin of the Property adjacent to the Archean basement. A layer of oxidized iron mineralization, usually no more than a few metres thick, also commonly lies along the upper surface of the taconite immediately under the Cenozoic cover rocks. The supergene mineralization comprises concentrations of martite and goethite/limonite mineralization. In the Soviet literature, this type of mineralization is called "oxidized quartzite mineralization".

The taconite mineralization in the Saksagan sequence extends along the entire NE-SW extent of the Property for 2.2km and beyond, and occurs over a width of 800m to 1km in a NW-SE direction. The

taconite is folded and its true thickness varies throughout because of tectonic thickening, erosion and possibly the original basin topology. The true thickness of the iron formation package, including the intervening inter-oxide iron formation "slate" members, is on the order of 200m to 250m. Because of the folding there is no consistent relationship between drill-hole orientation and the true width of mineralization.

Exploration and Drilling

Black Iron initiated exploration of the Property in 2011 and conducted Phase I and Phase II diamond drilling programs. Black Iron's programs also included ground magnetic and gravity surveys, and satellite imaging designed to construct a digital topographic model for the Property and environs. Part of this phase also involved the location and surveying of previous casings for validation of historic information. The Twin Drilling Program (Phase I) comprised 22 holes, aggregating 6,042m of drilling. Immediately following Phase I, the Phase II Drilling Program was initiated. It consisted of 48 holes aggregating 11,435m of drilling and included seven holes (totaling 695m) that were drilled to acquire larger diameter core for communition testwork. Black Iron's drilling was done largely along the same cross-sections used in the Soviet programs. Total Black Iron drilling aggregated 70 holes in 17,477m of drilling. The primary purpose of the Phase I Program was to collect material for metallurgical testwork by drilling a selection of drillholes as close as possible to historic locations and at a similar attitude. The secondary goal of the drilling program was to validate historic drilling completed on the Property. The purpose of the Phase II program was to provide additional information in order to advance deposit interpretation and support an updated and upgraded categorized Mineral Resource estimate.

Core Logging, Sample Preparation, Assaying and Quality Control

Black Iron's 2011 Phase I and Phase II drilling programs were managed by the local drilling contractor "GEORESOURCE". The company's drill rig geologists logged the drillholes in the field adjacent to the drills. The intervals for sampling were determined and marked on the core. Nominal sample length was 3m, with variations being based on geology and no narrow gaps being left between samples. Shoulder samples were collected on the margins of all mineralized intervals. The samples were sawn in half with diamond core saws. The primary laboratory for Black Iron's 2011 drilling programs was Mekhanobrchermet (MCM), based in Kryvyi Rih. Sample preparation for assaying included first-stage jaw crushing, second-stage roll crushing and finally, puck and ring pulverization. The samples were to provide representative pulps for assaying. Assaying at MCM included determination of Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S_T and P on all samples, including routine and field-inserted QA/QC samples and laboratory-inserted QA/QC materials. Determinations at MCM were generally by wet-chemical methods; Fe_{mag} was determined with a magnetization saturation analyzer. Specific gravity and bulk density were determined on selected samples.

The 2011 QA/QC program for sampling and for sample analysis included components conducted by GEORESOURCE that were initiated during core sampling in the field, in addition to the components that MCM operated as part of the in-laboratory QA/QC program. In-field, standards, blanks and duplicate samples were inserted into the sample stream going to MCM. Supplementary to the GEORESOURCE in-field QA/QC program, the MCM in-laboratory QA/QC program involved the preparation of duplicates

(replicates), analytical duplicates, blanks and Certified Reference Standards. These QA/QC materials were analyzed along with the samples received from GEORESOURCE. In addition to the in-field insertion of blanks, duplicates and standards, some follow-up check-assaying was completed with a view to understanding and resolving particular issues. Some of this check-assaying was managed by Black Iron; some, by WGM. Black Iron's checks included the re-assaying of samples at MCM as well as at SGS-Lakefield at Lakefield, Ontario, Canada; and at ALS in Perth, Australia.

Data Verification

WGM made site visits to the Property in 2011 to assist with the implementation of sampling and assaying protocols, to verify drilling, and to complete independent sampling. WGM checked collar locations for drillholes and also for historic casings that had been located. WGM "quick" logged a number of Black Iron Phase I and II drillholes. During this process, WGM confirmed that GEORESOURCE logging was reasonably accurate with its lithostratigraphic coding as it generally agreed with WGM's observations. During this process, WGM also checked the locations of sample intervals and sample identifiers for agreement with locations recorded in the database, and found no errors.

WGM completed independent sampling of Black Iron's half-split drill core and assay pulps prepared by MCM during its second, third and fourth site visits to the Property. In total, WGM collected 23 samples of half-split core and 93 pulps. WGM submitted these samples and some quality-control samples for assaying at SGS-Lakefield. WGM's independent sampling and assaying largely verified MCM's assays. WGM also completed the analysis of QA/QC data from the drilling program, including Black Iron's analytical results for samples analyzed at MCM, ALS and at SGS-Lakefield. WGM also researched and checked Soviet historic documents, including checking a selection of assay and geological records, drill-hole locations, azimuths and inclinations, with a view to validating the historic data used for the Mineral Resource estimate.

1.3 Mineral Resource and Reserve Estimates

The Mineral Reserve is the portion of the Mineral Resource that has been identified as being economically extractable and which incorporates mining recovery and waste dilution. The Reserve forms the basis for the production plan used in the FS. No Inferred Resource was included in the estimation of the Mineral Reserve.

The Mineral Reserve has been estimated for the Project based on a cut-off grade of 13.1% Fe_{Mag} and incorporates an ore loss of 2% and dilution of 7.1%.

In order to produce the required concentrate grade of 68% Iron, the target mill feed average Head grade must be in the range of 19.4% Fe_{Mag}. To provide an overall tonnage with this average grade, it was necessary to select the cut-off grade that results in the following targeted average head grade.

Table 1.2: Mineral Resource and Reserve Estimates

Category	Tonnes	$\%Fe_{Mag}$	$\%Fe_{tot}$
Proven	311,951,000	19.5%	31.1%
Probable	136,244,000	19.0%	31.2%
Total	448,195,000	19.4%	31.1%

The Mineral Reserve was developed in a three-step process:

- The optimized open pit shell was selected and used as the operational pit planning basis. P&E used the Lerchs-Grossman algorithm in the Whittle-4X software. The procedure was applied for the resource block model using mining, processing and G&A costs, selling prices, pit slopes, and process recoveries. Inferred Resources were considered as waste material in the optimization process.
- The optimum pit shell was selected from an economics analysis including strip ratio, operating costs and NPV. The optimum pit life was 16 years.
- Using the optimized pit-shell selected, an operational open pit design was developed that incorporates benches and truck haulage ramps.
- Finally, an estimate of the tonnage contained within the designed pit was obtained by applying the ore criteria (losses and dilution) to the in situ ore tonnage that meets or exceeds the Fe-Mag cut-off grade.

1.4 Mining Methods

The Shymanivske Project will be developed as a large-scale, open pit operation. The final dimension at surface will have a north-south length of 2,500m, an east-west width of 1,250m and a pit bottom elevation of -290m ASL.

For production-scheduling purposes, and in order to distribute the waste quantities over the life of the Project, a phased-pit approach has been implemented. The pit has been subdivided into four phases, the tonnages of which are summarized below. Mining may occur in multiple phases at the same time, so that mining is taking place in the deeper parts of one phase while stripping is taking place in the upper parts of the next phase. See table below.

Table 1.3: Mining Phase

Mining Phase	Ore	Fe_{Mag}	Fe_{tot}	Overburden	Waste	Total	Strip
	kt	%	%	kt	Rock	kt	Ratio
Phase 1	108,340	20.1	31.3	30,289	52,282	190,912	0.76
Phase 2	157,356	18.8	31.1	46,335	144,507	348,199	1.21
Phase 3	87,111	19.5	30.9	36,297	179,664	303,072	2.48
Phase 4	95,388	19.4	31.2	36,319	202,757	334,463	2.51
Total	448,195	19.4	31.1	149,239	579,210	1,176,645	1.63

The production schedule for a 16-year mine life requires the mining of 28.34 Mtpa of iron ore. Waste-stripping quantities will vary from year to year, depending on the area being mined.

Mining operations will be working two, 12-hour shifts per day. It is assumed that replacement operators will be made available for the major mining equipment to allow continuous operation. Mining operations are planned for 360 days per year to account for days lost to poor weather conditions.

The mining operation will consist of the following activities:

- Topsoil recovery and stockpiling;
- Overburden stripping by bulldozer ripping and pushing, using the mining fleet with some light blasting of some materials;
- Drilling and blasting of waste rock and ore, using 250mm-diameter blast holes and mining on 15m benches;
- Ore grade control;
- Loading and hauling of ore and waste, using 23m^3 hydraulic shovels and 226t capacity off-highway trucks. Over the life of the operation, the shovel fleet will range from five to six units and the truck fleet will range from 28 to 53 trucks;
- Open pit dewatering from in-pit water collection sumps; and
- Mine services provided by a fleet of dozers, graders, water trucks, and maintenance vehicles.

Over the life of the project, two designated waste-storage facilities (WSF) will be required. RMS-1 is a reclamation material stockpile (RMS) located north of the pit and which will contain 1.5 million m^3 of topsoil from the open pit. For overburden and waste rock, WSF-1 and WSF-2 are located to the west of the open pit mine and will contain approximately 265 million m^3. The footprint is approximately 467ha and will be

built to a height of approximately 100m. Some of the waste from the mining operation will be used to build the tailings containment cells.

The mine support facilities will include a truck shop and office complex that contains a personnel change house, technical and supervisory offices, and warehouse facilities.

The mining-operation manpower list includes all aspects involved with the open pit operation, including:

- Senior mine and maintenance supervision;
- Office technical staff, engineering, geology, surveying, etc;
- Clerical, maintenance planning, training;
- Mine operations crews;
- Mine support crews; and
- Mine maintenance crews.

The total mine workforce will vary over time as production rates increase or decrease, and it will range from 500 to 650 people over the life of the mine.

1.5 Mineral Processing and Metallurgical Testwork

A significant amount of testwork was completed over a number of years, including that done by WorleyParsons during the FS in 2012.

Metallurgical Testwork that has been done over the years can be divided into three parts: historical test-work prior to the PEA study, the PEA study test work, and the test work done as part of this FS. They are summarized as follows:

- Historical testwork done before the PEA study was taken from a technical report entitled “Detail elaboration of ferriferous quartzites of Shymanivske deposit of Kryvyi Rih iron ore basin of Dnepropetrovsk region, 1989.”
- Preliminary metallurgical test programs were conducted by BBA as part of the PEA completed in 2011.
- Metallurgical testwork was carried out at the Mekhanobrchermet (MCM) Institute in Kryvyi Rih, Ukraine and at SGS-Lakefield in Ontario, Canada. The Gravity and Davis Tube test done at MCM determined that magnetic separation is preferred over gravity separation. This was followed by Grindability testing and QEMSCAN™ analysis at SGS-Lakefield on sub-samples of the selected composite samples. Further lab tests were carried out at SGS-Lakefield on several flowsheet configurations and the results were used to develop the PFDs and mass-balance design for the PEA report.
- Comprehensive metallurgical testing was conducted by WP as part of the FS completed in 2012. The testing involved comminution, magnetite recovery and sulphur removal characterization

sufficient to develop further the process flowsheet design and the criteria required for detailed plant design. All testing was conducted according to industry best practice.

- Several samples of diamond core selected from drillhole intervals located throughout the Shymanivske mineralization zone were tested at specialized facilities operated by ALS AMMTEC in Perth, Australia.
- The testwork program consisted of the following:
  - Comminution testwork on SAGDesign, SMC, CWi and BWi;
  - Grind Liberation and Magnetic Separation; and
  - Magnetic Separation followed by reverse sulphide flotation optimization.

The conclusion arising from the testwork is that the iron mineralization from Shymanivske deposit can be processed and upgraded to the targeted specifications by crushing, stage grinding, low-intensity magnetic separation and sulphide flotation. Final grinding size at 80% finer than 32µm was required to achieve the desired quality of concentrate with iron content of 68%, SiO_2 content lower than 4.5% and sulphur content lower than 0.05%. The weight recovery averaged 32.7%, while the magnetite recovery was approximately 96%.

1.6 Recovery Methods and Beneficiation Plant Design

The Shymanivske Beneficiation plant has been designed for a nominal concentrate production of 9.1 Mtpa of high grade 68% iron ore concentrate on a dry basis. The average post ramp-up production is 9.2Mtpa with a peak production of 9.5Mtpa in Year 10. On the basis of the completed testwork, a 68% target iron grade is achieveable through the process of crushing, stage grinding, low-intensity magnetic separation and sulphide flotation.

There are four main areas in the ore beneficiation plant:

- Dry Processing (ore crushing, screening, dry cobbing magnetic separation, and storage);
- Wet Processing (screening, grinding, re-grinding, magnetic separation, classification, and flotation);
- Concentrate and Tailings Dewatering and Thickening; and
- Concentrate Storage and Handling.

The dry processing area is designed to receive the ore from the mine, and to prepare it through a crushing and screening circuit for processing in the Concentrator plant. The Dry Processing area operates 6,220h/y (71% utilization). This area processes Run-Of-Mine ore (ROM) at a nominal rate of 4479t/h. The product of the Dry Processing area is fine ore, which has been passed through dry cobbing magnetic separation at a P80 of size 3.3mm and sent to a stockpile at a nominal rate of 4031t/h.

The Wet Processing area consists of five processing stages:

- Primary grinding;
- Secondary grinding;
- Tertiary grinding;
- Finisher Magnetic Separation and
- Sulphide Flotation

The Concentrator plant is designed to process fine ore from the fine ore stockpile at a rate of 3,145t/h. For a design operating hours of 7,972 h/y (90% utilization), the nominal production is 9.1Mtpa of concentrate.

Concentrate slurry from the sulphide flotation stage is dewatered in a process consisting of thickening in a single high-rate thickener; and filtration in plate-and-frame filter presses.

Sulphide flotation concentrate is pumped to the concentrate thickener launder, where it combines with recycled filtrate from the filter presses. The design feed to the thickener has a solids content of 33%wt at a rate of 1,255t/h solids.

The underflow from the concentrate thickener will be dewatered by using seven plate-and-frame filter presses working in parallel (six operational and one standby). Filter cake from the filters will be sent to the product delivery area, which consists of product storage and rail load-out system.

Concentrate filter cake from the filter presses is conveyed for stockpiling, where it is stored in a rectangular storage pile by a tripper conveyor. The concentrate is then reclaimed by a dual-boom portal scraper and transported to the rail load-out station via transfer conveyors, and then the reclaimed material is fed into the rail load-out bin. The rail load-out operation is a continuous process with volumetric measurement.

1.7 Project Infrastructure

As part of this study, a site plan was developed for the Shymanivske site. Major site infrastructure consists of the following:

- Shymanivske open pit and associated waste-rock dumps;
- Haul trucks maintenance shop, mine administration building;
- Primary crusher and transfer conveyors;
- Secondary crushers and HPGRs building
- Dry-screening building (includes 10 dry double-deck screens);
- Cobbing building (housing 30 pieces of dry-cobbing magnetic separation equipment);
- Fine ore stock pile (includes the draw-down hoppers and take-away conveyor);
- Concentrator building (includes Primary Mill Wet Screens, Primary and Secondary Mills, VertiMills, four stages of Magnetic Separation, Flotation and Reagent area);

- Thickeners (includes tailing and concentrate thickeners as well as the main process water tank);
- Concentrate Filter building (includes pressure filters and associated tanks and transfer conveyors);
- Concentrate stock pile (includes the product stockpile, reclaimer system and transfer conveyors);
- Coarse tails stockpile;
- Rail load-out;
- Tailing storage facility (TSF);
- Plant control room building;
- Air compressors building (includes compressors and blowers that provide plant and instrument air);
- Concentrator warehouse and laydown area;
- Security building and truck scale;
- Administration building;
- HSE building, fire station and ambulance garage;
- Main plant sub-station;
- Process pump houses;
- Water ponds (raw water pond, storm water collection Pond B, tailing collection ponds, waste-pile collection ponds);
- Diesel fuel receiving and unloading station;
- Diesel fuel storage and vehicle fuelling system;
- Area electrical sub-stations;
- Bridges;
- Haul and service roads;
- Rail spurs; and
- Water treatment facilities.

The Shymanivske area is serviced by existing rail and ports. Several options were reviewed for the export of concentrate, which were subsequently narrowed down to two port options. The port of Nikolaev is the closest and therefore the most economical port of export; however, there is a limited capacity in excess of 2Mtpa. The balance of the production will be routed to the privately owned TIS-Ruda terminal located at the Yuzhny Port. Black Iron still needs to negotiate an operator's agreement with the ports of Nikolaev and TIS-Ruda to define all port activities.

The required utilities, such as power, process water and natural gas, are available in the vicinity of the Project. The existing power generation has capacity to support the Project demand. Overhead power lines and modifications and additions to the existing substations are required and have been considered as part of the total Project capital cost. The rail transportation system is available on site. A tie in point is already approved for the Project to connect to the national rail grid.

1.8 Market Studies and Contracts

Black Iron has engaged in discussions with several potential customers interested in the high grade iron ore concentrate which will be produced at the Shymanivske facility. As of the effective date of this Report, Black Iron has not entered into any material commercial agreements with any potential customers or export service suppliers.

Black Iron mandated CRU Strategies, a division of CRU International Limited of the United Kingdom, to perform a market study. The main objective of the study was to provide a view of developments in steel and iron ore markets that would affect the prospects of Black Iron's proposed Shymanivske iron ore mine given that this Project will likely be built to serve export markets. Black Iron identified the following countries and regions as its main targets: Turkey, Middle East, European Union, China, India, Japan, South Korea, Taiwan and Southeast Asia.

1.9 Environment

In accordance with the NI 43-101 F1 Standards of Disclosure for Mineral Projects, the study presents a summary of information about the environmental, permitting, social and community factors related to the Project. The scope of the environmental and social review has included the following:

1. The Project environmental and social management process that has been undertaken to date, including a summary of the key regulatory drivers, permitting process and voluntary commitments undertaken by Black Iron;
2. A summary of the available results of the environmental studies and a discussion of any known environmental issues that could materially impact the Project feasibility;
3. Where known, the potential issues arising from planned and unplanned emissions, discharges and disturbances from the Project construction activities, mining and processing operations, waste and tailings disposal, water usage and discharge, and the necessary site monitoring and management requirements during operations and after mine closure;
4. A summary of key aspects associated with Project stakeholder relations, including potential socio-economic effects, community engagement and resettlement issues, and plans for the Project and the status of any negotiations or agreements with local communities;
5. A discussion of mine-closure requirements, cost provisioning and the basis behind decisions to either defer reclamation or follow progressive rehabilitation procedures and the associated post-performance and/or reclamation bonding necessary; and

6. An outline of the next stages of execution required for on-going environmental and social management.

This review relies on information that has been provided by licensed and authorized Ukrainian professional institutes. These organizations have been, by necessity of conformance with the Ukrainian regulatory system, instrumental in collecting data and developing the regulatory materials for submission. WorleyParsons has incorporated this information in the review and, where reliance has been based on this information, it has been referenced and itemized.

As of December 2012, the baseline studies necessary for the development of the Ukrainian environmental regulatory submission, termed OVNS, have been completed. Three key issues associated with the Project have been identified relating to air quality, resettlement and land acquisition. In addition, there are several other lesser issues associated with the Project, including groundwater contamination, alteration of the hydrological regime, noise, socio-economic factors, and health.

1.10 Cost Estimate

Through the Value Improvement Process (VIP) in the FS, several improvements were implemented to the work completed last year for the Preliminary Economic Assessment (PEA). In particular, improvements were found and verified to optimize the process flowsheet, reduce the stripping ratio through phasing a shallower pit shell, and increase the weight recoveries. This process has verified an initial operation with 26% higher annual production and 16% lower operating costs than in the previous PEA study. The relatively low-unit operating cost of production, coupled with close proximity to Turkish, European, and Middle East customers, indicates that this operation has the potential to remain profitable, despite reasonable fluctuations in the iron ore price illustrated in the Tables below.

The FS outlines an operation producing 9.2Mtpa of high-grade 68% iron ore concentrate, projecting a pretax but post royalty 45.9% internal rate of return (IRR) and a U.S. $3.5 billion net present value (NPV) at an 8% discount rate.

The FS cost estimates were completed by WorleyParsons for the Beneficiation Plant and Infrastructure and by P&E for the Mine.

Table 1.4 below summarizes the key elements of the FS cost estimate and financial analysis for the Project. The Capital Cost estimate has a predicted accuracy of +/- 15%. An exchange rate of 8.1 Ukraine Hryvnia to the USD was used, and escalation was not included. The economic evaluation was performed, using a discounted cash flow model. The IRR on the total investment was calculated on the basis of 100% equity financing.

Table 1.4: Financial Analysis

NPV at 8% discount rate	$3.5 billion
IRR	45.9%
Total Estimated Capital Costs (excluding sustaining capital)	$1,094 million
Life of Mine FOB OPEX (Beneficiation, Mine & Transportation) Mine Gate OPEX (Beneficiation & Mine)	$43.97 /t $29.67 /t
High-Grade 68% Concentrate Sales Price Forecast. Based on long term CFR benchmark price of $95/t @ 62% iron adjusted for BKI's higher iron content and shorter shipping distance to end users (Year 1, 2016) (Year 2) (Year 3 onward, long-term)	 $ 125 $ 117 $ 115
Average Annual Cash Flow	$593 million
Estimated Mine Life	16 years
Final Product Iron Grade (Fine Iron Ore Concentrate)	68% Fe
Measured and Indicated Resource (at 31.6% iron)	645.8 Mt
Proven and Probable Reserves (at 31.1% iron)	448.2 Mt
Annual Production Rate (average life of mine, post ramp-up year)	9.2 Mt
Projected Plant Start-up and Commissioning	Q4, 2015
Projected Commencement of Revenue Generation	Q1,2016
Projected Years to Payback (at 8% Discount Rate)	2.2 years

The operation outlined by this FS for the Shymanivske Project indicates the potential for a high-value, low net cost iron ore development project. The projected high NPV, net cash flows, and relatively low unit cost for concentrate arise from Black Iron's advantages, which include an iron ore deposit with significant existing infrastructure (railway, power lines and port) and access to low-cost skilled labour.

Table 1.5: Financial Sensitivities at Various Discount Rates

IRR (pre-tax)	45.9%	
Discount Rate	Pre-Tax NPV USD (Millions)	Payback (Years)
0%	$ 8,392	1.9
6%	$ 4,328	2.1
8%	$ 3,524	2.2
10%	$ 2,887	2.3

The Project has favourable economic potential across a range of discount rates. The operations outlined in this FS are projected to generate over U.S. $1,136 million in average annual revenue over the life of mine.

On the basis of the metallurgical test work completed for this FS, it is estimated that the process weight recovery of 32.7% would yield a project life of 16 years at an average strip ratio of 1.63:1, according to the current estimated resource.

Capital Cost Estimate for the High-Grade 68% Iron Ore Concentrate Option

Total initial capital expenditures are estimated at U.S. $1,094 million to produce a high-grade 68% iron ore concentrate. The capital cost estimate excludes the sustaining capital cost of U.S. $689 million. The initial assessment of the preferred port facility indicates that sufficient capacity currently exists for the planned production.

Table 1.6: Capital Cost Summary

Summary of Estimated Initial Capital Costs	**USD (millions)**
Mining Capitalized Pre-Stripping Costs	61
Mine Fleet Lease Downpayment Costs	62
Concentrator and Site Infrastructure	654
Environmental and Tailings Management	20
Rail Spur	9
Port Facilities	Nil
Indirect Costs and Land Acquisition	189
Contingency (10%)	99
TOTAL	**1,094**

Operating Cost estimate for the High-Grade 68% Iron Ore Concentrate

The total average operating costs over 16 years are estimated at U.S. $43.97/t of high-grade 68% iron ore concentrate.

Table 1.7: Operating Cost Summary

Summary of Estimated Operating Costs	USD/t (Average Mine Life)
Mining	$13.51
Concentrator	$14.30
Site Infrastructure	$0.75
Sales and General Administration	$0.75
Environmental and Tailings Management	$0.37
Rail Transportation	$7.39
Port Facility	$6.90
TOTAL	**$43.97**

1.11 Project Schedule

A preliminary project execution schedule for the detailed engineering, construction, commissioning and start-up was developed, which includes the Ukrainian Environmental Assessment and Permitting process (OVNS) as well as the TEO and Proekt construction-permitting process. Construction can begin once all the required permits are obtained, which is currently estimated to be November 2013. Assuming duration of 23 months, construction of the mine, beneficiation plant and all infrastructure tie-ins are scheduled to be completed by the end of December 2015. The plant commissioning startup is expected to commence in September 2013 for completion by at the end of December 2015.

1.12 Qualified Persons' Conclusions and Recommendations

1.12.1 Drilling, Mineral Resources and Mineral Reserves

- The mineral reserve identified for the Project will allow for an operation with a 16-year mine life. Average head grades over that period will be approximately 19.37% Fe_{mag} and 31.1% Fe_{tot}.
- Life-of-mine production will consist of 448Mt of iron ore, at an average strip ratio of 1.63:1.

- The proposed mining fleet will consist of 23m^3 hydraulic shovels, loading 226t capacity off-highway trucks. The truck fleet size will range from 28 to 53 trucks over the life of the operation.
- The mine operating cost will vary from year to year; however, the life-of-mine average mining cost is expected to be around US$ 1.71/t of material moved.
- From a mine operations perspective, Black Iron should investigate the option of a maintenance and repair contract (MARC) with the equipment vendor. This could add value by outsourcing the equipment maintenance and guaranteeing mechanical availability.
- Further evaluation should be completed of the mine's geotechnical and hydrogeological aspects for the pit design and mining phases.
- The WGM proposed infill drilling program partially achieved its goals in delineating some structural elements within the deposit; however, in the steeply dipping areas close to the west limb of the main anticline structure, some proposed holes were not completed. WGM recommends completing the remainder of these holes in the future to obtain more structural information and help in the understanding of the controls and boundaries of the SX5F zone and the magnetite-bearing quartzite. This drilling can be completed as originally proposed, or by modification of the plan by in-pit drilling once production has commenced in order to more accurately define the geological boundaries and to achieve better mine planning and scheduling.

1.12.2 Mineral Processing and Metallurgical Testwork

Metallurgical testwork achieved the desired quality of concentrate and showed that, by using the designed process and flowsheet, it is possible to economically recover the magnetite from Shymanivske ore.

All testwork completed in the different studies, including work completed during the FS by WorleyParsons in 2012, has been done at the bench scale level. The designed process flowsheet contains several closed circuits and recycled streams. In order to investigate the impact of the closed circuits and recycled streams on the mass and magnetite recovery and also on energy efficiency, while optimizing the process and operational parameters, it is recommended that the Owner proceed with a pilot plant scale metallurgical testwork program.

The pilot plant program would be designed to:

- Provide enough sample to perform pelletizing testwork, to confirm that chemical, physical and metallurgical properties of the pellets made from the Shymanivske concentrate are consistent with market standards;
- Provide information for equipment sizing and plant design, and provide samples for testwork at the vendor's laboratories to obtain performance guarantees from vendors;
- Validate magnetic and weight recovery at each processing stage;
- Validate flotation residence time and reagent consumption;
- Provide samples for environment and tailings testwork; and

- Confirm the optimum transfer size between different stages of grindings.

1.12.3 Project Infrastructure

The assessment of the existing rail network and preferred port facilities infrastructure suggests that sufficient capacity currently exists for the planned production. 20Mtpa of available capacity has been confirmed by Dnieper Rail Road State Enterprise for Ukraine's national Rail Road in a letter dated September 10, 2012. As a result, no additional capital is anticipated to increase the current capacity of the rail network and port facilities. At the Project site, Black Iron will build a rail spur, railway station, and rail loadout. These costs are included in the CAPEX estimate.

The electrical power required for the Project is available from the local grid through a 30km overhead transmission line and modifications on the existing sub stations. The existing grid has sufficient excess capacity and this has been confirmed by a local consultant.

Long term service contracts need to be negotiated with:

- UNR Rail
- Port of Yuzhny and port of Nikolaev
- Local Power Authority
- Local Natural Gas Authority
- Local Potable Water Authority

1.12.4 Environmental

The primary social and environmental issue for the Project is poor air quality in the region resulting from dust emissions from the existing mines and metallurgical processing plant. Consequently, the Project design has incorporated dust suppression, minimization and control technologies to mitigate the generation of dust from the Shymanivske Facilities. Other air quality emissions for the project will be controlled, either at source or through end-of-pipe capture and treatment.

The project faces the challenge that pre-project (baseline) dust levels exceed local and international standards. Therefore, the level of dust control technology proposed is more advanced than currently being used by existing neighbouring mine operations. The benefit from these modern dust mitigation techniques will be quantified in the environmental regulatory submissions and the authorities in the Kryvyi Rih Area will be engaged on this specific matter. If these same technologies are applied to other plants in the areas, it is expected the overall dust in the environment could be reduced from the existing levels. The project Environmental and Social Management Plans will set out site-specific dust management approaches and monitoring that could form the basis for an air quality improvement steering group with other mining operations and the Authorities.

Two other key environmental and social issues will be managed through:

1. The development and implementation of a Resettlement Action Plan (RAP) associated with the required resettlement of the Rudnichne Village, and
2. Assessment, and, where necessary, site investigation of ground conditions of the land that will be acquired for the project to manage risks associated with the presence of unexploded ordinance (UXO) and/or contaminated ground in the former military site area. The management of these risks and the limitation of liability could necessitate ground remediation subject to the findings of the assessment.

Upon completion of the impact assessment in 2013 it will be possible to present the benefits derived from the planned mining operations in terms of employment, improved environmental performance and community measures which are expected to significantly outweigh any negative consequences of the project. The construction and operation of the minesite will generate over one thousand direct jobs and associated employee benefits plus corporate taxes. In addition, the Project will create a substantial number of indirect jobs, through direct and indirect business opportunities and the procurement of goods and services.

Several environmental permitting and planning activities are required prior to the commencement of Project mining activities.

Environmental Permitting

Several environmental permits will be required for the Project as discussed in detail in Section 25.3. The main requirement is for the OVNS to be submitted to the Ukrainian authority SER for formal approval, after which other related environmental permits can be obtained.

Mine Closure Plan

Definitive reclamation requirements are subject to specific mine licence agreements and conditions, as set out in the mining permit. A formal Mine Closure Plan will be developed prior to confirmation of the final project design and approvals submission (i.e. by mid-2013), which will address issues such as bonds, percentage of annual rehabilitation, community development and livelihood diversification. All these factors are complex instruments requiring negotiation as a condition for an individual mining agreement. Guidance on international best practice for mine closure will be referred to.

Environmental and Socio-Economic Management Plan

The definition of the environmental and social management system to be implemented by Black Iron should be in accordance with ISO 14001: 2004. An Environmental and Socio-Economic Management Plan (ESMP) for the Project will be required throughout the life-cycle of the project (i.e. during planning, pre-construction, construction, operation and mine closure), and will need to be a “live” system with continuous improvement targets and monitoring programs. The ESMP shall contain, amongst other things, a Legal Register and a number of individual Management Plans, addressing all environmental aspects of a particular facility, sensitive receptors, or activity of the project.

The Legal Register has already been developed and is a live document to be updated on an on-going basis by the Project's Environmental Department.

It is envisaged that the ESMP will include separate plans for waste-rock and tailings management, an Air Quality Management Plan and a Water Management Plan. The ESM System should be considered as an organizing framework that should be continuously monitored and periodically reviewed, to provide effective direction for Black Iron on how it should respond to changing internal and external factors during the Project.

1.12.5 Main Conclusion

This Feasibilty Study phase of the project was done to sufficient detail to outline the issues related to the project going forward. The Project economics are sufficiently robust to warrant moving to the next phase of bridging engineering, and the subsequent detailed engineering phase. Black Iron does not currently have the necessary surface rights to conduct mining activities on the Shymanivske Project. However, surface rights are not required to conduct the on-going exploration and engineering activities. The next major permitting step for Black Iron is to obtain a Mining Allotment, which entails government approval of the optimized pit shell and environmental impact.

2 INTRODUCTION

2.1 General

The following Technical Report presents the results of the Feasibility Study (FS) for Black Iron's Shymanivske Iron Ore deposit located in the KrivBass iron ore basin of the Dnepropetrovsk region in Ukraine. The Shymanivske subsurface usage permit for the extraction of iron ore, registered as Special Permit No. 4537, is 100% owned by Shimanivske Steel LLC who is 100% owned by Black Iron Inc. The property covers 256 hectares and is located approximately 330km south-east of Kiev and 150km north of the Black Sea in Ukraine.

This report was prepared at the request of Mr. Matt Simpson, CEO of Black Iron. Black Iron is a Canadian iron ore exploration and development company listed on the Toronto Stock Exchange (TSX) under the symbol BKI, with its head office situated at:

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Suite 800
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This Technical Report titled "Feasibility Study of the Shymanivske Iron Ore Deposit for Black Iron Inc." was prepared by Qualified Persons following the guidelines of the "Canadian Securities Administrators" National Instrument 43-101, and in conformity with the guidelines of the Canadian Mining, Metallurgy and Petroleum (CIM) Standard on Mineral Resources and Reserves.

This Report is considered effective as of December 14, 2012.

The FS was completed by:

- WorleyParsons Canada Services Ltd. ("WorleyParsons") for the process plant and infrastructure;
- Watts, Griffis and McOuat Limited ("WGM"), Consulting Geologists and Engineers of Toronto, for the geology, data verification and Mineral Resources; and
- P&E Mining Consultants Inc. ("P&E") for the Mineral Reserves and mine design.

2.2 Sources of Information

A number of suitably qualified consultants were contracted to carry out specific technical and economic studies for input to the FS report. These experts are listed below, in Section 2.3, together with their respective responsibilities:

Figure 2.1: Consultants and Responsibilities

Sub-consultants	Responsibilities
Ammtec	Bench scale metallurgical tests
Mekhanobrchermet (MCM)	Report of baseline mineralogical and metallurgical characteristics as well as a report on the development of a beneficiation process
SGS-Lakefield (SGS)	Grindability characteristics of the ore from the Shymanivske deposit
CRU Strategies	Market study report
KOLO	Ukraine Market Information, and Ukraine codes and regulations
NTF Piggit LLC (PIGGIT)	Mine geotechnical design parameters

Much of the material used to prepare this report has been provided by Black Iron and its predecessor, **2248964 Ontario Inc**. The material included the results for Black Iron's recent drilling programs, the documentation concerning historic Soviet exploration results, and the legal description of the Property. Research sources also include information collected by WGM during its site visits to the Property in 2011, in addition to analytical results from independent samples collected during these visits, and studies and reports commissioned by Black Iron completed in 2010 and early in 2011.

Drill core samples collected for Black Iron as part of their 2011 drilling programs were submitted by GEORESOURCE to MCM, SGS-Lakefield and ALS Minerals (ALS). WGM understands that MCM is accredited under Ukrainian regulations and holds an ISO 9001:2009 certification for quality management systems. SGS-Lakefield and Ammtec (SLA) are fully accredited under ISO 9001 and ISO 17025 for specific laboratory procedures. Although WGM has reviewed the assay results generated by MCM and SGS-Lakefield and believes that they are generally accurate, WGM relies on the two laboratories as independent experts in the field of analysis. Similarly, WP has relied on the bench test results provided by ALS.

WGM reviewed the documents available, and corroborated a number of details concerning the Property and deposit geology. A complete list of the material reviewed is found in the References Section of this report.

2.3 Qualified Persons

The following Qualified Persons (QP), as the term is defined by NI 43-101, have contributed to the writing of this Report and have provided the requisite QP certificates included at the beginning of it. The information contained in the certificates is outlined in each section of this Report that the designated QP is responsible for.

Mr. R.M. Spiering, P. Eng., WorleyParsons Canada Services Limited

Mr. Masoud Gorjian, P. Eng., WorleyParsons Canada Services Limited

Mr. Reza Ehsani, P. Eng., PMP, WorleyParsons Canada Services Limited

Mr. Philip Burris, C.Geol., Eur. Geol., WorleyParsons UK Limited

Mr. Eugene Puritch, P. Eng., P&E Mining Consultants Inc.

Mr. Richard W. Risto, M.Sc., P.Geo., Watts, Griffis and McOuat Limited

Mr. Michael Kociumbas, B.Sc., P.Geo., Watts, Griffis and McOuat Limited

The individuals listed below, who have contributed to the completion of the FS and this Report, have extensive experience in the mining and metals industry or in a supporting capacity in the industry. For the purpose of this Report, they are not considered QPs, as defined by NI 43-101.

Jose Sa Pereira	MSc (EnvMan) PDipEng (Railway)	WorleyParsons
Kirsten Roettcher	BSc (Hons) MSc. (Environmental)	WorleyParsons
Farshid Ghazanfari	P.Geo.	Black Iron
Stefan Gueorguiev	P Eng.	Black Iron
(CRU Limited)	Iron Ore Market Specialists	CRU Strategies

Table 2.1 outlines responsibility for the various sections of the Report.

Table 2.1: Technical Report Section List of Responsibility

Section Number	Section Title	Responsible QP	Co-author	Other Experts	Comments and Expectations
1	**Summary**	WP (Rob Spiering)	WGM (M.Kociumbas) / P&E (E. Puritch)		
2	**Introduction**	WP (Rob Spiering)			
3	**Reliance on Other experts**	WP (Rob Spiering)			
4	**Property Description and location**	WP (Rob Spiering)		BKI	
5	**Accessibility, Climate, Local Resources, Infrastructure and Physiography**	WP (Rob Spiering)			
6	**History**	WGM (Richard Risto)			
7	**Geological Setting and Mineralization**	WGM (Richard Risto)			
8	**Deposit Types**	WGM (Richard Risto)			
9	**Exploration**	WGM (Richard Risto)			
10	**Drilling**	WGM (Richard Risto)		BKI	
11	**Sample Preparation, Analyses and Security**	WGM (Richard Risto)			
12	**Data Verification**	WGM (Richard Risto)			
13	**Mineral Processing and Metallurgical Testing**	WP (Masoud Gorjian)			
14	**Mineral Resource Estimates**	WGM (Michael Kociumbas)		BKI	

Section Number	Section Title	Responsible QP	Co-author	Other Experts	Comments and Expectations
15	**Mineral Reserve Estimates**	P&E (Eugene Puritch)			
16	**Mining Methods**	P&E (Eugene Puritch)			
17	**Recovery Methods**	WP (Masoud Gorjian)			
18	**Project Infrastructure**	WP (Reza Ehsani)			
19	**Market Studies and Contracts**	WP (Rob Spiering)		BKI	Source: Black Iron's independent consultant CRU Strategies is not considered a QP
20	**Environmental Studies, Permitting and Social or Community Impact**	WP (Philip Burris)			
21	**Capital and Operating Costs**	WP (Rob Spiering)	P&E (Eugene Puritch)		
22	**Economic Analysis**	WP (Reza Ehsani)		BKI	
23	**Adjacent Properties**	WP (Rob Spiering)		BKI	
24	**Other Relevant Data and Information**	WP (Rob Spiering)			
25	**Interpretation and Conclusions**	WP (Rob Spiering)	WGM (M.Kociumbas) / P&E (E. Puritch)		
26	**Recommendations**	WP (Rob Spiering)	WGM (M.Kociumbas) / P&E (E. Puritch)		
27	**References**	WP	WGM (Richard Risto / P&E (Eugene Puritch)		

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 US Dollar (USD); and
- A foreign exchange rate of $1 USD = 8.1 UAH.

A list of abbreviations is included with the Table of Contents.

This report is intended to be used by Black Iron, subject to the terms and conditions of its contract with WorleyParsons, WGM and P&E. The contract permits Black Iron to file this Report as a Technical Report with Canadian Securities Regulatory Authorities, pursuant to provincial securities legislation. Except for the purposes legislated under provincial securities laws, any other use of this Report by any third party are solely at that party's risk.

2.5 Site Visit

WGM Senior Associate Geologist, Mr. Richard Risto, P.Geo, QP, visited the Property four times in 2011. WGM's first site visit was from April 11 to April 18; site visit two, from May 22 to May 29; site visit three, from June 27 to July 3; and site visit four from December 12 to 17. WGM then reviewed Black Iron's' program results with Black Iron's Geologist, Mr. Farshid Ghazanfari, P.Geo., and the GEORESOURCE personnel conducting the program. Mr. Risto collected independent drill core samples during the second, third and fourth site visits for independent assay.

Mr. Michael Kociumbas, P.Geo., Senior Geologist and Vice-President of WGM, QP and co-author of this Report, has not visited the Property.

WorleyParsons completed multiple site visits. The site visits were conducted between January 2012 and September 2012 by the WP QPs along with the team located in Ukraine associated with UDI management, including the management of the environmental testing. Rob Spiering and Philip Burris, Worley Parsons QPs, visited the Property on January 24, 2012. The primary objective of the site visits was to verify the site conditions. Rob Spiering made a second site visit on September 9, 2012, for the purpose of evaluating the site for constructability. Masoud Gorjian, another WorleyParsons QP, made a seven day trip to Ukraine and visited the Property in May 2012. Reza Ehsani, who is also a WorleyParsons QP, has not visited the Property.

Puritch Eugene Puritch of P&E and the QP for the mine design, made two trips to Ukraine to interface with the local mine engineering consulting firms in Kharkiv and Dnipropetrovk, his main objective was to facilitate the selection of the appropriate pit design parameters described in Table 15.3, which conform to current Ukrainian norms and mining regulations. Eugene Puritch visited the Property on February 27, 2012.

3 RELIANCE ON OTHER EXPERTS

This Report was prepared using the resource materials, reports and documents noted in the text and in Section 27, "References," at the end of the Report. Although the authors have made every effort to convey the content of the reports accurately, they cannot guarantee either the accuracy or the validity of the work described in them.

Black Iron retained the services of CRU Strategies, a division of CRU Limited, to perform a market study to evaluate potential target markets for the Black Iron Shymanivske iron ore concentrate. WP has reviewed the contents of the Market Study Report and believes that it provides a reasonable overview of the past and current iron ore market in addition to market, projections, according to various recognized sources.

The authors have not independently verified the legal title to the Property, nor have they verified the status of Black Iron's Property agreements. They rely on public documents and information provided by Black Iron for the descriptions of title and status of the Property agreements, and they have no reason to doubt that the status of the legal title is anything other than what is reported by Black Iron.

This Report is partly based on internal Black Iron technical reports, maps, published government reports, company letters and memoranda, and information, as listed in the "References" of this Report. Sections from reports authored by other consultants may have been directly quoted or summarized in this Report. 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).

WGM has not carried out any independent geological surveys of the Property, but did complete 2011 site visits from April 11 to April 18; May 22 to May 29; June 27 to July 3, and December 12 to 17, to view first-hand the Property site, view 2011 drill core, collect samples from the drill core and to review historic exploration and development work and provide guidance to GEORESOURCE in conducting the program.

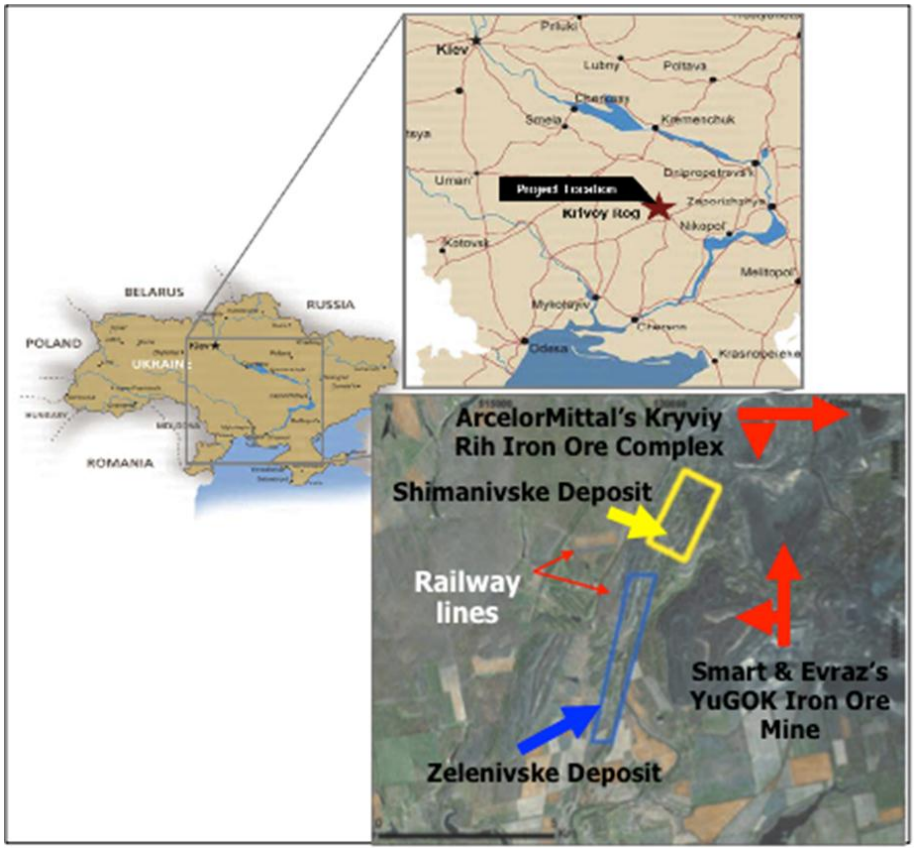
These new samples were collected by WGM and assayed independent of Black Iron, in order to validate the results shown by the existing samples. The authors have relied on geological descriptions and program results solely on the historic reports, field notes and communications with Black Iron.

4 PROPERTY DESCRIPTION AND LOCATION

4.1 Property Location

Ukraine is strategically situated between Europe, Russia, Asia and the Middle East. The Shymanivske iron ore deposit is located approximately 330 km south-east of Kiev (capital of the country) and 243 km north-east from Ukraine's largest Black Sea port of Odessa. The property encompasses an area of approximately 300 ha and is situated in the well-known iron ore mining district of KrivBass in the Dnepropetrovsk Region. KrivBass is the heart of mining and metallurgy in the country, containing 42% of Ukraine's ore reserves. The mine site is 12 km southwest from the city of Kryvyi Rih, shows a map of Ukraine and the Project site location. The pit is centered at approximately 47°50'N latitude and 33°16'E longitude. ArcelorMittal's Kryvyi Rih open pit mine is located immediately north of the Property and shares a property boundary. The Yuzhny (Southern) GOK (a.k.a. YuGOK) open pit mine is located immediately to the south-east and also shares a property boundary with Black Iron. Zelenivske, also shown in Figure 4.1, is another undeveloped iron ore deposit owned by Black Iron.

Figure 4.1: Map of Ukraine with Project Location



4.2 Property Description and Ownership

The existing Special Permit No. 4537, issued on December 13, 2007, covers 2.56 km² (256 ha) of land and is valid until November 1, 2024 with the option to renew it in 20-year increments. The permit authorizes the extraction of the subsurface ferriferous quartzite minerals from the Shymanivske deposit.

Table 4.1 provides the vertices of the Property as listed on the licence documentation issued by the government of Ukraine.

Table 4.1: Shymanivske Property in Ukriane

ID	Latitude (deg, min, sec)	Longitude (deg, min, sec)
T1	47 49 57 N	33 15 32 E
T2	47 51 02 N	33 16 21 E
T3	47 50 46 N	33 17 10 E
T4	47 49 40 N	33 16 22 E

In order to maintain the active mining licence, compliance with the following work program is required. All of the work required to be completed as of the time of writing this report has been done. Table 4.2 presents the type of work and time schedule.

Table 4.2: Program of Work under Special Permit No. 4537

Type of work	Beginning	End	Estimated Cost USD
Sign a monitoring and scientific supervision contract with the registered inspection agency	1 qt 2012	1 qt 2012	10 ,000/yr
Formation of project development works (mining part)	1 qt 2011	3 qt 2012	98,000
Formation and approval of draft mining and land allotments	4 qt 2012	4 qt 2013	39,000
Building of production base, provision of machinery for extraction of ferrous ores	1 qt 2014	4 qt 2015	11,250,000
Preparation of the Projection for its own processing complex	1 qt 2016	4 qt 2017	50,000
Start of deposit development and extraction of ferrous quartzites	1 qt 2018	4 qt 2024	1,250,000

The proposed pit shell covers the majority of the Shymanivske license area. However additional land for the plant, tailings and waste-rock dumps is needed for the development of the Project. The east and south sides of the licence area face space limitations due to close proximity of active mine operations and infrastructure. However, on the north and west sides of the Shymanivske licensed territory, there is more than 3,000ha of state-owned land currently being used by the Ministry of Defence, which is being sought to support project development and further expansions.

The area to the south is occupied by the village of Rudnichnoe. This village falls into the sanitary zone of the future open pit and will have to be relocated. In addition there is an old-mine service garage and reclaimed waste dumps owned by the neighbouring mines YuGOK and ArcelorMittal, which are located on the Shymanivske Property and that will have to be moved by BKI. The Company has started discussions with YuGOK and the local authorities with respect to the garage and partial waste dump removals.

4.3 Property Agreements

A land consultant was hired by Black Iron to perform a detailed “land audit” of the required Project properties. The audit confirmed that the land east of the ArcelorMittal railway needed for pit development (~450ha) belongs to the Kryvyi Rih City Council. The land west of the ArcelorMittal railway necessary for accommodating the Project general infrastructure, tailings storage facility, waste dumps, beneficiation plant (~3,000ha) is owned by the Ukrainian state. Black Iron is currently in discussion with the City Council and the State authorities regarding obtaining the surface rights for all lands required by the Project.

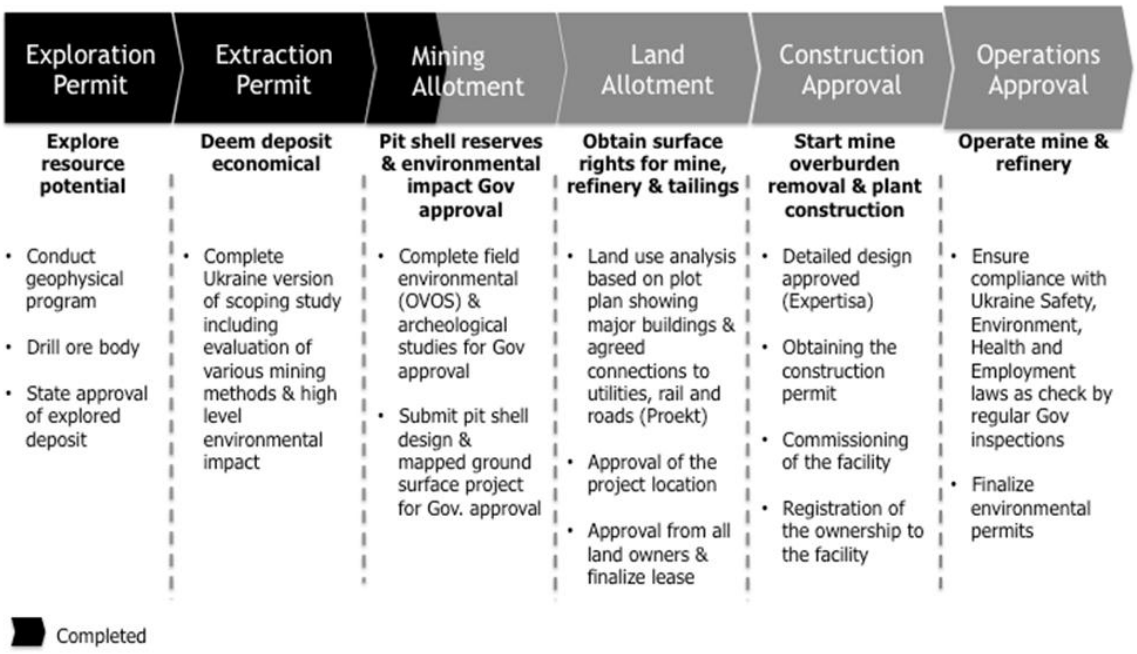
Black Iron is not aware of any environmental liabilities or any royalties attached to the Property, other than levies that are payable to the Ukrainian State, currently estimated at US $0.40 per tonne mined, based on the concentrate grade expected to be produced at the Shymanivske Project.

A portion of the surface rights over the Shymanivske Property has been leased to neighbouring mining companies by the Kryvyi Rih City Council. Acquisition of these surface rights is required to advance the Project to production. Black Iron has initiated a legal proceeding to challenge the legitimacy of the processes of the Kryvyi Rih City Council, as land owner, in granting these leases.

4.4 Permitting

Black Iron does not yet have all of necessary surface rights to conduct mining activities on the Shymanivske Project. However, surface rights are not required to conduct the on-going exploration and engineering activities. The next major permitting step for Black Iron is to obtain a Mining Allotment, which entails Government approval of the optimized pit shell and environmental impact. Figure 4.2 shows an overview of the major steps in the mine permitting process, according to current Ukrainian regulations.

Figure 4.2: Ukrainian Permitting Process Overview



The process consists of six major steps. The first step is to obtain an exploration permit that allows the company to conduct necessary ground geophysical surveys and exploration drilling to determine the resources available for extraction. The second step is to obtain an extraction permit, which entails proving the economic viability of mining the resources found using the optimal mining method. BKI possesses an extraction permit for its Shymanivske Project. Currently, BKI management is preparing all of the documentation required to obtain a Mining Allotment, which includes proving to the authorities that the deposit has sufficient reserves to justify industrial scale mining; that the design of the pit follows all local technical requirements; and that the current land owners do not object to mining activities on their land. Concurrently, the Company is in the midst of completing an ecological impact study to determine both the current baseline and the likely impact of this Project on parameters such as wildlife, fauna, air and water quality in the region. An archeological study is also being conducted to make sure that no historical or cultural landmarks are negatively impacted by the mining activities. Upon completion, both studies will have to be reviewed and approved by the State committees responsible for each area, along with a review and approval of the pit shell design by the Government's State Mining Technical Examination Board (Gosudarstvenoy Gornoy Technicheskiy Nadzor). With mining allotment in hand, BKI will then develop a land allotment plan for the pit and production facilities that includes the following: (i) analysis of the types of land that are going to be engaged in the mining activities; (ii) losses to the State budget related to the change of the land usage; (iii) the way the new development impacts local development plans and; (iv) tie-ins to the existing infrastructure, such as electricity, gas, water, railroad, etc. Once this work is completed, BKI will have to conduct a public hearing, with the goal of informing local residents about the new

development in the area and garnering community support for its planned activities. The final procedure for this phase is to obtain approval from all land owners and sign long- term leases.

After securing the land the company will start Phase Number 5, which will be the basic design of the complete production facility for approval by the State Architectural and Construction Commission known as GASK. As construction starts, BKI will sign contracts with local utilities and infrastructure providers, such as the National Railway, to connect services to their existing networks.

Once the tie-ins are completed for the pit, the beneficiation plant, and major infrastructure, a number of State agencies responsible for safety and environmental protection will have to inspect the facility and sign off their approval before starting operations. Regular checks will continue throughout the life of the asset to ensure that the standards and rules are being followed.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Access

The Property is immediately adjacent to the city of Kryvyi Rih and is encompassed by road systems serving the city and local mines. These roads are mostly paved. During the 2011 exploration program, the Property was accessed from the south via an old cobblestone road to the town of Shirokoe. Although there is an airport in Kryvyi Rih suitable for large commercial aircraft, international access is typically achieved using the Dnepropetrovsk International airport which is serviced by multiple daily flights and is a 2.5hr drive to site.

The government owned Ukrainian National Rail System is located within 2km of the Shymanivske Property.

There are five ports, ranging from 140km to 520km away from the site and including Odessa, Kerch, Yuzhny, Izmail and Nikolaev.

5.2 Climate

The climate of the Kryvyi Rih region is temperate-continental, semiarid (Bsk) according to the Köppen climate classification system. This climate tends to generate warm summers and cold winters, with low precipitation and an average annual air temperature +8.3°C. The average temperature in January is -4.9°C. The maximum temperature in July is +38°C. The average depth of snow cover is 10 to 14cm and the maximum depth of frost penetration is 0.8 to 1m.

Relative humidity of the air during the winter period is about 80-85% and about 55-60% during summer. The average annual quantity of precipitation generally ranges from 400 to 600mm.

5.3 Physiography

The Property is rather flat-lying, with some gullies. It slopes generally to the south-east. Its central part is divided by the Tymashova Valley and its southeast side drops towards the Inhulets River. The highest altitudes of the Property are in its western and eastern parts, at 122m ASL, while the central part is lower, ranging from 65m ASL down to 45m ASL.

There are three old pits on the Property, the vestiges of the mining of high grade mineralization and the extraction of limestone, clay and sand and gravel for building materials. Thin soil overlies flat-lying Cenozoic limestones and green and red clays, which vary in thickness from 9.7 to 21.2m with an average of 16m. Mine waste covers a significant portion of the Property, particularly its west and east margins, leaving its centre corridor mostly free. On the basis of comparison of the present topography with data presented on historical drill cross-sections for the Property, it is determined that waste rock in places is up to 30m thick.

The vegetation consists mainly of grassy pastures and shrubby areas. The village of Shimanovka previously occupied part of the Property but was removed several years ago to provide additional space for mine waste from YUGOK and NKODPE, predecessor of ArcelorMittal.

5.4 Local Resources and Infrastructure

Considerable infrastructure around the plant already exists. The mining operations local resources and infrastructure consist of.

- The Property is adjacent to the City of Kryvyi Rih, a major city with a population of 690,622 (as of 2007). Kryvyi Rih was built around the open pit and underground iron ore mines that are located within the city and to the northwest and southeast of it. Agriculture is also an important industry, and there are agricultural lands adjacent to the Property. City institutions include universities and trade schools, which in large part exist to supply direct and indirect labour to the local iron ore mines.
- With the five operating mines in the area there is a well educated and large resource pool of workers that have expertice in iron ore mining operations
- the electrical power for the Black Iron Project will be drawn from the existing "150kV Gornaya Substation," owned by the local Power Utility Dneprovskaya ElectroEnergetisheskaya Systema – NEK Ukrenergo and located 30km east of the Black Iron site. UESP confirmed that the local Power Grid has sufficient spare capacity (1600 MW by 2010 and 2400 MW by 2017) to deliver the required power to the Project. Currently the Gornaya Substation is loaded only at 30% of its full capacity.
- Process water for the plant will be provided by Yuzhnaya aeration plant. Water from the Yuzhnaya Aeration Plant is biologically treated prior to its use as make-up water. The maximum allotted withdrawal from the aeration plant is 15,700m^3/d and is provided free of charge.
- Natural gas from the public distribution system is obtained from ZelenaBalka through a 100mm line with pressure of 410KPa.
- The source of potable water is the Karachunovskoe Reservoir, north of the plant via a 7-km water pipeline.
- The Shymanivske area is serviced by existing rail and ports. Several options were reviewed for the export of concentrate, which were subsequently narrowed down to two port options. The port of Nikolaev is the closest and therefore the most economical port of export; however, there is a limited excess of only 2Mtpa. The balance of the production will be routed to the privately-owned TIS-Ruda terminal located at the Yuzhny Port. Black Iron still needs to negotiate an operator's agreement with the ports of Nikolaev and TIS-Ruda to define all port activities.

6 HISTORY

6.1 General

A summary of the historical work compiled from available documents is presented below. Details, however, are scant as documentation is incomplete. Most of the information described herein for the pre-1989 periods is derived from the 1989 Soviet report on the Property, titled: “Detailed Elaboration of Ferriferous Quartzites, Shymanivske Deposit of Krivorozhsky Iron-Ore Basin of the Dneprovsky Region” by Pashkova E.P., Postolyuk R.I. and others. GEORESOURCE Chief Geologist Leonid Galchansky, supervisor of Black Iron’s 2011 drill program, was a co-author of this 1989 report and has provided additional insight. In addition to what is summarized herein, the report also includes some description of geophysical surveys conducted throughout the Soviet era, but these surveys are not described in this report because they are not relevant to the current situation.

WGM believes the historical descriptions presented are generally accurate, but the company has not independently verified the data and there is no way for WGM to know if they are complete. This is particularly true for the post-Soviet period. WGM’s understanding from Black Iron is that all of the information contained in the government archives has been provided. WGM’s understanding from Black Iron is that government archives contain no additional information, and the lack of more complete files is said to be attributable to civil and political turmoil in the post-Soviet period.

The account below includes historic "mineral resource" and "reserve" estimates. These historic estimates were prepared prior to the implementation of NI 43-101, under different guidelines and specifications. WGM has neither audited these estimates nor made any attempt to classify them according to NI 43-101 standards and definitions. They are presented because Black Iron and WGM consider them to be relevant and of historic significance. Therefore, these estimates should not be relied on.

The 1989 report describes historic work in terms of four phases or periods:

- Period 1: Up to 1965;
- Period 2: 1966 to 1978;
- Period 3: 1982 to 1984; and
- Period 4: 1985 to 1989.

In 2005, Oberon Coal LLC (Oberon) obtained rights to the Property and carried out a pre-feasibility study. This study included work performed by Geo Inter Consulting Limited (GIC) to compile and create a database of drilling information, model the deposit and audit the 1989 Soviet “mineral resource” estimate.

Period 1: Up to 1965

In the period up to 1965, work was directed at achieving two goals:

- Drill testing the rich-iron (supergene) "oxidized quartzite" mineralization associated with the lithological contact between Gdantsev and Saksagan (or Saxagan depending on translation and spelling) sequence rocks (west margin of the Property); and
- Completing a series of short vertical exploratory drillholes to test taconite-style mineralization for a proposed Shymanivkse open pit mine.

The only record of pre-1965 work that WGM has seen is contained in the 1989 Soviet report that states 32 holes for the purpose of testing the rich iron mineralization on the contact were drilled, aggregating 6,818 m. WGM understands that these drillholes were not extended to test the taconite, but the drillholes were mostly terminated just after achieving the contact.

The 1989 report states that 48 short vertical holes, 22 m to 45 m long, aggregating 1,624 m were drilled on the site of the Shymanivske open pit. The report also states that magnetic iron was not determined in the samples from this drilling.

Because documentation for these programs is incomplete with respect to drillhole identifiers during these Soviet drilling programs, drilling dates for most of the historic drillholes are not available and drillhole identifiers are not entirely in sequence because of the existence of additional drillholes drilled in the drillhole sequence on adjacent properties. Consequently, there is a degree of uncertainty about which holes in the drillhole database, and which drillholes shown on historic Soviet cross-sections and maps, actually correspond to the drilling described.

Period 2: 1966 to 1978

During this period, work on the Property was carried out by two different entities. The Inguletsky GRP of Krivbassgeologiya Trust ("Inguletsky GRP") conducted work mainly to the south of the Property but partially coincident with the Shymanivske Deposit area, while the Central GDS of Krivbassgeologiya Trust ("Central GDS") carried out work elsewhere on the Property. The work by the Inguletsky GRP was aimed at achieving an estimate of mineralization (presumably mainly the rich-iron ores of the supergene type – "oxidized quartzite") and included metallurgical testwork. The program of Central GDS was aimed at evaluating the taconite - "un-oxidized quartzite" - mineralization. The 1989 report states that a total of nine holes aggregating 2,580 m were drilled. It is not clear to WGM whether this total includes all holes drilled by both Inguletsky GRP and Central GDS. It also is unclear which holes in the drillhole database this drilling represents.

Period 3: 1982 to 1985

During this period, a program was carried out and described as “preliminary prospecting of ferriferous quartzites [taconites] of I, II, IV and V ferriferous horizons on the site of the Shymanivske open pit.” The report for this program is available, but has not been translated into English. This program was conducted to increase the mineral resource base of NKODPE (the previous owner of the adjacent iron mines now owned by ArcelorMittal Kryvyi Rih). A total of 32 holes aggregating 9,902.6 m were drilled along Cross-Sections 1 to 7. This cross-section nomenclature is still maintained by Black Iron. From this work, “mineral resources” were estimated. The 1985 report includes the logs for the 30 drillholes and a series of cross-sections containing the holes drilled during the 1982 to 1985 period, and earlier. Downhole geophysical surveys included measuring electrical, electromagnetic, magnetic and radioactivity components, as well as hydrological surveys.

On the basis of exploration, drilling and testwork performed to 1985 at the Shymanivske Deposit, in-pit and global “mineral resources” for the un-oxidized ferriferous quartzites (taconite) were estimated. In addition, “mineral resources” for the “oxidized quartzite” (supergene) mineralization were estimated. These 1985 “mineral resources” are summarized in Table 6.1, from the Soviet 1989 report. No iron grades or cutoff grade information is specified.

Table 6.1: 1985 “Mineral Resourse” Estimate for the Shymanivske Deposit (Adapted after the Soviet 1989 Report)

	Category	Millions of Tonnes
Un-oxidized Quartzite (taconite)		
In-Pit:	C_1	228,117
	C_2	126,874
Global to depth of 300 m:	C_1	390,790
	C_2	145,653
Global to depth of 500 m:	C_1	432,578
	C_2	179,412
Oxidized Quartzite		
In-Pit	C_2	42,716
Global to depth of 500 m	C_2	56,466

Period 4: 1986 to 1989

During the period 1985-86, exploration, drilling and testwork continued. The program of detailed exploration of quartzites of I, II, IV and V of ferriferous horizons of the Shymanivske Deposit was conducted by the Krivorozhsky Prospecting Expedition. In all, 96 holes aggregating 18,113 m were drilled along Cross-Sections 1a, 1b, 1, 2, 2a, 3, 3a 4, 4a, 5, 6, and 7. These cross-sections are part of the same system mentioned previously, supplemented by infill sections. The drilling program and results leading to a new "mineral resource" estimate are summarized in the eight-volume 1989 Soviet report.

The 1989 "mineral resource" estimate included estimates for the in-pit and global taconite (un-oxidized ferriferous quartzites) and supergene enriched iron mineralization (oxidized quartzites – martite mineralization). For the taconite mineralization, the estimates were completed at cutoff grades of 16%, 12%, and 10% Fe_{mag} and for the supergene mineralization, at cutoff grades of 30% $Fe_{tot,}$ 28% $Fe_{tot,}$ and 26% Fe_{tot}. The estimate was completed using the cross-sectional method. Geological interpretation was completed and volumes calculated and iron grades assigned on the basis of area of influence of drillhole intersections. Rock density was applied to volumes on the basis of unit identification (horizons), and averages were calculated from determinations made on composites from each horizon.

Table 6.2 summarizes the in-pit "mineral resources" to a depth of 300 m for the taconite-type (un-oxidized ferriferous quartzites) mineralization, estimated at a cutoff of 10% Fe_{mag}, after Genivar, 2011. Table 6.3 presents the resources for the taconite mineralization extending below the pit (from 300 m to 500 m depth).

Table 6.2: Summary of 1989 In-Pit "Mineral Resourse" Estimate – Oxidized Ferriferous Quartzites, Cutoff of 30% Fe tot. (Adapted after Genivar, 2011)

Resource Classification	Horizon	Tonnes (millions)	% Fe_{tot}	% Fe_{mag}
B	sx1f	6,002	31.5	17.45
	sx2f	80,811	32.5	20.34
	Total	**86,813**	**32.4**	**20.14**
C_1	sx1f	24,150	30.8	17.51
	sx2f	137,403	31.6	19.84
	sx4f	74,409	32.7	20.41
	Total	**235,962**	**31.9**	**19.78**
B + C_1	sx1f	30,152	31.0	17.50
	sx2f	218,214	31.9	20.02

Resource Classification	Horizon	Tonnes (millions)	% Fe_{tot}	% Fe_{mag}
	sx4f	74,409	32.7	20.41
	Total	**322,775**	**32.0**	**19.87**
C_2	sx1f	1,170	33.1	18.34
	sx4f	8,005	32.3	20.52
	Total	**9,175**	**32.4**	**20.24**

Notes: The horizons are the interpreted lithological stratigraphic units to which the mineral resource blocks are assigned: sx = Saksagan Group; number = member number; f = ferriferous horizon. See Section 7 of this report for more on lithostratigraphic nomenclature.

Table 6.3: Summary of 1989 Below Pit "Mineral Resource" Estimate – Un-Oxidized Ferriferous Quartzites, Cutoff of 10% Fe_{mag} (Adapted after Genivar, 2011)

Resource Classification	Horizon	Tonnes (millions)	% Fe_{tot}	% Fe_{mag}
C_1	sx1f	23,402	30.6	17.93
	sx2f	2,241	29.8	15.84
	Total	**25,643**	**30.6**	**17.75**
C_2	sx1f	90,640	31.0	17.08
	sx2f	92,427	31.8	18.47
	sx4f	301,907	30.6	18.88
	Total	**484,974**	**30.9**	**18.46**

In addition, "mineral resources" for oxidized iron mineralization were estimated. These are summarized in Table 6.4.

Table 6.4: Summary of 1989 "Mineral Resourse" Estimate Oxidized Ferriferous Quartzites, CUTOFF OF 28% Fe_{tot} (Adapted after Genivar, 2011)

Resource Classification	Tonnes (millions)	% Fe_{tot}	% Fe_{mag}
In-Pit (to 300 m depth)			
C_1	3,672	33.5	-
C_2	19,286	34.4	-
Below Pit 300 m to 500 m			
C_2	93,223	31.9	4.05

2005 Pre-feasibility Study

Oberon-Coal LLC., acquired rights to the Property on November 4, 2004 through the granting of Licence 775189 by the State Committee of Ukraine on Building and Architecture. Its work consisted of a "pre-feasibility study" on the taconite mineralization of the Shymanivske Deposit. Pre-project development studies considered two scenarios: underground and open-pit mining. An English translation of a part of the report completed by Oberon is available.

As part of this work, GIC in January 2005, was mandated the task of compiling a digital drillhole database from the historical work available for the Shymanivske Deposit. Then, employing digital modeling, the company used this database to validate the 1989 "resources and reserves" for the deposit. According to Genivar, 2011, the 2005 GIC results confirmed the 1989 results. Apparently, no additional field work was completed as part of the 2005 study and no additional exploration was performed from 1989 onwards, until Black Iron started its programs.

Other

It is known that several underground mines once existed near the Property. For the most part, these are thought to have been small operations. These mines, presumably exploited by shafts, extracted high-grade martite-goethite-limonite supergene mineralization associated with the contact between the Gdantsev and Saksagan sequences. The "Novaya", a prominent example, was an underground, multi-level iron ore mine located immediately south of the Property. It operated from the mid-1960s to 1989, when it flooded and was shut down. These mines are now obscured by the piles of mine waste from the adjacent open-pit mines.

The Property was previously the site of the village of Shymanivske, which was removed several years ago to accommodate a mine development.

There is an existing quarry, partially filled with water, located just SW of the Property's centre, approximately 212 m long (NNW-SSE) and 100 m wide (WNW-ESE) at surface. The quarry was allegedly excavated to provide limestone to test and evaluate its potential (a flat-lying unit of limestone overlies the

older, folded rock sequence that includes the iron formation). The topographic survey by Abitibi Geophysics (Abitibi) shows that it is over 20 m deep, from water surface in pit to natural topographic level adjacent to pit. Observation by WGM suggests it penetrates into the iron formation and is very close to where an accumulation of martite mineralization would be expected to occur. No other information concerning this quarry, besides its surface dimensions in plan, and its location is available.

7 GEOLOGICAL SETTING AND MINERALIZATION

For geological descriptions and program results, WGM has relied solely on historic reports, notes and communications with Black Iron personnel. Additional results and descriptions have been summarized in previous NI 43-101 Technical Reports.

7.1 Regional Geology

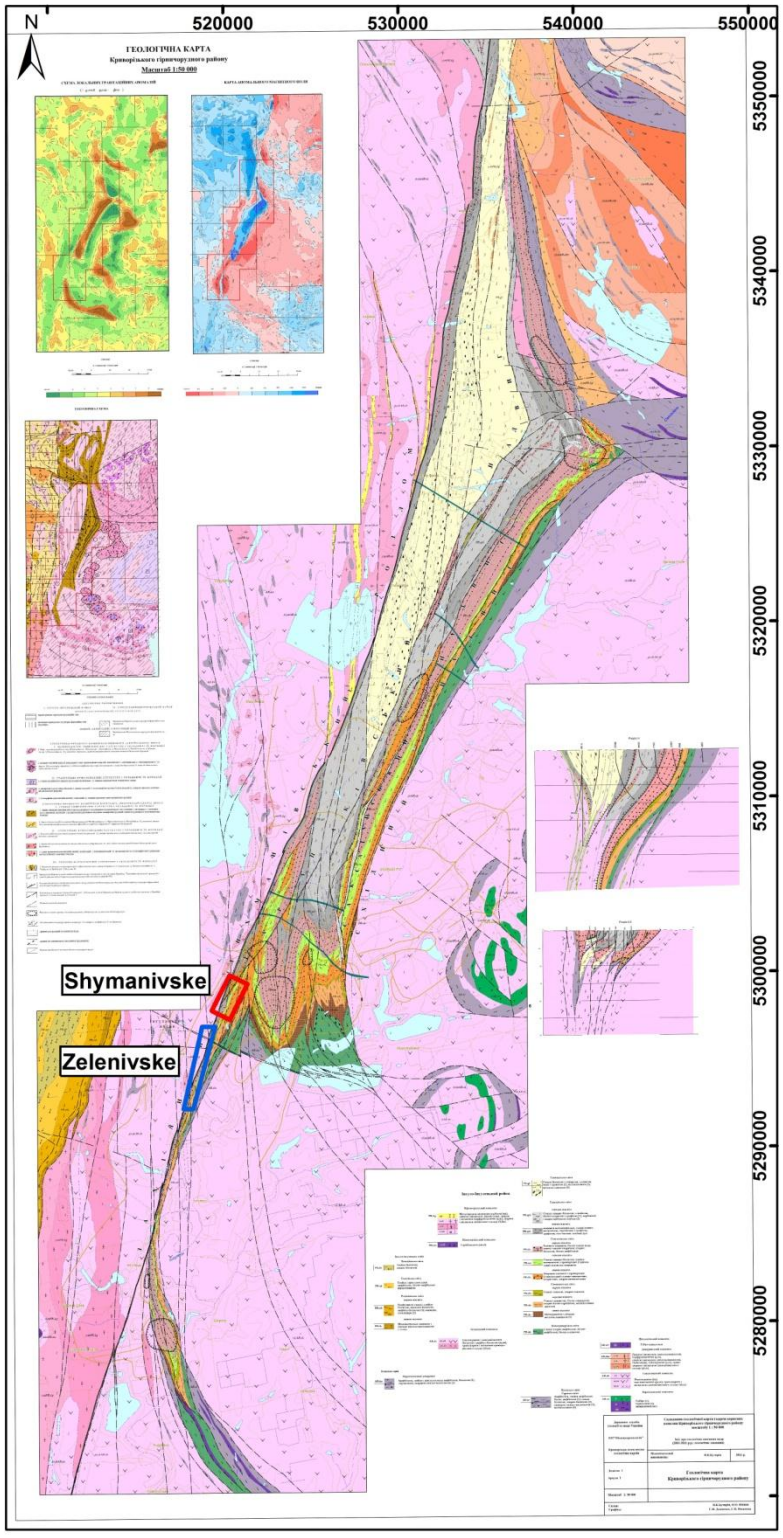
The Property is situated in the Kryvyi Rih Basin ("Krivbass"), a Paleoproterozoic synclinorium structure in the Archean Ukrainian Shield. The Krivbass lies along the western edge of the Middle Dnieper block of the Shield adjacent to the Inhul-Inhulets, or Kirovograd Block (Shchipansky and Bogdanova, 1996). The basin extends approximately 85 km north to south and is 2 to 10km wide. Krivbass is one of several Ukrainian iron formation-hosting Paleozoic basins on micro-plate boundaries. Most of the iron ore production in Ukraine comes from the Krivbass and Ukraine ranks as the sixth largest iron ore producer in the world, behind Russia and ahead of the United States and Canada.

Kulik and Chernovsky, 1996, describe the rocks in the basin or synclinorium as deformed by superimposed folds of several orders with amplitudes ranging from millimetres to kilometres. Several of the second order fold components have been named. After Belevtsev and Belevtsev, 1981, and from west to east, these major component folds are the Tarapako-Likhmanovakaya anticline, the Main Syncline and the Seksaganskaya anticline and syncline. The component fold structures tend to range from upright to slightly overturned. The larger folds have symmetrical hinges and asymmetric limbs. All folds are described as plunging gently northeast at 15 to 20 degrees. The western margin of the synclinorium is cut by a steep regional thrust fault or fault zone. This fault largely separates the Archean basement from the Krivbass Paleoproterozoic sequence and provides egress of meteoric fluids to weather the iron formation.

The Regional Geology is shown in Figure 7.1. The Archean basement comprises biotite and biotite-hornblende tonalite and microcline-plagioclase granite with relics of mafic volcanics and ultramafic rocks.

The Krivbass is filled with a folded sequence of Paleoproterozoic sedimentary rocks, including iron formation, clastic metasediments and remobilized basement as intrusions. The metasediment series is named the Kryvyi Rih Supergroup or Series, depending on source information.

Figure 7.1: Regional Geology



From bottom to top, this sequence consists of the Novokrivoirog (New Kryvyi Rih), Skelevat, Saksagan, Gdantsev and Gleevat Formations or Groups. Diabase dykes cut all older lithologies. The Krivbass regional stratigraphy, after Belevtsev and Belevtsev, 1981, and others is summarized in Table 7.1.

Table 7.1: Regional Stratigraphic Column

Cenozoic Limestone	
----------unconformity----------	
Microcline granites	
Diabase dykes	
Lower Proterozoic	
Gleevatskaya Formation (gl) OR Gleevat Group or Formation	Quartz-biotite schist and meta-sandstone
	Dolomite and dolomitized limestone
	Quartz-graphite schists, quartz-biotite-chlorite schist, meta-conglomerate and meta-sandstone
Gdantsevskaya Formation (gd) Gdantsev Group	Quartz-mica, quartz-chlorite, graphite schist
	Meta-sandstone, sandy shale, conglomerate, quartzite, magnetite-chlorite iron formation breccias
----------unconformity----------	
Saksaganskaya Formation (sx) OR Saksagan Group or Formation OR Saxagan Group	Up to seven ferruginous chert horizons or members 1f to 7f comprising amphibolite-magnetite-chlorite schists and in places martite (banded iron formation - japilites) separated by six members of amphibole-chlorite-biotite ±graphite-pyritic slate or schist designated 1s to 6s.
Skelevataya Formation (sk) OR Skelevat Group or Formation	Chlorite-talc schist, carbonate-talc, serpentine talc, sandstone conglomerate.
	Sericite-muscovite, mica staurolite phyllite
	Quartz-arkose meta-sandstone, conglomerate and quartzite

----------unconformity relicts of metamorphic residual soil ----------	
Archean	
Novokrivoroshskaya Formation (nk) Or New Kryvyi Rih Group	Biotite, hornblende, hornblende, epidote, amphibolite, biotite schist, meta-sandstone
	Meta-basite, and meta-ultrabasite, plagioclase granite and migmatite
Note: Belevtsev and Belevtsev, 1981 place an unconformity between the Saksagan and Skelevat but from other accounts (Kulik and Korzhnev, 1997) the relationship is conformable.	

The Saksagan sequence is the main iron formation host, although minor iron formation also is said to occur in the overlying Gdantsev sequence. The Saksagan lies conformably or unconformably on the underlying Skelevat sequence that contains talc schist (from WGM's observations on the Shymanivske Property, the relationship is conformable). The Saksagan or Saxagan sequence (depending on spelling and translation) contains up to seven horizons or members of ferruginous cherts (iron formation) named 1f to 7f separated by schist horizons, 1s to 5s (including the Formation or Group prefix: "sx" from Saxagan, the nomenclature is, for example: sx1f or sx2s). The schists range in composition from biotite to sericite-chlorite, sericite-amphibole-chlorite, graphite-sericite and carbonate. Contacts between members of the Saksagan are gradational. Not all members can be recognized through the extent of the Krivbass and all of the members are perhaps not strictly stratigraphic by usage. The total thickness of the Saksagan is said to be in the range of 1,200 m to 1,500 m. This entire thickness obviously does not prevail on the Property.

Multi-stages of metamorphism are described (Dagelaysky, 1993). The basement rocks are metamorphosed from epidote-amphibolite to granulite grade, while the Paleoproterozoic rocks are largely greenschist facies, but metamorphic grade increases northwards in the Krivbass, reaching amphibolite and granulite facies and leading to the remobilization and intrusion of granite bodies within the Paleoproterozoic sequence. A metamorphosed weathering crust has also been identified on the unconformity or regional-scale-fault zone between the Gdantsev and older Saksagan, adjacent to the contact with the Archean basement (Dagelaysky, 1993). This unconformity or fault zone is the site for the supergene iron-rich iron ore types produced from the taconites by alteration.

7.2 Property Geology

The Property geology appears analogous to the regional geology of the Krivbass in terms of both rock units and structure. However, several different structural interpretations are available for the Property, depending on the source of the interpretation and the drilling results available at the time the interpretation was made. The sources of historic interpretations for the Property are the 1985 and 1989 Soviet reports and the geological drill cross-sections and plans made during the course of these programs. No outcrop

is exposed on the Property, so all interpretation must be made from correlating the drilling and geophysical results. Superimposed scales of folding make interpretation from drillhole information difficult.

Most drilling has been close to vertical, with minimal assaying, and lithostratigraphic members are apparently compositionally indistinct. WGM has made its own geological interpretation, which differs markedly from the 1989 Soviet interpretation but is more similar to older Soviet interpretations and the regional interpretation. Figure 7.2 is a plan showing the current geological interpretation of the Property used for Black Iron's Mineral Resource estimate (Section 14 of this report) showing all drillholes known. Figure 7.3 and Figure 7.4 are, respectively, Abitibi Geophysics (Abitibi) magnetic and gravity surveys of the Property, as described under "Exploration," Section 9.2

The general structural alignment of rocks is NE-SW, parallel to the Krivbass, according to the interpretation of drilling results and surface geophysical surveys, notably the ground magnetic and gravity survey completed as part of Black Iron's 2011 exploration program. Similar to the regional context, the Krivbass Paleoproterozoic rocks, Skelevat to Gdantsev sequences, are deformed into a series of gently north-plunging sub-parallel first-order NE-SW folds, and have superimposed minor folding of multiple orders. The main fold components describe a tight to asymmetric anticline which, on the Property, includes the western part of the Paleoproterozoic sequence and a parallel trending open syncline that underlies the central and eastern parts of the Property. This large-scale structure is generally quite consistent from drill cross-section to cross-section, from SW to NE. The closure of the main open syncline is just SW of Cross-Section Line 1, as shown by drilling results and magnetics. To the NE, and perhaps not on the Property, but NE of the Property boundary, the Saksagan sequence rocks likely plunge below surface and are covered by Gdantsev metasediments. Drilling northeast of Cross Section 5 would be required to resolve this.

The oldest rocks on the Property are the Archean-age basement rocks intersected by historic drillholes on the northwestern part of the Property. None of Black Iron's drilling intersects these basement rocks, but they were drilled as part of historic programs. These rocks include granites with intercalated amphibolites that are part of the Novokrivoroshskaya or "New Kryvyi Rih" Group (nk). These rocks are cut by a series of NE-SW oriented steeply dipping to NW dipping faults. Eastwardly, the basement is succeeded by rocks of the younger Gdantsev Group. The Gdantsev rocks in fault, and/or unconformable contact with the older rocks, include quartz-biotite metasediments and perhaps minor iron formation. In some of the historic Soviet drillholes, intersections of "talc schist" are coded. In some interpretations they are correlative with rocks in the Skelevat sequence, but these may be chlorite schist, belonging to the Gdantsev or the New Krivoy Rog sequences, unrelated to the Skelevat.

Figure 7.2: Property Geology with Drillholes

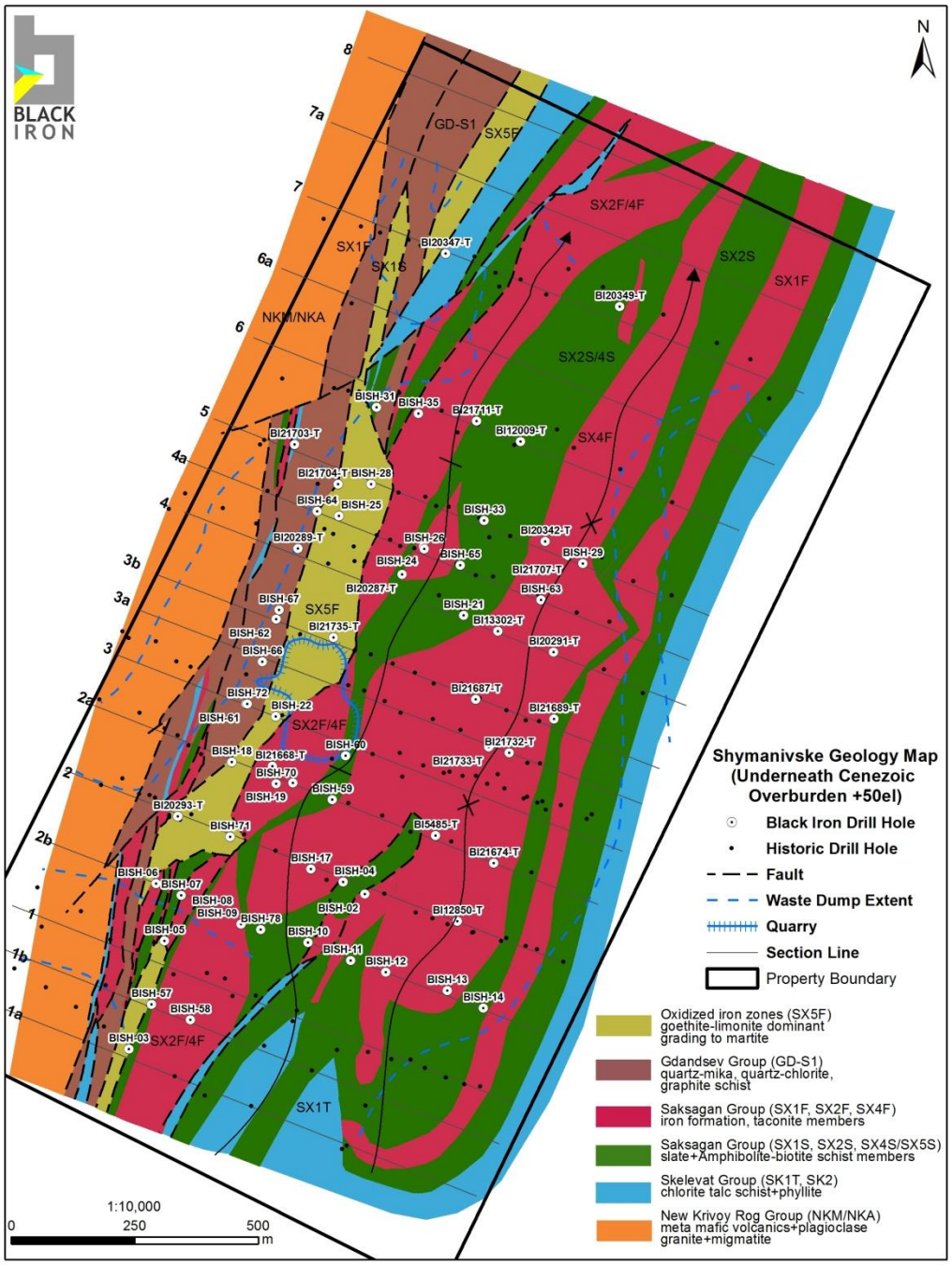


Figure 7.3: Total Magnetic Intensity Map after Abitibi Geophysics with Drillholes

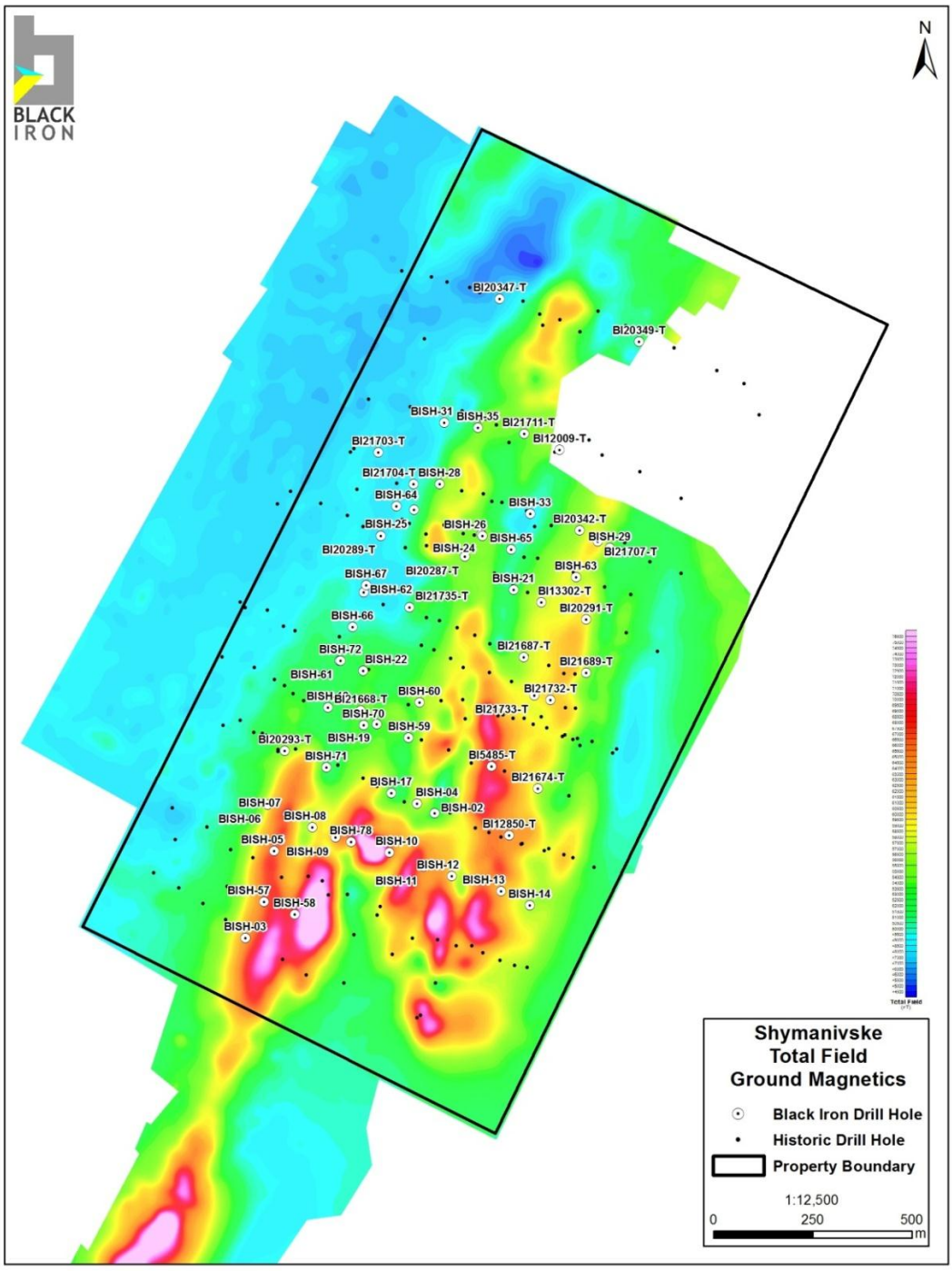
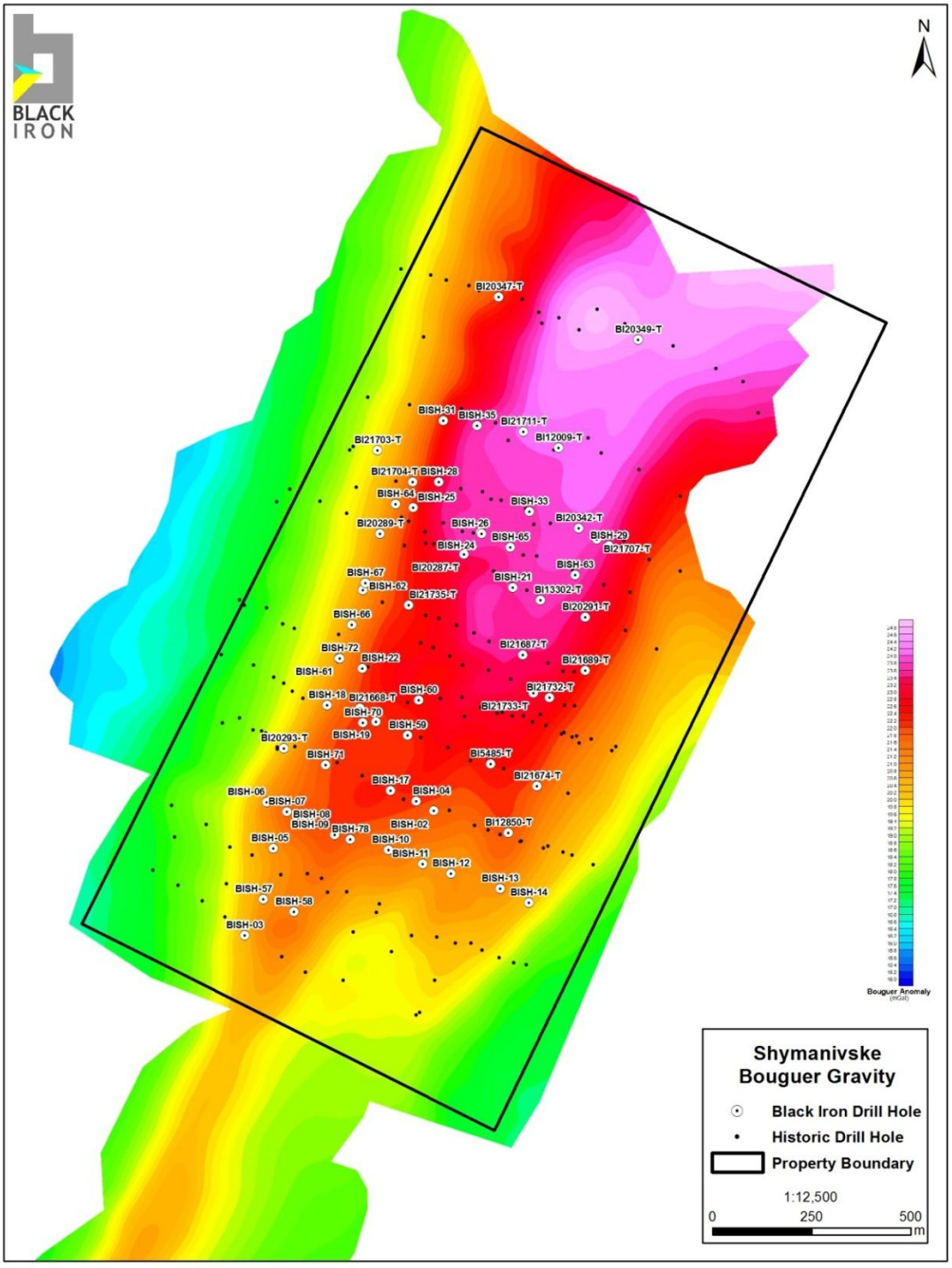


Figure 7.4: Residual Bouguer Gravity Survey Map after Abitibi Geophysics with Drillholes



The faulting has resulted in a complex *mélange*. The faults dip NW and are sub-concordant to the succeeding limbs of the older Saksagan sequence that contain the main taconite iron formation in a tight anticline and, to the SE, a more open syncline. In the central to eastern part of the Property, Saksagan members 1f and 2f, separated by the inter-slate member 2s, are clearly identifiable. In certain places these same members can be identified with some confidence in the anticlinal limb of the structure, but generally they cannot be identified and distinguished with certainty. The likely factors responsible for the difficulties in tracing these units include the tight folding and accompanying shearing, and perhaps some shifting of blocks attributable to the faulting, or even primary sedimentary thinning of members towards the edges of the basin. The Saksagan sequence rocks appear to lie conformably on, and are folded with, the Skelevat Group rocks and include phyllites and talc schist.

The location of the faults/unconformity along the contact between the Gdantsev and Saksagan sequences can often be recognized readily by the type of mineralization/alteration intersected and the drilling difficulties. Many of the historic drillholes that were collared from the granite basement on the western part of the Property to test the supergene iron mineralization situated along the Gdansev-Saksagan contact were terminated when little mineralization was encountered, or they were lost when the faults were intersected. Drillholes that did penetrate the fault zones at some depth below the surface often encountered martite mineralization, which replaced magnetite taconite in the Saksagan sequence adjacent to the contacts between the Gdantsev and Saksagan rocks. Nearer the surface, these drillholes encountered more goethite and limonite in place of martite, or martite and magnetite taconite, which made drilling and core recovery difficult.

A significant portion of the Property surface is covered by mine waste rock from the adjacent YUGOK mine. Comparison of the present topography, as determined by Abitibi Geophysics surveys in April 2011, with the historic Soviet cross- sections, shows this waste rock is up to 30 m thick in some areas. Below this there is a thin soil which overlies Cenozoic karsted fossiliferous limestone. The limestone is generally 10m to 25m thick and drapes the flat, lying to the rolling weathered Paleoproterozoic surface. The upper surface of the Paleoproterozoic rocks immediately under the limestone is weathered. Where the upper weathered surface is iron formation, the magnetite has often been oxidized and some or all of the magnetite, depending on depth, has been converted to goethite/limonite. In some places, iron enrichment that is caused by silica leaching occurs. Some of the weathered iron formation approaches the grade of Direct Shipping Ore (DSO). The strong weathering is generally restricted to a depth of less than 6m. This zone of sub-surface weathering thickens and merges with the fault zones or unconformity-controlled weathering and supergene iron enrichment, which exist on the western margin of the deposit along the Gdantsev-Saksagan contact. The oxidized iron layer can extend into areas not underlain by iron formation, and this material may be akin to canga.

Occasional narrow mafic dykes were intersected in some Black Iron drillholes.

7.3 Mineralization

7.3.1 General

Mineralization of economic interest on the Property is the oxide facies iron formation (OIF) or oxide facies banded iron formation and it is magnetite-rich taconite that contains minor hematite throughout. The Soviet literature commonly refers to this mineralization as “un oxidized ferriferous quartzite”. As mentioned above, concentrations of martite and goethite/limonite mineralization also occur on the Property. This latter type of mineralization is a weathering product derived from the taconite. In the Soviet literature, this type of mineralization is called “rich iron ore” or “oxidized quartzite mineralization.” This supergene enriched iron mineralization is commonly associated with the faults and fault zones, perhaps coincident with an unconformity that occurs along the western margin of the Shymanivske Deposit adjacent to the Archean basement. It has been suggested that this mineralization, rather than being controlled by faults and fluids running in the faults, is related to weathering on the paleo-surface between the Saksagan and Gdantsev sequences, which now constitute the unconformity. Also a layer of oxidized iron mineralization commonly lies along the upper surface of the taconite immediately under the Cenozoic cover rocks. It is usually no more than a few metres thick, but in some areas it is thicker. This mineralization was the target of early drill programs in the 1960s. In some places, this oxidized iron material is sufficiently enriched in iron and it approaches the commercial DSO grade.

The Novaya was an underground iron ore mine located immediately south of the Property, where high-grade oxidized iron mineralization was mined from the mid-1960s to 1989, when it flooded and was shutdown. Various underground workings and mines also operated on the Property along its northwest margin, but little is known about them because records are poor and all their shafts are now under layers of mine waste from the adjacent open pits. One of Black Iron’s drillholes was lost when it intersected an underground gallery in one of these mines.

Several underground iron mines are still operating in the Krivbass; however, only the magnetite-rich taconite on the Property is considered of immediate economic interest. WGM understands that under Ukrainian law martite mineralization, if not exploited, must be stockpiled for possible later use.

The iron formation on the Property is mainly confined to the Saksagan sequence and is folded into a NE gently plunging anticline (west part of the deposit) and an adjacent open syncline (central and east parts of the deposit). The taconite extends the entire NE-SW extent of the Property, 2.2km and beyond, and occurs over a width of 800m to 1km in a NW-SE direction. The taconite is folded and its true thickness varies throughout because of tectonic thickening, erosion and possibly the original basin topology. The true thickness of the iron formation package, including the intervening inter-oxide iron formation “slate” members, is in the order of 200m to 250m. Because of the folding, there is no consistent relationship between drillhole orientation and the true width of mineralization. Drill testing has been completed, generally to a vertical depth of 300m to 500m. Mineralization along the western margin of the deposit, particularly the steeply dipping NW limb of the main anticline, extends to unknown depth and has been tested by drilling to a maximum vertical depth of 500m.

The Saksagan ferruginous members (f-members) are in gradational contact with the "slate" members (s-members) of the group. No sharp contacts between these members are discernible and % Fe_{tot} and %Fe_{mag} grades are also gradational between these members. Small-scale folding likely contributes to the gradational affect. Maximum iron grade is often reached in the centre of the drillhole intersections in magnetite taconite (f) members, while minimum grade is reached in the middle of the "slate" intersections (s) members and the iron grade generally is smoothly progressive between these extremes. These slate members are mainly composed of amphibolite, with lesser amounts of chert and magnetite. Where the slate members contain more than 15% Fe, then the rock could be called silicate iron formation (SIF). SIF consists mainly of amphibole and chert, often associated with carbonate (often iron carbonate) and it can contain magnetite or hematite in minor amounts. According to historic records, the amphibole commonly associated with magnetite on the Shymanivske Property is cummingtonite, but Black Iron's mineralogical studies completed by SGS Lakefield (see below) have named the iron silicate grunerite. Wherever carbonate becomes more prevalent, the rock is named silicate-carbonate or carbonate-silicate iron formation, although infinite variations exist between the OIF and silicate-carbonate iron formation end members. Little carbonate iron formation appears to be present on the Property.

The lithological coding nomenclature used by GEORESOURCE for logging the Shymanivske drill cores consists of a stratigraphic component and a rock composition component. Black Iron and WGM have elected to minimize the stratigraphic part of the code because the company believes it isn't very reliable, particularly for the individual members of the Saksagan sequence rocks. The composition portion of the code is based on the proportion of iron oxide, silicate and chert in the rocks. The rock composition codes used for logging Black Iron's programs are summarized in Table 7.2. The composition codes are in reverse mineral prominence. For example, for the code QSM, which is code for Quartz - Silicate - Magnetite, magnetite is the most prominent mineral in the rock and quartz is the least prominent mineral.

Table 7.2: Rock/ Unit Coding for Shymanivske Drill Core Logging

Code	RockName	Comment	Formal Unit
LS	Limestone		Cenozoic
MaficDike	Mafic Dike		Upper Proterozoic
QC	Quartz-Carbonate rocks		Gdantsev Group
QHMR	Quartz Hematite Martite iron Ore	Oxidized IF	Saksagan Group
QH	Quartz-Hematite	Oxidized IF	Saksagan Group
QMH	Quartz-Magnetite-Hematite	Partially oxidized	Saksagan Group
QHM	Quartz-Hematite-Magnetite		Saksagan Group
QSHM	Quartz-Silicate-Hematite-Magnetite	Partially oxidized	Saksagan Group
QM	Quartz-Magnetite		Saksagan Group

Code	RockName	Comment	Formal Unit
QSM	Quartz-Silicate-Magnetite		Saksagan Group
QSMH	Quartz-Silicate-Magnetite-Hematite	Partially oxidized	Saksagan Group
QMS	Quartz-Magnetite-Silicate		Saksagan Group
QA	Quartz Amphibolite		Saksagan Group
QAS	Quartz Amphibolite Slate		Saksagan Group
QB	Quartz Biotite		Saksagan Group
QBS	Quartz Biotite Slate		Saksagan Group
QS	Quartz-Silicate		Saksagan Group
Slate	Slate		Saksagan Group
PS	Phyllite Schist		Skelevat Group
TS	Talc Schist		Skelevat Group

Twelve drill cross-sections oriented NW-SE approximately perpendicular to the general strike of the rocks are laid out at uneven intervals. The principal Cross-Sections, 1 to 7, vary from 200m to 500m apart and extend from the SW edge of the Property to its NE boundary. The cross-section nomenclature is historic. In places, there are intermediate cross-sections designated with a letter suffix, such as 1c or 3b. Cross-Section 1 or 1a is located towards the SW edge of the Shymanivske Property and is also the north-easternmost section of the Zelenivske magnetite deposit. Cross- Section 7 is towards the NE end of the Shymanivske Deposit and is also the south westernmost cross-section for ArcelorMittal's Kryvyi Rih Skelevatsky magnetite deposit–open-pit mine. Figure 7.5 and Figure 7.6 (Cross- Sections 2 and 5), located 800m apart along the strike of the deposit are two of these Shymanivske Deposit drill cross-sections selected to illustrate the description of geology and mineralization on the Property.

Figure 7.5: Shymanivske Deposit Cross Section 2

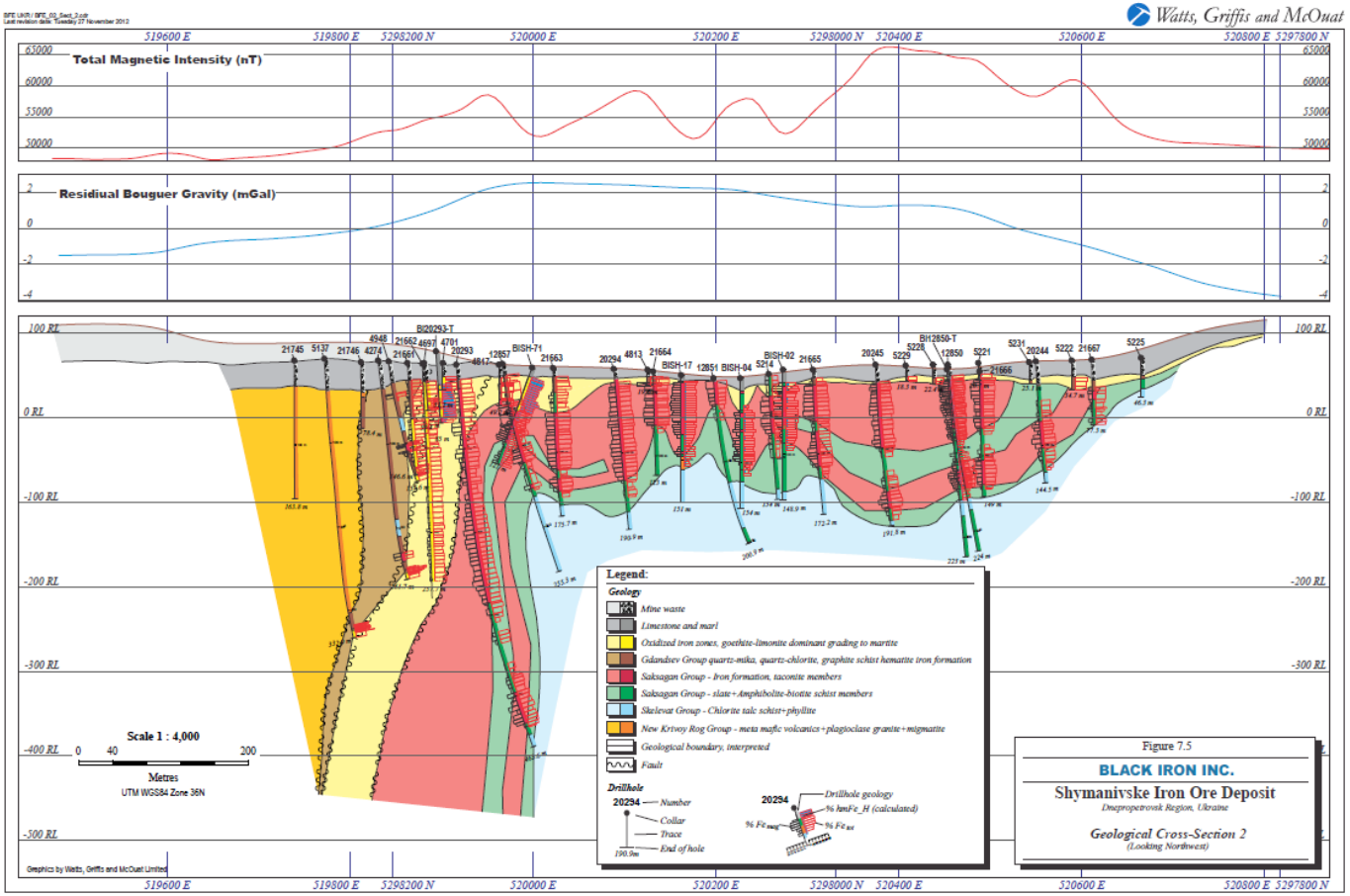


Figure 7.6: Shymanivske Deposit Cross Section 5

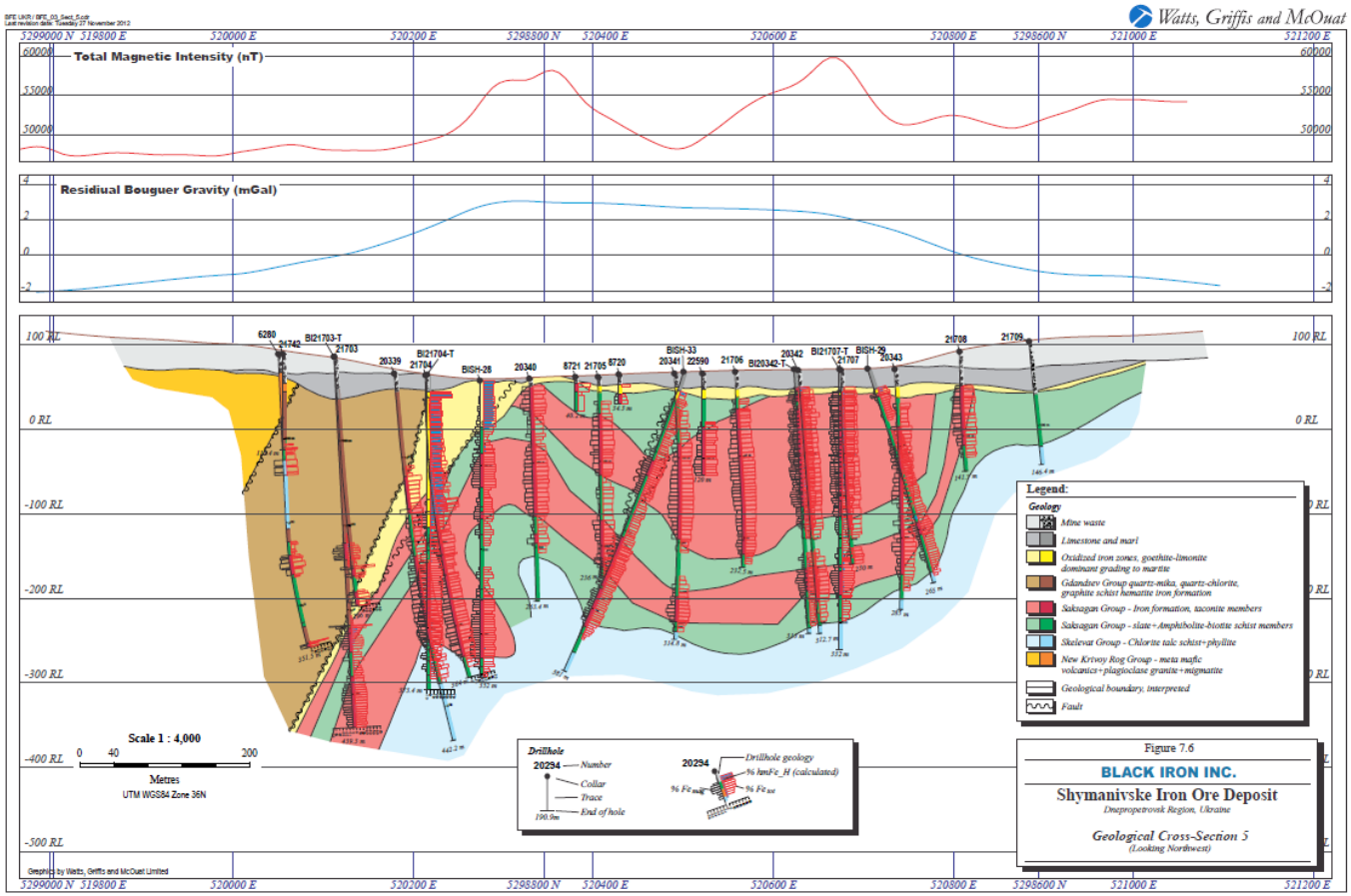


Figure 7.5 is Cross-Section 2, looking northeast. It shows the intense drilling density characteristic of the work completed, with many of the drillholes collared less than 50m apart along the section. The oldest drillholes are assumed to be the holes with four-digit numbers and are believed to represent the programs completed prior to 1965. Magnetic Fe was seldom determined in samples from these drillholes. The Fe_{mag} assays that are present may have been completed at a later date on archived drill core, but records are insufficiently detailed for certainty. There are two sets of these older drillholes (see Section 10, Drilling). The first set of holes tested the NW contact of the deposit. Drillholes, such as 5137, 4948 and 4274 (the westernmost holes on the section) were designed to explore for "rich-iron ores," (i.e., supergene mineralization along the lithological contact between Gdantsev and Saksagan rocks). Drilling these holes was stopped not far beyond the contact because the taconite mineralization was not of interest. The second set of pre-1965 drillholes are represented by drillholes 4813, 5229, 5228, 5231 and 5222, etc. Generally, these drillholes were drilled vertically and were very short. In many cases, drilling was stopped immediately after penetrating the supergene mineralization lying along, and immediately adjacent to the interface between the Cenozoic limestone and the Saksagan iron formation. A few of these drillholes were drilled further into the taconite to provide some information for evaluation. The remaining drillholes were drilled throughout the 1980s. Figure 7.6 also shows Black Iron's 2011 drillholes named BISH or BI#####-T (T for Twin).

The three westernmost drillholes (21745, 5137 and 21746) intersected Archean tonalite basement rock. Drillholes 5137 and 21746 below the basement intersected Gdantsev sequence metasediments in fault or unconformable contact with the basement. Drillholes 5137, 4274 and 4948 stopped in martite mineralization in the upper part of the iron formation sequence just below the Gdantsev rocks. Drillholes 21661, 21662 and Black Iron Twin drillhole BI20293-T intersected extensive martite mineralization beneath upper goethite/limonite. In drillhole BI20293-T, calculated Fe^{+++} (in this report, also designated %hmFe is coincident with oxidized iron mineralization. The martite defines a fault zone along the contact between the Gdantsev metasediments and Saksagan iron formation. Alternatively, part or all of this martite could represent a paleo-weathering surface, now an unconformity.

Many of the drillholes penetrated sufficiently deep to pass through the Saksagan iron formation to terminate in the underlying Skelevat Group rocks that include phyllite and characteristic talc schist. The Skelevat rocks, including their talc schist component, are folded together with the younger iron formation.

The general distribution of lithologies from drillhole intersections defines a western anticline fold with a steep SW limb (up against the Gdantsev and basement rocks), giving way to a more gently folded syncline centred approximately on drillholes 20245 or 5229. Several other lesser folds are indicated between the SW anticline and the NE gentle syncline.

Most of the iron formation, except for the martite mineralization, comprises magnetite, quartz and iron silicate. Fe_{mag} and Fe_{tot} grades are symmetrically distributed and correspond well with intervals logged as OIF. An intervening inter-iron formation "slate" horizon, which occurs towards the lower margin of the Saksagan sequence, is prominent. This member is likely 2s. For many drillholes, this member has not

been entirely sampled. % Fe_{tot} assays drop off in this rock type and %Fe_{mag} assays drop off more sharply that % Fe_{tot}. The principal and most persistent of the inter-iron formation sedimentary horizons is 2s, which can be traced across the entire cross- section and is in the range of 15 to 40m thick. Intense small-scale folding no doubt obscures refinement.

The magnetic and residual Bouguer gravity profiles from Abitibi's survey roughly map out the location of the concentrations of the iron formation and deposit.

Figure 7.6 is Section 5 looking northeast; 750m along general strike to the NE from Section 2 (see Figure 7.12 - Plan map). Despite being 750m from Cross-Section 2, the geology of Cross-Section 5 is similar to that of Cross-Section 2.

Mine waste covers the surface on both the NW and NE margins of the cross-section. Beneath the mine waste there is a layer of flat-lying Cenozoic limestone and marl. Beneath this layer, there is a thin horizon of limonite/goethite and this is the upper limit of the folded Proterozoic sequence of iron formation interlayered with slate. This thin hydroxide iron layer merges with the thicker martite mineralization on the NW margin of the deposit, which is thickest in drillholes BISH-28 and 21704. This mineralization shows up clearly as calculated hematitic Fe. In the older holes this mineralization is obvious from assays that show normal level Fe_{tot}, but minimal Fe_{mag} (magnetite oxidized to hematite/martite). The martite zone follows down the interface between the iron formation sequence and the Gdantsev metasediments. This interface is a fault zone or an unconformity, or a fault zone superimposed on an unconformity. The steep western margin of the deposit has not been well drilled. The Archean basement occurs further west of the NW margin of the cross-section, and it is in contact with the Gdansev sequence.

Because the fold structures plunge gently NE, both the tighter antiform on the NW edge of the deposit and the central gentle synforms are at lower elevation on Cross-Section 5 than on Cross-Section 2. The sx2s inter-iron formation sedimentary unit is still prominent within the gentle syncline, but it occurs at a lower elevation. Another inter-iron formation sedimentary unit that might be sx3s or sx4s occurs close to surface in the tops of drillholes BISH-033, 21706 and 21705. On the western margin of the deposit along the steep west dipping limb of the anticline, there is a sedimentary unit just below the martite mineralization. On Figure 7.6 this is correlated with sx2s, but may or may not be sx2s. If it is sx2s, then a thickness of iron formation along the Archean Proterozoic sequence has been eroded away with much of the remnant magnetite converted to martite and goethite/limonite.

The iron formation sequence is underlain by slates and talc schist of the Skelevat sequence, which are folded with the younger overlying metasediments.

7.3.2 Whole Rock Chemistry

MCM's assays grouped by rock type are shown on Table 7.3. SGS-Lakefield's Whole Rock ("WR") assays for WGM's independent samples are summarized in Table 7.4. The results from SGS-Lakefield are included here because they provide more complete assays than either the samples done at MCM or ALS, and are a more complete guide to the composition of mineralization and associated rock types.

On Tables 7.3 and 7.4 the potential "ore" lithologies are shaded, but the ore will also contain some other lithologies as the oxide iron formation members are interlayered with the metasedimentary units. These samples of potential ore have higher levels than other rock types of contained magnetite, indicated by $\%Fe_{mag}$ values. Variations designated with "H" and or "M" in their Lith Code also contains appreciable martite or goethite/limonite, as indicated by elevated calculated hmFe values.

The estimates of %Fe in the form of hematite, (%hmFe) or more correctly Fe^{+++} where goethite/limonite is present have been made by WGM. For all cases, the distribution of Fe^{++} and Fe^{+++} to magnetite was done assuming the iron in magnetite is 33.3% Fe^{++} and 66.6% Fe^{+++}. The estimation method also assumes that all iron in silicates, carbonates and sulphides is Fe^{++}. This assumption is generally believed to be substantially true for the Shymanivske Deposit, but this will not be known with certainty until detailed mineral chemistry is completed.

For the drill core samples from the field submitted to MCM, % Fe_{tot} was determined by wet chemical methods and by XRF at SGS-Lakefield (see Section 11-94). %FeOT at both labs was determined by titration and $\%Fe_{mag}$ using Saturization Magnetization Analysers. Hematitic Fe, where Fe_{mag} and FeO_H assays are available, was estimated by subtracting the iron in magnetite (assayed as Fe_{mag}) and the iron from the FeO analysis, in excess of what can be attributed to the iron in the magnetite from % Fe_{tot}, and then restating this excess iron as hematitic Fe, as below:

$$(1) \quad \%hmFe = \%\ Fe_{tot} - (Fe^{+++}{}_{(computed\ from\ Femag)} + Fe^{++}{}_{(computed\ from\ FeO)})$$

In practice, %OtherFe was computed as the first step in the calculation and %hmFe = % Fe_{tot} - ($\%Fe_{mag}$+%OtherFe), where %OtherFe is assumed to represent the Fe in sulphides, carbonates and/or silicates is the iron represented by Fe^{++} from FeO that is not in magnetite. Where Fe^{++} from magnetite exceeds Fe^{++} from %FeO, negative values can accrue.

Some of these magnetite taconites, such as those coded QMS or QSM, with the "S" being silicate, also contain appreciable silicate iron. P and Mn values are mainly low throughout all rock types averaging approximately 0.1 %.

The various inter-oxide iron formation metasedimentary rocks coded QA (quartz amphibolite), QAS (quartz amphibolite silicate), QB (quartz biotite), and QBS (quartz biotite slate) have elevated levels of Fe_{tot}, but low levels of Fe_{mag}, with most of the iron in OtherFe. These rocks also have elevated levels of aluminum befitting higher clay content and levels of sulphur much higher than in oxide iron formation.

The QC (quartz carbonate) code is used for rocks of the Gdantsev sequence. As shown by the results presented in both Tables, these rocks are more siliceous and have lower Fe_{tot} than Saksagan slates.

The TS (talc schist) rocks of the Skelevat Group have higher levels of MgO and chromium appropriate for ultramafic rocks.

Rock type designations from logging agree well in general with composition from assays.

7.3.3 Mineralogy Details

The magnetite-rich taconite iron formation on the Property consists mainly of semi-massive bands, or layers, and disseminations of magnetite containing very minor hematite (specularite), not readily visible, in re-crystallized chert[1] and interlayered with bands (beds) of chert with carbonate and iron silicates and amphibolitic slate.

[1] Soviet literature refers to this re-crystallized chert as quartzite

Table 7.3: Composition by Rock Type Based on MCM Assays

Lith Code	QC	QA	QAS	QB	QS	QBS	QH	QHM	QSMH	QSHM	QHMR	QMH	QSM	QM	QMS	TS	PS	Total
Count	19	5	233	3	70	126	55	117	3	2	4	38	1697	86	1392	15	4	**3869**
Avg Fe_{tot} (%)	7.01	17.32	19.15	12.67	19.45	15.83	37.25	35.94	31.73	35.15	49.08	33.51	32.92	33.38	26.99	8.65	20.23	
Avg Fe_{mag}(%)	1.1	1.1	2.0	1.3	2.4	1.3	2.2	1.8	7.4	9.5	15.0	9.7	20.6	22.5	8.7	0.8	3.3	
Avg hmFe (%)	4.86	1.47	2.84	0.27	2.01	2.27	34.06	33.39	18.55	19.13	32.55	20.67	2.28	3.05	2.45	0.85	2.30	
Avg OtherFe (%)	1.08	14.75	14.31	11.10	15.01	12.27	1.00	0.76	5.78	6.52	1.57	3.16	10.04	7.85	15.85	6.97	14.60	
Avg FeO (%)	1.83	19.44	19.26	14.83	20.34	16.33	2.23	1.74	10.60	12.45	8.43	8.21	21.73	19.72	24.12	9.32	20.20	
Avg SiO2 (%)	67.85	56.64	55.06	53.98	54.45	53.91	43.64	46.10	45.72	46.71	26.37	47.56	45.51	45.53	50.20	42.51	54.89	
Avg P (%)	0.05	0.06	0.06	0.05	0.07	0.06	0.03	0.03	0.06	0.10	0.03	0.05	0.09	0.08	0.08	0.02	0.08	
Avg S (%)	0.14	0.32	0.36	1.25	0.32	9.21	0.01	0.01	0.04	0.03	0.05	0.12	0.13	0.10	0.97	0.15	0.32	
Count of BDensity	0	0	9	0	3	5	3	9	0	0	0	2	102	6	68	0	0	**207**
Avg BDensity			2.88		2.82	2.85	3.43	3.25				3.10	3.33	3.32	3.18			
Count of SG	2	0	23	0	8	13	5	14	0	0	0	4	155	9	123	0	0	**356**
Avg SG	3.05		3.05		3.00	2.95	3.73	3.56				3.53	3.44	3.49	3.29			

Table 7.4: Composition by Rock Type Based on SGS-Lakefeild Assays For WGW Sample

Lith Code	QC	QAS	QBS	QS	slate	QH	QHM	QMH	QMS	QM	QSM	TS	Total
Count	1	5	5	2	3	3	2	2	36	6	48	2	115
Avg Fe_{tot} (%)	4.31	14.56	14.66	19.15	13.87	44.70	37.30	26.55	27.24	34.10	33.77	7.48	
Avg Fe_{mag} (%)	0.29	0.74	0.75	1.99	0.75	1.23	3.00	10.09	10.23	24.69	23.61	0.00	
Avg hmFe (%)	1.2	1.5	1.0	1.2	0.6	42.7	33.9	9.0	2.1	1.2	1.0	0.4	
Avg OtherFe (%)	2.9	12.3	12.9	16.0	12.6	0.8	0.4	7.4	15.0	8.3	9.1	7.1	
Avg FeO_T (%)	3.80	16.10	16.90	21.40	16.47	1.52	1.84	13.89	23.63	21.18	21.87	9.13	
Avg SiO2 (%)	68.80	57.46	57.74	55.40	52.83	34.56	46.55	50.80	50.25	44.97	44.79	41.40	
Avg Al2O3 (%)	13.70	10.77	10.06	8.26	9.67	1.00	0.18	4.44	4.21	1.68	1.82	7.25	
Avg MgO (%)	1.47	3.05	4.03	4.13	9.15	0.07	0.08	2.10	3.31	2.53	2.85	25.70	
Avg CaO (%)	0.05	0.42	0.63	0.46	2.66	0.03	0.03	0.56	0.90	1.08	1.21	3.21	
Avg Na2O (%)	0.09	0.25	1.48	0.18	0.16	0.01	0.01	0.09	0.11	0.08	0.11	0.08	
Avg K2O (%)	3.65	3.42	1.36	1.70	1.76	0.03	0.02	0.58	0.78	0.20	0.32	0.03	
Avg TiO2 (%)	1.13	0.28	0.32	0.23	0.25	0.02	0.01	0.11	0.11	0.05	0.05	0.27	
Avg P2O5 (%)	0.040	0.114	0.116	0.145	0.087	0.018	0.030	0.120	0.163	0.155	0.179	0.020	
Avg MnO (%)	0.030	0.122	0.068	0.095	0.170	0.005	0.005	0.105	0.120	0.087	0.091	0.135	
Avg Cr2O3 (%)	0.03	0.02	0.08	0.02	0.10	0.04	0.05	0.02	0.02	0.02	0.02	0.29	
Avg LOI (%)	4.77	3.17	3.19	2.24	3.66	0.38	0.40	3.54	1.37	0.08	0.35	10.55	
Avg S_T (%)	1.240	0.408	0.852	0.335	0.183	0.012	0.008	0.020	0.156	0.057	0.122	0.200	
Count Bulk Density	1	0	1	0	1	1	1	0	4	3	10	1	23
AvgOfBD	2.59		2.94		2.92	3.32	3.49		3.18	3.48	3.46	2.84	
Count SG	1	5	5	2	3	3	2	2	36	6	48	2	115
AvgOfSG	2.84	2.98	2.97	3.11	3.02	3.98	3.71	3.18	3.31	3.52	3.52	2.92	

Note: For more information on WGM's samples see Section 11-94 – Data Verification.

As a component of BBA's, 2011 PEA, a program of metallurgical work was undertaken (BBA, December 14, 2011 and SGS Canada Inc., January 9, 2012). This metallurgical testwork program included the selection of two bulk composite samples from mineralization intersected in Phase I (Twin Program) drillholes. Both composites were taken from the SE part of the deposit where modeling of mineralization is simpler. Composite 1 was taken to represent Saksagan iron formation, Member 2, (sx2f) and Composite 2 to represent the lower iron formation member or Saksagan Member 1 (sx1f). This work on the composites, as well as being aimed at achieving measurements of iron recovery, included mineralogical components, both optical (by MCM) and instrumental, QEMSCAN™ (by SGS-Lakefield).

It is not completely clear if the mineralization comprising Composite 1 is strictly sx2f or a merged unit of sx2f and sx3f or even includes some sx4f, but it is clear that along the SE part of the Property this mineralization forms a coherent, mappable lithological sub-unit. Similarly, the sx1f member along the southeast part of the Property also forms a coherent, mappable lithological sub-unit.

Table 7.5: Location Information for Metallurgical Composits 1 and 2

	Black Iron Twin Drillhole				Historic Equivalent		
Composite ID	**Drillhole**	**From (m)**	**To (m)**	**Length (m)**	**From (m)**	**To (m)**	**Length (m)**
1	BI20342-T	24.0	185.0	161	29.5	190.1	160.6
	BI21674-T	22.0	87.8	65.8	17.0	90.0	73.0
	BI5485-T	14.3	106.5	92.2	14.6	109.3	94.7
	BI21733-T	18.5	133.1	114.6	17.3	137.0	119.7
	Total			**433.6**			**448.0**
2	BI20342-T	237.0	271.0	34.0	233.0	275.0	42.0
	BI21674-T	128.0	152.0	24.0	129.0	156.0	27.0
	BI21733-T	161.5	185.3	23.8	Drillhole not sufficiently long		
	BI5485-T	173.5	201.0	27.5	Drillhole not sufficiently long		
	BI12850-T	114.0	142.5	28.5	116.0	148.0	32.0
	BI13302-T	216.5	260.0	43.5	210.0	264.0	54.0
	BI20291-T	205.0	231.0	26.0	186.5	231.5	45.0
	Total			**207.3**			**200.0**

Note 1: In the December 14, 2011 BBA report the meterage intervals for BI5485_T and BI21733_T are interchanged. It is unknown if the sample material that went for the test was also selected incorrectly or if this error is an error in the report.

The composites collected comprised two fractions: a -35-mesh (500 microns) portion, which was sub-sampled from the coarse assay rejects by MCM; and the coarser fraction, which was made up from selected drill core fragments. The finer fraction was used by MCM for mineralogical, Davis Tube and gravity table tests. Two, 2kg sub-samples of this fraction (one for each of the two composites) were forwarded to SGS-Lakefield for size-by-size assays and mineralogy by QEMSCAN™. These results are presented in SGS-Lakefield report 13219-001 Progress Report #1, dated January 10, 2012, and in BBA's December PEA report. MCM's results for mineralogy and testwork were provided to Black Iron as a series of spreadsheets in the fall of 2011.

The coarse material was picked by MCM personnel, under instruction from BBA, from the core trays containing the second half core (i.e., the remaining half drill core not sent for routine assay). MCM personnel selected a representative sample by picking periodic pieces of core from the designated sample intervals. A 30-kg sample of this coarse material for each composite was sent to SGS-Lakefield for Bond rod mill and ball mill grindability tests under BBA's auspices. Results for this program component are presented in BBA's 2011 PEA.

MCM was provided a list of samples. From each sample bag, after thoroughly mixing the contents, MCM extracted a portion of material. The sub-samples for each of the composites were combined and composites of required size were prepared by a process of successive cone and quartering. A representative sample was sent to its microscopy department for mineral identification and description. Another portion of each was subject to composition determination by a process of sequential chemical analysis. The results for the distribution of minerals and iron for Composites 1 and 2 are presented in Table 7.6 and Table 7.7. A portion of the composites was forwarded to SGS-Lakefield for further testwork. MCM also computed normative mineralogy, based on a sequence of selective digestions and chemical analysis. These results are shown in Table Table 7.8.

The mineral abundance as measured by QEMSCAN™ after SGS-Lakefield is presented in Table 7.9. No optical microscopy was included to differentiate the magnetite and hematite; instead, both phases are reported as "Fe-Oxides."

SGS-Lakefield found that both composites were predominantly composed of Fe-Oxides (30.9% and 26.4% in Composite #1 and Composite #2, respectively), quartz (28.4% and 31.8%) and Fe-silicates (23.8% and 20.9%) which were identified by X-Ray Diffraction as mainly grunerite. Micas/clays were present in both samples, especially in Composite #2, at 11.4%, compared to 5.75% in Composite #1. Pyroxene (3.61% and 2.56%), chlorite (2.54% and 2.68%), amphiboles (1.09% and 1.59%) and dolomite (1.39% and 0.60%) were also present, as well as apatite (0.23% and 0.24%). Both samples contained similar levels of pyrite (0.17% and 016%) and pyrrhotite (0.17% and 0.18%).

Table 7.6: Main Characterisitcs of Main Minerals in the Composite 1 Sample (after MCM 2011)

Minerals Designation	Shape of Grains and Aggregates	Grains and Aggregates Size, mm (dominant size)		Intergrowths with other Minerals
		Ore Layer and Mixed Metallic and Non-metallic Layer	Non-metallic Layer	
Magnetite	Irregular, (seldom) polygonal	- grains 0.02-0.09 (0.03-0.06); - aggregates 0.15- 0.36 (0.10-0.12)	- grains 0.006-0.036	with silicates, quartz, sulfides and Fe oxides
Ferric hydroxide	Irregular, filling-type	- aggregates 0.096-0.24 (0.12)		with silicates, carbonates, magnetite
Martite	Rim-type and acicular	- grains 0.003x0.036	-	with magnetite
Iron sulfides (pyrite, pyrrotine)	Isometric and crevice-like	- grains 0.012-0.060 (0.024-0.048); - aggregates 0.10-0.24	- grains 0.012-0.060 (0.024-0.048); - aggregates 0.12-4.0	with magnetite, silicates, quartz
Silicates: - cummingtonite (dominant mineral) - tremolite, actinolite - biotite - muscovite - chlorite	 - acicular - columnar - isometric - isometric - lamellate	- grains 0.010x 0.050-0.02x0.07 - -	- grains 0.008x0.320-0.032x1.2 (0.020x0.270) - grains 0.20x0.50-0.40x0.70 - grains 0.2-0.32 - grains 0.096-0.48 - grains 0.020-0.040	with magnetite, quartz

Table 7.7: Main Charateristics of Main Minerals in the Composite 2 Sample (After MCM 2011)

Minerals Designation	Shape of Grains and Aggregates	Grains and Aggregates Size, mm (dominant size)		Intergrowths with other Minerals
		Ore Layer and Mixed Metallic and Non-metallic Layer	Non-metallic Layer	
Magnetite	Irregular, (seldom) polygonal	- grains 0.025-0.084 (0.03-0.06); - aggregates 0.12- 0.54 (0.12-0.16)	- grains 0.006-0.025	with silicates, quartz, sulfides and hematite
Hematite	Irregular, plate-type	- grains 0.003x0.048-0,012x0,060 - aggregates 0.060x0.120-0,084x0,180	-	with magnetite, quartz and silicates
Martite	Irregular, polygonal	- grains 0,048-0,060 - aggregates 0,072-0,12	-	with magnetite, quartz and silicates
Iron sulfides (pyrite, pyrrotine)	Irregular, isometric and crevice-like	- grains 0,024-0,084 (0,024-0,048); - aggregates 0,12-0,32	- grains 0,024-0,084 (0.024-0.048); - aggregates 0,12-0,32	with magnetite, silicates, quartz
Silicates: - cummingtonite, cummingtonite turning into riebeckite (dominant mineral) - hornblende	- acicular - columnar	- grains 0,010x0,050-0,016x0,120 -	- grains 0,010x0,300-0,025x1,1 (0,025x0,280) - grains 0,04x0,16-0,045x0,025	with magnetite, quartz

Table 7.8: Mineral Composition of the Ore Composite Sample 1 and 2 Based on the Results of Phase Chemical Analysis (After MCM, 2011)

Size Fractions, mm	Mineral weight percent (M) and iron content therein (Fe), %															
	Magnetite		Hematite, martite/Fe-Hydroxides[1]		Carbonates		Silicates		Iron Sulphide				Quartz	Apatite	Total	
									Pyrite		Pyrrotine					
	M	Fe	M	Fe	M	Fe	M	Fe	M	Fe	M	Fe	M	M	M	Fe
Composite 1	27.9	20.2	7.5	4.5	4.3	1.2	33.4	7.16	0.11	0.05	0.14	0.09	26.15	0.5	100.0	33.2
Composite 2	25.0	18.1	4.7	3.3	2.12	0.9	41.74	9.17	0.07	0.03	0.17	0.10	25.7	0.5	100.0	31.6
Note: In Composite 1 MCM noted Fe-hydroxides but in Composite 2 the mineral phases and iron distribution values are for hematite-martite only.																

Table 7.9: Overall Mineral Abundance (after SGS Minerals Services)

% Mineral Mass	Composite 1	Composite 2
Calculated ESD Particle Size	23	21
Fe-Oxides	30.9	26.4
Fe-Silicate	23.8	20.9
Siderite	0.28	0.12
Calcite	0.45	0.32
Dolomite(Fe)	1.39	0.6
Mn-Oxide/Carbonate	0.02	0.01
Other Carbonates	0.2	0.05
Quartz	28.4	31.8
Plagioclase	0.33	0.41
K-Feldspar	0.03	0.03
Micas/Clays	5.75	11.4
Chlorite	2.54	2.68
Amphiboles	1.09	1.59
Pyroxene	3.61	2.56
Other Silicates	0.39	0.43
Pyrite	0.17	0.16
Pyrrhotite	0.17	0.18
Other Sulphides	0.02	0.01
Apatite	0.23	0.24
Other	0.14	0.2
Total	**100.00**	**100.00**

The elemental distributions within the different mineral phases were calculated with iExplorer. The distribution of Fe is presented in Table 7.10. Most of the Fe occurs in Fe-Oxides (68.2% and 65.1%) and Fe-silicates (22.4% and 20.4%). The other major carriers of Fe are micas/clays (3.30% and 8.50%) and pyroxene (2.98% and 2.50%). Pyrrhotite carries more Fe (0.32% and 0.39%) than pyrite (0.24% and 0.26%).

Table 7.10: Average Fe Deportment (after SGS)

Mineral	Composite 1	Composite 2
Fe-Oxides	68.2	65.1
Fe-Silicate	22.4	20.4
Siderite	0.42	0.21
Dolomite(Fe)	0.15	0.05
Other Carbonates	0.16	0.04
Micas/Clays	3.3	8.5
Chlorite	1.29	1.72
Amphiboles	0.39	0.43
Pyroxene	2.98	2.5
Other Silicates	0.07	0.13
Pyrite	0.24	0.26
Pyrrhotite	0.32	0.39
Other Sulphides	0.02	0.01
Other	0.15	0.29
Total	**100.00**	**100.00**

QEMSCAN™ does not have the ability to resolve hematite from magnetite. Consequently, it is not known how much of the iron in iron oxides is magnetite and how much is hematite and hydroxides.

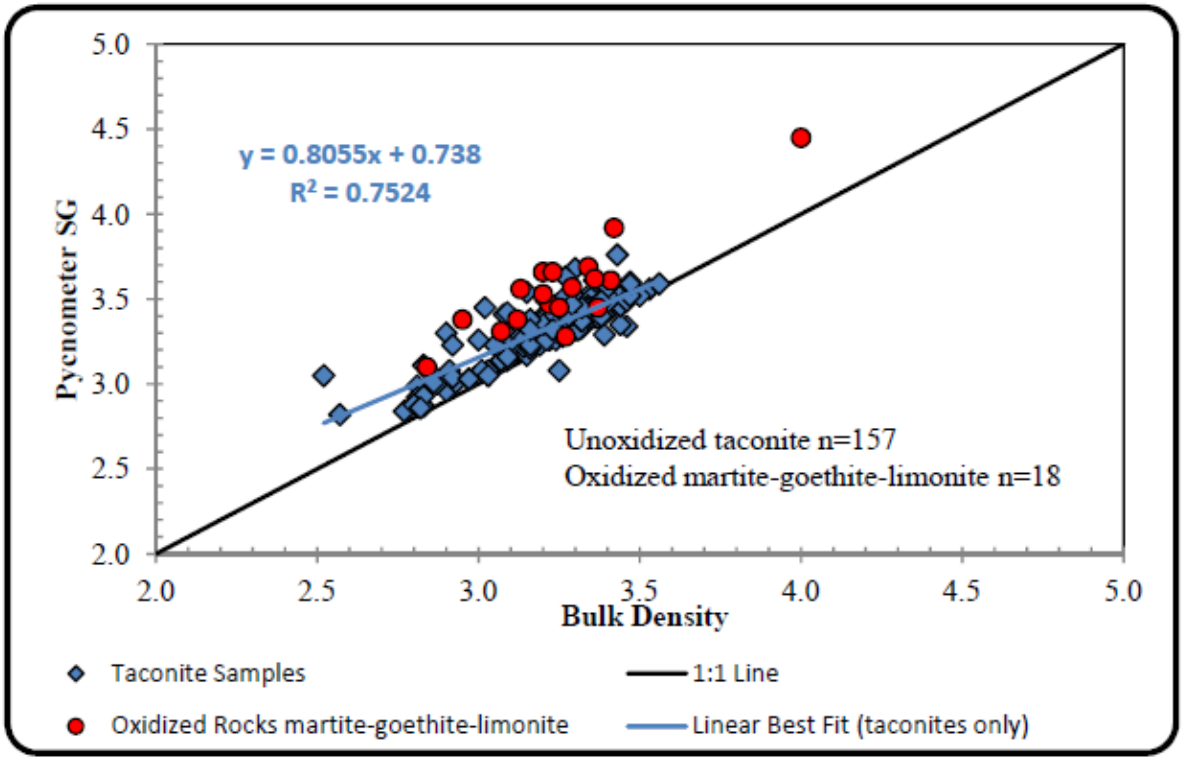
7.3.4 Density and Specific Gravity

MCM completed both bulk density and pycnometer specific gravity (SG) measurements on routine drill core samples submitted to the lab as part of the analytical package for Black Iron's 2011 drill programs. Sampling and assaying are described more completely in Section 11 of this report. The samples were selected on a periodic basis by GEORESOURCE to represent mineralization intersected in the drilling.

In addition, WGM collected samples for independent analysis to validate the work of Black Iron and GEORESOURCE. These samples were submitted by WGM to SGS-Lakefield for an analytical package that also included measurements of bulk density and SG. At SGS-Lakefield, bulk density measurements and pycnometer SG were determined on half-split drill core samples; pycnometer SG was determined on all of the pulp samples selected by WGM previously prepared by MCM. Results for these samples are found in Section12, "Data Verification".

At MCM, a total of 175 samples had both bulk density on spit core and pycnometer SG completed. Of these 175 samples, 157 samples are taconite while 18 samples contain substantial martite or goethite-limonite. On these figures, "substantial martite-goethite-limonite" is designated by samples with greater than 5% hmFe calculated. Figure 7.7 shows bulk density plotted against pycnometer SG.

Figure 7.7: SG vs. Bulk Density – MCM Determinations



SG pycnometer values are a little higher than bulk density values. This can occur and would be expected for the oxidized altered iron samples due to development of internal porosity, but would not be expected for dense fresh massive taconite. This result may thus point to a problem in instrument calibration, but this same pattern is shown in results for samples submitted by WGM to SGS-Lakefield (Section 12, Data Verification), so additional work is warranted to further address the issue.

During the course of Black Iron's drilling programs, 356 Routine samples were selected by GEORESOURCE for determination of SG by pycnometer. Figure 7.8 shows pycnometer SG plotted against % Fe_{tot} Heads; on Figure 7.9, SG is plotted against %Fe_{mag} Heads.

Also shown on Figure 7.9 is the polynomial best-fit trendline (orange) for the samples submitted to SGS-Lakefield from Section 12, "Data Verification." The black trendline is fit only to the taconite sample results from MCM.

Figure 7.10 and Figure 7.11 show MCM bulk density results for 206 samples.

Figure 7.8: SG vs. % Fe_{tot} – Determinations by MCM

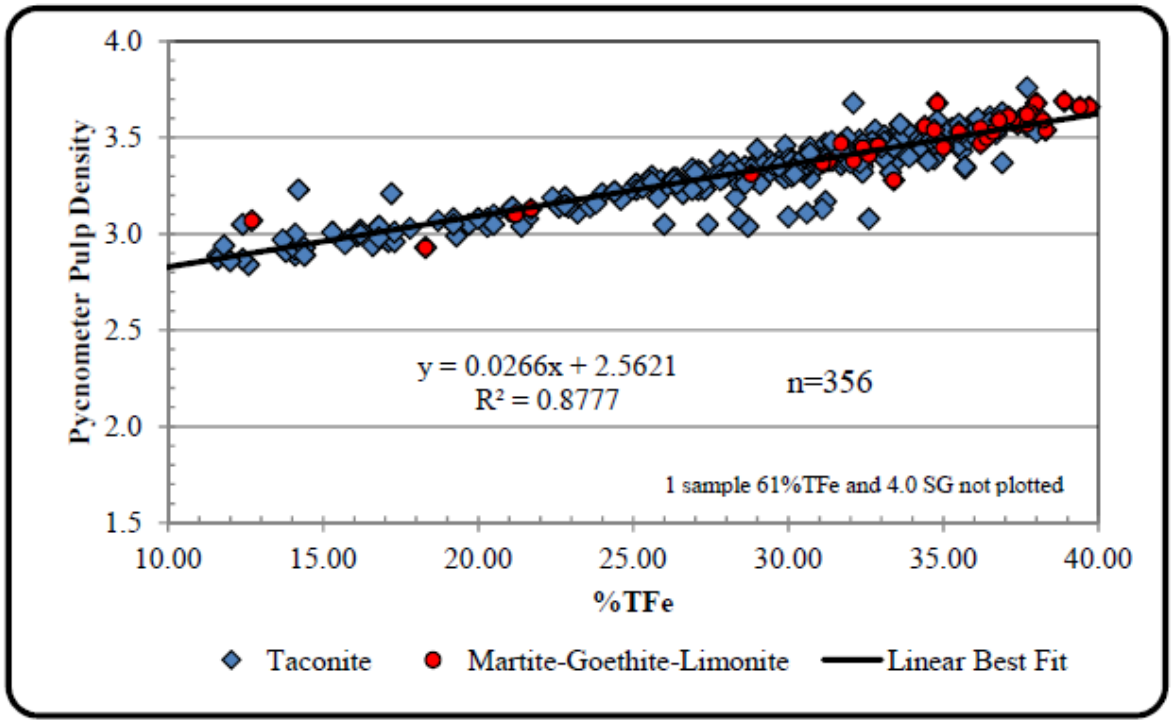


Figure 7.9: SG vs. %Fe_{mag} – Determinations by MCM

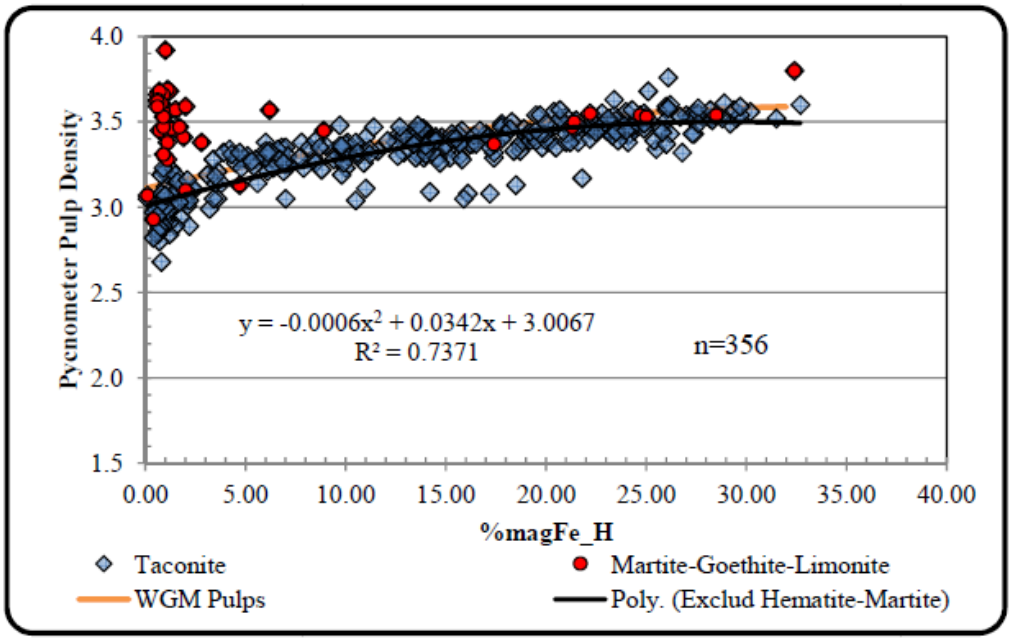


Figure 7.10: Bulk Density vs. % Fe_{tot} – Determinations by MCM

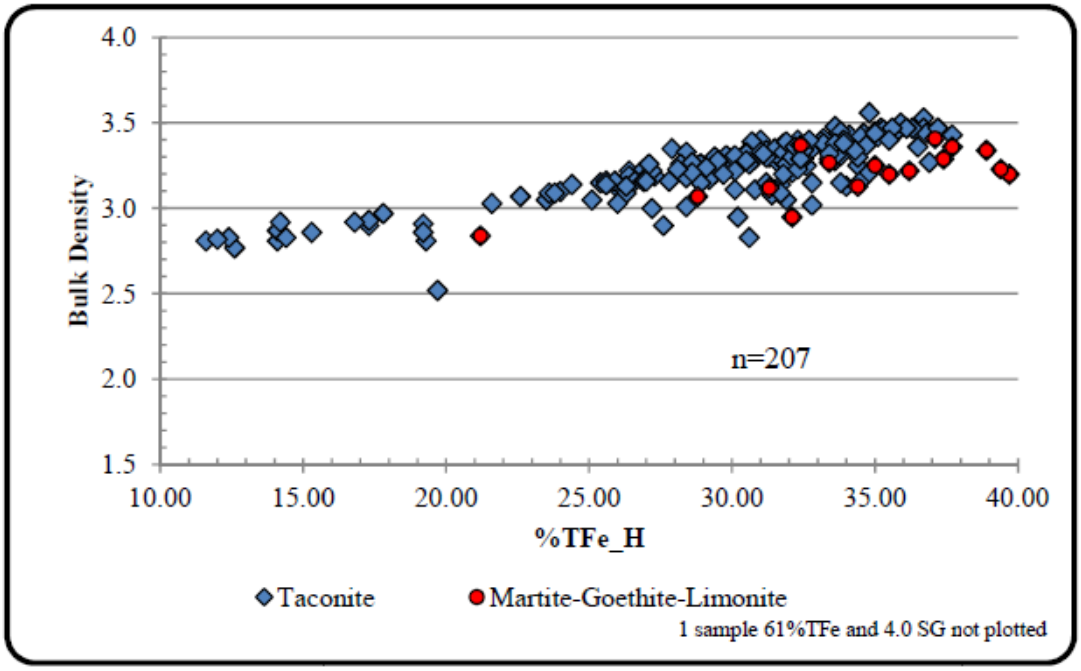
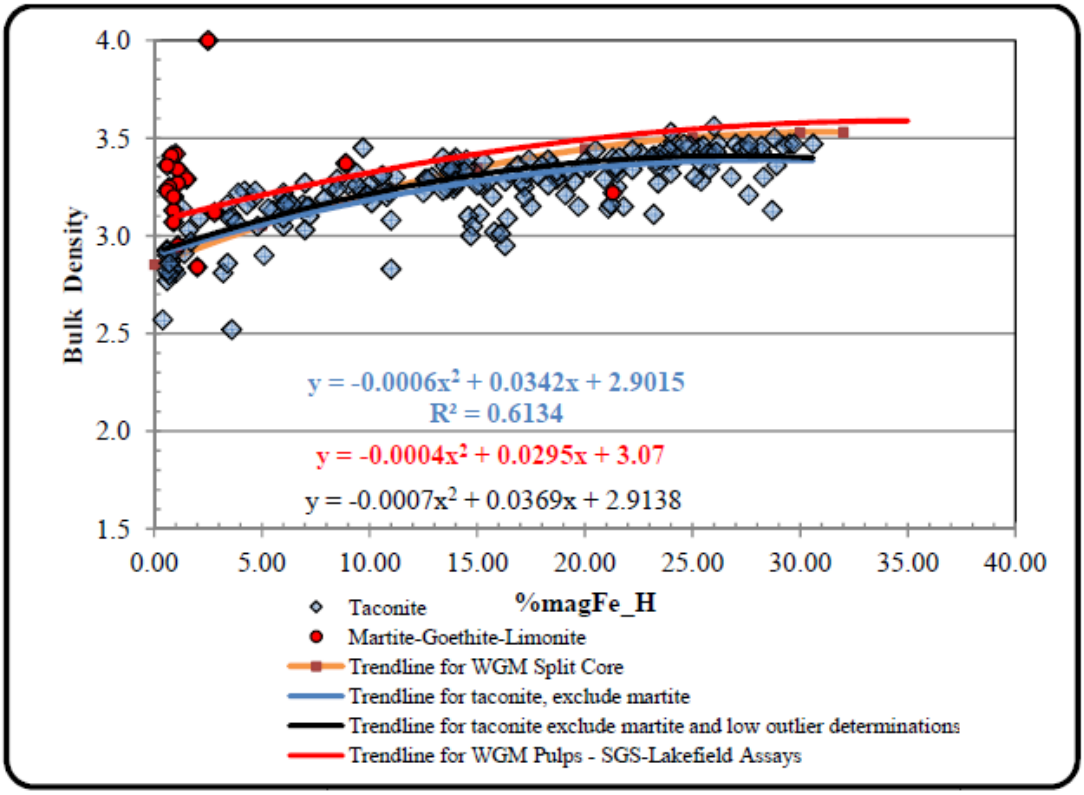


Figure 7.11: Bulk Density vs. %Fe_{mag} – Determinations by MCM



Four polynomial trendlines are shown on Figure 7.11. The blue is fit through all taconite samples (excluding the martite-goethite-limonite samples); the black trendline excludes 20 samples that plot below the main trend (the data points are still shown on the plot). These samples reported lower density than expected for the iron Head grades. WGM believes these samples have incorrect results (see Section 12, "Data Verification"). The red trendline (density = -0.0004*%Fe_{mag}^2 + 0.0278*%Fe_{mag} + 3.1089) is one based on WGM's pulp samples submitted to SGS-Lakefield, described in "Data Verification."

The red trendline was used for the Mineral Resource estimate, Section 14. It may be a little too high, however, its is WGM's understanding the Mineral Resources models were run with the other model lines for comparison and the difference was insignificant.

8 DEPOSIT TYPES

The iron formation on the Property is of the Lake Superior-type. This type of iron formation consists of banded sedimentary rocks composed principally of bands of iron oxides, magnetite and hematite within quartz or chert-rich rock with variable amounts of silicate, carbonate and sulphide lithofacies. Such iron formations have been the principal sources of iron throughout the world (Gross, 1996). Table 8.1 (after Eckstrand, editor, 1984) presents the salient characteristics of the Lake Superior-type iron deposit model.

Lithofacies that are not highly metamorphosed or altered by weathering and are fine grained are referred to as taconite. Taconite generally ranges in iron content from 15% to 45%. The ferruginous quartzite (meta-chert) horizons characteristic of the Saksagan sequence that comprise the majority of mineralization on the Property and are mined throughout the Krivbass are identified as magnetite taconite. In general, the Property and the Krivbass also hosts a certain amount of supergene: weathered oxidized taconite leading to martite-magnetite, martite and goethite/limonite – martite mineralization. In the historic interpretations, this mineralization on the Property has been mainly attributed to sxf5 unit, the fifth ferruginous horizon of the Saksagan Group associated with the regional NE-SW oriented fault zones that form the western margin of the Krivbass (see also the “Mineralization” section). WGM believes that for the Shymanivske Property, it is not clear that the martite mineralization actually belongs to sx5f, but may be lower down in the stratigraphy. WGM believes the main control on the location of the oxidized mineralization is the fault or uniformity interface between the Gdantsev and Saksagan, which may cross cut stratigraphy.

Supergene weathered taconite becomes enriched in iron through oxidation, the leaching of silica and the concentration of oxide iron. Strongly enriched variations of this type of material are often known as Direct Shipping Ores (DSO). Such mineralization was prevalent through the Krivbass, especially prior to WWII, but is still mined underground in the Krivbass today. The Novaya Mine, a former underground producer located just south of the Property, exploited this type of mineralization and a number of small underground mines were located on the Property, but little is known of them. Any surface evidence is covered now by mine waste but, according to hearsay, Soviet drillholes intersected some of these underground workings. One of Black Iron’s drillholes also intersected one and was terminated when it intersected the underground opening.

For non-supergene-enriched iron formation to be mined economically, oxide iron content must be sufficiently high, but also the iron oxides must be amenable to concentration (beneficiation) and the concentrates produced must be low in deleterious elements such as silica, aluminum, phosphorus, manganese, sulphur and alkalis. For bulk mining, the silicate and carbonate lithofacies and other rock types interbedded in general, within the iron formation must be sufficiently segregated from the iron oxides. Folding can be important for repeating iron formation and concentrating iron formation beds to create economic concentrations of iron.

Table 8.1: Deposit Model for Lake Superior Type Iron Formation (after Eckstrand, 1984)

	Fe (Mn)
Examples: **Canadian – Foreign**	Knob Lake, Wabush Lake and Mont-Wright areas, Que. and Lab. - Mesabi Range, Minnesota; Marquette Range, Michigan; Minas Gerais area, Brazil.
Importance	Canada: the major source of iron. World: the major source of iron.
Typical Grade, Tonnage	Up to billions of tonnes, at grades ranging from 15 to 45% Fe, averaging 30% Fe.
Geological Setting	Continental shelves and slopes possibly contemporaneous with offshore volcanic ridges. Principal development in middle Precambrian shelf sequences marginal to Archean cratons.
Host Rocks or Mineralized Rocks	Iron formations consist mainly of iron- and silica-rich beds; common varieties are taconite, itabirite, banded hematite quartzite, and jaspilite; composed of oxide, silicate and carbonate facies and may also include sulphide facies. Commonly intercalated with other shelf sediments: black
Associated Rocks	Bedded chert and chert breccia, dolomite, stromatolitic dolomite and chert, black shale, argillite, siltstone, quartzite, conglomerate, redbeds, tuff, lava, volcaniclastic rocks; metamorphic equivalents.
Form of Deposit, Distribution of Ore Minerals	Mineable deposits are sedimentary beds with cumulative thickness typically from 30 to 150 m and strike length of several kilometres. In many deposits, repetition of beds caused by isoclinal folding or thrust faulting has produced widths that are economically mineable. Ore mineral distribution is largely determined by primary sedimentary deposition. Granular and oolitic textures common.
Minerals: Principal Ore Minerals **- *Associated* Minerals**	Magnetite, hematite, goethite, pyrolusite, manganite, hollandite. - Finely laminated chert, quartz, Fe-silicates, Fe-carbonates and Fe-sulphides; primary or. metamorphic derivatives
Age, Host Rocks	Precambrian, predominantly early Proterozoic (2.4 to 1.9 Ga).
Age, Ore	Syngenetic, same age as host rocks. In Canada, major deformation during Hudsonian and, in places, Grenvillian orogenies produced mineable thicknesses of iron formation.
Genetic Model	A preferred model invokes chemical, collodial and possibly biochemical precipitates of iron and silica in euxinic to oxidizing environments, derived from hydrothermal effusive sources related to fracture systems and offshore volcanic activity. Deposition may be distal from effusive centres and hot spring activity. Other models derive silica and iron from deeply weathered land masses, or by leaching from euxinic sediments. Sedimentary reworking of beds is common. The greater development of Lake Superior-type iron formation in early Proterozoic time has been considered by some to be related to increased atmospheric oxygen content, resulting from biological evolution.
Ore Controls, Guides to Exploration	1. Distribution of iron formation is reasonably well known from aeromagnetic surveys. 2. Oxide facies is the most important, economically, of the iron formation facies. 3. Thick primary sections of iron formation are desirable. 4. Repetition of favourable beds by folding or faulting may be an essential factor in generating widths that are mineable (30 to 150 m). 5. Metamorphism increases grain size, improves metallurgical recovery. 6. Metamorphic mineral assemblages reflect the mineralogy of primary sedimentary facies. 7. Basin analysis and sedimentation modelling indicate controls for facies development, and help define location and distribution of different iron formation facies.
Author	G.A. Gross

9 EXPLORATION

9.1 General

For descriptions of exploration program results, WGM has relied solely on the basis of historic reports, notes and communications with Black Iron personnel and various other geophysical and geological contractors. Additional results and descriptions have been summarized in previous Technical Reports. Pre-2011, during the ramp-up to exploration, Black Iron commissioned Genivar to prepare a NI 43-101 report for the Property and to review and validate the historic Soviet mineral resource estimates. This work by Genivar in 2011 resulted in the definition of NI 43-101 compliant Mineral Resources for the Property, which is on file with SEDAR.

The historic exploration is summarized under the History section of the report. Black Iron initiated the exploration of the Property in 2011 and conducted Phase I and Phase II diamond-drilling programs. The drilling components are described in Section 10-78, “Drilling”. Black Iron’s programs also included ground magnetic, gravity surveys and satellite imaging to construct a digital topographic model for the Property and environs and complete the survey of known historic casings for validation of historic information.

9.2 Abitibi Geophysics GPS-Itegrated Magnetic Field and Ground Gravity Survey

On behalf of Black Iron, Abitibi Geophysics of Val d’Or, Quebec, performed a GPS-Integrated ground magnetic field and a ground gravity survey over the Property. The goal of this geophysical work was to improve the geological understanding of the Property and to delineate magnetic and gravity highs related to taconite and supergene iron mineralization.

From April 1 to April 25, 2011, a total of 72 line-km of magnetic surveying and 1,239 gravity readings with a 50 x 50 m nominal sampling were recorded using a GSM-19 Proton precession magnetometer and two CG-5u Autograv gravimeters (Scintrex), positioned in DGPS fashion using dual frequency Trimble systems R7 GNSS. Survey specification, instrumentation control, data acquisition and processing were, according to Abitibi, all successfully performed within its quality system framework.

The magnetic survey grid consists of 46 WNW-oriented cross lines, extending from L0+00 to L22+50N. The lines vary in length from about 0.55km to roughly 1.50km and are spaced as close as possible to 50m apart. The magnetic survey lines were accurately positioned, using the GPS guidance system integrated into the GSM-19 magnetometers. GPS readings were recorded every second. The magnetometer readings were corrected for diurnal variations, using readings from a synchronized mag-base station.

The gravity survey was completed with an expected Bouguer anomaly accuracy of better than 0.05 mGal (before terrain corrections). The survey is not tied to the Absolute Gravity Base Station Network (IAGBN)

of the Ukrainian government. A local base station (Shymanov #9999) located at the survey grid was established and used daily. Each survey loop began and ended with a reading at the Project base station. These readings were used to calculate the instrumental drift. The drift correction was then linearly applied to all the data contained within the loop. The Bouguer anomaly grid was calculated employing standard reductions using a mean crustal rock density value of 2.67 g/cm^3. To resolve (i.e., isolate or separate) the local gravity anomaly from the regional component, the upward continuation of the potential gravity field was implemented. For this purpose, a simple Fourier method was used to continue the Bouguer field upward to level 1200m. The residual anomaly was then generated in a straightforward way, by subtracting the regional field from the Bouguer grid.

Three-dimensional magnetic susceptibility and density-contrast models of the iron formation were built. Overall, the 3D inversions allowed the identification of a complex-shaped and rather large gravity and magnetic anomalies, reaching 4mGal and 1.5 SI, respectively.

Figure 7.3 (see “Geological and Mineralization”) includes Abitibi’s total magnetic field survey results while Figure 7.4 (also previously shown) shows Abitibi’s residual Bouguer gravity results.

9.3 Satellite Imaging and Topographic Model

Effigis Geosolutions (Effigis) of Montreal was contracted by Black Iron to generate a Digital Elevation Model (DEM) for a 100km^2 area covering the Property and environs.

The production of a DEM involves the extraction of elevation information using stereoscopic imagery from the American satellite WorldView-2. The satellite has a resolution of 50cm and can be programmed to acquire the sets of stereoscopic images, which are necessary for the extraction of elevation information covering the area of interest. For this project, the work was carried out on SOCET SET photogrammetric workstations. The absolute accuracy of the DEM was produced to reach 50 cm in X and Y and 1m in Z at CE90 (90% of cases). To obtain such results, ground control points (GCP) were used, with an accuracy of 25cm.

Effigis delivered the product as raw images and Geotiff with a 1m contour interval.

The information was used for site planning.

9.4 Search and Survey for Historical Drillhole Casings

GEORESOURCE was requested to search out and locate all possible drillhole casings on the Property that were not yet identified, in order to provide further validation of historic collar locations. WGM understands that a thorough search was never undertaken, but some of known historic casings were surveyed.

The surface survey contractor for the Project, TNT TPI LLC (TNT TPI) of Dnepropetrovsk, Ukraine, has provided coordinates for seven casings identified (see Table 9.1). No labels were found with the casings, and so absolutely positive identifications cannot be made. On the other hand, these casings are reasonably coincident with historic collars described in historic documents. Tentative identities for the casings are also listed in the Table. These drillholes all represent holes from the later Soviet programs. All but one of these, C5, is identified with drillholes for which historic Pulkovo 42 datum coordinates are available. The locations for each of the casings surveyed by TNT TPI are generally 4 to 8m offset from the coordinates listed for drillholes in the database, but not systematically in the same direction. It is possible that some of the differences may be attributable to data transformation inexactitudes.

Table 9.1: Historic Casings Surveyed by TNT TPI

ID	Probable Drillhole ID	Comment	Easting (WGS84, Zone 36N)	Northing (WGS84, Zone 36N	Elv (m)
C1	21724	~8m offset	5297570.24	520258.47	48.233
C2	20244	~1 m offset	5297913.908	520550.773	66.456
C3	20285	~8 m offset	5298244.665	520541.138	62.304
C4	20622	~2 m offset	5298608.959	520415.144	62.444
C5	21657	~4 m offset	5297798.353	520040.842	49.097
C6	21719	~4 m offset	5297635.945	519882.671	47.597
C7	21720	~4 m offset	5297596.835	519939.13	58.312

WGM knows of at least six other casings on the Property. Most of these were identified by GEORESOURCE prior to program start-up or during initial spotting of drillholes for the program. These other six casings have not been surveyed by TNT TPI. For further information about these casings, see Section 12, “Data Verification.”

In WGM’s opinion, the survey results for the casings support the validation of the historic drillhole collar locations. However, WGM still recommends that a thorough search be completed and all casings that are found be surveyed.

10 DRILLING

For descriptions of exploration program results, WGM has relied solely on historic reports, notes and communications with Black Iron personnel and various other geological contractors. Additional results and descriptions have been summarized in previous Technical Reports.

10.1 Historic Drilling

According to the records available, the historic drilling completed on the Property was done in several phases in the 1960s through 1989. These holes, drilled mostly steep to vertical, were placed along cross-sections generally oriented 111.5 degrees azimuth crossing the Property. The basic cross-section nomenclature comprises Sections 1 to 7, but some intermediate cross-sections, such as 2a and 2b, etc., also contribute. Based on available records, total historic drilling, including several twin drillholes, aggregates to approximately 40,772m in 217 drillholes, as tabulated in Appendix E. Black Iron is also aware that an additional series of at least 13 short drillholes (probably vertical) were drilled along a section approximately 300m northwest of Cross-Section 7, in the north part of the Property, but records are scant. These collars are, however, shown on the Soviet 1989 geological surface plan of the Property.

For most of the historic drilling, no drill logs or journals have been located. The few logs that have been acquired for the 1982 to 1984 drillholes are from the 1985 Soviet report on the Property. Good- quality plans showing the collar locations and cross-sections for all of the historic drillholes are available from the 1989 Soviet report (and earlier ones from the 1985 report). These plans show the collar locations, and the cross-sections show the traces of the drillholes in plan and down dip. One limitation of the plans is that they do not include any coordinate grids or topographic features for indexing their locations. Original Soviet lists of collar coordinates in Pulkovo 42 datum, Baltic elevation system, assumed to be the Gauss Kruger Zone 6 projection, are available for only the 1980, 2000, 2100, 2200 and 2300- series drillholes. Volumes attendant to the 1985 and 1989 Soviet reports include lists of sample assays and lithological coding.

GIC, as part of their work mandate for Oberon Coal, was to compile a digital database for all drilling. It is understood that GIC had the same list of Soviet-era collar coordinates that Black Iron has in its possession and it used this partial list, supplemented by the 1989 Soviet geological plan, to define collar locations for all drillholes known. It is understood that GIC also transformed each of the Pulkovo coordinates available for the drillholes that have coordinates into WGS84, Zone 36N UTM datum coordinates. Using interpolation and a best-fit method, GIC generated new WGS84, Zone 36N UTM coordinates for the collars with no historic Pulkovo coordinates. From the Soviet cross-sections and attendant traces of the drillholes on plan, GIC generated digital listings of collar and down-hole azimuth and dip information. From the cross-sections it also generated down-hole lithological codes--Tos and Froms—and acquired sample locations and assays from the various volumes containing lists of assays in

the 1989 report. This database is available and Black Iron, after some checking and minor revision, has used this database as the fundamental source of information for the historic drilling and the input into the Mineral Resource estimate.

From the core logs available for this period, it is known that many of the Soviet drillholes were drilled either at an azimuth of 107 degrees to 115 degrees, nominal 111.5 degrees, or the reverse orientation of 291.5 degrees. Most holes were drilled steeply with collar dips of 85 degrees to vertical. The drillhole diameter for the 1985 drillholes was 76mm. It is expected that the 1989 program drillholes were of similar diameter. It is unknown if the early drillholes were of similar diameter or smaller.

The logs available for the 1982 to 1984 program are of good quality. They provide rock description and lists of assays and include collar elevation, but do not report collar eastings and northings. They also include down-hole inclinations; infrequently, they report downhole azimuth, even when gyro surveys are known from other sources to have been completed. The logs also report rod diameter and drilling dates. Book 4, Appendix 38, of the 1989 Soviet report is a Table that summarizes collar and downhole azimuth, drillhole-inclination and downhole deviation for all project holes including older pre-1980, 4000, 5000, 6000 and 7000-series drillholes. Gyroscopic downhole surveys were completed for most of the drillholes, completed during the 1980s as were downhole geophysical surveys. Most of the pre-1980 drillholes had no down hole attitude surveys completed, but for a few of these older holes downhole azimuths were surveyed.

Many of the later Soviet drillholes had downhole attitude and geophysical surveys completed, while the earlier drillholes had no downhole surveys. This is generally appropriate and reasonable because these older drillholes were often vertical and short. The geophysical information for the 1985 and 1989 program drilling is compiled on cross-sections attached to the 1985 and 1989 reports. The downhole attitude surveys were completed by gyroscopic methods, as described in the text of the 1989 report. Similar to other early drillholes, they were targeted on the oxidized quartzite type of enriched iron mineralization.

The early drillholes were drilled mainly for exploring for enriched iron ore, either along the steep NW dipping lithological/fault/unconformity contact between the Gdantsev and Saksagan sequences, adjacent to the basement gneisses; and/or the uppermost parts of the Saksagan iron formation units immediately under the Cenozoic limestone cover. Many of these early holes were apparently terminated as they entered fresh taconite. Sampling and assaying for the historic holes is described in Section 11. It is known that many of the earliest drillholes were assayed only for Fe_{tot} and that Fe_{mag} was generally not determined. It is known that in addition to Fe_{tot} and Fe_{mag}, FeO_T was also determined in some of the drillholes. FeO_T assays are compiled in the 1985 logs, but are not listed in the assay compilation of the 1989 report, or in GIC's 2005 database, nor have they been added to Black Iron's database. The Soviet 1989 assay Tables do include tabulation of rock code and core recovery by sample. Composites of samples were assayed for additional elements.

There are a number of steeply dipping drillholes where no end-of-hole azimuths were reported in Appendix 38 of the 1989 Soviet report. In the 2005 database, these holes are often listed with an end-of-hole azimuth equivalent to their collar azimuth. WGM understands that there is no end-of-hole azimuth for these steep holes because the gyro instrument could not resolve azimuth where inclinations were so steep (i.e., close to vertical). Accordingly, WGM recommended to Black Iron that the drillholes with no end-of-hole azimuth (as shown in Appendix 38) were revised to have no azimuth and only vertical dips per conventional practice.

WGM presumes that the downhole dips posted in the 2005 database, and maintained in the current database, are largely interpolated between collar inclination and end-of-hole inclinations. This is because few of the available documents report incremental downhole inclinations. However, the 1985 logs do contain complete listings of downhole dips). WGM does not consider this matter serious.

WGM recommends that Black Iron, before mining commences, complete a search of the archives in Moscow for additional missing documentation, particularly the missing drill core logs, collar coordinates for the 4000, 5000, 6000 and 7000-series of drillholes (i.e., pre-1980) and any downhole orientation information for post-1980 drillholes.

WGM believes the data available is generally reliable, sufficiently complete and suitable to support a Mineral Resource estimate. However, as mentioned earlier, the company believes that additional documentation can likely be found to support the geotechnical database and that research and acquisition should continue to provide a more complete record.

10.2 Black Iron's 2011 Phase I – Twin Drilling Program

10.2.1 General

To date, Black Iron has conducted two drilling programs on the Property. The Twin Drilling Program also known as Phase I Drilling Program comprised 22 holes aggregating 6,041.8m. Immediately following this, the Phase II Drilling Program was initiated. It consisted of 48 holes aggregating 11,435m, including seven holes (totalling 695m) that were drilled to acquire larger diameter core for communition testwork. Total drilling thus aggregated 70 holes and 17,477m. The primary purpose of the Phase I program was to collect material for metallurgical testwork by drilling a selection of drillholes as close as possible and at similar attitude to historic locations. The secondary goal of the drilling program was to validate the historic drilling completed on the Property. The purpose of the Phase II program was to provide additional information to advance deposit interpretation to support an updated and upgraded categorized Mineral Resource estimate. Drillhole details for Black Iron's Phase I (Twin) and Phase II programs are summarized in Table 10.1.



Table 10.1: Drilling Summary – Black Iron's Phase I and II Programs

Drillhole ID	Easting	Northing	Elv	Azm	Dip	FDepth	Date Started	Date Finished
Phase I								
BI21674-T	520524.57	5298064.49	66.242		-90	190.00	28-Mar-11	21-Apr-11
BI20342-T	520629.26	5298716.63	71.054	109.00	-87	313.00	03-Apr-11	19-Apr-11
BI5485-T	520406.79	5298120.41	61.098		-90	196.00	07-Apr-11	20-Apr-11
BI21733-T	520514.98	5298299.71	63.194		-90	250.00	08-Apr-11	22-Apr-11
BI12850-T	520451.02	5297946.61	57.47	94.00	-84	223.00	12-Apr-11	02-May-11
BI13302-T	520533.00	5298534.13	65.7	114.00	-85	313.40	20-Apr-11	06-May-11
BI21711-T	520490.31	5298960.11	69.888		-90	430.00	22-Apr-11	10-May-11
BI20291-T	520645.54	5298491.83	68.247		-90	267.00	23-Apr-11	12-May-11
BI21704-T	520209.97	5298832.50	64.84		-90	373.40	23-Apr-11	15-May-11
BI21732-T	520555.74	5298288.42	62.862		-90	235.50	23-Apr-11	13-May-11
BI21689-T	520646.31	5298356.66	64.482	111.50	-87	200.00	01-May-11	12-May-11
BI20349-T	520779.22	5299192.58	80.282	107.00	-85	447.40	07-May-11	28-May-11
BI21707-T	520675.76	5298687.66	71.199		-90	332.00	09-May-11	23-May-11
BI20289-T	520128.40	5298702.38	66.065		-90	351.00	09-May-11	04-Jun-11
BI12009-T	520578.76	5298918.66	72.091		-90	330.00	12-May-11	26-May-11
BI21687-T	520488.15	5298396.44	64.058		-90	251.80	14-May-11	30-May-11
BI20287-T	520339.70	5298649.83	55.663	112.00	-87	283.00	16-May-11	10-Jun-11
BI21668-T	520076.60	5298260.86	66.512		-90	190.00	17-May-11	27-May-11
BI20347-T	520427.19	5299299.67	85.822		-90	266.00	26-May-11	23-Jun-11
BI21703-T	520121.82	5298912.54	85.927	111.50	-87	439.30	27-May-11	23-Jun-11
BI20293-T	519885.28	5298159.71	78.837	108.00	-86	85.00	28-May-11	18-Jun-11
BI21735-T	520200.75	5298521.56	67.364		-90	75.00	29-May-11	27-Jun-11
Subtotal Phase I		**22 Drillholes**				**6041.8m**		

Table10.1: Drilling Summary – Black Iron's Phase I and II Programs (continued)

Drillhole ID	Easting	Northing	Elv	Azm	Dip	FDepth	Date Started	Date Finished
Phase II								
BISH-02	520264.32	5298001.94	57.13		-90	154.00	16-Aug-11	23-Aug-11
BISH-03	519786.65	5297687.79	64.584	111.50	-75	220.50	08-Jul-11	29-Jul-11
BISH-04	520219.62	5298026.19	46.926		-90	154.00	25-Aug-11	31-Aug-11
BISH-05	519858.26	5297907.06	60.123	111.50	-80	466.00	20-Jun-11	05-Aug-11
BISH-06	519841.60	5298023.44	54.91	111.50	-80	527.00	17-Jul-11	15-Sep-11
BISH-07	519892.33	5297999.66	49.19	111.50	-80	337.00	19-Jun-11	17-Jul-11
BISH-08	519954.74	5297966.69	47.632	111.50	-80	202.00	12-Jun-11	18-Jun-11
BISH-09	520013.77	5297940.86	46.921		-90	247.00	25-Jun-11	11-Jul-11
BISH-10	520148.83	5297903.70	47.65		-90	212.00	01-Aug-11	08-Aug-11
BISH-11	520235.49	5297867.50	55.652		-90	151.40	12-Jun-11	24-Jun-11
BISH-12	520306.40	5297843.33	57.296		-90	136.50	25-Jun-11	06-Jul-11
BISH-13	520431.16	5297806.06	56.462		-90	35.30	03-Aug-11	
BISH-14	520503.74	5297770.53	63.248		-90	123.00	02-Jun-11	10-Jun-11
BISH-17	520155.02	5298053.04	50.541		-90	151.00	03-Sep-11	08-Sep-11
BISH-18	519994.80	5298269.32	65.12	111.50	-78	310.00	31-Oct-11	28-Nov-11
BISH-19	520117.95	5298227.03	64.094	111.50	-80	217.00	25-Jun-11	01-Aug-11
BISH-21	520463.57	5298566.65	64.73	291.50	-70	400.00	08-Aug-11	07-Sep-11
BISH-22	520083.57	5298361.84	68.947	111.50	-70	229.00	22-Jul-11	12-Aug-11
BISH-24	520382.41	5298705.86	62.4	291.50	-70	336.00	12-Aug-11	29-Aug-11
BISH-25	520211.38	5298767.97	65.069	111.00	-80	153.50	05-Jun-11	29-Jun-11
BISH-26	520384.55	5298701.54	62.616	111.50	-85	308.00	02-Jul-11	09-Aug-11
BISH-28	520276.44	5298832.86	57.697		-90	352.00	03-Oct-11	31-Oct-11
BISH-29	520705.30	5298671.82	71.746	111.50	-70	265.00	04-Aug-11	22-Aug-11
BISH-31	520287.60	5298988.37	60.079		-90	375.80	23-Oct-11	16-Nov-11
BISH-33	520505.42	5298758.42	68.11	291.50	-75	381.00	14-Jul-11	14-Sep-11
BISH-35	520372.78	5298975.39	65.853	111.50	-75	400.50	16-Sep-11	19-Oct-11
BISH-57	519832.53	5297778.28	62.149	111.50	-70	253.00	19-Sep-11	30-Sep-11
BISH-58	519910.66	5297747.42	56.431	111.50	-70	152.00	11-Sep-11	18-Sep-11
BISH-59	520198.22	5298192.95	61.033	111.50	-65	280.00	24-Aug-11	06-Sep-11
BISH-60	520225.30	5298282.09	63.111	111.50	-75	321.70	10-Sep-11	23-Sep-11
BISH-61	520023.89	5298387.06	69.421	111.50	-70	288.40	18-Sep-11	13-Oct-11

Drillhole ID	Easting	Northing	Elv	Azm	Dip	FDepth	Date Started	Date Finished
Phase II								
BISH-62	520084.22	5298559.31	68.687	111.50	-80	450.30	21-Sep-11	08-Nov-11
BISH-63	520620.55	5298597.69	69.22	111.50	-70	290.00	11-Sep-11	02-Oct-11
BISH-64	520167.74	5298777.15	66.004	111.50	-70	174.80	25-Sep-11	
BISH-65	520456.87	5298667.89	65.8	111.50	-75	332.00	31-Aug-11	16-Sep-11
BISH-66	520056.82	5298472.75	70.38	111.50	-85	43.00	11-Dec-11	
BISH-67	520090.69	5298577.51	68.69		-90	447.00	12-Nov-11	07-Dec-11
BISH-70	520084.77	5298225.15	65.176	291.50	-70	354.00	19-Nov-11	
BISH-71	519991.23	5298118.00	59.5	291.50	-70	121.00	12-Nov-11	
BISH-72	520026.39	5298386.75	69.42	291.50	-70	236.50	16-Nov-11	16-Dec-11
BISH-78	520053.20	5297929.90	48.8	111.50	-76	152.00	01-Dec-11	09-Dec-11
Subtotal Phase II		**41 Drillholes**				**10,740.2m**		
Bulk Sample Collection								
BISHHQ-1	520484.92	5298321.39	63.522		-90	150.00	27-Jul-11	09-Sep-11
BISHHQ-1a	520487.20	5298322.47	63.355		-90	134.70	11-Sep-11	26-Sep-11
BISHHQ-1b	520526.04	5298064.92	66.332		-90	94.00	27-Sep-11	12-Oct-11
BISHHQ-2	519906.01	5297837.80	59.795		-90	34.00	20-Oct-11	27-Oct-11
BISHHQ-2a	519912.64	5297820.95	59.175		-90	42.30	15-Oct-11	18-Oct-11
BISHHQ-2b	520080.60	5298259.47	66.39		-90	136.00	31-Oct-11	08-Dec-11
BISHHQ-2c	520081.04	5298245.88	65.813		-90	104.00	22-Nov-11	
Subtotal Bulk Sample		**7 Drillholes**				**695.0 m**		
Total Drilling		**70 Drillholes**				**17,477.0m**		

Notes: Coordinates are WGS 84 Zone 36N.

The initial drillhole selection and collar location planning for the Twin drillhole program was completed by SGS Geometallurgy, a division of SGS Canada Incorporated (SGS). Primary data for this review were derived from a drillhole database created by GIC in 2005. WGM reviewed SGS's drillhole selection and provided some revisions. GEORESOURCE subsequently made some further revisions, in consultation with Black Iron's representatives.

The original drillhole selection was not fully completed, but the majority of the selection was successfully completed. Reasons for non-completion mainly consisted of drilling difficulties in strongly weathered rock oxidized Iron mineralization along the northwest margin of the deposit. No drillholes were successfully completed through this style of mineralization. In addition, the locations for a couple of drillholes were revised due to local on-site conditions.

Drilling was carried out between early April and the end of November 2011 by drillers under contract to GEORESOURCE, 24 hours per day. The rigs were mainly mobile on wheels. The drills were equipped for drilling core of various irregular standards from 59mm to 96mm. The drilling nominally took place on a two-shifts-per-day basis, 20 hours per day, seven days per week. The number of drills working on the Property varied during the program. At times, up to seven rigs were at work or were located on the Property. The rig-geologists from GEORESOURCE supervised the drills ensuring that the drills were properly setup and properly aligned on the collar and foresight markers established by the surveyors.

Descriptions of mineralization and estimated true widths are discussed in this report in “Mineralization,” Section 7.3.

10.2.2 Black Iron 2011 Program Drill Hole Collar and Down-Hole Surveying

Drillhole collars were spotted prior to drilling by the Project surveyors TNT TPI. For the Phase I program, holes were staked out using DGPS. Later in Phase II, conventional transit was used. The surveyors also surveyed the foresights to be used for aligning the drills during set-up and for aligning the gyroscopic downhole attitude survey at termination of the holes. Drilling azimuths were established by lining up the drill visually on collar picket and foresight. Drill inclinations were established using an inclinometer on the drill head. Drill set-up was supervised by the rig-geologist.

After the holes were completed and the drill dismounted and moved off, the collar locations were again re-surveyed by TNT TPI and a picket planted to identify the drillhole. These final surveys are the coordinates listed in Table 10.1.

As well as surveying the collars of the Black Iron drillholes, the surveyors also surveyed the historical casings that had been located. This program component is described in Section 9.4

Downhole geophysical and gyroscopic attitude surveys were systematically performed by Pivnichgeologiya, a Ukrainian company under contract to GEORESOURCE. WGM understands that Pivnichgeologiya is certified according to ISO 9001: 2008 and ISO 14001: 2004. The downhole geophysical surveys included measurement of natural radioactivity (gamma ray survey), rock density (gamma-gamma survey using a cesium radioactive source), electrical conductivity, magnetic susceptibility, caliper and flowmeter. Almost all of the drillholes were surveyed.

The gamma-gamma rock density survey results were provided by Pivnichgeologiya as instrumental readings, but were not translated into density units. Pivnichgeologiya was requested to convert the data, but this work was not completed. Density values determined by the downhole surveys may be of value for estimating the tonnage for the martite mineralization and perhaps some of the goethite-limonite mineralization as laboratory measurements of bulk density/pycnometer SG completed to date for these types of mineralization may be misleading. The geophysical survey results provided by Pivnichgeologiya have not been compiled or used for the geological interpretation or Mineral Resource estimate and have not been reviewed by WGM.

The gyroscopic downhole azimuths and drillhole inclinations are used to establish the trace of the drillhole. Given that most of the drillholes were vertical, these surveys didn't provide much relevant information. Where deviations from vertical were less than four degrees, the instrument could not resolve azimuth. For the few non-vertical holes, the gyro surveys provide dip and azimuth.

After the holes were completed, they were reclaimed by cementing.

10.2.3 Results of the Twin Hole Drilling Program

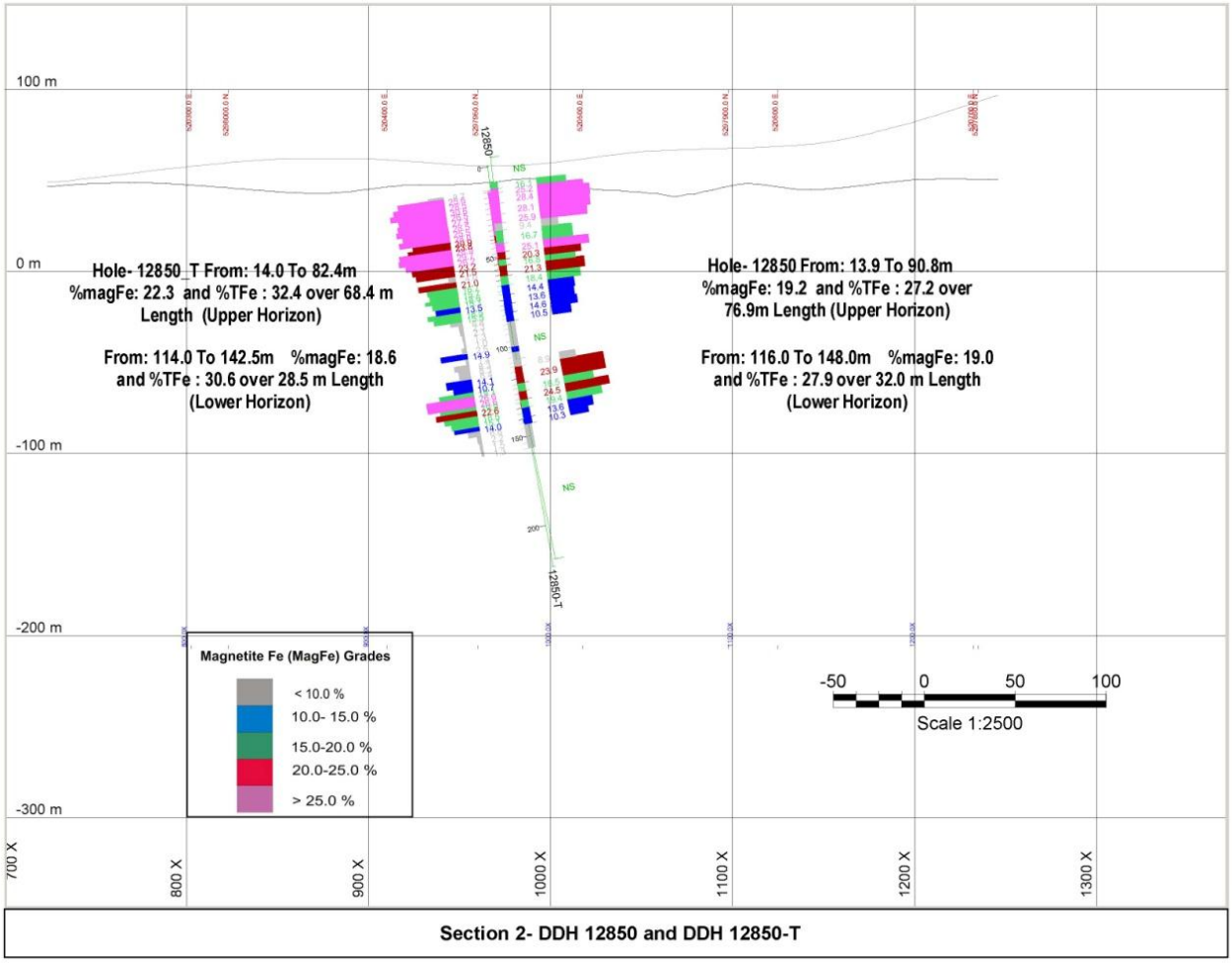
For most of the Twin holes, the positional relationship between the original historical collar and the new Twin collar is not precisely known. The exact positional relationship can only be determined for the historic holes where casings have been identified; otherwise, locational relationships must be inferred from historic database coordinates. For a few of the Twin hole locations, a historic casing or sump was located adjacent, providing some assurance of correct location. However, the number of Twin holes with a historic casing was small and no holes were labelled. WGM observed four or five of these historic casings (see Section 12, "Data Verification"). GEORESOURCE found an additional seven casings (see Section 9, "Exploration"), but none of these corresponds to historic holes that were twinned by Black Iron.

In all cases, these historic casings were within several metres (10m to 12m) of the location of the Twin hole collars, as spotted by TNT TPI. The various reasons for the known difference in location between the casings and the drillhole collar locations, as surveyed for the present program, are not known. The differences may be attributable to differences between traditional survey methods and datum or conversion errors from original datum. Also, the actual coordinates are not known for all the historic drillholes (see Section 10) and it is believed that, by capturing the locations from those shown on the Soviet plan maps and cross sections, GIC determined collar locations for these other holes for which Soviet coordinate lists are not available. Therefore, the lack of perfect coincidence between casing locations and database locations for some holes is probably partly due to small measuring errors from the Soviet plan maps.

Figure 10.1 to Figure 10.4 show selected Twin holes, compared against their corresponding historic drillholes with respect to geology and sample/assay results.

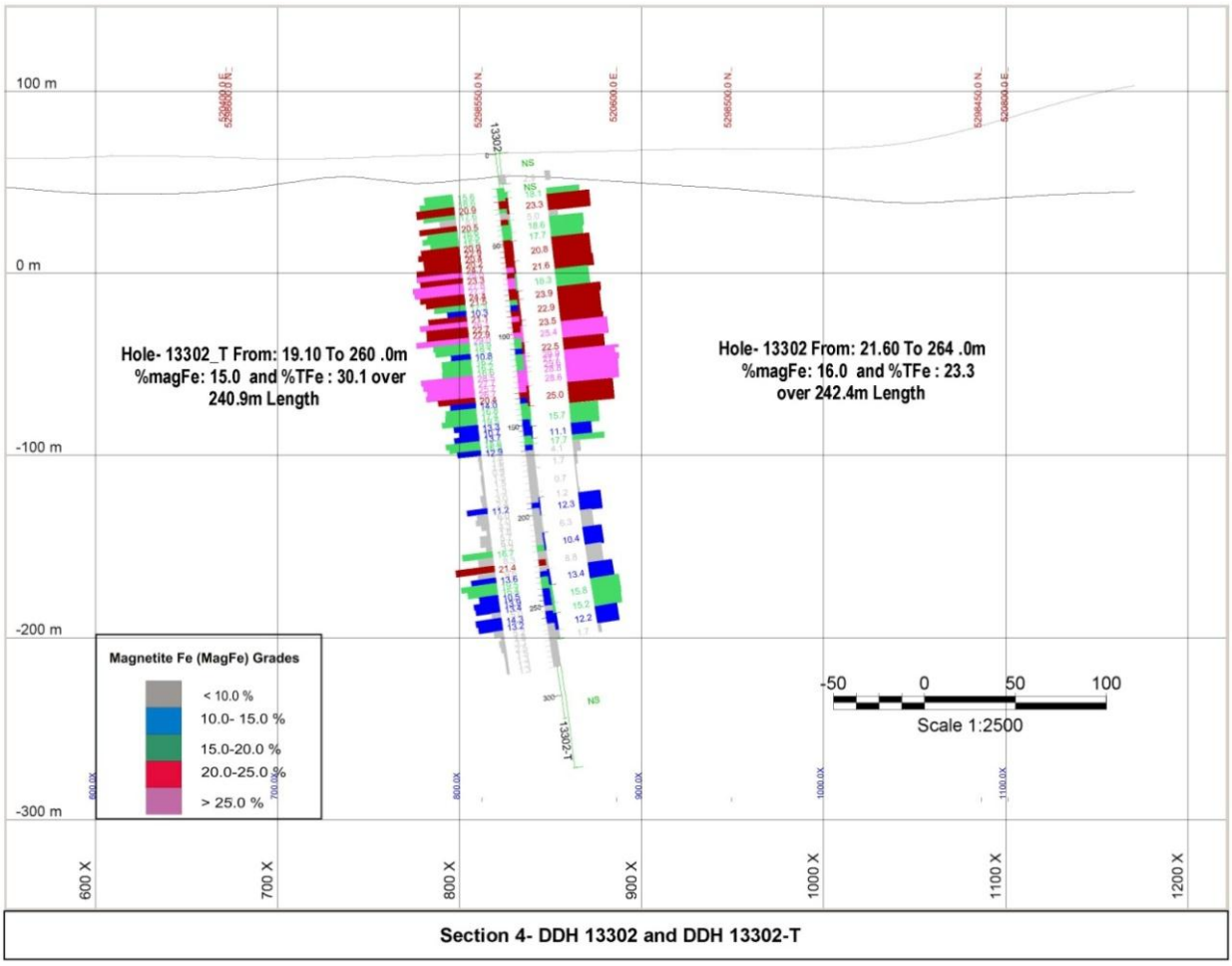
Each of the cross-sections show $\%Fe_{mag}$ assays as histograms down the drillholes with different colors based on grades. Also shown are composite averages (length weighted averages) for $\%\ Fe_{tot}$ and $\%Fe_{mag}$ over intersection length. The composite locations were selected to represent as best as possible the equivalent intervals in the Twin and historic drillholes, so that assay averages for close-to-equivalent material could be compared. In some cases, the locations were selected to calculate average grade for distinct units of OIF; in other cases, the assayed portions of nearly- whole holes are considered. In many cases, the limits on the composite intervals have been selected on the basis of a Fe_{mag} cutoff of 10%.

Figure 10.1: Twin Drillhole Comparison DDH 12850



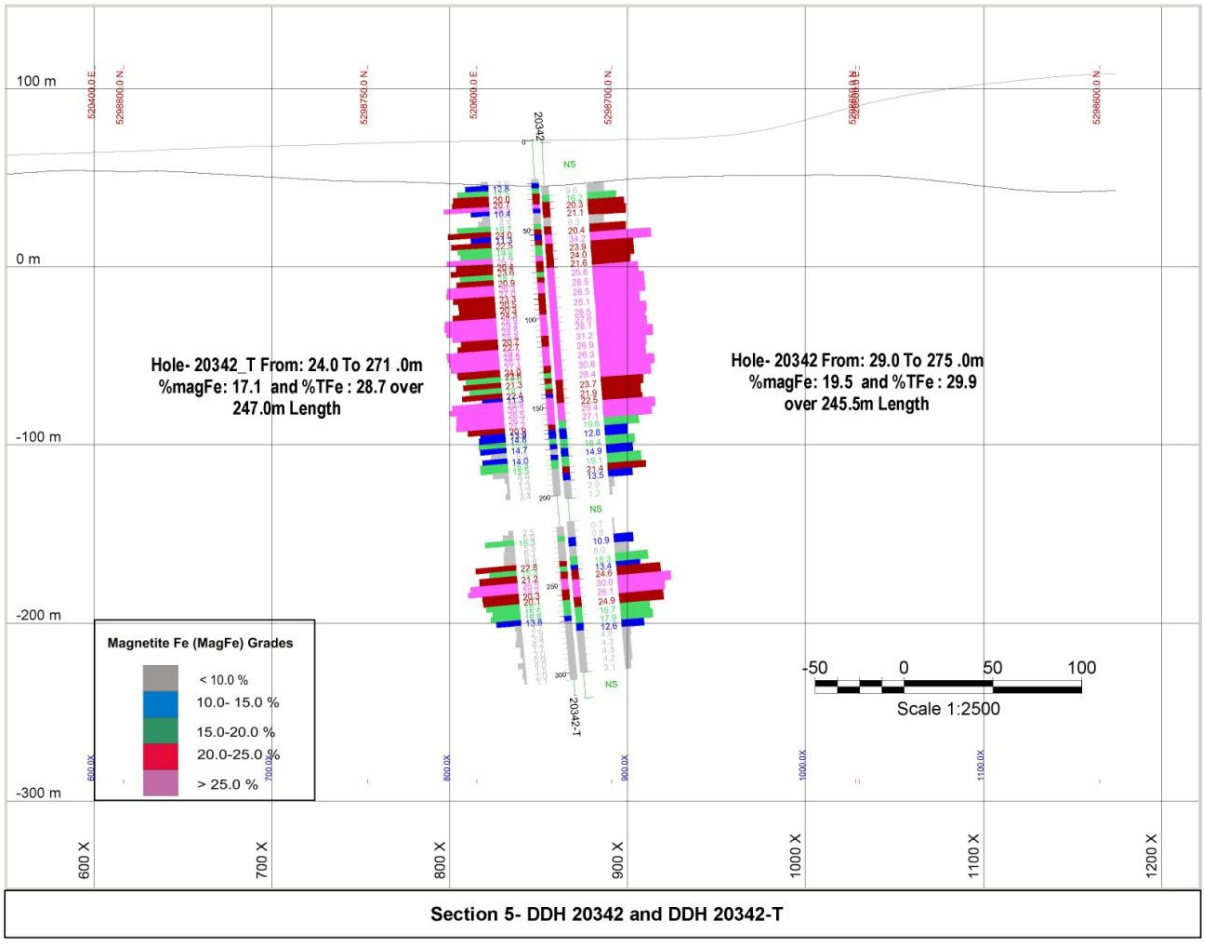
Section 2- DDH 12850 and DDH 12850-T

Figure 10.2: Twin Drillhole Comparison DDH 13302



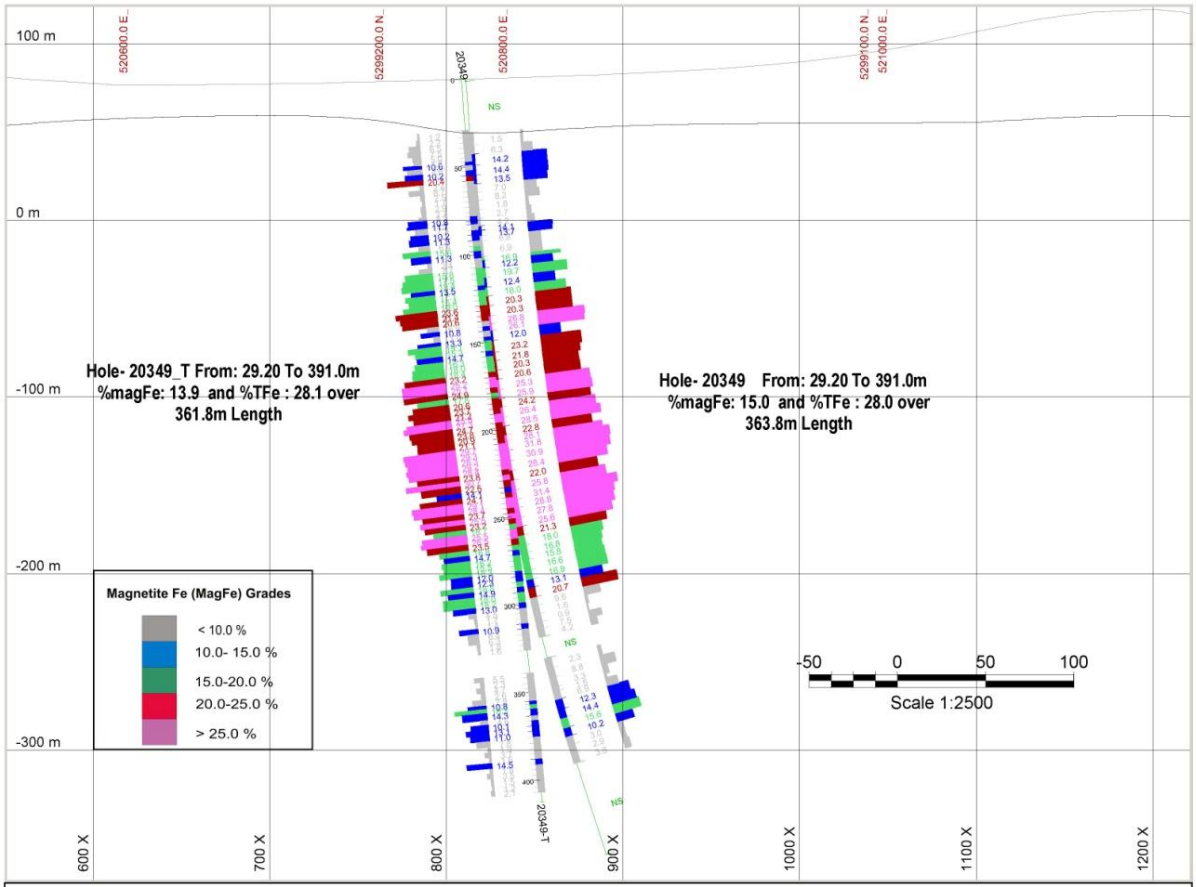
Section 4- DDH 13302 and DDH 13302-T

Figure 10.3: Twin Drillhole Comparison DDH 20342



Section 5- DDH 20342 and DDH 20342-T

Figure 10.4: Twin Drillhole Comparison DDH 20349



Section 7- DDH 20349 and DDH 20349-T

Usually, this approach was applicable because the general pattern of assay results between drillhole pairs was quite similar. However, the method was not completely objective and required some subjective licence. The overall aim was to provide minimally biased results, so that the analysis would be more effective at discerning significant differences. In WGM's opinion, selection bias was minimal and had a minimal effect on composite average assay. Table 10.2 summarizes sample assay results and composite averages for comparison.

Generally, agreement is very good with respect to intersected lithology and assays between Twin and historical drillholes. Also notable, as described in Section 7.3, "Mineralization," is the martite or strongly oxidized mineralization that often occurs immediately under the limestone cover. The calculated %hmFe spikes for this type of mineralization are caused by increased Fe^{+++}. The $\%Fe_{mag}$ decreases sharply due to the oxidization of any magnetite. For the "slate" intervals, where they have been sampled and assayed, $\%\ Fe_{tot}$ often decreases only slightly compared with the OIF intervals, but $\%Fe_{mag}$ decreases much more considerably. In these intervals, the iron is hosted largely in silicates.

Although the patterns of highs and lows in assays are very similar between historic and the Twin drillholes, certain assay biases appear to be present. For certain historic drillholes, $\%\ Fe_{tot}$ appears to be significantly biased low (drillholes 13302 and 12009). Figure 10.5 is a plot of Fe_{mag} versus Fe_{tot} for Twin and historic samples for the drillholes that were twinned by Black Iron. For most samples, the ratio of Fe_{mag} to Fe_{tot} is similar. However, a population of samples does not correspond, as indicated by the oval. These largely represent samples from drillholes 5485, 13302 and 12009. These two latter drillholes are holes where Fe_{tot} is biased low. An observation of a similar plot of all historic samples shows many more samples that are similar. WGM can't be sure if these are all because Fe_{tot} is low or if Fe_{mag} is too high. It would have been helpful if drilling dates for each of the historic drillholes were available, so that drilling by campaign could be determined. This might make it possible to determine which historic drillholes or campaigns had low-biased assays. However, very few of the historic drill core logs are available to allow for this analysis.

Figure 10.5: $\%Fe_{mag}$ vs. $\%\ Fe_{tot}$ in Historic and Twin Drillhole

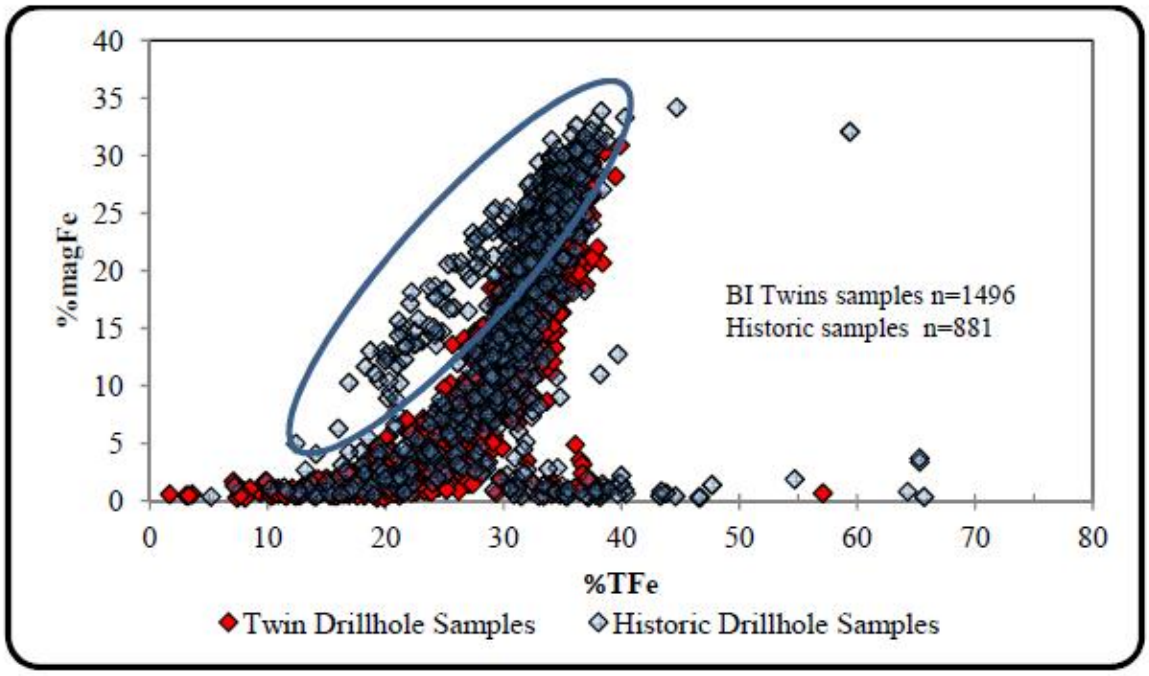


Table 10.2: Summary of Comparison Between Historic and Black Iron Twin Drillholes

Drillhole Pair	Section	Zone	Historic from(m)	Historic to(m)	Twin from(m)	Twin to(m)	Historic % Fe_{tot}	Twin % Fe_{tot}	Difference % Fe_{tot}	Historic % Fe_{tot}	Twin % Fe_{tot}	Difference % Fe_{tot}	Historic %Fe_{mag}	Twin %Fe_{mag}	Difference %Fe_{mag}	Historic %Fe_{mag}	Twin %Fe_{mag}	Difference %Fe_{mag}	Historic Length	Twin Length	Comment
							wt avg	wt avg	wt avg	Med	Med	Med	wt avg	wt avg	wt avg	Med	Med	Med	(m)	(m)	
12850	2	UIF	13.90	90.75	14.00	82.40	27.2	32.4	5.2	27.00	33.3	6.3	19.2	22.3	3.1	17.6	23.5	5.9	76.85	68.4	Composite limits based on 10% Fe_{mag} cutoff.
12850	2	LIF	116.00	148.00	114.00	142.50	27.9	30.6	2.7	27.1	30.6	3.5	19.0	18.6	-0.4	17.9	18.8	-0.9	32	28.5	Composite limits based on 10% Fe_{mag} cutoff.
20293	2																				No comparison completed.
21674	2A	UIF	17.00	90.00	22.00	87.80	33.2	32.1	-1.1	33.2	31.8	-1.4	20.1	20.5	0.4	18.7	20.2	-1.5	73	65.8	Composite limits based on 10% Fe_{mag} cutoff.
21674	2A	LIF	129.00	156.00	128.00	152.00	31.8	31.4	-0.4	31.4	31.7	0.3	19.1	20.5	1.4	18.6	21.9	3.3	27	24	Composite limits based on 10% Fe_{mag} cutoff.
5485	2A	UIF	14.60	109.80	14.30	106.50	28.5	32.1	3.6	30.2	31.2	1.0	21.0	21.7	0.7	23.3	19.9	-3.4	95.2	92.2	
21668	2A		20.10	160.00	22.00	163.00	30.1	29.6	-0.5	30.7	30.8	0.1	15.1	15.1	0	16.1	15.3	-0.8	139.9	141	
21732	3A	UIF	16.10	142.20	16.50	143.00	33.3	33.0	-0.3	33.4	32.9	-0.5	22.0	20.9	-1.1	21.0	19.6	-1.4	126.1	126.5	Composite limits based on 10% Fe_{mag} cutoff.
21733	3A	UIF	17.30	137.00	18.50	133.10	33.2	32.7	-0.5	33.5	33.2	-0.3	21.6	22.9	1.3	23.8	23.5	-0.3	119.7	114.6	Composite limits based on 10% Fe_{mag} cutoff.
21687	3B	UIF	16.40	158.80	24.00	169.00	33.9	31.7	-2.2	34.2	33.3	-0.9	23.6	19.5	-4.1	24.0	19.7	-4.3	142.4	145	Composite limits based on 10% Fe_{mag} cutoff.
21735	3B																				No Comparison completed.
21689	3B																				No Comparison completed.
20289	3C		132.00	308.00	126.30	294.00	30.3	29.0	-1.3	30.6	29.9	-0.7	15.6	13.6	-2.0	13.8	12.9	-0.9	176	167.7	
20287	4		18.50	185.50	20.80	187.00	30.8	30.0	-0.8	31.8	31.5	-0.3	16.5	15.8	-0.7	17.9	17.7	-0.2	167	166.2	
13302	4		21.60	264.00	19.10	260.00	23.3	30.1	6.8	23.9	31.1	7.2	16.0	15.0	-1.0	17.9	16.5	-1.4	242.4	240.9	
20291	4		20.00	231.50	23.10	231.00	31.7	30.9	-0.8	33.2	31.7	-1.5	18.4	18.1	-0.3	20.5	18.2	-2.3	211.5	207.9	
21707	5		24.00	188.80	27.00	190.00	34.0	33.5	-0.5	34.4	34.4	0.0	22.6	22.5	-0.1	23.6	24.6	1.0	164.8	163	Composite limits based on 10% Fe_{mag} cutoff.
20342	5		29.50	275.00	24.00	271.00	29.9	28.7	-1.2	32.8	32.0	-0.8	19.5	17.1	-2.4	21.8	20.1	-1.7	245.5	247	
21703	5																				No Comparison completed.
21704	5																				No Comparison completed.
21711	6		68.10	320.00	81.00	327.00	29.6	31.2	1.6	32.8	32.3	-0.5	16.2	16.5	0.3	17.2	17.1	-0.1	251.9	246	
12009	6		113.50	308.50	118.50	311.60	19.1	26.1	7.0	24.2	31.6	7.4	14.5	13.1	-1.4	17.3	16.1	-1.2	195	193.1	
12009	6	UIF	113.50	227.70	118.50	224.50	24.5	32.2	7.7	23.2	32.1	8.9	18.7	18.0	-0.7	17.7	17.8	-0.1	114.21	106	
20347	7		109.60	230.70	147.00	266.00	32.6	33.8	1.1	32.6	34.0	1.4	25.2	25.0	-0.2	25.5	25.1	-0.4	121.1	119	
20349	7	UIF	29.20	318.70	29.20	326.00	29.8	29.6	-0.2	30.4	30.6	0.2	17.3	15.5	-1.8	18.0	16.0	-2.0	289.5	296.8	
20349	7	Entire drillhole	29.20	393.00	29.20	391.00	28.0	28.1	0.1	29.9	30.1	0.2	15.0	13.9	-1.1	15.6	14.7	-0.9	363.8	361.8	
Average Difference									1.2			1.4			-0.48			-0.65			

Fe_{mag} results are results after the magnetic saturation recalibration
Differences in all cases are calculated as Twin result - Historic Result and use both negative and positive values; Med is Median
Average Difference in the bottom row of table is simply the average of the column (not averages of absolute values).

WGM is satisfied the historic results for Fe_{tot} are suitable for a Mineral Resource estimate, but they appear to be less reliable and biased low for certain drillholes. This bias is likely not correctable, except by re-drilling the affected historic drillholes. However, determining which drillholes are affected may not be possible with much certainty. Regardless, Fe_{tot} is not a very valuable parameter for grade estimation for this type of deposit because the mineralization has a high component of silicate Fe.

10.2.4 WGM Comment on Black Iron Phase I and II 2011 Drilling Programs

WGM is satisfied that Black Iron's drilling was reasonably well supervised and logging was reasonably well done. WGM agrees the Project drillhole database provides an excellent compilation of drillhole information. However, in WGM's opinion, the logs are not very satisfactory and they generally remain incomplete and difficult to read. This is partly because of translation issues and WGM understands that Black Iron intends to address this issue. The project database is in much better condition, and it provides a complete record for the drillholes and samples without the descriptions in the logs. The database includes a collar table with collar coordinates, drillhole azimuth dip, depth start and complete dates. A Lithology Table contains "Tos and Froms" for the various units/rock types intersected and rock-type codes, but not a lithological unit description beyond lithology coding. The Sample Table reports sample type and sample intervals. The database also includes a Table containing Rock Quality Index (RQD) and the estimates of core recovery. WGM warns that the RQD calculation method may not be correct.

WGM recommends that the drill logs be compiled into a standard format and completed with all data.

11 SAMPLE PREPARATION, ANALYSES AND SECURITY

For descriptions of sample preparation and analyses, WGM has relied solely on historic reports, notes and communications with Black Iron personnel and the labouratories, as well as on our site visits. Additional results and descriptions have been summarized in previous Technical Reports.

11.1 Historical In-Field Sampling and Preparation

Information about the Soviet practice for the later programs is available from the 1989 Soviet report. No information regarding sampling methods is available for the earliest drilling programs, and WGM does not know if sampling practice as outlined in the 1989 Soviet report was the same for the earliest programs. Additional information may be available in the 1985 report, but this report has not been translated into English.

For the later Soviet programs, it is known from sample assay records that the sample lengths averaged approximately 4m and varied generally from 2m to 6m, with some variation in sample lengths from program to program. Samples were split in two equal parts, one half was used for assay and the other half was returned to the core trays for use for testwork and, in some cases, for quality control. Sample composites averaging 20m length were also created, using duplicate routine sample portions.

11.2 2011 In-Field Sampling and Preparation

Black Iron's 2011 Phase I and Phase II drilling programs were managed by GEORESOURCE, which conducted the drill core sampling under guidelines provided by WGM.

11.2.1 2011 Drill Core Handling and Logging

GEORESOURCE drill rig geologists logged the drillholes in the field adjacent to the drills. Leonid Galchansky, Chief Geologist for GEORESOURCE, established the standards and nomenclature to be applied to the logging and supervised the drill rig geologists. WGM contributed guidance. Lithological coding was recorded in an MS Excel database. The logging procedure included core photography.

11.2.2 Sampling

The intervals for sampling were determined and marked on the core with permanent markers, once the core was transferred to the GEORESOURCE core shed. Sample limits were defined by geology, where lithological variations were significant. The sample limits and the Sample IDs were marked on the core. Sampling guidelines from WGM included a nominal sample length of 3m, with variations being based on geology and no narrow gaps to be left between samples. Shoulder or bracket samples were to be collected on the margins of all mineralized intervals.

The samples were sawn in half using diamond core saws. Guidelines called for sample sawing to be nominally perpendicular to layer banding to maximize sample symmetry. However, folding of the iron

formation was often so intense that compliance was not often feasible. In the rubble zones, generally associated with the martite mineralization and limonite/goethite weathered zones, sawing of the core was not always possible and sampling was simply done by trying to take out a representative half-portion of core. The half-core comprising the samples was bagged with a corresponding sample tag and protected by a plastic envelope. The remaining core was returned to the core trays and the other sample tag, also in a plastic envelope, was inserted in the trays under the first piece of core retained for the sample.

11.2.3 2011 Core Storage

WGM understands that the remaining drill core remains in Black Iron's core shed, cross piled hole-by-hole. The building is a large warehouse-style structure, with a concrete floor, secure doors and security fence.

11.2.4 2011 Sample Security

After being sawed, samples were trucked under GEORESOURCES supervision directly to MCM in Kryvyi Rih for preparation and assaying. GEORESOURCE provided MCM with a sample list for each shipment.

WGM understands that all sample materials, rejects and pulps originally in the possession of MCM are now stored on racks in Black Iron's core shed.

11.3 Laboratory Sample Preparation and Analysis

11.3.1 Historic Sample Preparation

Little is known about pre-1980s in-lab sample preparation for assaying. However, it is known from the 1989 Soviet report for the programs conducted in the 1980s that sample preparation and assaying were conducted at MCM, which was a government institution, and at a second lab, Krivorozhsky GRE. A third lab, Central Laboratory of NPO, "Yuzhukrgeologiya', was used to check the assaying of selected samples. Sample preparation, as described in the Soviet 1989 report, consisted of successive crushing stages (10mm, 5mm, 3mm, and 1mm) and included screening to ensure proper sizing and sample reduction using cone and quartering and mechanical splitters. Pulverization to analytical powder was to 0.074 mm, using vibrogrinder.

11.3.2 Historic Sample Assaying

Again, little is known about sample assaying in the pre-1980s period. It is known that determinations of magnetic iron were infrequent. Only assay results for Fe_{tot} are generally available for pre-1980 samples. The exploration target for these programs was the enriched iron ores; therefore, the taconite potential was not evaluated and determinations of Fe_{mag} were not completed. Assays for pre-1980 samples are compiled along with later assays in volumes of the 1989 report.

Post-1980 drill core regular samples were assayed for Fe_{tot}, Fe_{mag} and some for FeO_T. FeO_T results have not been compiled into the Project database and WGM recommends that they be added. Assaying for post-1980 samples was, as aforementioned, completed at MCM. Composite samples were assayed for whole rock major elements: Fe_2O_3, SiO_2, Al_2O_3, TIO_2, CaO, MgO, MnO, Na_2O, K_2O, CO_2, H_2O+, H_2O-. Selected samples also had more extensive assaying with 42-elements determined, including gold, using spectroscopy.

Mineralogical studies were performed and physical properties including density were determined. Density determination for 437 samples, averaging 0.5kg, was completed on waxed samples by the weighing-in-air and water method.

Specific assay methods for Soviet samples are not described in the reports available. WGM queried MCM personnel about historic assay methods and was told that the historic methods were probably very similar to current methods, as the classical methods were still in use and had changed very little. WGM also inquired if MCM still possessed assay records from historic times and the answer was no.

11.3.3 Historic Quality Assurance and Quality Control

The 1989 Soviet report describes second half-core and quarter-core check assaying and secondary lab check assaying, regular assaying being done at MCM and check assaying being done on duplicates at Krivorozhsky GRE and the Central Laboratory of NPO. Results were subjected to statistical analysis and some of the drillholes were twinned. For the program documented in the 1989 report, drillhole 20348 was twinned and there is a 20348, 20348a and 20348b version, which were compared on the basis of Fe_{tot} and Fe_{mag} assays, lithology and down-hole geophysical results.

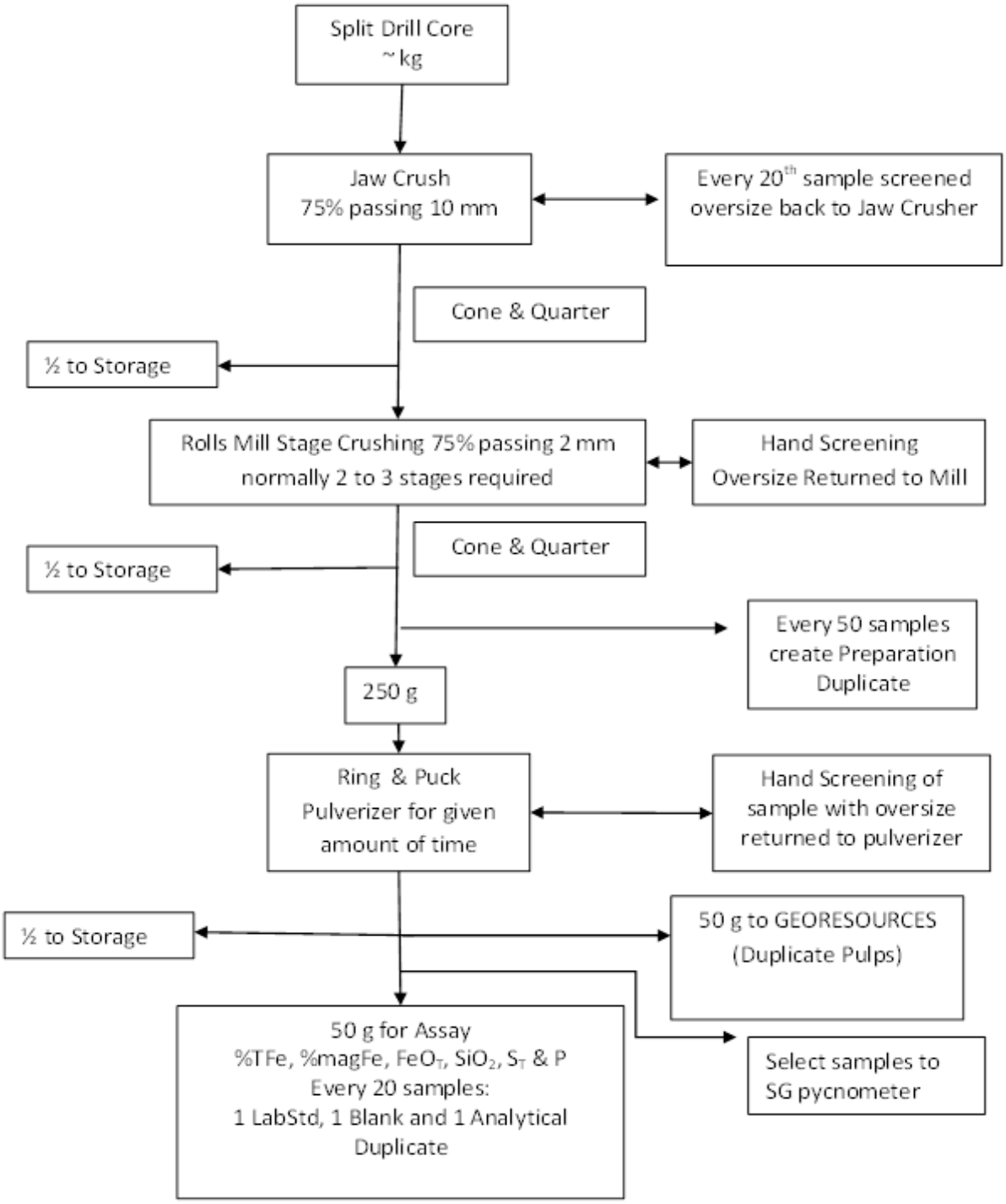
11.3.4 2011 Laboratory Sample Preparation

The primary laboratory for Black Iron's 2011 Twin Drilling (Phase I) and Phase II drilling programs was MCM, based in Kryvyi Rih. Sample preparation for assay included first-stage jaw crushing, second-stage roll crushing and finally puck and ring pulverization to provide a representative pulp for assay. Figure 11.1 illustrates the sample preparation and analysis flowsheet.

Each entire half- split core sample was jaw-crushed to 75%, passing 10mm. At every 20th sample, the crushed product was tested by screening, using a 10mm screen. The total weight of the sample was recorded. After each sample, the crusher was blown out with compressed air. On a plastic sheet the sample was then thoroughly mixed by trowelling the sample three times back and forth from pile to pile. The thoroughly mixed sample was then coned and quartered. One-half of the sample was returned to the original sample bag with the original sample tag, and subsequently returned to GEORESOURCE for storage. The retained half portion was weighed to ensure it amounted to one-half of the sample. The retained half was then transferred to the rolls mill where it was stage-crushed, which usually required two to three stages. After each stage, the sample material was screened at 2mm, the oversize being returned to the mill for further crushing aimed at achieving 75% passing 2mm. The product sub-sample was then thoroughly mixed by trowelling the material back and forth three times on the plastic sheet. It was then reduced in size again by cone and quarter. Normally two successive stages of cone and quartering were

required to separate 250 g of the sub-sample. The reject was weighed, the mass being recorded on the assay certificates, and then put into a new sample bag for storage.

Figure 11.1: Sample Preparation and Assay Flowsheet at MCM



The 250g (approximate) sub-sample was pulverized in a ring and puck pulverizer for a specified time, with the aim of achieving 100% passing 0.1mm. Two pulverizers were required for each sample to handle the 250g. The sample, after each stage of pulverization, was hand screened at 0.1mm. The oversize was returned to the pulverizer until 100% passing 0.1mm was achieved. After each sample, the pulverizers were blown out with compressed air and wiped clean.

The pulverized sub-sample was divided into three portions. This was done by coning the pile, flattening the pile and then using a small scoop to select material from different parts of the disc of material. Two 50g pulps were collected, one was for assay at MCM and the other was sent to GEORESOURCE for storage and future use. The excess material was bagged and retained in storage at MCM and, apparently, moved to the core shed later.

11.3.5 2011 Sample Assaying

Assaying at MCM included determination of Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S_T and P on all samples, including routine and field-inserted QA/QC samples and laboratory-inserted QA/QC materials. Table 11.1 describes the assay methods used by MCM. Sample and analysis statistics for the 2011 program are summarized in Table 11.2.

Selected samples also had their bulk density determined, by weighing in air and in water the core pieces that comprised the entire sample intervals. Other selected samples had SG determined by a pycnometer method. GEORESOURCE selected the samples for bulk density and SG. The guidelines from WGM were to try to select samples throughout the deposit that represented the entire range of rock types and mineralization intensity. Routine samples included all drill core samples, split and sampled, to evaluate their mineral content, including Bracket and or Shoulder samples. Bracket or Shoulder samples are samples of waste from the margins of mineralized intersections. A total of 3,869 routine samples were assayed during the Phase I and II programs. In-laboratory and in-field QA/QC are described in Section 11.3.6 of this report. The QA/QC program resulted in the identification of a number of sampling and assaying issues, and the follow-up of these issues generated additional samples for assaying.

Table 11.1: Summary of Analytical Methods at MCM

Methods	Description
Fe_{tot}	Method based on ferric iron reduction by stannous chloride with titration using potassium dichromate. The sample is digested with hydrochloric acid in presence of sodium or ammonium fluorides. National State Standard for Ukraine: 23581.18:2008
Fe_{mag1}	Primary method was by magnetic saturation analyser, similar to Satmagan. Instrument requires calibration at beginning of each shift using series of samples of known saturation magnetization. National State Standard for Ukraine: 3203-95.
Fe_{mag2}	Wet chemical method. Magnetic fraction (0.5 g – 1.0 g) separated from sample using hand magnet. Fraction digested in nitric acid. After acid removed Fe_{mag} determined by bichromate titration method with diphenylamine sodium sulfonate tracer. State Standard for Ukraine:3203-95
FeO_T	The method is based on titration of iron (II) with a solution of potassium bichromate in presence of a tracer, i.e. sodium diphenylaminesulfonate. The sub-sample (0.5 – 0.25 g) depending upon weight percent of ferrous oxide is placed into a conical flask (250 ml), then 50 ml of hydrochloric acid (2:1), 0.5 g sodium fluoride and 2g sodium bicarbonate (NaHCO3) are added. The flask is plugged with a cork with a long glass tube in it, promptly heated and boiled for 20 –to 40 minutes to avoid iron (II) oxidation with air. After cooling of the solution, a tracer is added and iron (II) is titrted with potassium bichromate solution.
SiO_2	Gravimetric hydrochloric acid method. This method is based on silicic acid release from hydrochloric acid solution in presence of gelatin at the temperature of not more than 60°C. Sample decomposition is carried out by sintering with mixture (sodium carbonate, top-quality flour and magnesium oxide at a ratio of 3:2:0.05 in a platinum crucible at 750-800°C (for 15-20 minutes).
P	Photometric method of determination of phosphorus in iron ores. This method is based on formation of phosphomolybdic heteropolyacid with its further recovery by Fe(II) ions in presence of hydrochloric acid hydroxylamine until a blue complex compound is formed and on photometric measurements of a dyed solution at 730 nm wave length. The sample batch of 0.1 g is dissolved in hydrochloric acid adding nitric acid during heating then it is boiled for nitric oxides removal and the solution is evaporated dry. The salts are dissolved by heating in a small quantity of hydrochloric acid then filtered and the phosphorus is determined in the filtrate.
S_T	Determination of Total sulfur. The method is based on ignition of sample in oxygen at temperature of 1,250 – 1,350^{o}C, absorption of sulphur dioxide by water and titration of sulphurous acid with iodite-iodate solution in presence of starch tracer. State Standard for Ukraine: 23581.20:2008
Bulk Density	Weighing–in–water/weighing-in-air method on full size half split core. The sample weight should not be less than 4kg. The sample is first dried in a drying box at (105 ± 5°C). The basket is filled with a batch and weighed in air, and then it is gradually dipped into the vessel and kept in water for 5 minutes, shaken from time to time without taking the basket out of water to remove air bubbles from the surface of ore pieces. After abovementioned actions, the water-dipped basket with a batch in it is weighed in water. Then basket with the batch in it is taken out of the vessel and 2 minutes later (after water drains), it is weighed in air. The results of the batch weighing in water and in air are logged. The volume of water displaced by the basket is determined 5 times. The arithmetical average of all determination results is assumed to be the weight of displaced water which corresponds to the basket volume.
Pycnometer SG	The method is based on the determination of volume of a sample by measuring its weight by pycnometer without fluid in it and then with fluid and by calculation of ratio of weight of solid to its volume without regard for pore volume inside grains and volume of voids between them. A sample of size not more than 0.16 mm and its weight 60 g minimum is used here. After accurate agitation, the sample is dried in a drying box at (105 ± 5°C) to a constant weight. The determination is done in duplicate.

Table 11.2: Summary of Geological Drill Core Samples and Analysis at MCM

Items	Description	Count of Samples
Routine	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P.	3,869
Field Blanks (FBLK)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P.	217
Field Standard (FSTD)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P.	225
Field Duplicates (FDUP)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P	92
Total Field Samples submitted to MCM by GEORESOURCE		**4,403**
Pycnometer Pulp Density		356
Bulk Density		207
MCM		
Preparation Duplicate (PDUP)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P	50
Analytical Duplicate (ADUP)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P	83
Lab Standard (P010)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P	192
Lab Blank (LBLK)	Fe_{tot}, Fe_{mag}, FeO_T, SiO_2, S, P	77

11.3.6 2011 Quality Assurance and Quality Control

The 2011 QA/QC program for sampling and sample analysis included components conducted by GEORESOURCE that were initiated during core sampling in the field in addition to components operated by MCM as part of the in-laboratory QA/QC program. Samples and analysis for both these components are summarized in Table 11.2. The In-field components included the insertion of blanks, duplicates and Certified Reference Standards into the sample stream going to MCM. The in-MCM components included the use of blanks, duplicates and Certified Reference Standards throughout the sample preparation and assaying procedure.

Additional QA/QC components were operated by Black Iron and WGM. Black Iron's components are described under "Supplementary Assaying" at the end of this report section and include check assaying at SGS-Lakefield and ALS in Australia. The components performed under the auspices of WGM are described in Section 12.4 of this report, "Data Verification". WGM's work included check assaying of a selection of samples submitted "blind" to both SGS-Lakefield and MCM.

2011 In-Field QA/QC

In the field, standards, blanks and duplicate samples were inserted into the sample stream going to MCM. The Certified Standard Reference material used for field standards (FSTD) was CANMET FER-3. This material was pre-packaged in small jars and, as required, GEORESOURCE extracted a teaspoon of material, placed it into a sachet that was given a routine sequential sample number and inserted into the sample stream going to MCM. The FER-3 standards were inserted into the sample stream at a frequency of one per 20 routine samples. The relevant certified and provisional values for FER-3 are listed in Table 11.3. Unfortunately FER-3 has no Certified Reference Standards value for Fe_{mag}.

Table 11.3: Certified Reference Values for the Canmet Fer-3 Standard

	TFe(%)	Fe_2O_3(%)	FeO(%)	MnO(%)	SiO_2(%)	TiO_2(%)	Al_2O_3(%)	MgO(%)
FER-3	31.15	29.4*	13.63	0.08	53.61	0.01	0.09	1.02
		CaO(%)	Na_2O(%)	K_2O(%)	H2O+(%)	CO_2(%)	P (%)	S(%)
FER-3		0.84	0.03	0.03	0.2	1.2	0.030	0.03

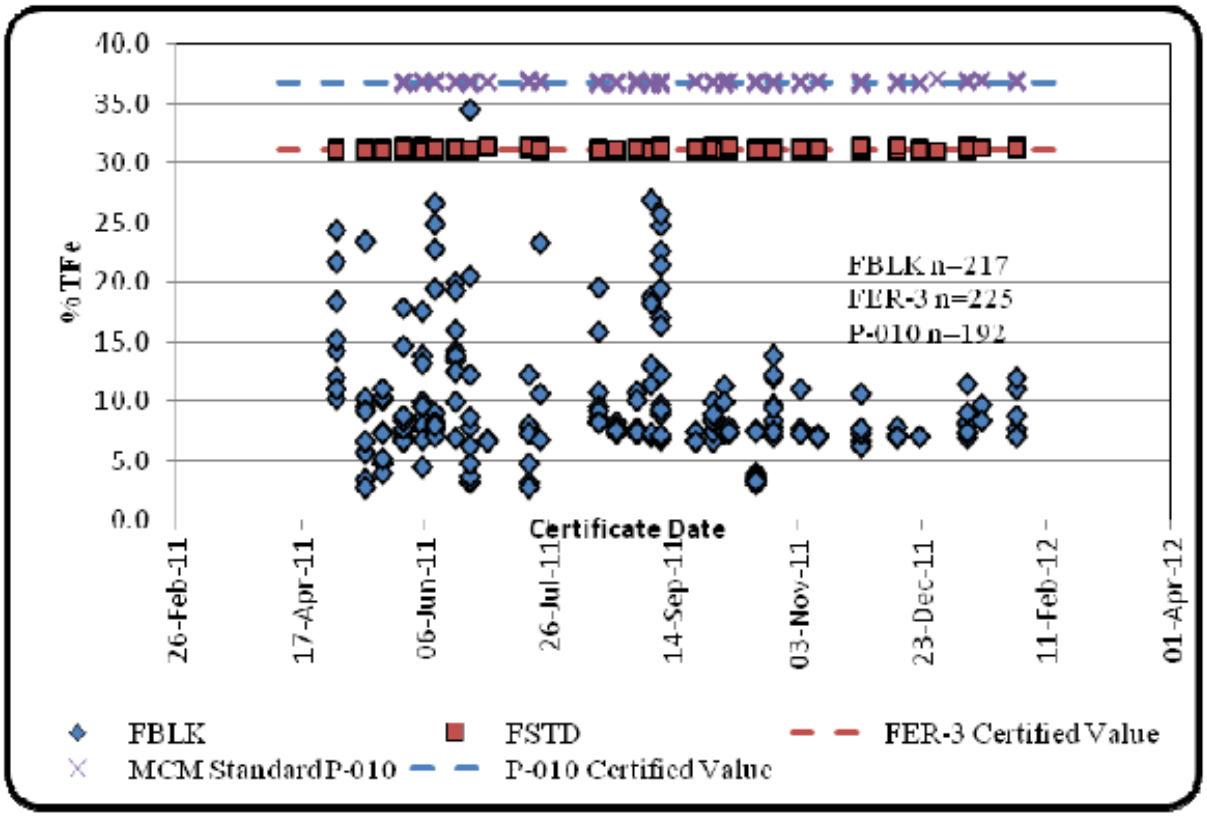
Fe_2O_3 is total Fe expressed as Fe_2O_3

The material used for field blanks (FBLK) was metasedimentary, amphibolitic slate rock harvested by GEORESOURCE from waste bands in the Black Iron drillholes. Field blanks were inserted into the sample stream at a frequency of one per 20 routine samples. Generally, the blanks and the FER-3 standards were consecutive samples in the sampling sequence. The natural drill core blanks used for this program have an advantage over prepared blanks in that natural blanks are “blind” to the lab. However they do contain some varying uncontrolled levels of iron, whereas prepared blank materials are more uniform.

Field duplicate (FDUP) samples were second-half core samples. These samples were cut and inserted into the sample stream at a frequency of one per 50 routine samples. Whenever FDUP samples are taken, both halves of the drill core are sampled; one half becomes the routine sample and the other half becomes the duplicate. When this type of sampling is performed, no archived core for these sampled intervals remains. These types of samples are “blind” to the lab. Duplicates in the sample sequence generally follow immediately after the “original.” In WGM’s opinion, it would have been better practice to make the sequencing more irregular, but this could not be implemented.

Figure 11.2 to Figure 11.7 present selected assay results for field blanks and field standards, showing assays plotted against the MCM certificate date. Figure 11.2 shows results for % Fe_{tot}. As indicated on the plot, 217 instances of FBLKs for Black Iron’s drill program were inserted into the sample stream going to MCM. The plot also indicates that 225 instances of FER-3 were inserted and analyzed at MCM for Fe_{tot}. The figure also shows results for the Standard P-010, which is a Certified Reference Standard inserted into the analytical stream at MCM, by MCM, and is described more fully under 2011 in-MCM (Primary Assay Laboratory) QA/QC.

Figure 11.2: % Fe_{tot} vs. Certificate Date for Field Blanks, FER-3 and P-010



As shown on the plot, the blanks are highly variable in Fe_{tot} content and have little value for monitoring Fe_{tot} assays. However, the results for the FER-3 FSTD appear to be excellent, having all data points close to the Certified Reference Standards value.

Figure 11.3 shows Fe_{mag} results for the FBLKs and the FER-3 FSTD. The FBLK was selected to be low in Fe_{mag}, as magnetite is the principal mineral of interest on the Property. Most FBLKs returned less than 5% Fe_{mag}. One anomalous sample was noted on initial review of results and inspected in the field. No re-assays were undertaken because it is believed that the higher than expected value was the result of a poorly selected sample. FER-3 does not have a Certified Reference Standard value for Fe_{mag}, but the samples assayed within tight limits indicated the excellent performance of the lab. Table 11.4 presents summary statistics for FER-3 for all program samples at MCM.

Table 11.4: Summary Statistics for Field Standard (Fer-3) at MCM

	% Fe_{tot}	%Fe_{mag}	%FeO	%SiO_2	%P	%S
Count	225	223	222	224	224	225
Avg	31.18	28.32	13.25	53.06	0.034	0.032
Median	31.20	28.30	13.30	53.04	0.034	0.030
Min	30.90	27.70	12.90	52.24	0.017	0.026
Max	31.40	30.40	13.80	53.50	0.040	0.300

Figure 11.3: %Fe_{mag} vs. Certificate Date for Field Blanks, FER-3 and P-010

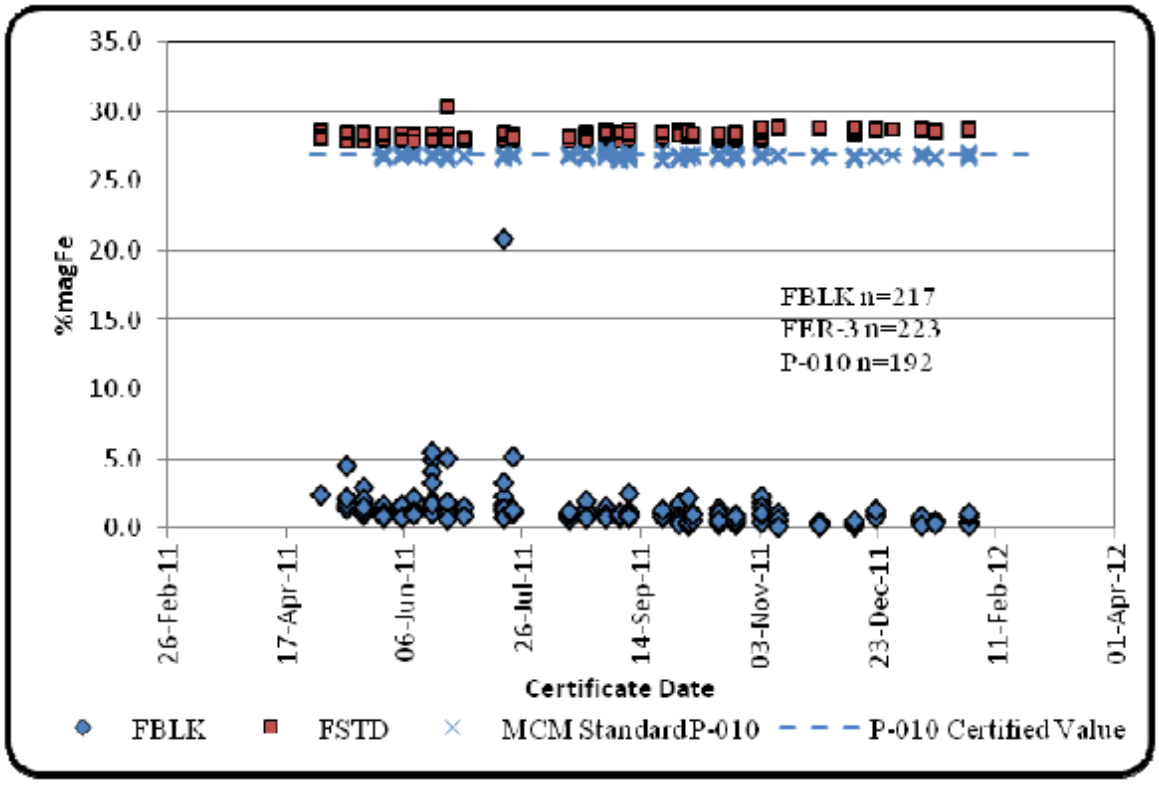


Figure 11.4 to Figure 11.7 show analytical results for FeO, SiO2, P and S for FBLKs and the field standard FER-3. For these plots, the FBLK is not very useful because of its irregular composition, but results for FER-3 are relevant. Results for FER-3 appear to be all excellent, except for one instance of FER-3 having high S (see Figure 11.7).

Figure 11.4: %FeO_T vs. Certificate Date for Field Blanks, FER-3 and P-010

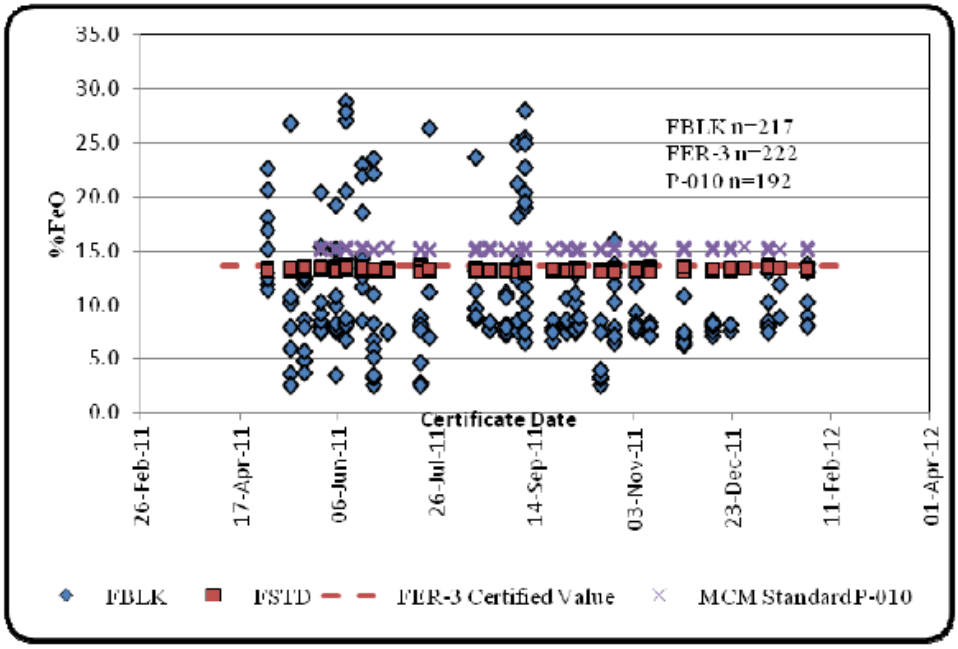


Figure 11.5: %SiO_2 vs. Certificate Date for Field Blanks, FER-3 and P-010

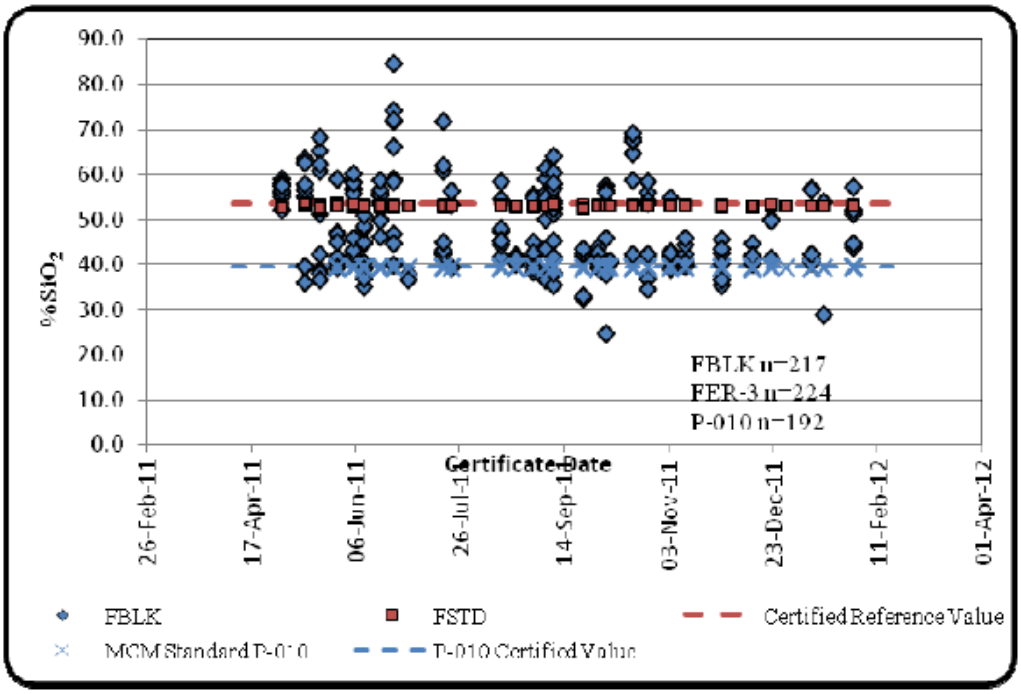


Figure 11.6: %P vs. Certificate Date for Field Blanks, FER-3 and P-010

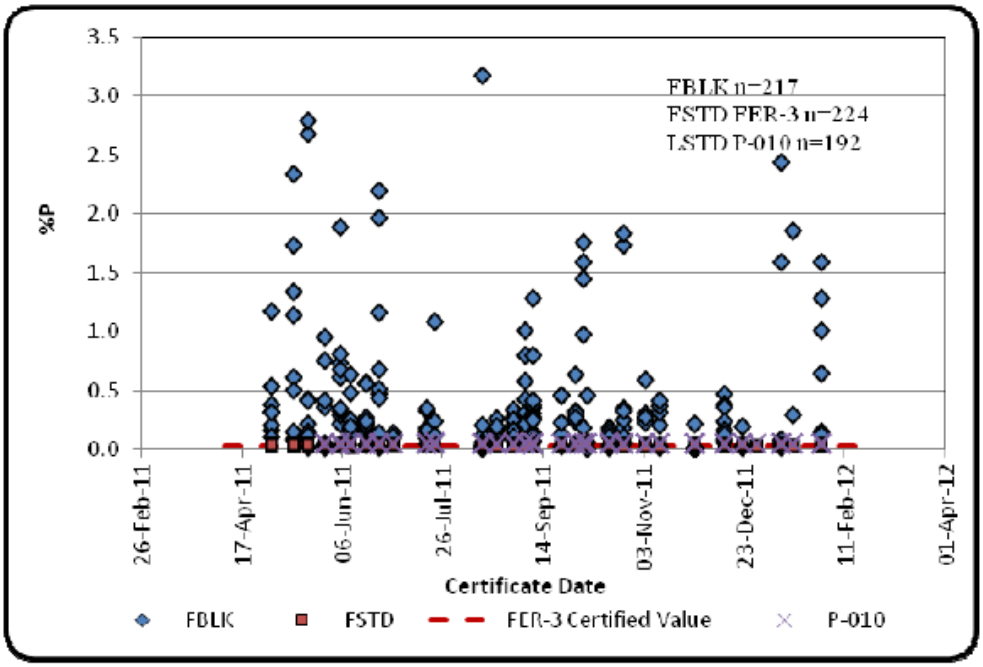
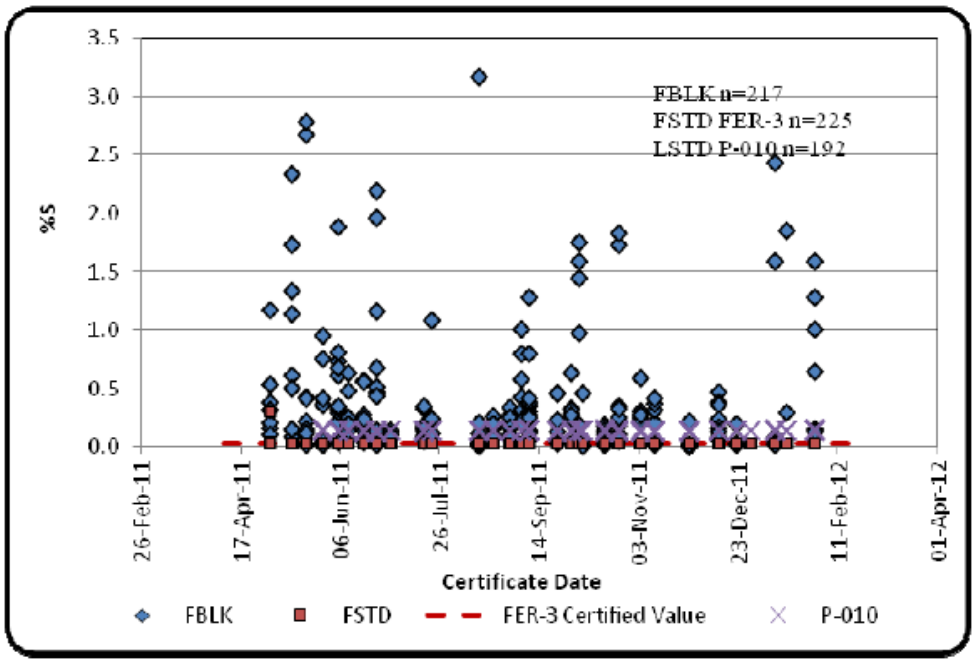


Figure 11.7: $\%S_T$ vs. Certificate Date for Field Blanks, FER-3 and P-010



Results for Fe_{tot} and Fe_{mag} for the field duplicates are shown on Figures Figure 11.8 to Figure 11.9. Similar plots for FeO_T, SiO_2, P and S_T were reviewed to confirm good assay repeatability between original and duplicate samples.

Figure 11.8: % Fe_{tot} vs. % Fe_{tot} for Field Duplicates

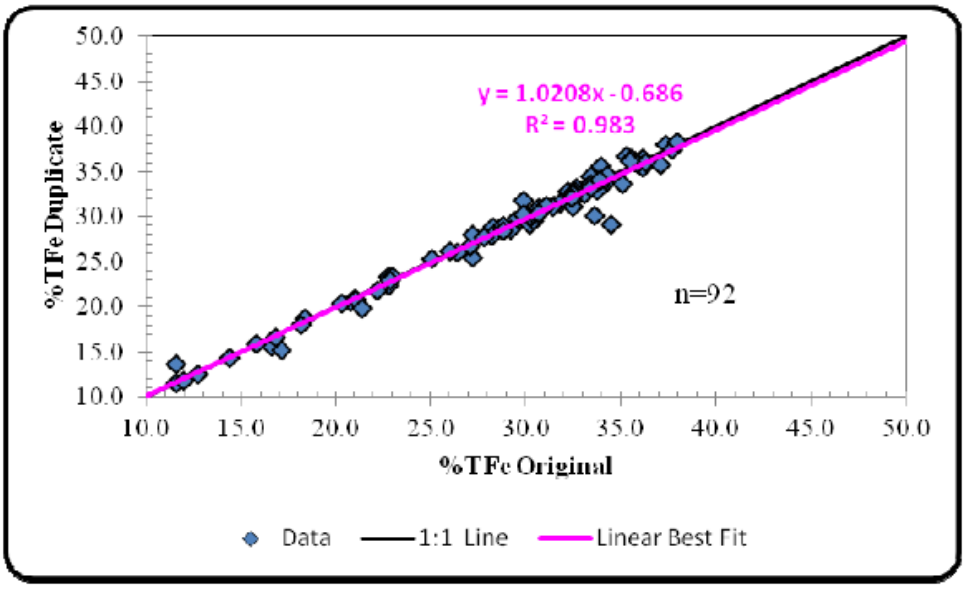
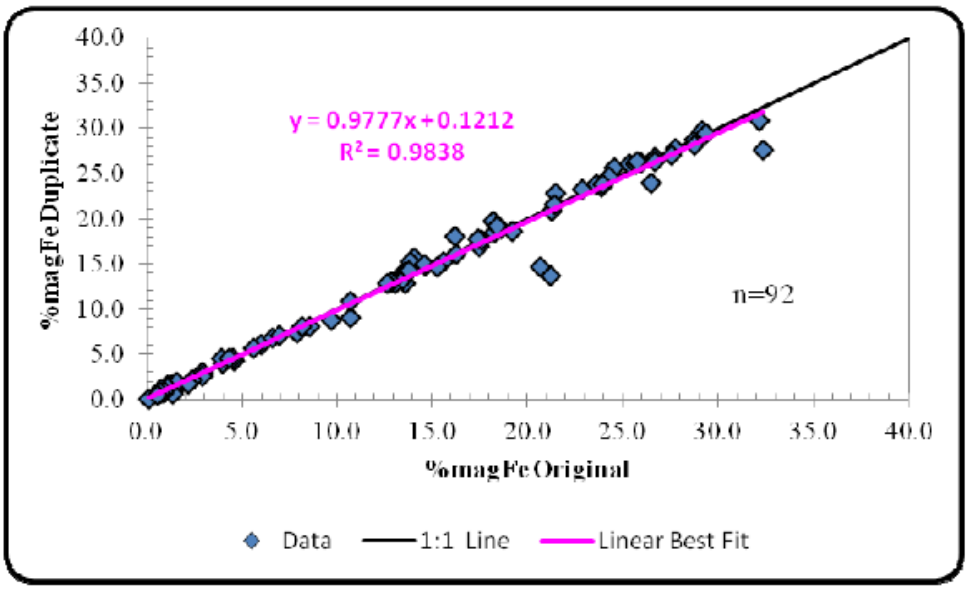


Figure 11.9: %Fe_{mag} vs. %Fe_{mag} for Field Duplicates



Generally, the results shown on the plots show good assay precision; however, two samples appear to plot out of pattern. WGM believes that four samples (BI04644, BI04645, BI04694 and BI04695) may be mixed up, either because of coding in GEORESOURCE's sampling records or because the samples were mixed up at the lab. No re-assaying is necessary.

2011 In-MCM (Primary Assay Laboratory) QA/QC

Supplementary to the GEORESOURCE's in-Field QA/QC program, MCM, the primary analytical laboratory for Black Iron's drill programs, operated an in-laboratory QA/QC program involving preparation duplicates (replicates), analytical duplicates, blanks and Certified Reference Standards. These QA/QC materials were analyzed along with the samples received from GEORESOURCE.

The preparation duplicates comprise a second sample, riffled out after coarse crushing to enable the monitoring of sample preparation variance. For normal samples received by the lab, one sample is partitioned off from the reject and then proceeds to pulverization. When a preparation duplicate is called for, two portions are partitioned off from the reject and two pulps are created instead of one. Preparation duplicates were prepared at a frequency of one per 50 field samples to MCM. Accordingly for every 50 samples a second sub-sample was generated for assaying. The preparation duplicates were labelled with a (PDUP) prefix. Analytical Duplicates (ADUP) are second portions of pulps that are sub-sampled from normal pulps and assayed. These samples were also completed at a frequency of one per 50 samples to the lab.

Later in the program, a MCM in-house standard was added to the in-laboratory assay scheme to fulfill the role of a blank (LBLK) and to provide a standard with very low levels of iron.

Instances of PDUP, ADUP and LBLK were inserted into the sample stream every 50 samples from the field. MCM also assayed a Certified Reference Standard at a frequency of one per 20 field samples. This standard was a Ukrainian Certified Standard, namely P-010, characterized as magnetite iron ore. To document this material, MCM provided certificate 1063, issued 17 December, 2009, by the State Committee of Ukraine for Technical Regulation and Consumer Policy. The Certified Reference Values for this Standard are listed in Table 11.5.

Table 11.5: Certified Reference Values for the P-010 Ukrainian Standard

Element	Certified Value (%)	Confidence Limit 95% (%)
Fe_{tot}	36.82	0.08
Magnetic Fe	26.9	0.2
SiO_2	39.4	0.1
CaO	1.62	0.03
MgO	2.65	0.05
Al_2O_3	1.02	0.05

WGM understands that this P-010 Standard was also used to monitor analyses from the start of the program; however, initial results, unlike later results, are not listed on the Certificates of Analysis issued by MCM.

Each of the samples was assayed for the Project's analytical package, but SG was not determined on any of the laboratory standards; MCM reports that P-010 was not suitable for pycnometer SG because it was too fine-grained for MCM to determine.

The analytical results for the P-010 Standard are shown previously on Figure 11.2 to Figure 11.7, along with the results for the field-inserted blanks and standards. The results for all analytes are indicated as excellent. Table 11.6 shows the summary of analytical results for P-010.

Table 11.6: Summary Statistics for P-010 Standrad at MCM for Shymanivske Program

	% Fe_{tot}	%Fe_{mag}	%FeO_T	%P	%S_T	%SiO_2
Count	192	192	192	192	192	192
Avg	36.83	26.83	15.16	0.05	0.14	39.36
Median	36.80	26.82	15.20	0.05	0.14	39.34
Min	36.60	26.40	14.90	0.04	0.12	38.88
Max	37.10	27.30	15.40	0.06	0.15	39.72

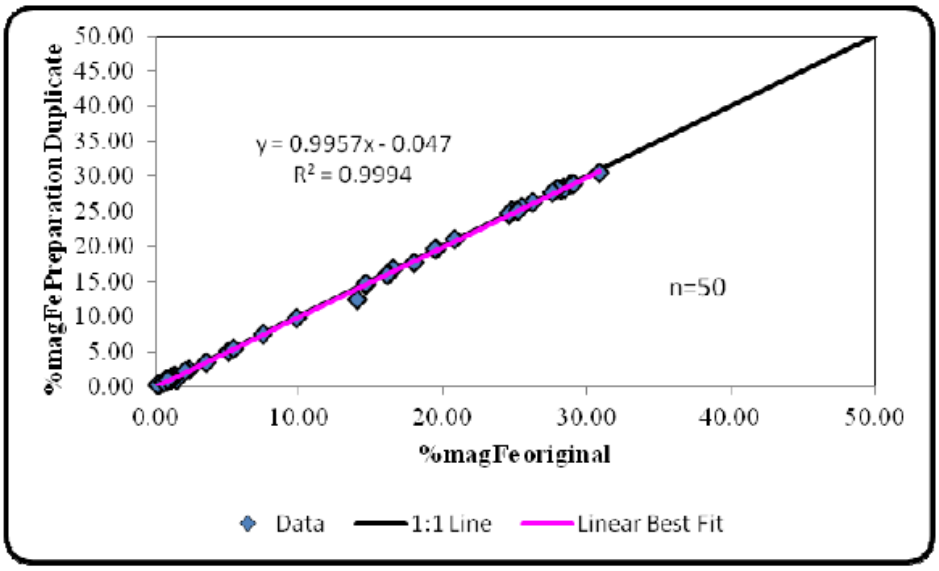
Seventy-seven instances of the laboratory Blanks are reported by MCM. None generated anomalous results. Table 11.7: Statistical Summary for MCM-Inserted Blanks provides a statistical summary for the LBLKs.

Table 11.7: Statistical Summary for MCM-Inserted Blanks

	pct Fe_{tot}	pctFe_{mag}	pctFeO	pctP	pctS	pctSiO2
Count	77	77	77	77	77	77
Avg	8.23	0.63	9.25	0.021	0.329	41.04
Median	8.30	0.60	9.20	0.021	0.330	41.04
Min	8.00	0.50	9.10	0.017	0.291	39.20
Max	8.40	0.80	9.50	0.024	0.351	41.50

Figure 11.10 presents Fe_{mag} results for the 50 Preparation Duplicates assayed at MCM with the Shymanivske drill core samples.

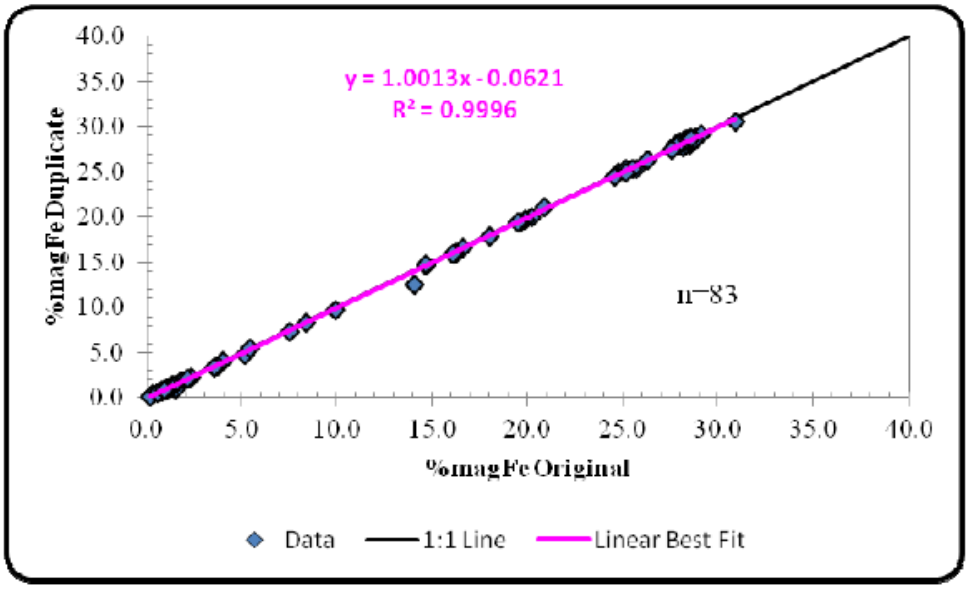
Figure 11.10: $\%Fe_{mag}$ vs. $\%Fe_{mag}$ for Preparation Duplicates



Results for the PDUPs for the other analytes are similarly well correlated.

Figure 11.11 shows results for Fe_{mag} in 83 Analytical Duplicates. Similar to PDUPs, assays for the two samples of each pair of the ADUPs are also highly correlated, indicating excellent quality assay data

Figure 11.11: $\%Fe_{mag}$ vs. $\%Fe_{mag}$ for Analytical Duplicates



Supplementary Assaying

In addition to the in-field insertion of blanks, duplicates and standards, some follow-up check-assaying was completed, with a view to understanding and resolving particular issues. Some of this was managed by Black Iron; some, by WGM. The components managed by WGM are described in Section 12, "Data Verification." The components managed principally by Black Iron are described herein. These supplementary sample assaying components include:

1. Re-assaying 100 selected samples at MCM, for the purpose of validating its new calibration standard for Fe_{mag}.
2. Check-assaying at SGS-Lakefield of the 100 samples, for the purpose of validating MCM's new Fe_{mag} calibration.
3. Check-assaying of 35 samples of the aforementioned 100, at ALS in Australia, and later check-assaying of additional samples at ALS.
4. Re-assaying of selected samples from drillhole BISH-29.
5. Re-determination of SG by pycnometer of selected samples at MCM.

1 Re-assay of 100 samples at MCM and check-assaying at SGS-Lakefield, in order to validate "new" MCM Fe_{mag} calibration

On November 18, 2011, a letter report was sent to Black Iron further to an initial draft dated 14 September, 2011. The document was titled "Draft of Review of Twin Drillhole Program and QA/QC Results Shimanovskogo Iron Property, Ukraine". In the document, WGM brought to Black Iron's attention the fact that MCM's magnetic Iron (Fe_{mag}) assays appeared to be lower in value than historic assays in the corresponding twin drillholes and in initial check-assays of MCM pulps that WGM had collected during its second site visit (this component of WGM's verification program is described under Section 12, "Data Verification"). Black Iron communicated this finding to MCM, and it is the understanding of WGM that MCM acknowledged its Fe_{mag} assays were a little too low. MCM subsequently completed a re-calibration of its instrumentation and provided newly adjusted Fe_{mag} assays for the previously assayed samples (all samples pre-SH18, 23 September 2011, assay certificates). The new calibration was used for all later samples. In the plots and Tables concerning the analysis and interpretation of the samples and assay data contained in Section 11.2.2, all Fe_{mag} data is subsequent to the re-calibration.

Following this re-calibration, Black Iron selected, in October 2011, 100 pulps from samples previously assayed at MCM, which spanned the twin-hole program and also various Fe_{tot} and Fe_{mag} grades. The list of samples was provided to MCM to check the newly adjusted Fe_{mag} values. WGM recommended that the samples be sent "blind" to MCM, however, the samples were not sent "blind" and included no standards, which would have been more useful. Black Iron requested MCM to re-assay these samples for Total Iron ("Fe_{tot}") and Fe_{mag}. MCM performed this service, completing the assays in duplicate.

The new and original MCM results for the 100 samples are summarized in Table 11.8.

Table 11.8: Statistical Comparison of MCM Original and October 2011 Re-Assays

	MCM Original		MCM Re-Assay		Difference Fe_{mag} (%)
	Fe_{tot} (%)	Fe_{mag} (%)	Fe_{tot} (%)	Fe_{mag} (%)	
N	100	100	100	100	
Avg	31.61	16.01	31.68	17.65	1.6
Median	32.30	16.50	32.25	17.40	0.9

Figure 11.12 and Figure 11.13 compare, respectively, MCM Original versus re-assays for Fe_{tot} and Fe_{mag} for the 100 samples.

Figure 11.12 clearly shows that Fe_{tot} original and re-assays are strongly correlated, and no assay bias is evident. Figure 11.13 shows that MCM re-assays strongly correlate with original MCM assays, but are biased, given that the re-assays report slightly higher values. The difference between MCM Fe_{mag} original assays and re-assays is similar to the difference between SGS-Lakefield's results for assays on WGM's independent samples and original MCM assays (Section 12), although the differential is not quite as high.

Figure 11.12: % Fe_{tot} for MCM Re-assays vs. Original MCM Assays for 100 Samples

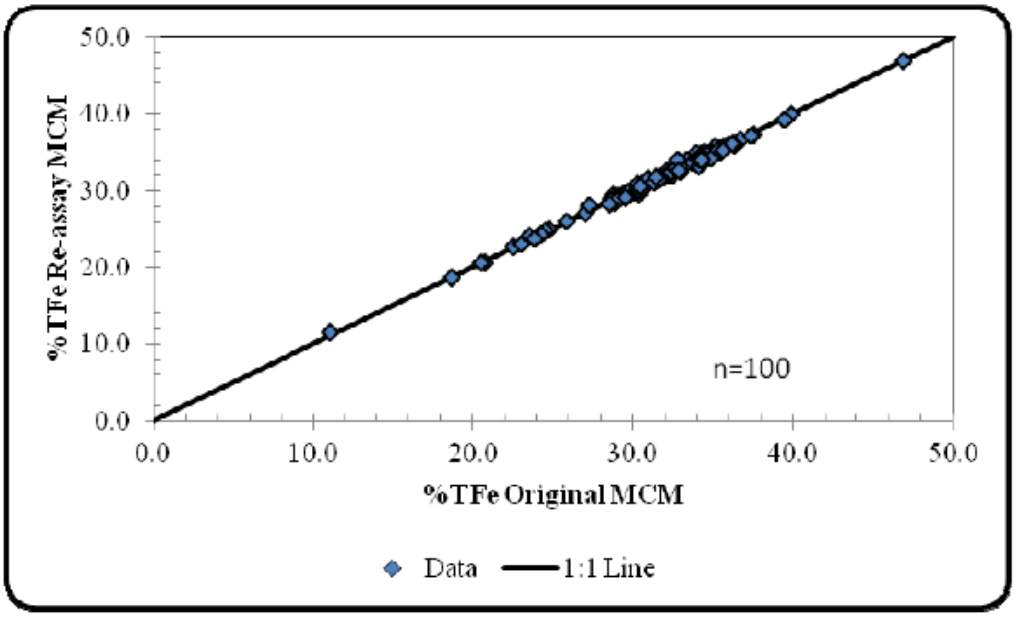
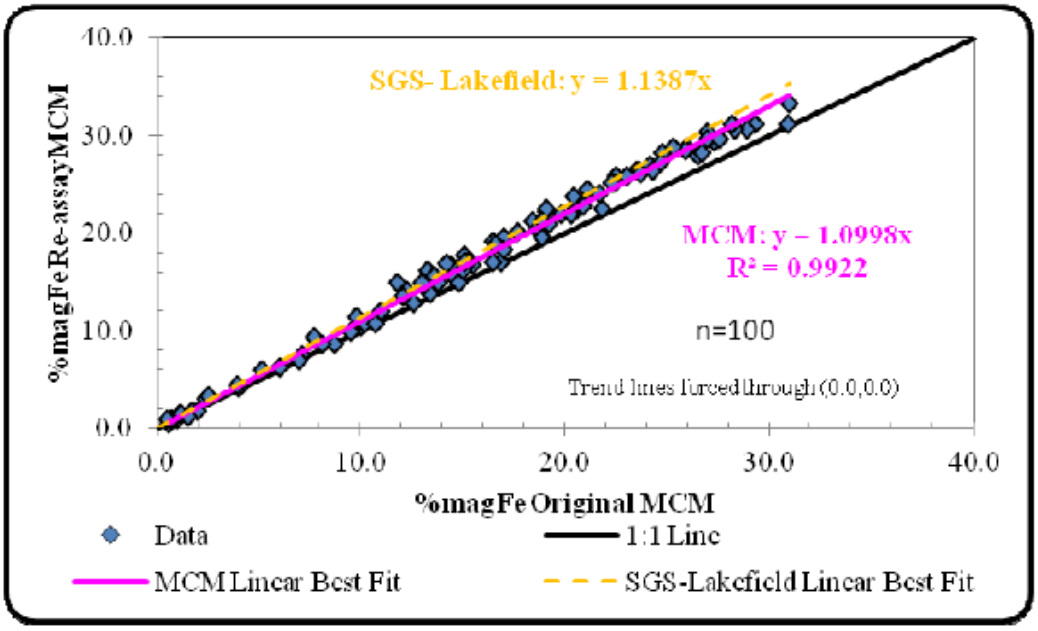


Figure 11.13: %Fe_{mag} for MCM Re-assays vs. Original MCM Assays for 100 Samples



MCM subsequently forwarded a portion of the pulps for these 100 samples to SGS-Lakefield for check-assaying.

2 Check-assaying at SGS-Lakefield of the 100 samples towards validating MCM's new Fe_{mag} calibration

SGS-Lakefield assayed the 100 samples received from MCM for WR-XRF major elements and Satmagan, and issued its results in February 2012. A selection of 25 of these samples also had Davis Tube tests completed at SGS-Lakefield, and their magnetic concentrate products were analyzed for major elements by Whole Rock – X-Ray Fluorescence (WR-XRF). Neither FeO_T nor S_T was completed on the head samples.

Figure 11.14 and Figure 11.15 show results for % Fe_{tot} and %Fe_{mag} at SGS-Lakefield for the 100 samples, as compared to MCM's re-assays.

Figure 11.14: Comparison of % Fe_{tot} at SGS-Lakefield vs. MCM

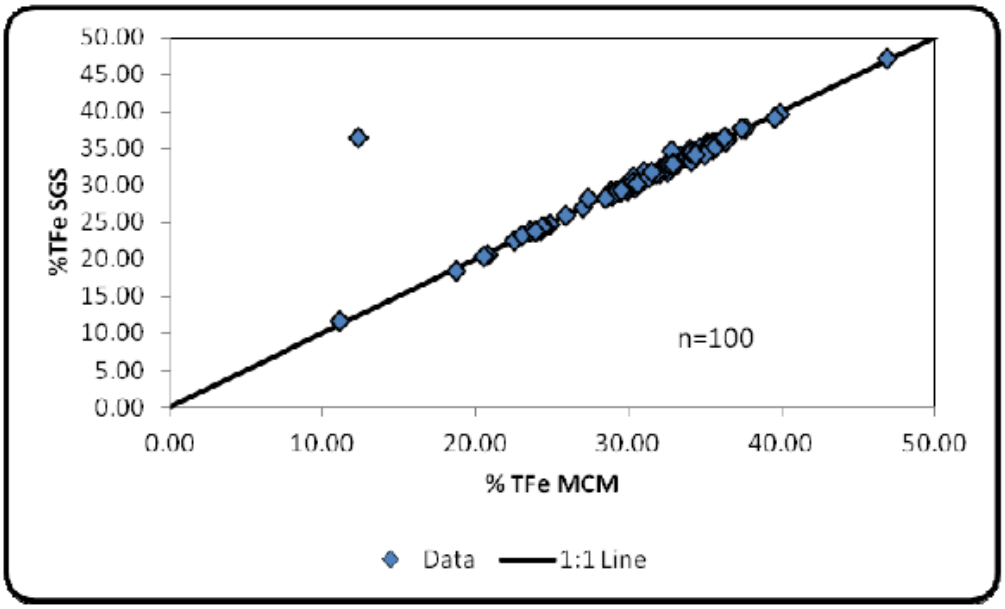


Figure 11.15: Comparison of %Fe_{mag} at SGS-Lakefield vs. MCM

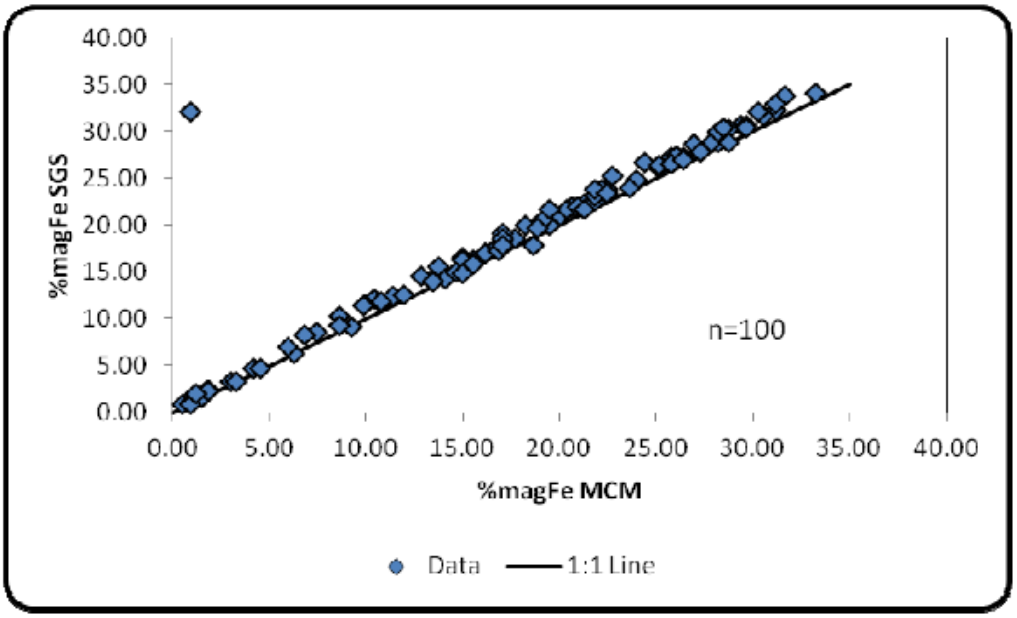


Figure 11.14 shows that % Fe_{tot} at both labs is very similar, with minimal bias. Figure 11.15 shows that Fe_{mag} at SGS-Lakefield by Satmagan is highly correlated with Fe_{mag} at MCM. However, it remains a little higher at SGS than at MCM, even after the MCM re-calibration. Clearly one sample is reporting an error caused by a sample mix-up. The sample that plots incorrectly on both Figure 11.14 and Figure 11.15 is

the same one (BI00207). For the statistical summary in Table 11.9, this sample has been removed; therefore, only 99 samples are used in the comparison.

Table 11.9: Comparison of MCM Assays (After Mag Re-Calibration) to SGS-Lakefield Assays for 100 Samples

	MCM (after re-calibration)		SGS-Lakefield-Assays		Difference Fe_{mag} (%)
	Fe_{tot} (%)	Fe_{mag} (%)	Fe_{tot} (%)	Fe_{mag} (%)	
N	99	99	99	99	99
Avg	31.56	17.54	31.58	18.53	-0.99
Median	32.30	17.70	32.17	18.67	-0.97

Note: one sample has been removed.

The SGS-Lakefield Fe_{mag} values from Satmagan are still higher than MCM, even after MCM's re-calibration of its instrumentation.

On 25 of the 100 samples sent to SGS-Lakefield, Davis Tube tests were completed. The samples were pulverized to 95% passing 45 um (325 mesh). SGS-Lakefield results for Fe_{mag}, calculated from the Davis Tube results against Fe_{mag} from Satmagan, are shown in Figure 11.16. Results for the two methods of determination are close, but the Satmagan numbers are generally a little higher.

Figure 11.16: %Fe_{mag} from Davis Tube vs. Satmagan for 25 selected samples: Determinations at SGS-Lakefield

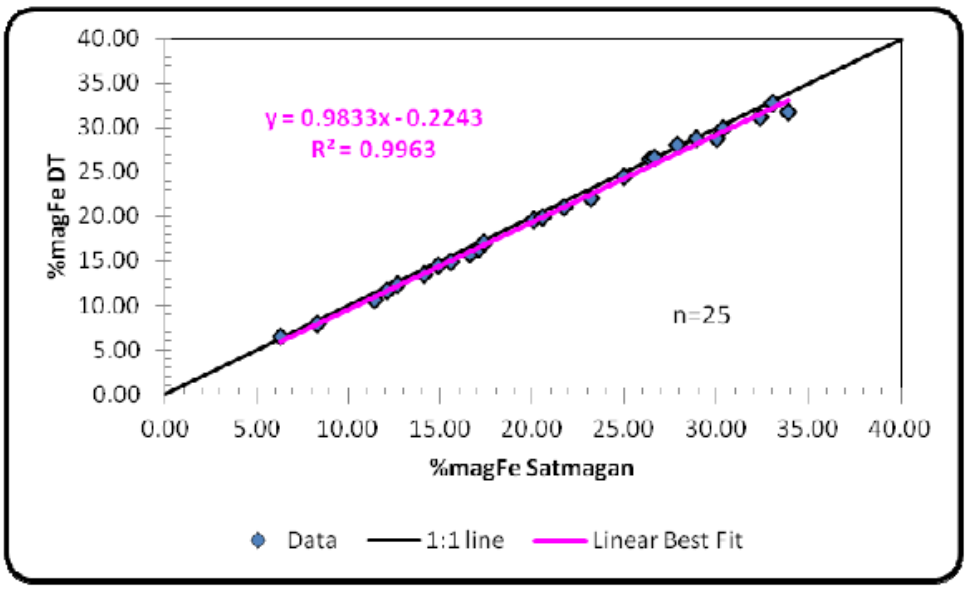


Figure 11.17 and Figure 11.18 show, respectively, the comparison of MCM and SGS for SiO_2 and P for the 99 samples.

Figure 11.17: Comparison of %SiO_2 at SGS-Lakefield vs. MCM for the 99 Samples

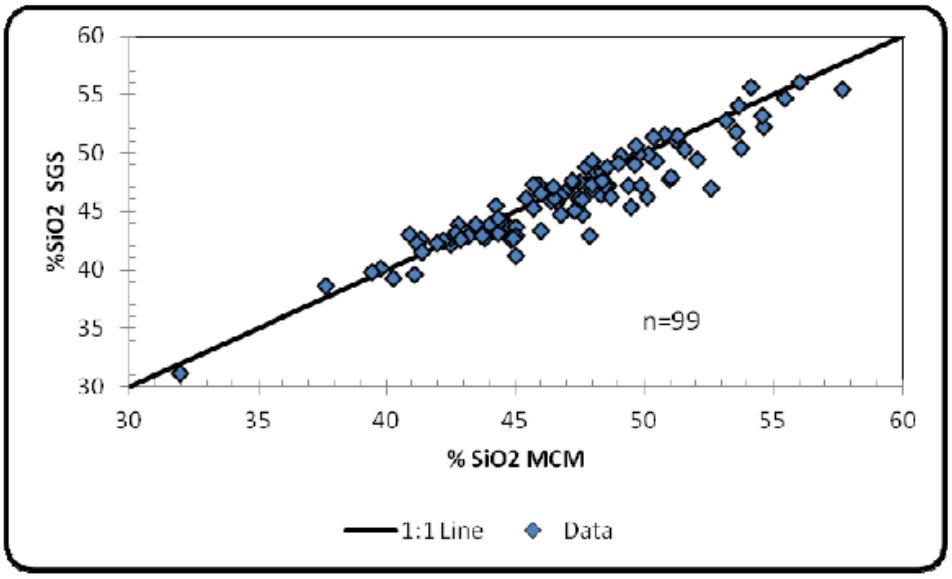
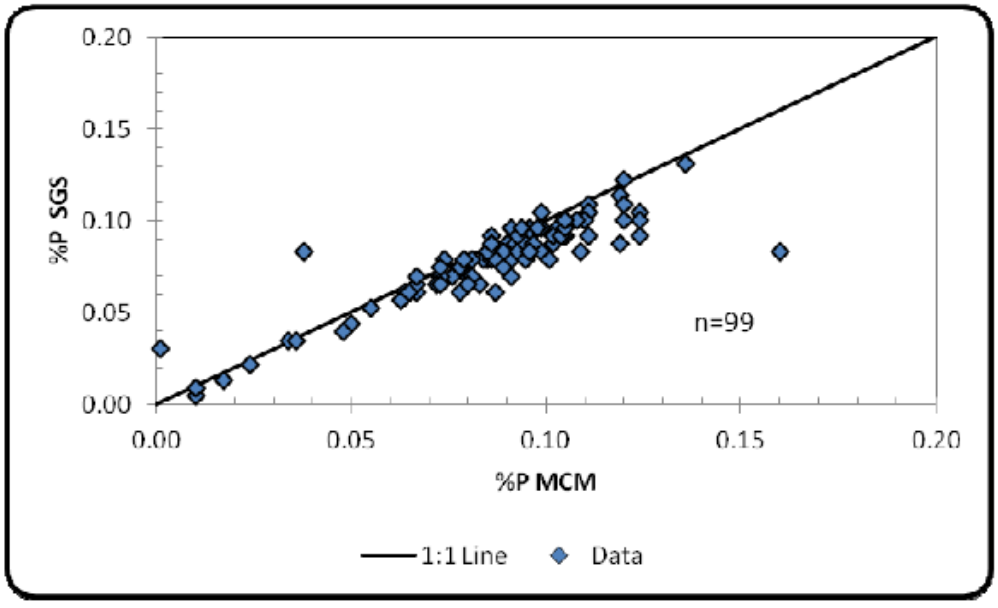


Figure 11.18: Comparison of %P at SGS-Lakefield vs. MCM for the 99 Samples



Based on the analysis of the 99 pulps at SGS-Lakefield, MCM's SiO_2 assays are a little too high and assays of P are significantly too high.

Based on the 99 samples check- assayed, Table 11.10 provides a statistical comparison summary for SiO_2 and P at MCM and SGS-Lakefield.

Table 11.10: Statisical Comparison of MCM Assays for SiO_2 and P to SGS-Lakefield Assays for 99 Samples

	SiO_2 (%) MCM	SiO_2 (%) SGS	SiO_2 Avg Diff (%)	P (%) MCM	P (%) MCM	P Avg Diff (%)
N	99	99	99	99	99	99
Avg	47.00	46.26	0.73	0.086	0.078	0.007
Median	47.24	46.20	1.04	0.090	0.083	0.007

3 Check-assaying at ALS in Australia

Early in 2012, Black Iron selected 35 of the aforementioned 100 samples and requested SGS-Lakefield to forward a portion of the pulps to ALS in Australia. The 35 samples at ALS were assayed for a variety of analytes, including major elements by XRF, magnetic susceptibility and FeO_T. Original assaying at MCM included the Project standard analytical package, including Fe_{tot}, Fe_{mag}, FeO_T, P and S_T. The above analytical summary shows that a complete comparison between all analytes cannot be completed between all labs because the samples were not analyzed for the same analytes at each lab.

Later in 2012, Black Iron selected and collected 115 routine samples and four Certified Reference Standards (2 each of FER-3 and P-010) from the archived sample pulps and rejects in storage at the Ukrainian core shed. When the samples were forwarded to ALS, magnetic susceptibility and FeO_T were determined.

Figure 11.19 and Figure 11.20 shows a comparison of Fe_{tot} between SGS-Lakefield, ALS and MCM for the original 35 samples sent for analysis at ALS.

Figure 11.19: Comparison of % Fe_{tot} at ALS vs. SGS-Lakefield

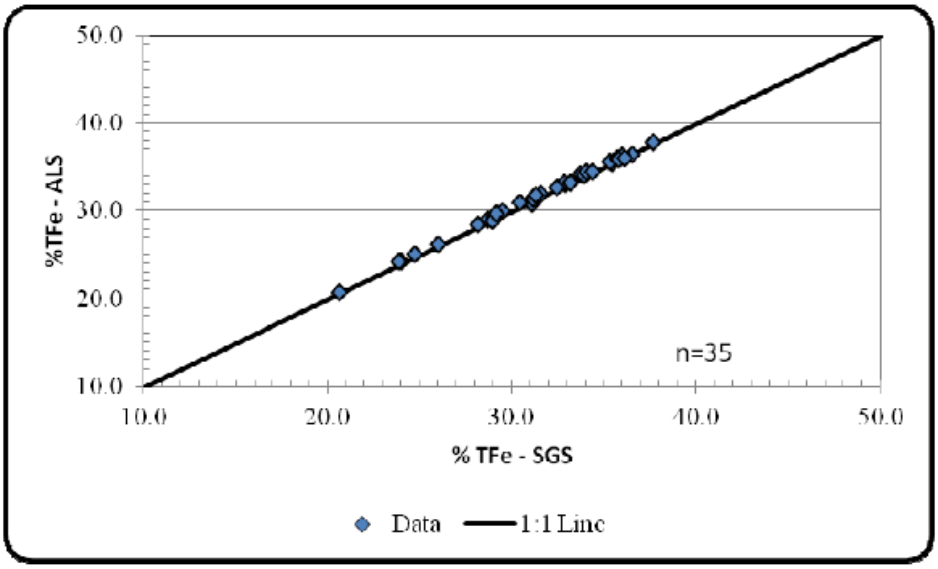
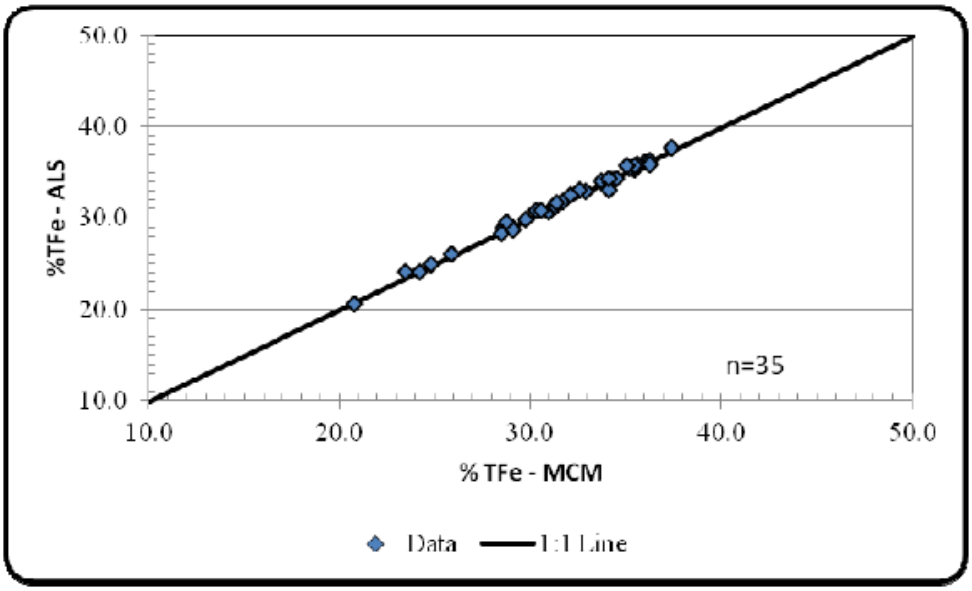


Figure 11.20: Comparison of % Fe_{tot} at ALS vs. MCM



The plots for Fe_{tot} show a very strong correlation and no bias between labs. These results are in accord with previous results, wherein previous sets of data have shown excellent agreement between MCM and SGS-Lakefield.

Figures 11.21 to 11.25 show comparisons between SGS-Lakefield, ALS and MCM for magnetic components for all samples checked at ALS. As mentioned above, ALS's magnetic susceptibility is

assumed by WGM to be equivalent to % Fe_3O_4. Given that MCM's results are in terms of Fe_{mag}, MCM's Fe_{mag} has been adjusted to %Fe_3O_4 by dividing MCM's values by 0.7236.

Figure 11.21: Comparison of magSusc at ALS vs. %Fe_3O_4 at SGS-Lakefield

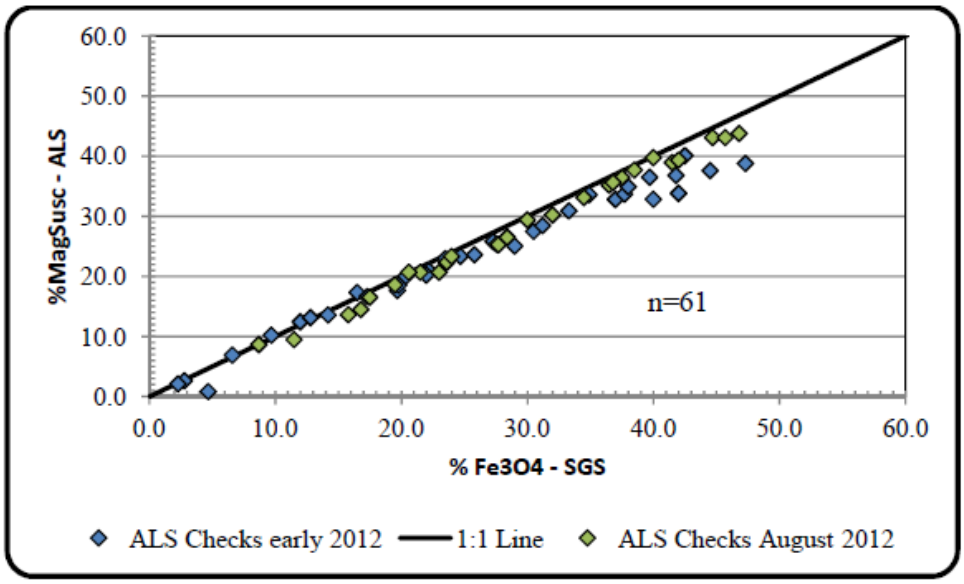


Figure 11.22: Comparison of magSusc at ALS vs. %Fe3O4 at MCM

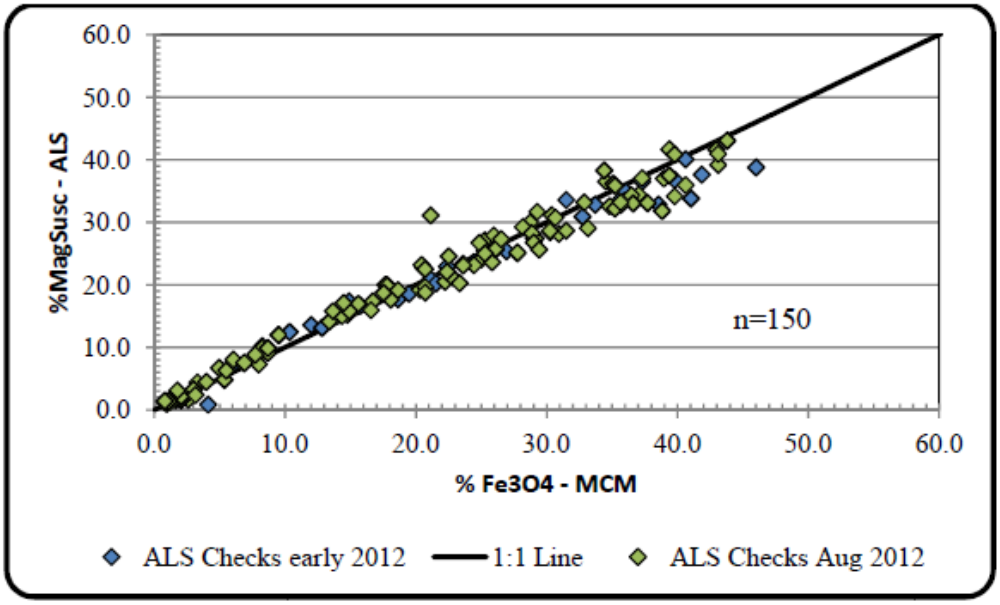


Figure 11.21 shows that results for SGS-Lakefield and ALS for magnetic iron are reasonably well correlated. At lower levels of Fe_3O_4, ALS and SGS-Lakefield results are similar; at higher levels, SGS-Lakefield's Fe_3O_4 are a little higher than they are at ALS.

The patterns shown in Figure 11.22 are similar. They reveal reasonably well-correlated values of Fe_3O_4 between MCM and ALS, while MCM shows values that are a little higher at higher magnetic iron levels. MCM is perhaps a little lower than ALS at lower magnetic iron levels.

Comparison of Figure 11.15 to Figure 11.21 and Figure 11.22 shows that magnetic iron results for SGS-Lakefield and MCM are better correlated than they are between MCM and ALS, or between ALS and SGS-Lakefield, which are very slightly higher. This latter observation is consistent with previous results.

This analysis of results for the samples are reassuring, in that MCM's magnetic Fe results post MCM re-calibration seem pretty close to those of SGS and ALS, but SGS-Lakefield may be a little too high.

Figure 11.23 shows a comparison of FeO_T, at MCM and ALS. FeO was not done on this batch of samples at SGS-Lakefield.

For many of the samples, the results appear to be reasonable, showing ALS values that are very slightly higher than those from MCM. It also appears, however, that ALS mixed up some of the samples.

Figure 11.23: Comparison of FeO_H at ALS vs. MCM

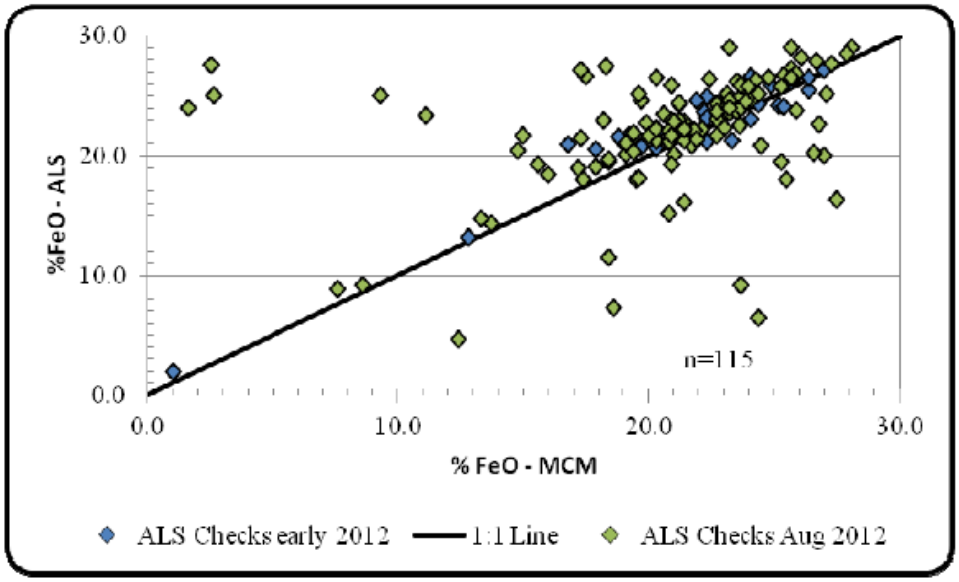


Figure 11.24, Figure 11.25 and Figure 11.26 show comparison of assay results for P. Figure 11.24 shows that P for ALS and SGS is closely equivalent. Figures11.25 and 11.26 show that P at MCM is higher than at ALS and SGS. The comparison for P for samples done at ALS is similar to that for 99 samples that were check-assayed at SGS-Lakefield (see Figure 11.18 and Table 11.10). MCM's assays likely exaggerate the P content of the mineralization.

Figure 11.24: Comparison of P at ALS vs. SGS-Lakefield

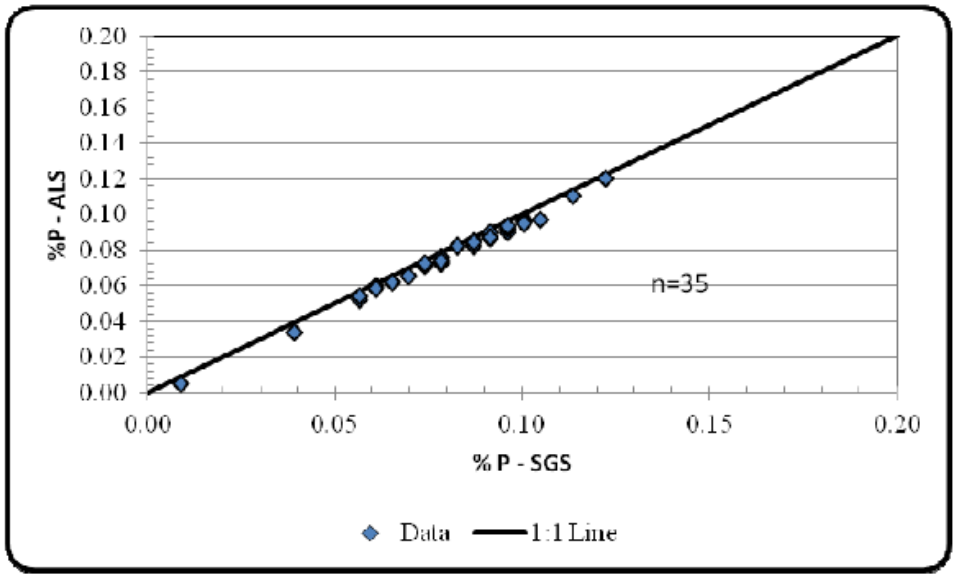


Figure 11.25: Comparison of P at ALS vs. MCM

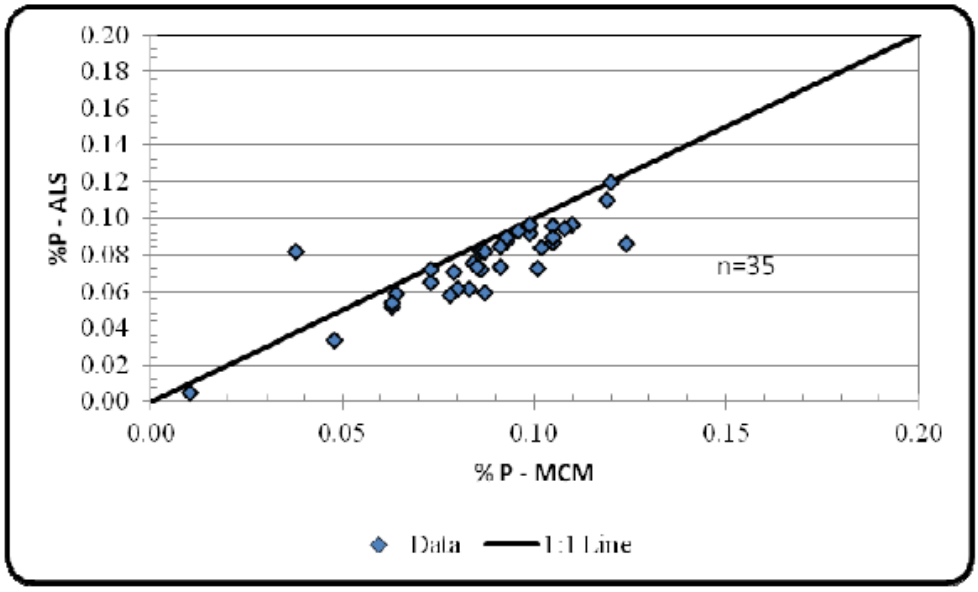


Figure 11.26: Comparison of P at SGS vs. MCM

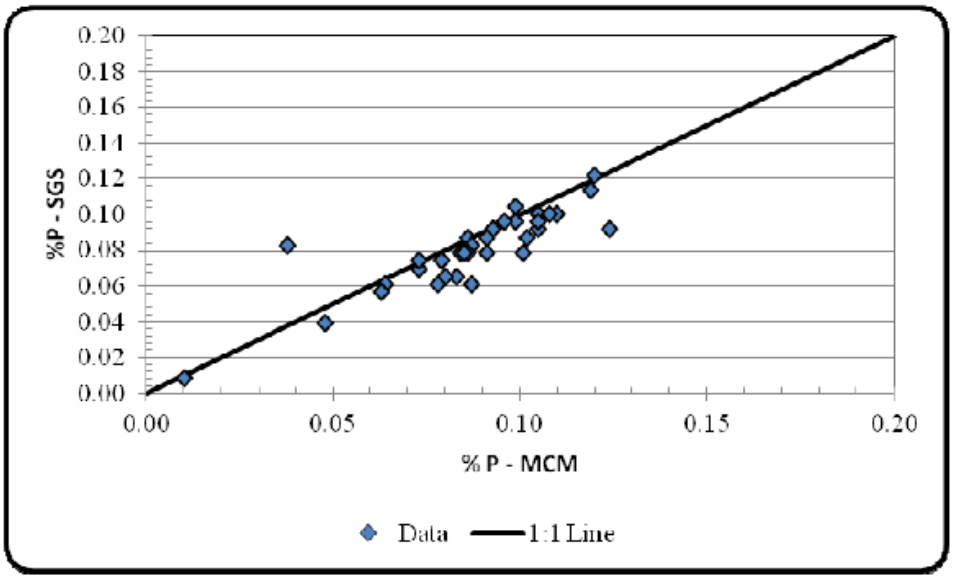
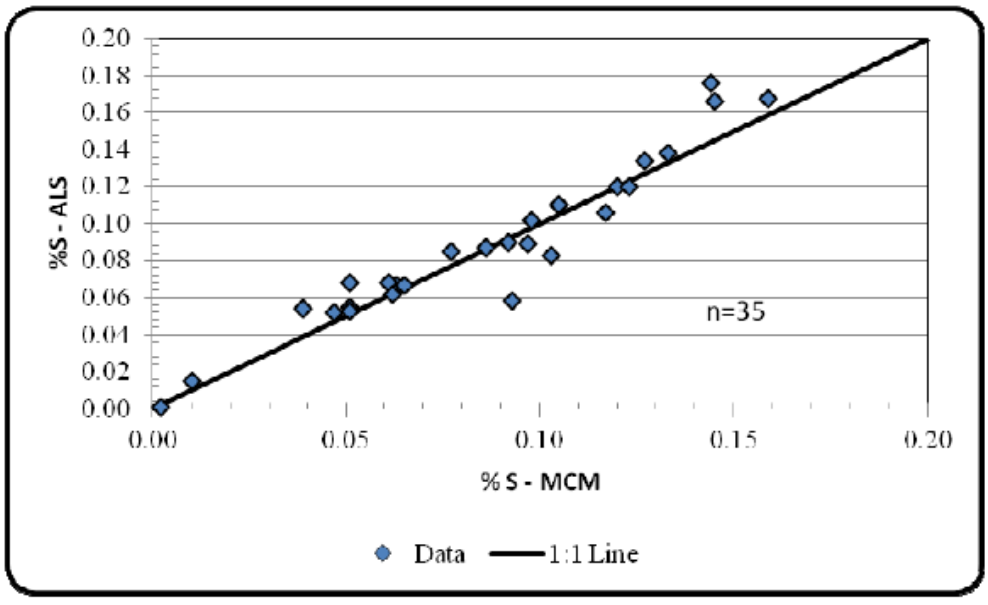


Figure 11.27 presents results for S_T at MCM and ALS. S was not determined for this batch of samples at SGS-Lakefield.

Figure 11.27: Comparison of S_T at ALS vs. MCM



The plot shows that S results between MCM and ALS are unbiased, indicating good accuracy, and that they are reasonably well correlated, but not highly correlated.

4 Re-determination of SG by pycnometer of selected samples at MCM

WGM first analyzed the density/SG data being generated by MCM in the fall of 2011. To do so, the company examined SG/Density versus % Fe_{tot} and %Fe_{mag} and surmised that the data appeared reasonably accurate. However, there was significant scattering with some samples reporting lower SG/density values than predicted by density/SG iron-grade modeling. After subsequent review, the archived drill core in Ukraine that corresponded to some of the samples appeared to have lower unexplained SG/density results, although WGM could find no obvious explanation for the lower values. In December 2011, WGM selected seven samples for checking. Black Iron requested MCM to complete determinations of SG by pycnometer on each pulp.

The original and check results for the seven samples are listed in Table 11.11.

Table 11.11: Check on Density/SG of Seven Samples Done at MCM in July 2012

Sample ID	Fe_{tot} (%)	Fe_{mag} (%)	FeO (%)	SG Pycn Orig	Bulk Density Orig	SG Pycn Check
BI00255	34.00	28.70	19.50		3.13	3.53
BI00265	30.80	23.20	19.70		3.11	3.39
BI00292	31.70	21.10	20.90		3.14	3.45
BI00537	30.20	16.30	23.20		2.95	3.32
BI00647	31.90	14.80	25.80		3.05	3.20
BI00998	31.20	21.80	20.30	3.15	3.17	3.26
BI01186	32.80	15.80	26.20	3.45	3.02	3.40

Generally, the SG check values are higher than the original bulk-density values for the samples. The new values plotted against % Fe_{tot} and %Fe_{mag} Head assays fit the predicted models much better. It could be argued that the higher pycnometer values, compared to bulk-density values, could be caused by the loss of existing porosity in natural samples through pulverization. However, this possibility was the reason for examining the drill core and no extraneous features, such as weathering or vugs, were found during this review. The core appeared to be good quality, normal magnetite-rich taconite.

WGM concludes that the new check results support the supposition that the original density determinations were low outliers, attributable to some laboratory error.

11.3.7 WGM Comment on Logging, Sampling and Assaying

Core recovery for taconite mineralization from Black Iron's drilling was generally high throughout. Therefore, core recovery for the taconite mineralization is not a factor affecting the reliability of Black Iron's results. Core recovery was understandably poor when drilling the limonite-goethite mineralization,

and some of the martite mineralization associated with the Gdansev-Saksagan contacts and associated faults. For the supergene mineralization, core recovery is a detrimental factor for reliability. However, this type of mineralization is not of significant economic interest to Black Iron.

Most of the historic drillholes were very steep to vertical. WGM believes that drillhole orientation for Black Iron's drilling and the historic programs was not optimal for interpreting geology and assessing some parts of the deposit, particularly the steeply dipping limbs of the anticline NW margin of the deposit. For the Twin-hole Phase I program, however, drilling steep holes was required in order to mimic the historic drillholes. For Black Iron's programs, steeply inclined holes were partly required because of the difficult drilling conditions. Access to drilling sites, because of mine waste and YUGOK interference, restricted collar location and also generated less than optimal drilling orientations. Drillhole location and drilling orientation are factors that affect the reliability of information but, for most part, any potentially detrimental effect is surmounted by the high-drilling density along the cross-sections. Drillhole location and drilling orientation remain a detrimental factor for exploring, interpreting and assessing the mineralization adjacent to the Gdansev-Saksagan contact. Again, this mostly affects the martite-limonite-goethite-altered mineralization occurring in this area but, to some extent, drilling orientation also affects adjacent taconite mineralization and reduces the reliability of sample assays and the distribution of mineralization information.

For the earliest historic programs, the mine waste wasn't a problem because it didn't exist at that time. The historic drillholes drilled NW to SE from the Archean basement to test the NW limb of the deposit were, however, not sufficiently long to thoroughly test the taconite and zones adjacent to the Gdantsev-Saksagan contact. The assaying and sampling of these historic drillholes testing the Gdantsev-Saksagan contact area were also insufficient, as Fe_{mag} was not determined in all samples and sampling was not very extensive.

On the basis of the review of historic sampling and assaying method descriptions available for the most recent Soviet programs (Section 11.3.2), WGM believes that sampling and assaying for these programs is generally reliable. The method descriptions outline high-quality work and attention was paid to assuring quality. Nothing, however, is known about the earliest Soviet drill programs because only the sample assay results are available. On the basis of Black Iron's twin-hole program results, as shown in report Section 10.2.3, WGM believes that Fe_{mag} assays of the historic campaigns are generally reliable, but assays for Fe_{tot}, for some of the campaigns cannot be relied upon and it is not clear which drillholes are affected.

On the basis of its review of drill core and "quick logs" completed, which included checking sample intervals and tags in Ukraine at Black Iron's core shed, WGM is satisfied that logging and sampling by the GEORESOURCE's personnel was of reasonable quality. Information gathered by WGM was compared against the database being built by GEORESOURCE for accuracy and representivity. The GEORESOURCE's personnel, in addition to capturing data and recording them in the database, also collected some descriptive data. WGM has not been able to review these logs because they are not in English and they have not been fully finalized. More details concerning WGM's validation process and procedures are contained in Section 12, "Data Verification."

WGM provided feedback to Black Iron after its site visits. WGM recommended that logging could be improved by taking more time. Use of hand-held magnetic susceptibility meters to log core, as recommended in WGM's original guidelines for Black Iron, would have also helped the company to conduct better logging.

WGM suggested based on its initial review of MCM assay results for the twin drillholes and also on a review of check- assay results at SGS-Lakefield that MCM's Fe_{mag} assays were perhaps biased slightly low, that its assays of Fe_{tot}, FeO_T, SiO_2 and S_T assays were accurate and precise-- and MCM's assays of P were biased too high.

Black Iron communicated this assessment to MCM, and it is the understanding of WGM that MCM acknowledged its assay values for Fe_{mag} as being slightly too low. To address this issue, MCM performed a recalibration of its magnetic saturation analyzer. The data were presented and critiqued for the 100 samples and the 35 samples of MCM's assay results, undertaken to validate the "new" calibration. Following this validation, the Fe_{mag} assay for the early program samples were all reissued by MCM and the new calibration was used for all subsequent samples.

WGM's continued its monitoring of MCM's assay results and collected more independent samples in Ukraine. As more assay data accrued, as described in Section 12.3, further assessment of MCM's assay data proceeded. WGM became concerned with the fact that MCM Fe_{mag} assays for routine samples increased after the re-calibration, but assays on the Certified Reference Standards, FER-3 and P-010, did not (see Section 12.4, "Data Verification"). Comparison of Fe_{mag} assays pre-new calibration and post-new calibration also shows some irregularities associated with samples adjacent to the Certified Reference Standards in the assay sequence.

In conclusion, on the basis of all the sample assays from secondary laboratories, WGM is satisfied that MCM's assays for the routine samples are generally reliable. As aforementioned, Fe_{tot}, FeO_T, SiO_2 and S_T assays are accurate and precise, although MCM's assays of P are biased too high. MCM's final assays for Fe_{mag} are generally reasonably accurate and precise. For very few samples, depending on the assaying sequence, Fe_{mag} values may be very slightly too low. Because of the aforementioned assay irregularities that are not understood, WGM cautions that the Fe_{mag} assays for control samples such as FER-3 and P-010, or any of the others inserted by MCM and not "blind" to MCM such as those summarized in Tables 11.4, 11.6 and 11.7, and shown on Figure 11.2 to Figure 11.7 should not be relied upon.

12 DATA VERIFICATION

Drill core samples collected for Black Iron as part of the 2011 drilling programs were submitted by GEORESOURCE's to MCM, SGS-Lakefield and ALS. WGM understands that MCM is accredited under Ukrainian regulations and holds an ISO 9001:2009 certification for quality management systems. SGS-Lakefield is fully accredited under ISO 9001 and ISO 17025, for specific laboratory procedures. ALS is similarly accredited under ISO 9001 and ISO 17025, for specific laboratory procedures. Although WGM has reviewed the assay results generated by MCM and SGS-Lakefield and believes the results are generally accurate, WGM is relying on the two labouratories as independent experts in the field of analyses.

WGM Senior Associate Geologist, Mr. Richard Risto, P.Geo., QP, visited the Property four times in 2011 to assist with implementation of sampling and assaying protocols verification of drilling and to complete independent sampling. WGM's first site visit was completed between April 11 and April 18; site visit two between May 22 and May 29; site visit three between June 27 and July 3; and site visit four between December 12 and 17. WGM reviewed the Black Iron program results with Black Iron's senior Geologist, Mr. Farshid Ghazanfari, P.Geo, and the GEORESOURCE personnel conducting the program. Mr. Risto collected independent drill core samples during the second, third and fourth site visits for independent assaying.

Other Data Verification activities included:

1. Witnessing Black Iron drilling in process and confirming that the drilling was being conducted on the Property. Independently validating the collar coordinates of a number of the drillholes comprising Black Iron's drilling program to a reasonable degree using a hand-held GPS. Also checking the azimuths and the inclinations of a number of the drillholes.
2. Confirming that iron formation was being cored;
3. Confirming that the lithological information being logged by the drilling rig geologists was reasonably representative of the lithologies intersected in the drillholes;
4. Confirming that the sample information recorded by the GEORESOURCE samplers was reasonably accurate;
5. Confirming by observation the presence of previous drilling on the Property. WGM witnessed the presence of six historic drill casings on the Property that could likely be drillholes in the historic database.
6. Confirming that the geophysical surveys conducted for Black Iron by Abitibi were performed on the Property;
7. Reviewing a selection of assay information for historic drillholes in historic documents and confirming that Black Iron's assay database accurately portrayed this information;

8. Checking historic Soviet maps, cross-sections and tabulated data to validate drillhole collar locations and attitudes, as portrayed in Black Iron's database;
9. Completing analysis of Black Iron's assay data from its primary and secondary labs and confirming agreement between assays and geology in drill cores;
10. Completing geological interpretation of the deposit and verifying agreement between drillhole geology and Abitibi geophysical survey results;
11. Collecting independent samples of mineralization and submitting them independently for assaying. Completing an analysis of results by comparing primary lab assays to secondary lab assays in order to verify and validate primary lab assaying and GEORESOURCE's sampling.

The most important aspects of WGM's Data Verification are explained more fully below, under separate headings.

12.1 Validating Diamond Drilling in Progress and Confirming Iron Formation was Being Cored in Black Iron Drillholes

During its site visits, WGM visited the drills in progress for both the Phase I and II drilling programs. During these visits, WGM confirmed the coordinates of the drillhole collars to be similar to those which had been proposed and confirmed that they were located on the Property.

Table 12.1 lists the drillholes checked by WGM, using a hand-held GPS during its site visits while drilling was in progress or after drill dismount and compares these coordinates to the coordinates listed in the 2005 drillhole database for the corresponding historic holes. The final surveyed coordinates for Black Iron's drillhole collars from the Project surveyors TNT TPI are also listed.

The coordinates are generally reasonably close, within a few metres, which is the accuracy of the hand-held GPS method and therefore validate the locations of the Black Iron collars.

Table 12.1: WGM Check of Collar Locations During Drilling

Hole ID	WGM Easting	WGM Northing	2005 DB Easting	2005 DB Northing	TNT TPI Final Easting	TNT TPI Final Northing
BI21674-T	520530	5298073	520527.16	5298063.94	520527.077	5298064.176
BI5485-T	520413	5298131	520402.52	5298119.46	520409.299	5298120.096
BI20287-T	520344	5298657	520339.73	5298645.71	520342.204	5298649.517
BI21704-T	520216	5298837	520209.48	5298835.94	520212.476	5298832.183
BI20289-T	520138	5298707	520125.92	5298703.18	520130.903	5298702.064
BI21707-T	520679	5298698	520676.80	5298685.69	520678.263	5298687.338

Hole ID	WGM Easting	WGM Northing	2005 DB Easting	2005 DB Northing	TNT TPI Final Easting	TNT TPI Final Northing
BI20342-T	520639	5298716	520633.31	5298712.58	520631.768	5298716.313
BI21687-T	520495	5298387	520497.07	5298398.71	520490.653	5298396.119
BISH-80	520655	5297987	-	-	520656.105	5297992.943
BISH-67	520094	5298583	-	-	520090.582	5298577.651
BISH-62	520102	5298551	-	-	520086.724	5298558.996
BISH-66	520064	5298478	-	-	520056.821	5298472.753
BISH-70	520088	5298229	-	-	520084.768	5298225.152
BISH-29	520706	5298678	-	-	520707.807	5298671.502

Note: Coordinates are UTM, WGS 84, Zone 36N

12.2 Confirming Historic Casings

During the site visits, WGM also witnessed the existence of six historic drill casings on the Property. These six casings are listed in Table 12.2. Several of them were located close to Twin-hole collar locations to which they are believed to correspond. All of these casings, except for one, were shown to WGM by GEORESOURCE. The one exception, labelled T-6 in the Table, was spotted by WGM during a visit to Black Iron's drillhole BISH-33, in progress at that time.

Table 12.2: WGM Check of Historical Casing Locations

ID	Hole ID (Assumed)	WGM Easting	WGM Northing	2005 DB Easting	2005 DB Northing
1	21708	520804	5298642	520807.84	5298635.91
2	21704	520213	5298840	520209.48	5298835.94
3	20287	520345	5298653	520339.73	5298645.71
4	13302	520537	5298540	520535.91	5298536.03
5		519988	5298377		
6	T-6	520449	5298769		

Note: Coordinates are UTM, WGS 84, Zone 36N

As mentioned in this report, in Section 9.4, seven other historic casings were subsequently identified on the Property and surveyed, but the six listed in Table 12.2 have not yet been surveyed by the Project surveyors. The locations of the first four listed in Table 12.2 appear to correspond reasonably well with historic drillholes, with differences of up to 11m. The casing indexed as Number 5 corresponds with no known drillhole. This casing was at least 10cm in diameter and stood 1m above ground surface. Some pieces of un-split drill core were lying beside it.

The casing identified with an ID of Number 6 also corresponds to no known historic drillhole. However, its location does correspond to an indication marked in pencil on the 1989 Soviet Property Geology map as T-6. On this map, other T-holes are also marked. These marks were previously understood to be planned locations, rather than actual drillhole locations, but the identification of the casing at the T-6 location and the other casing labelled as 5 suggests that some additional undocumented drilling may have taken place on the Property.

12.3 Confirming Validity of GEORESOURCES Core Logging and Sampling

WGM “quick” logged a number of Black Iron Phase I and II cores at the GEORESOURCE core shed during its site visits. During this process, WGM confirmed that the GEORESOURCE logging was reasonably accurate with its lithostratigraphic coding that generally agreed with WGM’s observations. Some suggestions for improving the logging process were provided to GEORESOURCE to prompt improvements in future.

During this process, WGM also checked the locations of sample intervals and sample identifiers for agreement with locations recorded in the database, and found no errors.

12.4 Independent Sampling and Assaying

WGM completed independent sampling of Black Iron’s half-split drill core and assay pulps prepared by MCM during its second, third and fourth site visits to the Property. In total, WGM collected 23 samples of half-split core and 93 pulps (one pulp was lost in transit, providing 92 for assay at SGS-Lakefield). To this stream, WGM inserted instances of two Certified Reference Standards: CANMET’S FER-3 and the Ukrainian Standard P-010.

The pulps were collected from second pulps prepared by MCM. The laboratory protocol called for MCM to prepare a second 100g pulp for every sample processed. MCM riffled this material out of the pulverized fraction. One pulp went to analysis at MCM; the second pulp was put aside for our use. During its visits, WGM selected the pulps and sub-sampled each one, extracting 20 to 30g and placed this material in small bags. The samples were selected by WGM to be representative of the entire assay/sample program, with samples taken from each of the sample shipment/MCM certificate batches. The samples were also selected to span the range of mineralization represented by a range of MCM assay results.

The drill core samples were sampled by WGM from the core boxes. For the most part, WGM's samples represented the remainder of the half-split core left in the core trays after original sampling for MCM assaying. All but two of WGM's samples correspond to GEORESOURCE's samples.

These samples were assigned new sample identities, placed in sample bags with tamper-evident closures and shipped to SGS-Lakefield. It is important to note that the identity of the samples was not known to MCM, GEORESOURCE, Black Iron, or SGS-Lakefield. Upon arrival, SGS-Lakefield performed an inspection of the bags and reported that they were in good shape, showing no evidence of tampering.

At SGS-Lakefield, each sample was analyzed for major elements by lithium metaborate fusion Whole Rock–X-Ray Florescence (WR-XRF); FeO_T was determined by H_2SO_4/HF acid digest potassium dichromate titration; Fe_{mag} was determined by Satmagan: and S_T by LECO. Each sample also had SG determined on pulp, by gas comparison pycnometer. Bulk density was determined on each of the core samples (not the pulps) prior to crushing, using the weighing–in-water/weighing-in-air method.

The pulps required no sample preparation at SGS-Lakefield. The drill core samples were cone crushed to nominal ¼" and then a 1kg sub-sample was riffled out. The sub-sample was stage-crushed to 10-mesh (2mm), a 100g was pulverized in a ring pulverizer to 200-mesh (75µm), and then sent for analysis.

Each of the samples collected during WGM's fourth site visit was split into two portions, one portion going to SGS-Lakefield and the second portion going "blind" to MCM for re-assay, using the analytical package standard to the project.

Analysis of Initial Analytical Results

Samples collected during WGM's second and third site visits aggregated 53 pulps and 18 half-split drill core samples, including six Certified Reference Standards. Initial interpretation of analytical results for these samples showed that results for Fe_{tot}, SiO_2, Fe_{OT}, and S_T were closely comparable between SGS-Lakefield and MCM. However, for Fe_{mag}, initial results showed that MCM values were lower than SGS-Lakefield values. An analysis of the Twin drillhole results was completed at the same time, by comparing assay results in Black Iron's Twin drillholes with its corresponding historic twin. Fe_{mag} values returned for Black Iron's samples were also generally lower than historic values. These two findings suggested that MCM's Fe_{mag} values were generally 2%-4% lower.

Figure 12.1 shows SGS-Lakefield assays of Fe_{mag} by Satmagan, plotted against original MCM assays.

Figure 12.1: %Fe_{mag} at SGS-Lakefield vs. MCM on WGM Duplicate Pulps and Second half drill Core Samples

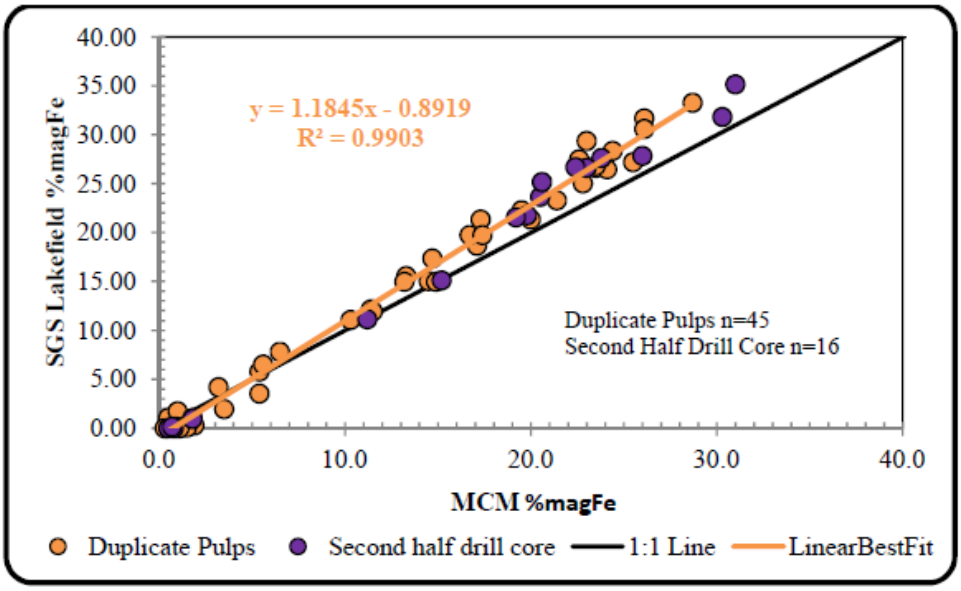


Table 12.3 and Table 12.4 report the SGS-Lakefield results for WGM control samples for comparison with MCM pre-saturation magnetizer recalibration assays and certified values.

Section 11-2 provides further description of this issue, for which the outcome was that MCM completed a re-calibration of its saturation magnetization analyzer and re-issued revised Fe_{mag} values for all its samples done prior to this re-calibration. All samples submitted and assayed after this re-calibration were done using the "new" calibration.

Results after MCM Saturation Magnetizer re-Calibration

After the re-calibration at MCM was completed, WGM collected additional samples of pulps and half-core on subsequent visits to the site. Tables 12.5, 12.6 and 12.7 list analytical results for the duplicate pulp and second half-core samples selected by WGM and assayed at MCM and SGS-Lakefield. Fe_{mag} values in these tables and in subsequent plots of analytical results use only the Fe_{mag} values from the "new" calibration.

Table 12.3: Assay Results for the Fer-3 Standard at MCM and SGS-Lakefield

	pct Fe_{tot}	pctFe_{mag}	pctFeO_T	pctSiO_2	pctP	pctS_T	SG
Assays at MCM - Pre-magnetization Saturation Analyser Re-Calibration							
Count	132	130	129	131	131	132	
Avg	31.17	28.17	13.27	53.05	0.034	0.033	
Median	31.20	28.15	13.30	53.04	0.035	0.030	
Min	30.90	27.70	12.90	52.24	0.017	0.026	
Max	31.40	28.70	13.80	53.50	0.040	0.300	
Assays at MCM - Post-magnetization Saturation Analyser Re-Calibration							
Count	250	248	247	249	249	250	
Avg	31.19	28.36	13.26	53.06	0.034	0.032	
Median	31.20	28.40	13.30	53.04	0.034	0.030	
Min	30.90	27.70	12.90	52.24	0.017	0.026	
Max	31.40	30.40	13.80	53.50	0.040	0.300	
WGM inserted FER-3 Duplicate Pulps – Assays at SGS-Lakefield							
Count	8	8	8	8	8	8	8
Avg	31.20	31.06	13.89	53.38	0.029	0.031	3.42
Median	31.15	31.19	13.80	53.40	0.031	0.030	3.40
Min	30.90	30.61	13.80	53.10	0.026	0.030	3.35
Max	31.50	31.48	14.10	53.60	0.031	0.040	3.57
Certified Values	31.15	-	13.63	53.61	0.030	0.030	

Table 12.4: Assay Results for the P-010 Standard at MCM Pre Mag Recalibration and SGS-Lakefield

	pctTFe	$pctFe_{mag}$	$pctFeO_T$	$pctSiO_2$	pctP	$pctS_T$	SG_T
MCM inserted P-010 - Assays at MCM - Pre-magnetization Saturation Analyser Re-Calibration							
Count	63	63	63	63	63	63	
Avg	36.85	26.82	15.18	39.35	0.050	0.137	
Median	36.90	26.80	15.20	39.30	0.05	0.14	
Min	36.70	26.50	15.00	39.16	0.040	0.124	
Max	37.10	27.00	15.40	39.70	0.056	0.149	
Assays at MCM - Post-magnetization Saturation Analyser Re-Calibration							
Count	216	216	216	216	216	216	
Avg	36.83	26.83	15.17	39.36	0.05	0.14	
Median	36.80	26.80	15.20	39.34	0.05	0.14	
Min	36.60	26.40	14.90	38.88	0.04	0.12	
Max	37.10	27.30	15.50	39.72	0.06	0.15	
WGM inserted P-010 Duplicate Pulps – Assays at SGS-Lakefield							
Count	7	7	7	7	7	7	7
Avg	36.87	28.54	15.71	39.57	0.04	0.14	3.62
Median	37.00	28.44	15.70	39.50	0.04	0.14	3.63
Min	36.50	27.93	15.50	39.50	0.04	0.12	3.51
Max	37.10	29.23	16.10	39.70	0.04	0.15	3.68
Certified Values	36.82	26.9		39.4			

Table 12.5: MCM and SGS-Lakefield Assay Results for WGM Duplicate Pulps

Original Sample ID	WGM Sample ID	MCM Fe_{tot}	SGS Fe_{tot}	MCM $pctFe_{mag}$	SGS Fe_{mag}	MCM FeO_T	SGS FeO_T	MCM SiO_2	SGS SiO_2	MCM P	SGS P	MCM S_T	SGS S_T	MCM BDensity	MCM PycSG	SGS PycSG
BI00022	BICH-01	31.30	31.1	18.70	18.67	22.80	23.4	40.66	43.1	0.11	0.09	0.28	0.24	3.3		3.45
BI00047	BICH-02	30.20	31.5	22.40	21.35	19.10	22.4	48.14	48.3	0.07	0.07	0.96	0.78			3.49
FER-3	BICH-03		31.2		30.68		13.8		53.5		0.03		0.03			3.40
BI00069	BICH-04	16.90	16.9	1.20	1.01	19.40	19.4	55.74	56.1	0.06	0.05	0.41	0.34			3.01
BI00082	BICH-05	31.50	31.1	21.20	22.00	20.30	20.8	48.66	47.2	0.08	0.08	0.09	0.08			3.42
BI00110	BICH-06	35.50	35.2	26.80	28.37	20.60	21.0	44.16	42.7	0.08	0.07	0.08	0.07			3.60
BI00141	BICH-07	25.60	25.3	5.80	5.79	21.00	26.0	52.12	51.4	0.08	0.07	0.15	0.14			3.29
BI00217	BICH-08	33.40	34.1	26.40	26.63	19.70	19.6	47.60	44.6	0.11	0.10	0.10	0.07			3.52
BI00267	BICH-09	30.40	30.1	16.10	15.05	24.50	25.0	49.14	47.8	0.11	0.10	0.12	0.11			3.43
BI00292	BICH-10	31.70	31.8	21.10	22.29	20.90	20.7	48.10	46.8	0.11	0.10	0.08	0.08	3.14		3.50
BI00398	BICH-11	35.50	36.2	28.50	31.69	19.50	18.9	46.90	41.7	0.10	0.07	0.03	0.05			3.58
BI00398	BICH-12	35.50	35.7	28.50	30.61	19.50	20.0	46.90	43.2	0.10	0.10	0.03	0.05			3.52
BI00418	BICH-13	15.90	15.8	0.90	1.09	17.50	17.9	57.94	56.2	0.06	0.06	0.40	0.41			3.00
BI00426	BICH-14	26.40	27.0	6.00	6.51	27.00	28.2	54.86	49.8	0.07	0.07	0.10	0.12	3.22		3.30
BI00468	BICH-15	36.50	36.0	31.10	33.29	18.20	18.4	46.18	42.4	0.10	0.10	0.05	0.06			3.59
BI00497	BICH-16	28.50	28.7	14.90	15.56	22.70	23.0	48.32	48.1	0.08	0.08	0.10	0.10			3.38
BI00523	BICH-17	26.90	26.4	6.90	7.81	26.60	26.1	51.94	51.6	0.08	0.07	0.07	0.08	3.16		3.27
BI00537	BICH-18	30.20	30.0	16.30	17.37	23.20	23.3	48.00	47.6	0.09	0.07	0.11	0.12	2.95		3.40
BI00547	BICH-19	10.10	10.1	1.40	1.74	11.10	10.2	56.64	54.6	0.04	0.02	1.69	1.66			2.86
BI00553	BICH-20	23.10	23.6	3.60	4.20	25.90	25.8	55.66	54.6	0.13	0.09	0.16	0.18			3.20
BI00584	BICH-21	36.30	36.5	25.00	27.50	23.50	23.7	45.34	41.7	0.08	0.08	0.09	0.08			3.57
FER-3	BICH-22		30.9		30.61		13.8		53.2		0.03		0.03			3.35
BI00635	BICH-23	33.40	33.2	18.90	21.35	23.70	23.7	45.80	45.1	0.11	0.10	0.13	0.13			3.58
BI00656	BICH-24	32.90	32.5	18.30	19.75	23.50	23.5	46.20	46.1	0.10	0.09	0.07	0.07			3.47
BI00710	BICH-25	36.20	35.5	25.40	29.38	20.30	20.8	46.72	44.3	0.10	0.09	0.06	0.06			3.47
P-010	BICH-26		36.5		27.93		15.7		39.5		0.04		0.12			3.66

Original Sample ID	WGM Sample ID	MCM Fe_{tot}	SGS Fe_{tot}	MCM $pctFe_{mag}$	SGS Fe_{mag}	MCM FeO_T	SGS FeO_T	MCM SiO_2	SGS SiO_2	MCM P	SGS P	MCM S_T	SGS S_T	MCM BDensity	MCM PycSG	SGS PycSG
BI00778	BICH-27	64.10	64.3	5.80	3.55	2.60	2.5	4.04	4.0	0.02	0.01	0.00	0.02			4.79
BI00794	BICH-28	34.20	34.3	1.30	0.14	1.60	1.5	49.16	50.0	0.02	0.01	0.01	0.01			3.55
BI00863	BICH-29	33.60	33.9	25.20	25.04	20.90	20.6	44.96	44.5	0.09	0.07	0.14	0.13			3.51
BI00958	BICH-30	29.20	29.4	16.50	14.98	22.70	23.5	54.56	50.9	0.10	0.10	0.15	0.13			3.38
BI01002	BICH-31	29.10	29.2	13.00	12.16	19.60	25.4	48.80	49.0	0.11	0.10	0.15	0.14			3.40
FER-3	BICH-32		31.1		30.75		13.8		53.6		0.03		0.03			3.40
BI01013	BICH-33	21.60	21.5	2.20	1.01	24.40	23.8	49.62	54.7	0.07	0.07	0.14	0.14			3.13
BI01072	BICH-34	12.10	11.8	1.50	0.07	12.40	12.7	57.28	56.9	0.05	0.04	0.31	0.33			2.97
BI01107	BICH-35	31.70	31.6	13.10	11.94	26.70	26.8	45.50	45.5	0.04	0.03	0.13	0.12			3.42
BI01132	BICH-36	35.70	35.5	25.50	27.21	20.30	20.7	40.00	42.5	0.09	0.09	0.06	0.06	3.34	3.46	3.57
BI01157	BICH-37	21.20	21.1	2.20	1.01	7.60	8.9	54.52	54.4	0.07	0.07	0.02	0.02			3.04
BI01180	BICH-38	28.40		11.30		23.70		46.18		0.07		0.78				
BI01307	BICH-39	35.70	35.4	26.50	26.48	21.70	22.0	43.90	43.0	0.08	0.07	0.06	0.06			3.57
FER-3	BICH-40		31.1		31.33		14.0		53.3		0.03		0.03			3.42
BI01352	BICH-41	15.80	15.8	1.50	0.07	17.90	18.1	57.12	56.8	0.06	0.05	0.33	0.33			3.03
P-010	BICH-42		36.5		28.15		15.6		39.7		0.04		0.14			3.68
BI01364	BICH-43	31.70	31.6	14.80	14.98	24.80	25.8	46.20	46.3	0.09	0.09	0.10	0.09			3.46
BI01366	BICH-44	35.20	34.9	23.80	23.30	21.20	23.1	44.00	44.4	0.10	0.10	0.05	0.06			3.57
BI01373	BICH-45	18.80	18.8	2.30	0.29	17.30	21.3	56.66	57.0	0.07	0.07	0.19	0.21			3.10
BI01463	BICH-46	17.00	17.0	1.90	0.07	18.40	19.7	55.92	56.2	0.07	0.05	0.99	0.93			3.01
BI01470	BICH-47	28.00	28.5	10.70	11.07	22.40	24.0	49.88	50.3	0.07	0.06	0.55	0.56			3.36
BI01485	BICH-48	35.30	35.0	25.90	26.85	21.40	22.4	44.80	44.5	0.10	0.09	0.06	0.05			3.64
BI01499	BICH-49	23.20	23.2	3.90	1.95	24.30	26.2	53.28	53.6	0.08	0.07	0.34	0.29			3.23
BI01504	BICH-50	31.20	31.3	19.00	19.75	19.90	21.6	47.72	48.2	0.12	0.12	0.09	0.07			3.47
BI01538	BICH-51	12.90	12.9	1.50	0.00	13.70	15.0	58.54	59.0	0.05	0.05	0.39	0.40			2.97
BI01566	BICH-52	7.40	7.6	0.70	0.00	8.60	9.1	42.68	42.6	0.02	0.01	0.25	0.21			2.95
BI01950	BICH-53	9.20	9.3	1.10	1.16	8.90	10.8	45.32	44.5	0.01	0.00	0.01	0.02			3.06
BI01952	BICH-54	33.40	33.4	20.80	24.75	19.30	20.5	41.00	41.5	0.11	0.09	0.17	0.14			3.43

Original Sample ID	WGM Sample ID	MCM Fe_{tot}	SGS Fe_{tot}	MCM $pctFe_{mag}$	SGS Fe_{mag}	MCM FeO_T	SGS FeO_T	MCM SiO_2	SGS SiO_2	MCM P	SGS P	MCM S_T	SGS S_T	MCM BDensity	MCM PycSG	SGS PycSG
BI02002	BICH-55	25.50	25.7	4.40	5.93	25.80	25.5	51.46	51.8	0.06	0.06	0.38	0.33			3.26
BI02142	BICH-56	33.50	33.9	18.10	17.80	26.10	27.4	44.40	44.8	0.06	0.06	0.56	0.50			3.48
BI02149	BICH-57	35.20	35.3	26.00	26.05	21.20	22.5	43.66	43.8	0.08	0.07	0.15	0.13			3.51
P-010	BICH-58		37.1		29.23		16.1		39.5		0.04		0.14			3.57
BI02254	BICH-59	31.20	31.3	15.30	13.68	26.80	9.5	47.60	47.7	0.11	0.10	0.08	0.08			3.41
BI02278	BICH-60	27.60	27.4	2.40	2.89	31.10	31.4	49.84	49.8	0.08	0.07	0.14	0.14			3.35
BI02321	BICH-61	27.20	27.5	9.70	0.94	21.70	21.1	44.48	44.8	0.08	0.07	0.18	0.16			3.28
BI02330	BICH-62	18.80	18.9	1.10	0.94	21.20	22.5	55.96	56.2	0.07	0.07	0.31	0.30			3.03
BI02389	BICH-63	29.20	29.4	12.80	14.47	23.70	24.8	48.02	49.5	0.08	0.07	0.10	0.10			3.36
FER-3	BICH-64		31.1		31.26		14.1		53.1		0.03		0.03			3.41
BI02410	BICH-65	33.90	32.9	22.80	25.47	13.30	14.0	49.94	49.3	0.02	0.02	0.03	0.02			3.46
BI02412	BICH-66	34.40	34.3	20.10	19.68	17.20	18.2	43.98	44.2	0.02	0.02	0.04	0.05			3.45
BI02530	BICH-67	26.90	27.1	10.40	10.56	23.90	25.2	52.52	52.5	0.08	0.08	0.20	0.19			3.24
BI02538	BICH-68	30.50	30.6	17.70	17.00	23.10	24.5	48.40	48.5	0.08	0.08	0.06	0.05			3.43
BI02547	BICH-69	35.20	35.3	28.10	26.27	20.00	21.5	42.88	43.3	0.10	0.09	0.07	0.06			3.62
P-010	BICH-70		36.9		28.80		15.9		39.7		0.04		0.14			3.58
BI02555	BICH-71	25.50	25.9	6.30	6.51	25.70	26.9	50.40	52.4	0.08	0.08	0.23	0.22		3.28	3.24
BI02691	BICH-72	33.90	34.1	18.40	20.04	23.70	25.6	44.52	45.6	0.11	0.10	0.22	0.18			3.74
BI02693	BICH-73	27.20	27.4	10.80	11.94	20.90	22.7	49.50	51.8	0.09	0.08	0.19	0.16			3.25
BI02713	BICH-74	26.60	26.4	4.00	4.41	28.10	29.1	51.12	51.3	0.08	0.08	0.16	0.16			3.30
BI02762	BICH-75	22.50	22.5	0.60	0.87	25.70	26.9	53.24	54.4	0.08	0.08	0.16	0.16			3.13
FER-3	BICH-76		31.3		31.11		14.0		53.2		0.03		0.03			3.38
BI02773	BICH-77	15.30	15.5	0.60	0.94	17.30	18.5	59.58	59.7	0.05	0.05	0.97	0.88			2.92
BI02790	BICH-78	34.70	34.8	18.80	20.62	25.50	26.7	42.08	42.3	0.05	0.04	0.21	0.16			3.59
BI02853	BICH-79	32.20	32.2	22.00	23.30	20.80	21.5	46.80	46.8	0.10	0.10	0.08	0.07			3.41
BI02863	BICH-80	15.20	15.1	1.30	2.03	15.00	16.6	56.74	57.2	0.05	0.05	0.42	0.38			2.99
BI02927	BICH-81	31.20	31.3	12.10	13.02	27.50	28.5	47.58	47.9	0.08	0.07	0.20	0.17			3.44
BI02933	BICH-82	37.30	37.7	27.00	28.44	23.20	23.5	41.54	41.6	0.08	0.07	0.06	0.05			3.58

Original Sample ID	WGM Sample ID	MCM Fe_{tot}	SGS Fe_{tot}	MCM $pctFe_{mag}$	SGS Fe_{mag}	MCM FeO_T	SGS FeO_T	MCM SiO_2	SGS SiO_2	MCM P	SGS P	MCM S_T	SGS S_T	MCM BDensity	MCM PycSG	SGS PycSG
P-010	BICH-83		37.0		28.37		15.5		39.5		0.04		0.14			3.63
BI02977	BICH-84	23.70	23.5	5.00	5.07	24.10	25.2	56.56	56.9	0.05	0.07	0.21	0.18			3.20
BI03022	BICH-85	24.60	25.0	5.60	5.93	24.00	25.5	51.58	52.0	0.07	0.07	0.24	0.22			3.30
BI03028	BICH-86	30.80	31.0	12.90	14.33	25.90	27.0	46.82	46.4	0.08	0.07	0.17	0.16			3.45
BI03075	BICH-87	36.20	36.6	22.20	22.58	18.30	19.0	41.98	42.8	0.08	0.08	0.05	0.05		3.55	3.53
BI03097	BICH-88	14.00	14.1	0.80	0.72	14.80	14.8	58.18	58.4	0.05	0.03	0.55	0.52			2.97
BI03278	BICH-89	35.20	35.6	25.80	27.50	20.80	21.8	42.78	43.3	0.05	0.06	0.10	0.08			3.55
BI03287	BICH-90	31.30	31.6	18.30	19.32	23.00	23.5	47.82	48.1	0.10	0.09	0.11	0.10			3.56
FER-3	BICH-91		31.5		31.26		13.8		53.6		0.03		0.03			3.57
BI03472	BICH-92	20.10	22.1	2.90	3.18	23.90	24.4	55.32	55.6	0.08	0.07	0.21	0.19			3.13
BI03491	BICH-93	30.40	30.6	17.10	17.73	9.30	9.1	51.56	51.9	0.05	0.05	0.04	0.04			3.37
BI03587	BICH-94	32.00	32.0	18.00	19.18	18.40	18.9	46.82	47.2	0.04	0.04	0.01	0.02			3.32
BI03592	BICH-95	35.30	35.5	20.40	21.42	25.30	26.0	42.46	42.6	0.08	0.07	0.06	0.06			3.59
BI03754	BICH-96	38.20	38.0	5.00	5.43	2.50	3.1	44.88	45.2	0.01	0.02	0.00	0.01			3.74
BI03765	BICH-97	27.20	26.6	14.70	15.05	18.60	18.7	51.68	51.5	0.04	0.03	0.11	0.09	3	3.26	3.21
P-010	BICH-98		37.0		28.44		15.7		39.6		0.04		0.15			3.68
BI03817	BICH-99	14.30	14.2	0.60	0.80	15.60	15.7	59.58	59.7	0.06	0.07	0.52	0.44			2.93
BI03989	BICH-100	33.50	33.5	18.90	19.90	21.40	22.4	45.30	45.3	0.08	0.07	0.27	0.23			3.43
BI03996	BICH-101	29.40	29.7	12.70	13.46	23.60	24.1	46.90	47.6	0.10	0.09	0.17	0.16			3.26
BI04011	BICH-102	36.40	36.2	28.80	30.39	19.60	20.5	42.34	41.8	0.09	0.07	0.08	0.06			3.56
BI04192	BICH-103	38.80	38.7	29.40	30.03	21.90	21.6	41.56	42.0	0.02	0.01	0.05	0.05			3.60
FER-3	BICH-104		31.4		31.48		13.8		53.5		0.03		0.04			3.39
BI04204	BICH-105	39.40	39.2	24.90	31.11	23.10	23.1	40.16	40.3	0.02	0.01	0.14	0.14			3.61
BI04232	BICH-106	33.60	34.0	20.90	22.07	24.40	24.4	43.88	44.7	0.07	0.05	0.46	0.38			3.54
P-010	BICH-107		37.1		28.87		15.5		39.5		0.04		0.15			3.51
BI04243	BICH-108	31.30	32.0	21.00	21.93	21.40	21.2	45.78	46.3	0.10	0.08	0.21	0.18			3.40

Note: Sample BICH-38 was not received by SGS-Lakefield.

Table 12.6: MCM and SGS-Lakefield Assay Results for WGM Secod-half Drill Core Samples

Original Sample ID	WGM Sample ID	MCM Fe_{tot}	SGS Fe_{tot}	MCM Fe_{mag}	SGS Fe_{mag} Sat	MCM FeO_T	SGS FeO_T	MCM SiO_2	SGS SiO_2	MCM P	SGS P	MCM S_T	SGS S_T	MCM BD	MCM PycSG	SGS BD	SGS PycSG
BI00925	BIWGM-01	34.60	35.3	26.20	27.64	20.20	21.4	47.40	44.9	0.06	0.05	0.11	0.09			3.50	3.60
BI00986	BIWGM-02	29.80	29.8	11.60	11.14	24.10	27.1	48.44	48.0	0.09	0.08	0.09	0.04	3.33		3.36	3.42
BI01015	BIWGM-03	20.10	19.7	2.20	0.94	22.60	23.0	55.34	56.6	0.08	0.08	0.30	0.29			3.00	3.09
BI00116	BIWGM-04	32.10	32.5	21.90	21.78	20.30	22.2	48.60	47.3	0.09	0.09	0.10	0.04			3.47	3.58
BI00137	BIWGM-05	10.30	9.5	0.90	0.00	10.40	11.3	55.80	58.5	0.03	0.03	0.09	0.04			2.89	2.95
BI00049	BIWGM-06	34.70	35.2	28.40	27.86	18.20	20.5	44.00	45.2	0.08	0.08	0.18	0.04			3.53	3.56
BI00090	BIWGM-07	31.10	30.4	16.80	15.12	22.30	25.1	46.34	47.4	0.09	0.10	0.12	0.03			3.35	3.44
BI00478	BIWGM-08	34.80	35.1	25.40	26.63	20.60	21.3	44.16	44.8	0.10	0.10	0.15	0.07			3.50	3.59
BI00242	BIWGM-09	38.60	37.7	31.30	31.84	20.60	21.2	38.92	39.0	0.12	0.10	0.05	0.01			3.49	3.68
BI00836	BIWGM-10	38.20	36.7	24.80	26.70	16.10	17.9	41.58	43.9	0.06	0.05	0.07	0.01			3.42	3.56
BI00791	BIWGM-11	34.80	35.5	1.20	0.00	1.30	0.6	48.56	49.7	0.02	0.00	0.01	0.01		3.68	3.32	3.59
BI00388	BIWGM-12	34.50	34.3	22.90	23.66	23.00	22.8	44.44	44.5	0.08	0.07	0.08	0.06			3.52	3.58
BI00888	BIWGM-13	32.60	32.2	20.80	21.56	19.20	22.0	44.00	43.6	0.10	0.10	0.16	0.06			3.46	3.62
	BIWGM-14		4.3		0.29		3.8		68.8		0.02		1.24			2.59	2.84
BI01664	BIWGM-15	37.40	37.2	33.30	35.17	16.80	18.0	39.46	39.5	0.05	0.04	0.24	0.20			3.53	3.59
	BIWGM-16		7.4		0.00		9.2		40.2		0.01		0.19			2.84	2.89
BI01527	BIWGM-17	34.30	35.1	23.00	25.18	23.10	23.2	45.30	45.0	0.09	0.09	0.06	0.05		3.45	3.40	3.57
BI01330	BIWGM-18	13.90	13.4	1.10	0.14	14.20	16.1	56.50	57.8	0.05	0.04	0.24	0.23			2.92	2.97
BI04664	BIWGM-19	32.60	32.9	18.50	18.31	25.20	25.5	43.48	43.7	0.08	0.09	0.31	0.20			3.37	3.53
BI04782	BIWGM-20	18.50	17.8	0.90	1.01	21.90	21.1	58.40	59.2	0.09	0.08	0.50	0.39			2.94	3.08
BI04431	BIWGM-21	35.00	35.0	26.40	28.58	18.30	17.9	41.10	41.9	0.04	0.03	0.06	0.03			3.43	3.57
BI04258	BIWGM-22	35.70	35.9	29.90	31.84	19.10	18.7	43.42	44.3	0.09	0.08	0.10	0.08			3.56	3.62
BI04425	BIWGM-23	37.10	36.6	0.80	0.58	0.60	0.6	46.10	47.9	0.01	0.01	0.00	0.01	3.41	3.61	3.49	3.68

Table 12.7: Comparison of Assays Completed on WGM Pulps December 2011

WGMSample ID	tblSample.SampleID	MCM1 Fe_{tot} (%)	MCM2 Fe_{tot} (%)	MCM1 Fe_{mag} (%)	MCM2 Fe_{mag} (%)	MCM1 FeO_T (%)	MCM2 FeO_T (%)	MCM1 P (%)	MCM2 P (%)	MCM1 S_T (%)	MCM2 S_T (%)	MCM1 SiO_2 (%)	MCM2 SiO_2 (%)
BICH-53	BI01950	9.20	9.0	1.10	0.9	8.90	10.2	0.01	0.011	0.01	0.021	45.32	43.91
BICH-54	BI01952	33.40	33.5	20.80	24.6	19.30	19.8	0.11	0.099	0.17	0.162	41.00	40.86
BICH-55	BI02002	25.50	25.5	4.40	5.5	25.80	25.5	0.06	0.060	0.38	0.365	51.46	51.50
BICH-56	BI02142	33.50	33.6	18.10	17.1	26.10	27.2	0.06	0.055	0.56	0.526	44.40	44.51
BICH-57	BI02149	35.20	35.0	26.00	25.2	21.20	22.4	0.08	0.074	0.15	0.146	43.66	43.32
BICH-59	BI02254	31.20	31.3	15.30	13.8	26.80	25.7	0.11	0.104	0.08	0.078	47.60	47.46
BICH-60	BI02278	27.60	27.4	2.40	2.5	31.10	31.0	0.08	0.078	0.14	0.135	49.84	49.93
BICH-61	BI02321	27.20	27.4	9.70	12.0	21.70	20.2	0.08	0.075	0.18	0.178	44.48	44.19
BICH-62	BI02330	18.80	18.9	1.10	0.8	21.20	22.0	0.07	0.067	0.31	0.324	55.96	56.33
BICH-63	BI02389	29.20	29.4	12.80	14.1	23.70	24.2	0.08	0.072	0.10	0.102	48.02	49.24
BICH-65	BI02410	33.90	33.9	22.80	26.1	13.30	13.8	0.02	0.022	0.03	0.029	49.94	49.22
BICH-66	BI02412	34.40	34.5	20.10	18.9	17.20	18.1	0.02	0.024	0.04	0.045	43.98	43.66
BICH-67	BI02530	26.90	27.2	10.40	10.0	23.90	25.2	0.08	0.076	0.20	0.187	52.52	52.05
BICH-68	BI02538	30.50	30.7	17.70	16.5	23.10	24.0	0.08	0.080	0.06	0.056	48.40	48.10
BICH-69	BI02547	35.20	35.3	28.10	25.8	20.00	21.0	0.10	0.088	0.07	0.067	42.88	43.01
BICH-71	BI02555	25.50	25.9	6.30	6.0	25.70	26.5	0.08	0.084	0.23	0.216	50.40	51.89
BICH-72	BI02691	33.90	33.9	18.40	18.9	23.70	25.0	0.11	0.112	0.22	0.196	44.52	45.08
BICH-73	BI02693	27.20	27.3	10.80	11.4	20.90	22.5	0.09	0.089	0.19	0.157	49.50	51.24
BICH-74	BI02713	26.60	26.5	4.00	4.2	28.10	29.2	0.08	0.086	0.16	0.146	51.12	50.85
BICH-75	BI02762	22.50	22.4	0.60	0.8	25.70	26.7	0.08	0.085	0.16	0.153	53.24	53.89
BICH-77	BI02773	15.30	15.6	0.60	0.8	17.30	18.2	0.05	0.045	0.97	0.848	59.58	59.48
BICH-78	BI02790	34.70	34.6	18.80	19.8	25.50	26.6	0.05	0.049	0.21	0.180	42.08	41.85
BICH-79	BI02853	32.20	32.4	22.00	22.5	20.80	21.1	0.10	0.099	0.08	0.074	46.80	46.66
BICH-80	BI02863	15.20	15.2	1.30	1.7	15.00	16.4	0.05	0.052	0.42	0.376	56.74	56.80
BICH-81	BI02927	31.20	31.2	12.10	12.6	27.50	28.2	0.08	0.076	0.20	0.196	47.58	47.58
BICH-82	BI02933	37.30	37.5	27.00	27.3	23.20	23.1	0.08	0.078	0.06	0.058	41.54	41.26

WGMSample ID	tblSample.SampleID	MCM1 Fe_{tot} (%)	MCM2 Fe_{tot} (%)	MCM1 Fe_{mag} (%)	MCM2 Fe_{mag} (%)	MCM1 FeO_T (%)	MCM2 FeO_T (%)	MCM1 P (%)	MCM2 P (%)	MCM1 S_T (%)	MCM2 S_T (%)	MCM1 SiO_2 (%)	MCM2 SiO_2 (%)
BICH-84	BI02977	23.70	23.4	5.00	4.9	24.10	24.9	0.05	0.071	0.21	0.203	56.56	56.56
BICH-85	BI03022	24.60	24.6	5.60	5.6	24.00	25.1	0.07	0.076	0.24	0.239	51.58	51.62
BICH-86	BI03028	30.80	31.0	12.90	13.5	25.90	26.6	0.08	0.088	0.17	0.163	46.82	46.27
BICH-87	BI03075	36.20	36.6	22.20	21.6	18.30	19.2	0.08	0.085	0.05	0.056	41.98	42.20
BICH-88	BI03097	14.00	13.9	0.80	0.7	14.80	15.0	0.05	0.040	0.55	0.502	58.18	58.20
BICH-89	BI03278	35.20	35.5	25.80	26.4	20.80	21.6	0.05	0.062	0.10	0.090	42.78	42.88
BICH-90	BI03287	31.30	31.5	18.30	18.9	23.00	22.6	0.10	0.092	0.11	0.099	47.82	47.34
BICH-92	BI03472	20.10	22.4	2.90	2.9	23.90	24.2	0.08	0.074	0.21	0.192	55.32	55.34
BICH-93	BI03491	30.40	30.5	17.10	18.3	9.30	9.3	0.05	0.050	0.04	0.029	51.56	51.68
BICH-94	BI03587	32.00	32.2	18.00	18.3	18.40	18.7	0.04	0.037	0.01	0.015	46.82	47.20
BICH-95	BI03592	35.30	35.6	20.40	21.0	25.30	25.8	0.08	0.055	0.06	0.063	42.46	42.74
BICH-96	BI03754	38.20	38.1	5.00	5.2	2.50	3.4	0.01	0.022	0.00	0.004	44.88	44.76
BICH-97	BI03765	27.20	26.8	14.70	14.4	18.60	18.5	0.04	0.029	0.11	0.106	51.68	51.90
BICH-99	BI03817	14.30	14.4	0.60	0.6	15.60	14.8	0.06	0.063	0.52	0.435	59.58	59.00
BICH-100	BI03989	33.50	33.6	18.90	19.2	21.40	22.2	0.08	0.074	0.27	0.231	45.30	45.00
BICH-101	BI03996	29.40	29.7	12.70	12.9	23.60	24.0	0.10	0.090	0.17	0.159	46.90	47.00
BICH-102	BI04011	36.40	36.1	28.80	29.1	19.60	20.0	0.09	0.078	0.08	0.067	42.34	41.50
BICH-103	BI04192	38.80	39.0	29.40	30.5	21.90	21.4	0.02	0.013	0.05	0.045	41.56	41.50
BICH-105	BI04204	39.40	39.2	24.90	30.6	23.10	23.0	0.02	0.011	0.14	0.125	40.16	40.00
BICH-106	BI04232	33.60	33.9	20.90	21.0	24.40	24.2	0.07	0.047	0.46	0.370	43.88	44.16
BICH-108	BI04243	31.30	32.0	21.00	21.6	21.40	21.2	0.10	0.086	0.21	0.204	45.78	46.00

Figure 12.2 to Figure 12.7 show the results of assaying at SGS-Lakefield compared to the assays at MCM on duplicate pulps and second half-drill core samples selected by WGM during its site visits.

Figure 12.2 is for Fe_{mag}. It shows that SGS-Lakefield and MCM Fe_{mag} assays following the re-calibration are quite similar, revealing no evidence of significant bias. One sample looks like it is an error due to mix-up, or cross-contamination.

Figure 12.2: Comparison of $\%Fe_{mag}$ at SGS-Lakefield vs. MCM for WGM's Independent Samples

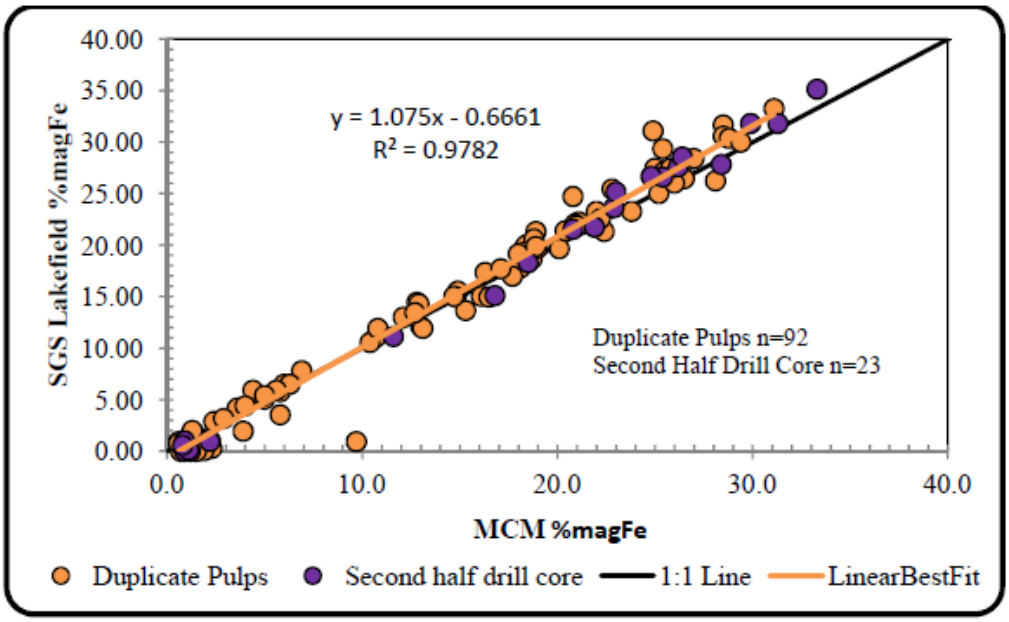


Figure 12.3 shows results for Fe_{tot}. Similar to Black Iron's results for the 100 samples assayed at MCM and SGS-Lakefield, (Figure 11.14) and for the 35 samples assayed at ALS (Figure 11.20), Fe_{tot} is unbiased between MCM and SGS-Lakefield.

Figure 12.3: Comparison of % Fe_{tot} at SGS-Lakefield vs. MCM for WGM's Independent Samples

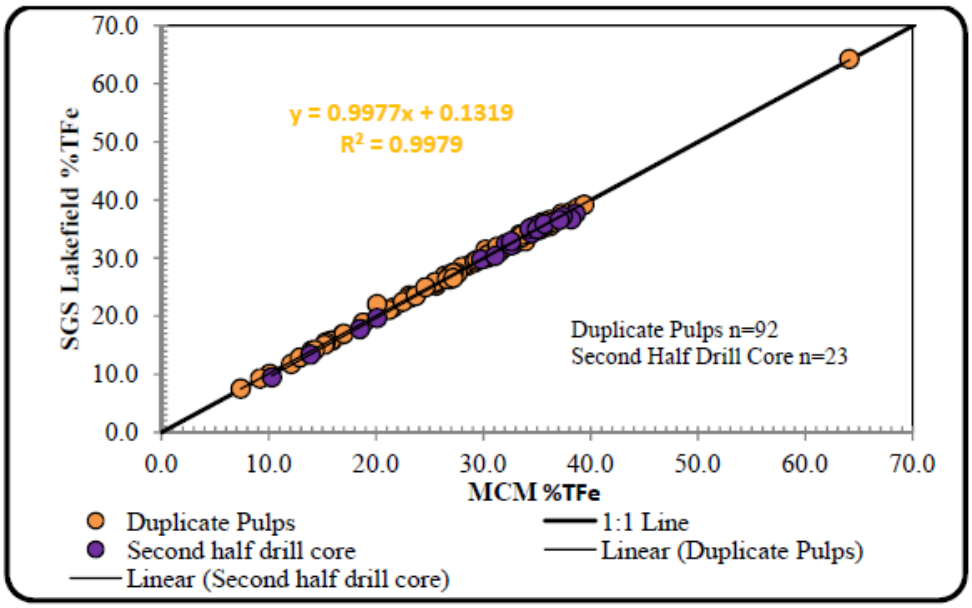


Figure 12.4 shows results for FeO_T. Results are strongly positively correlated between the two labs. FeOT at SGS-Lakefield appears to be slightly higher. One sample shows some unknown error.

Figure 12.4: Comparison of %FeO_T at SGS-Lakefield vs. MCM for WGM's Independent Samples

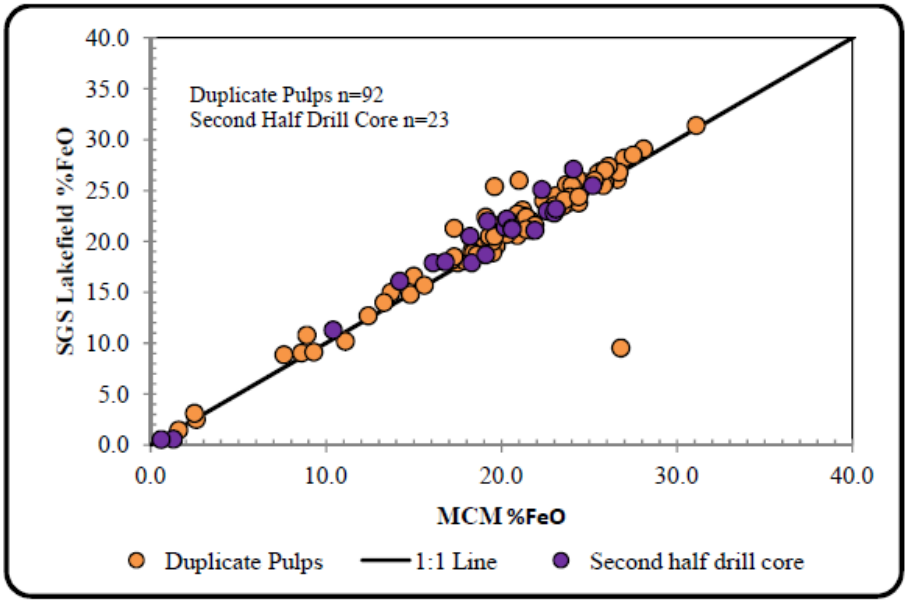


Figure 12.5 shows results for SiO_2. Black Iron's check analysis with MCM and SGS-Lakefield (Figure 11.17) showed a slight bias with MCM's being very slightly higher than SGS-Lakefield, but this pattern is not shown here.

Figure 12.5: Comparison of %SiO_2 at SGS-Lakefield vs. MCM for WGM's Independent Samples

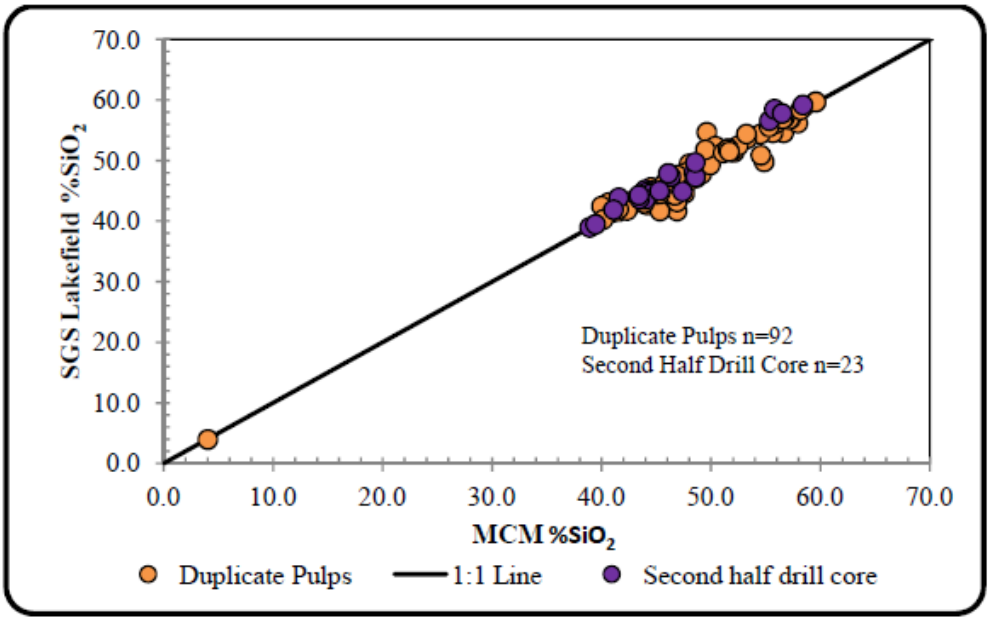


Figure 12.6 shows results for P at MCM and SGS-Lakefield. Similar to results shown for Black Iron's check analysis (Figure 11.18, Figure 11.24 and Figure 11.25) phosphorous at MCM is a little too high.

Figure 12.6: Comparison of % P at SGS-Lakefield vs. MCM for WGM's Independent Samples

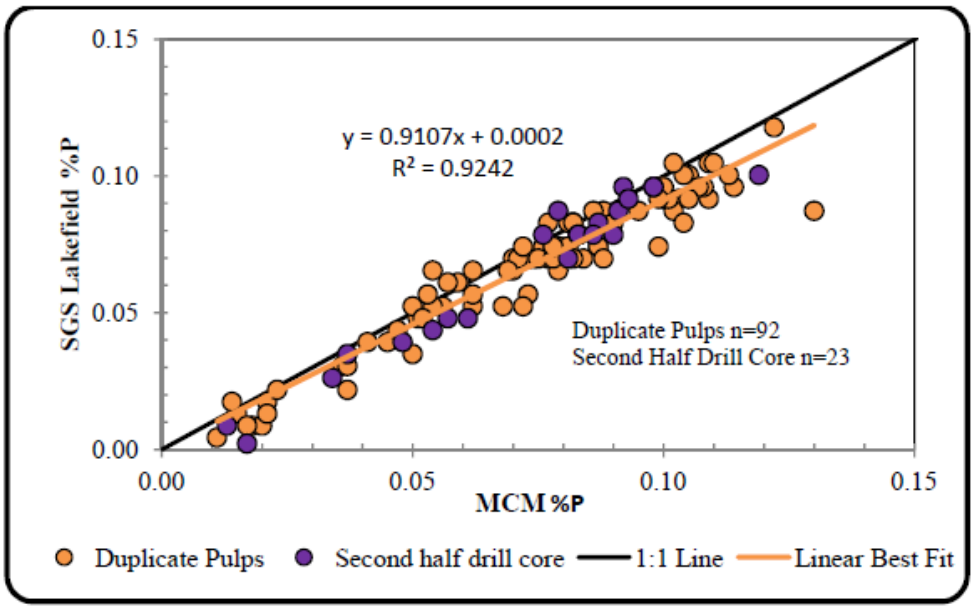
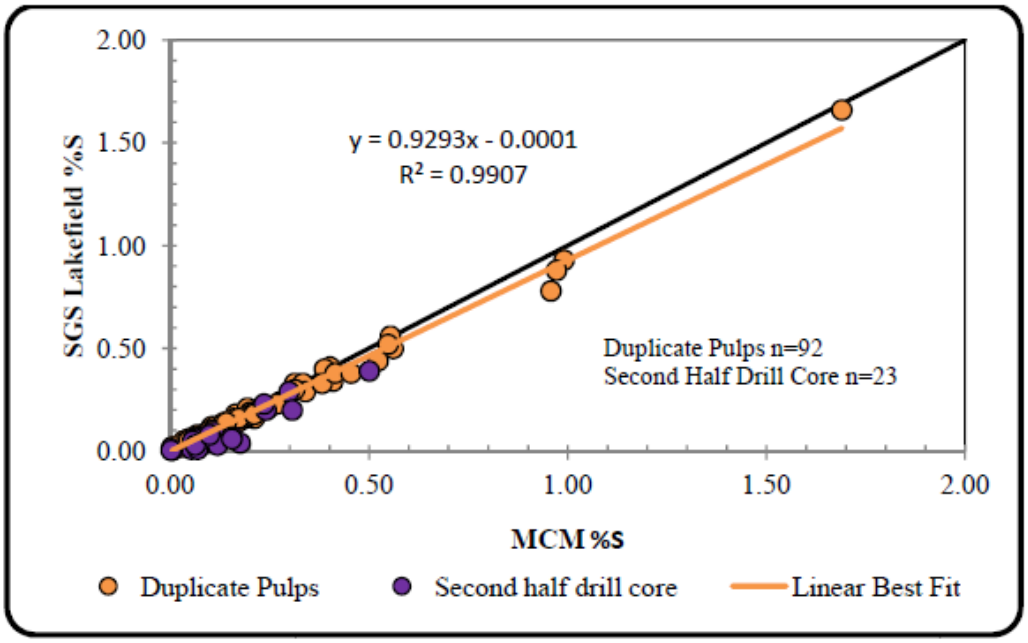


Figure 12.7 shows results for S_T at MCM and SGS-Lakefield. Results are highly correlated with a slight bias in favour of MCM.

Figure 12.7: Comparison of % S_T at SGS-Lakefield vs. MCM for WGM's Independent Samples



WGM's pulp samples had SG determined by gas comparison pycnometer at SGS-Lakefield, while the split core pre-crushing had bulk density determinations and, after crushing, pycnometer SG. A direct comparison of density/SG between MCM and SGS-Lakefield cannot be made for most of these samples because only a few of these original samples had density and/or SG determined at MCM.

Figure 11.25 shows a comparison of bulk density and pycnometer SG completed on the half-core samples at SGS-Lakefield. The bulk densities are all a little higher than the pycnometer SG. Patterns like this are possible for rock samples that have inherent porosity because they lose porosity when they are crushed or pulverized. Subsequent pycnometer SG determinations on such samples can generate SGs that are too high because any porosity originally present is removed and not measured. However, for these samples, WGM believes the likely reason the pycnometer densities are a little higher is because of calibration errors.

Figure 12.8: Comparison of SG vs. Bulk Density for WGM's Independent Samples – Determinations at SGS-Lakefield

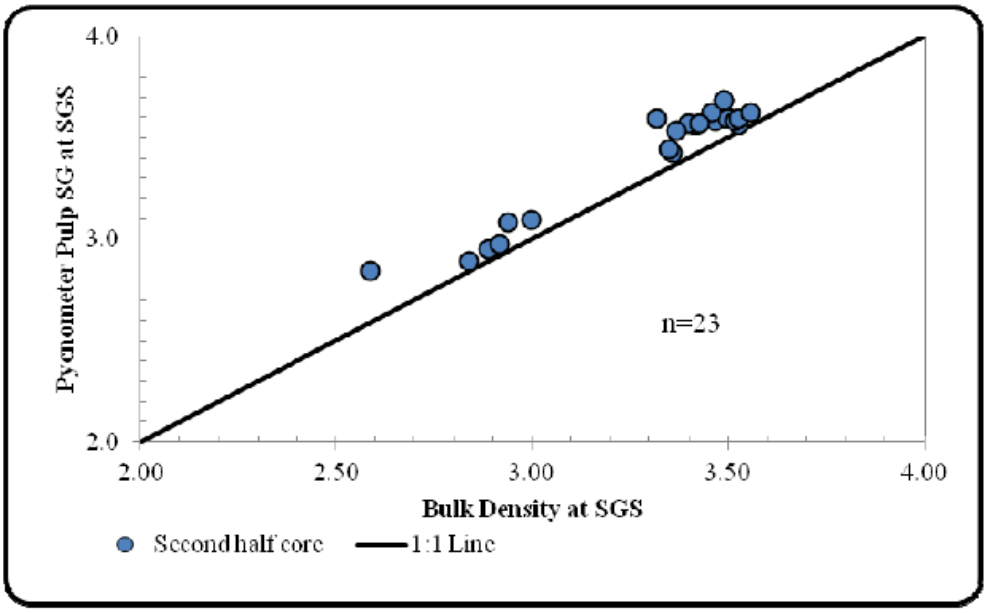


Figure 12.9 shows bulk density versus $\%Fe_{mag}$. A polynomial trend line has been best fit through the data points, excluding two samples of martite mineralization. Figure 12.10 similarly shows bulk density versus $\%\ Fe_{tot}$.

Figure 12.9: Bulk Density vs. $\%Fe_{mag}$ for WGM's Independent Samples – Determinations at SGS-Lakefield

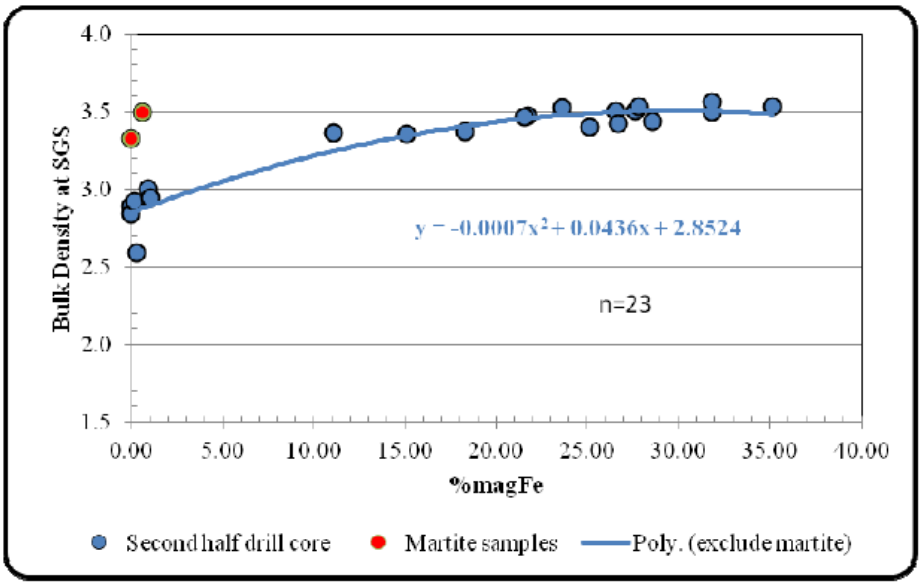


Figure 12.10: Bulk Density vs. % Fe_{tot} for WGM's Independent Samples – Determinations at SGS-Lakefield

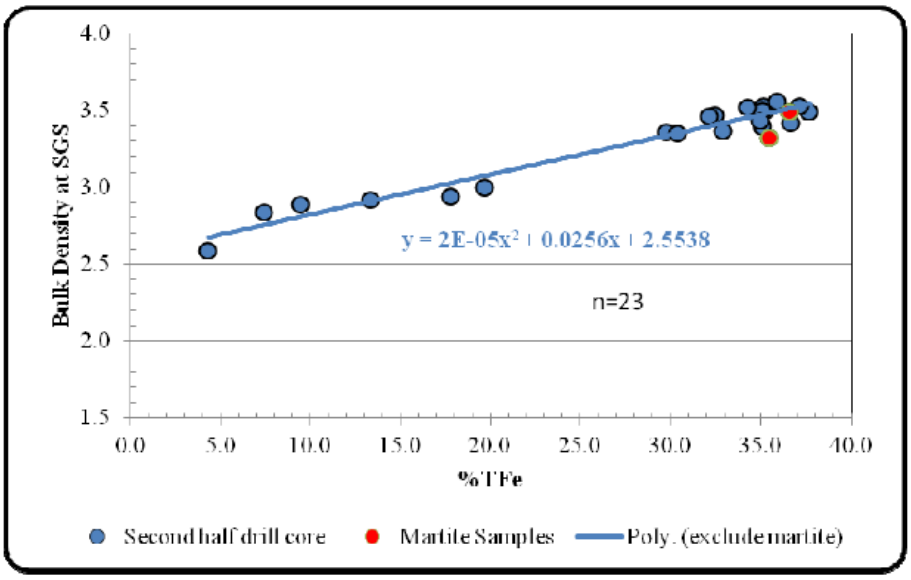


Figure 12.11 shows results for pycnometer SG versus $\%Fe_{mag}$ for the MCM pulps and split-core samples collected by WGM. The pattern on Figure 11.17 is similar to that on Figure 11.16, except that the trend line is at a slightly higher value of SG.

Figure 12.11: SG vs. $\%Fe_{mag}$ for WGM's Independent Samples – Determinations at SGS-Lakefield

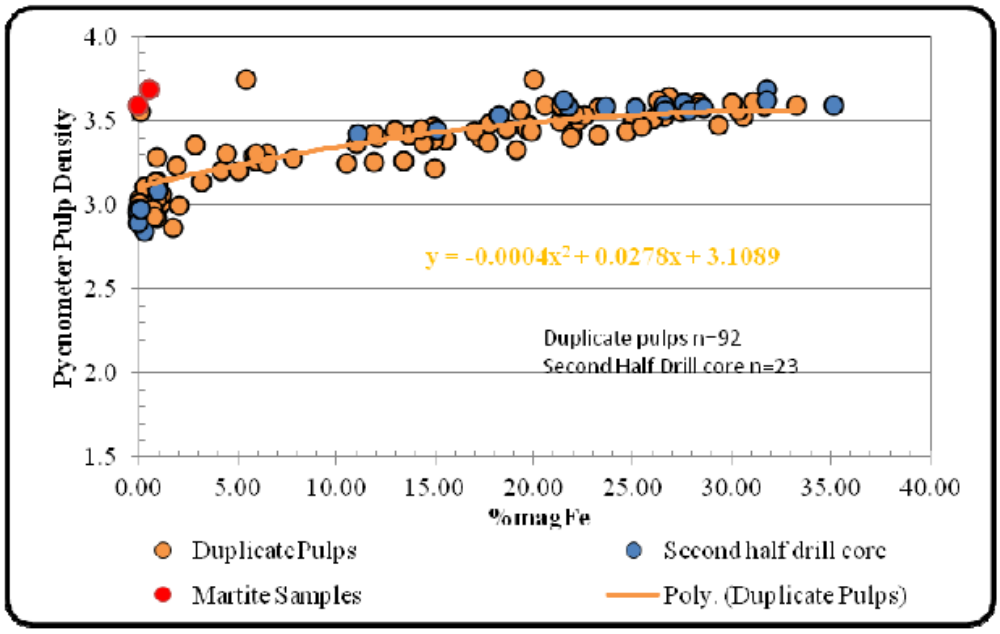
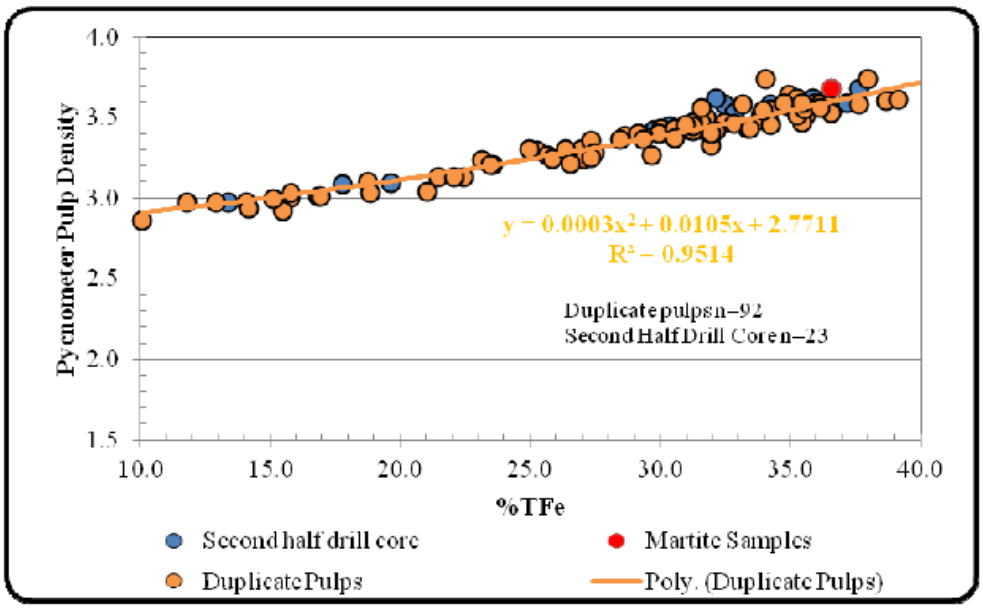


Figure 12.12 shows results for pycnometer SG versus % Fe_{tot} for the MCM pulps and split-core samples collected by WGM. Again, results for pycnometer SG are similar to the results for bulk density (see Figure 12.10).

Figure 12.12: SG vs. % Fe_{tot} for WGM's Independent Samples – Determinations at SGS-Lakefield



12.5 Checking Historical Documents

WGM completed a drillhole-by-drillhole review of the drillhole attitude information in the 2005 database vs. collar azimuth, collar dip, end-of-drillhole azimuth and dip information from the 1989 Soviet report. For a number of the drillholes, there are discrepancies between the two sets of data. Where there was a discrepancy, WGM also reviewed the Soviet cross-sections and the drill logs, where available. The discrepancies are often minor and immaterial. More significant differences are often not resolvable with certainty because there is insufficient information detailing the data and its quality. WGM provided Black Iron with comments for each drillhole, making recommendations for revisions of drillhole attitude for several drillholes. Black Iron used this information to adjust the attitudes for some of the historic drillholes.

WGM performed a random check of a small selection of the sample intervals and assays in the logs and in volumes VI and VII of the 1989 Soviet FS report. When the company checked the samples against the database, it found substantial agreement and occasional differences. For a few cases, the 2005 database agrees with the data in volume VII of the 1989 Soviet report, but differs from the log. The core logs contain assays for FeO_T that are not in the Soviet volume or the 2005 database. Lithology intervals in the logs agree approximately with the database, which is reasonable if the 2005 database data was determined from the Soviet cross-sections. The sample tables in volumes VI and VII of the Soviet report also tabulate lithology codes for samples, but these were apparently not compiled by GIC.

12.6 Comments on Data Verification

After completing its verification in the field in Ukraine, its review of the Twin hole drilling program results, and its review of historical documents--including checking various documents against each other--WGM is satisfied that Soviet drilling locations, assay and lithology results are substantially and generally reliable, with a few caveats. The review, documented in Section 10-2 of the Twin hole drilling results and compared with Soviet results, showed that Black Iron's Twin drillholes returned very similar lithology and Fe_{mag} assay intercepts that are similar to those in the corresponding, historic drillholes.

WGM believes that minor errors and uncertainties are associated with many of the Soviet data items, but the extent of these errors has not proven to be significant. These data items include accuracy of drillhole collar locations, collar azimuths and inclinations, and downhole attitude surveys. WGM's review of Appendix 38 in the 1989 Soviet report, Soviet plans and cross-sections, and GIC's database showed a number of discrepancies with respect to historic drillhole azimuth, dip and downhole attitude and for many of these issues resolution was not possible. Inspection of historic casings in the field showed several metres of difference between coordinates for historic drillholes and the located historic casings, but these differences are of little significance to the current study and they may be the result of data transformations or other minor errors. However, WGM did observe two historic casings that are not documented as drillholes in the information made available. The fact of the existence of these casings suggests that perhaps more drillholes exist on the Property than are documented. But other explanations for the unidentified casings, such as their being abandoned holes, may be possible.

It can be a challenge to secure high-quality, completely and properly documented exploration data from Ukraine. WGM was provided sets of drillhole coordinates that were slightly different, at different times. The differences are small, but no explanation to rationalize the differences was forthcoming. WGM requested a copy of a historic map showing historic drillholes that it had witnessed briefly in Ukraine, but this map was not provided.

WGM found the lithological rock-composition coding documented in the historic reports, drill logs and database to be generally reasonable. However, the company believes some of the stratigraphic assignments lack basis. The Soviet lithological codes incorporate stratigraphic assignment, as well as rock-composition. The issue is the stratigraphic component, particularly concerning sx5f and adjacent members. WGM believes that the Soviet geologists were too presumptive in assigning any strongly oxidized–martinized iron formation to the fifth member of the Saksagan sequence, (sx5f) and believes that this assignment affects the coding for adjacent iron formation members and influences the geological interpretation of the Shymanivske Deposit itself.

Review of drill logs and comparison with data tables in the Soviet reports shows minor differences for some assays. However, these differences appear to be minor and perhaps could be due to normal re-assaying with records not completely updated by the Soviet authors. One of the significant findings is the historic drillhole assays for Fe_{tot}. As concluded in Section 10.2.3of this report, it appears that Fe_{tot} assays for individual holes or for certain Soviet drilling campaigns are not always accurate and cannot be relied upon. It is likely that some historic Fe_{mag} sample assays are also a little too high, while others are a little too low. However, the Twin hole drilling program shows that Fe_{mag} results are substantially correct.

On the basis of Check assay comparisons with SGS-Lakefield and ALS—in which much of the Check assaying is based on samples “blind” to all parties, except WGM--WGM is satisfied that MCM assay results for Black Iron’s drilling are generally reliable. Some inaccuracy appears to be present for bulk density results, and phosphorus assays at MCM are evidently too high. However, WGM also believes that some assay irregularities have occurred and bases this belief on the assay results for the Certified Reference Standards by MCM and SGS-Lakefield for WGM’s independent samples and inspection and comparison of Fe_{mag} results on a sample-by-sample basis with post-re-calibration results (see Section 11 in this report). These assay irregularities may relate to MCM’s assigning Fe_{mag} values on the basis of sample identity, rather than on actual assay values. This issue has affected WGM’s faith in the assay results, especially for Fe_{mag}, for MCM inserted Standards, and for Blanks and Duplicates. Despite this caveat, the Check assaying done on MCM-prepared pulps and non-MCM processed second half-split core samples using secondary labs and “blind” samples--suggests that any possible assay inaccuracies are not very significant for evaluating the Shymanivske Deposit.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

A significant amount of test work was completed over a number of years, including that done by WorleyParsons during the FS in 2012.

The main conclusion that came from the test work is that the iron mineralization from the Shymanivske deposit can be processed and upgraded to the targeted specifications with crushing, stage grinding, low intensity magnetic separation and sulphide flotation.

A final grinding size of 80% passing 32 µm is required to achieve a concentrate grading 68% iron and 4.5% silica with a sulphur content of 0.05%. The weight recovery at this product grade averaged 32.7% with a magnetite recovery of 96%. A brief summary of the test work, including that performed by WorleyParsons in 2012 follows.

Mineral processing and metallurgical testing prior to 2012 are documented and summarized by BBA Inc. in the PEA Report. The PEA report is available on SEDAR.

13.1 Historical Testwork

13.1.1 Testwork before PEA

Historical test work information was taken from a technical report entitled “Detailed elaboration of ferriferous quartzites of Shymanivske deposit of Kryvyi Rih iron ore basin of Dnepropetrovsk region 1989.” This testwork was also summarized in the NI 43-101 Technical Report “Resource Estimate Shymanivske Deposit in Ukraine,” dated January 27, 2011.

Magnetic separation testing was carried out at the Mekhanobrchermet Institute (MCM) on oxidized quartzite material obtained from diamond drill core of the Shymanivske deposit. Several samples were ground to 98% passing 0.074mm and then in a second pass to 95% passing 0.045 mm. The results are presented in Table 13.1 and are compared to the adjacent ArcelorMittal mine formerly known as NKODPE.

Table 13.1: Historical Magnetic Separation Test Results

Test Number	Grind Size (mm)	% passing	Indicators %					
			Weight Recovery (%)	Iron Recovery (%)	% Fe in Concentrate		% Fe in Tails	
					Head Fe (%)	Magnetite (%)	Head Fe (%)	Magnetite (%)
2	0.074	98	34.5	68.4	67.4	97.4	16.4	0.8
	0.045	95	34.0	68.0	68.0		16.5	
3	0.074	98	33.0	68.2	68.4	98.5	15.7	0.5
	0.045	95	32.3	67.6	69.3		15.8	
4	0.074	98	31.3	65.5	69.0	98.0	16.6	0.6
	0.045	95	30.9	65	69.4		16.7	
5	0.074	98	20.5	48.8	69.3	96.1	18.7	0.7
	0.045	95	20.3	48.6	69.6		18.8	
6	0.074	98	20.8	47.1	68.6	97.1	20.2	0.5
	0.045	95	20.6	46.9	69.0		20.3	
7	0.074	98	19.2	44.4	69.6	96.3	20.7	0.6
	0.045	95	19.0	44.1	69.9		20.8	
Burden	0.074	98	27.4	59.0	69.1	98.1	18.1	0.5
	0.045	95	27.2	58.8	69.4		18.2	
NKODPE Concentrate	0.074	98	34.5	65.8	68.0			

13.1.2 PEA Study Testwork

A metallurgical testwork program was developed by BBA Inc. in the early stages of the PEA study, designed to characterize the Black Iron Shymanivske ore body. The objective of the testwork was to evaluate the ore's amenability to processing by gravity separation and/or by magnetic separation, in order to produce a commercially acceptable, high-quality product that would allow for the economic development of the Shymanivske Project. An important part of the testwork consisted of evaluating whether using a gravity separation circuit before a magnetic separation circuit could contribute to an increase in iron and weight recovery.

The testwork results were then used in defining a conceptual process flowsheet for the PEA study.

The main metallurgical testwork was carried out at MCM in Kryvyi Rih, Ukraine.

In addition to the test work carried out at MCM, grindability testing and mineralogical study by QEMSCAN^{TM} analysis were carried out at SGS Lakefield on sub-samples of the selected composite samples.

After preliminary testing, further laboratory tests were carried out on several flowsheet configurations. The results from this testwork were used to develop the preliminary process flowsheet as well as preliminary mass and water balance, forming the basis of process design for this PEA study. Preliminary sizing of

major process equipment was also developed. The metallurgical testwork for the PEA is described in greater detail in the following sections.

13.1.2.1 SAMPLE SELECTION AND PREPARATION

In May 2011, two composite samples were prepared from drill cores of the ongoing Twin Drillhole Program. Approximately 300 kg of material per composite sample was selected for metallurgical testing at the MCM laboratory. Approximately 30kg of plus 25mm pieces from each composite sample were sent to SGS Lakefield for grindability characterization. The remainder was ground to 10mm and used for metallurgical testing. Table 13.2 shows the make-up of each composite sample.

Table 13.2: Composite Samples Used in PEA Metallurgical Testwork

Composite No.	Drillhole	Interval (m)
1	BI20342-T	24.0 to 185.0
	BI21674-T	22.0 to 87.8
	BI5485-T	14.3 to 106.5
	BI21733-T	18.5 to 133.1
2	BI20342T	237 to 271
	BI21674T	128 to 152
	BI21733T	161.5 to185.3
	BI5485T	173.5 to 201
	BI12850T	114 to 142.5
	BI13302T	216.5 to 260
	BI20291T	205 to 231

13.1.2.2 MINERALOGICAL ANALYSES

Composite samples 1 and 2 were ground to 0.25 mm and sub-samples were submitted for mineralogical analyses. The samples were characterized as being of the silicate-magnetite variety. Size-by-size mineralogical analyses are presented in Table 13.3 and Table 13.4. Composite sample Number 1 contained about 28% magnetite, 7% hematite-martite, 4% carbonates and 33% silicates. The silicates contained about 21% iron, which represents about 20% of the total iron. Composite sample 2 contained about 25% magnetite, 5% hematite-martite, 2% carbonates, and 40% silicates. The iron contained in the silicates represents about 29% of the total iron. The iron silicates are essentially not recoverable because of the low iron content.

The magnetite levels increase with increasing fineness and the bulk of the magnetite is found in the minus 44 µm range. Based on the QEMSCAN™ analyses, less than 5% of the iron oxides are locked for all size ranges and less than 20% are locked in size fractions greater than 212 µm.

Table 13.3: Mineralogical Analysis of Composite Sample 1 by Size Fraction

Size Fractions, mm	wt. (%)	Mineral Weight Percent % (M) and Iron Content(Fe)															
		Magnetite		Hematite, Martite		Carbonates		Silicates		Iron Sulphide				Quartz	Apatite	Total	
										Pyrite		Pyrrotine					
		M	Fe	M	Fe	M	Fe	M	Fe	M	Fe	M	Fe	M	M	M	Fe
-0.25 / 0		27.9	20.2	7.5	4.5	4.3	1.2	33.4	7.16	0.11	0.05	0.14	0.09	26.15	0.5	100	33.2
+0.25	8	17.5	12.7	4.2	2.5	3	1.4	38.5	8.48	0.1	0.05	0.11	0.07	36.09	0.5	100	25.2
-0.25 / +0.16	5.1	19.1	13.8	5.2	3.1	3.1	1.2	37.7	8.07	0.11	0.05	0.14	0.08	34.15	0.5	100	26.3
-0.16 / +0.07	27.2	25.4	18.4	7.5	4.5	2.9	1.3	31.6	6.96	0.09	0.04	0.17	0.1	31.94	0.4	100	31.3
-0.07 / +0.056	6.6	38.8	28.1	6.3	3.8	3.7	1.2	24.5	5.26	0.1	0.05	0.14	0.09	26.06	0.4	100	38.5
-0.056 / +0.044	8.4	41	29.7	4.2	2.5	4.9	1.3	23.5	5.17	0.09	0.04	0.14	0.09	25.87	0.3	100	38.8
-0.044 / +0	44.7	28.2	20.4	9.2	5.5	3.7	0.8	36.5	7.84	0.1	0.05	0.17	0.11	21.53	0.6	100	34.7

Table 13.4: Mineralogical Analysis of Composite Sample 2 by Size Fraction

Size Fractions, mm	wt. %	Mineral Weight Percent (M) and iron Content(Fe), %															
		Magnetite		Hematite, Martite		Carbonates		Silicates		Iron Sulphide				Quartz	Apatite	Total	
										Pyrite		Pyrrotine					
		M	Fe	M	Fe	M	Fe	M	Fe	M	Fe	M	Fe	M	M	M	Fe
-0.25 / 0		25	18.1	4.7	3.3	2.12	0.9	41.7	9.17	0.07	0.03	0.17	0.1	25.7	0.5	100	31.6
+0.25	5.8	13.5	9.8	2.9	2	2.83	1.3	49.1	10.7	0.07	0.03	0.1	0.06	31	0.5	100	23.9
-0.25 / +0.16	6.1	15.7	11.4	3.6	2.5	2.85	1.3	45.4	10	0.07	0.03	0.1	0.06	31.8	0.5	100	25.3
-0.16 / +0.07	24.2	23.9	17.3	2.9	2	2.57	1.2	41.4	9	0.07	0.03	0.11	0.07	28.6	0.5	100	29.6
-0.07 / +0.056	10.2	31.6	22.9	6	4.2	3.23	0.9	34.7	7.58	0.06	0.03	0.14	0.09	23.9	0.4	100	35.7
-0.056 / +0.044	7.9	36.2	26.2	3.7	2.6	1.75	0.7	37.1	8.15	0.05	0.03	0.19	0.12	20.7	0.3	100	37.8
-0.044 / +0	45.8	24.9	18	3.9	2.7	2.69	1.3	47	10.3	0.07	0.03	0.23	0.14	20.6	0.6	100	32.5

13.1.2.3 PEA GRINDABILITY AND BENIFICIATION TESTWORK

Approximately 30kg of plus 25mm material from each composite sample were sent to SGS Lakefield Research for grindability characterization. The main purpose of these preliminary tests was to establish the appropriate grind size for magnetic separation and to determine whether the ore is amenable to gravity separation. The results of these tests are summarized in the following sections.

13.1.2.3.1 SHAKING TABLE TESTS

Gravity separation tests were carried out on composites 1 and 2, using a laboratory scale shaking table at grind sizes of minus 0.8 mm and 0.5 mm. The product was subdivided into 3 fractions; heavy fraction, middlings, and tails.

In both composite samples, about 70% of the feed reported to the middling fraction at both particle sizes, which contained about 30% iron. The iron content of the middlings was too low to be recombined with the heavy fraction in order to produce an acceptable concentrate grade. In all cases, the heavy fractions

contained about 65% iron or greater, but represented about 10% or less of the feed by weight. This weight recovery was too low for gravity separation to be viable on its own.

The middling and tails fractions from these tests were recombined and subjected to further upgrading by magnetic separation.

13.1.2.3.2 Davis Tube (DT) Test

Composite samples 1 and 2 were subjected to magnetic separation tests, using Davis Tube. The tests were performed at various levels of grind size, ranging from 80% passing 0.074mm to 95% passing 0.044mm. The results showed that the Shymanivske ore would require a grind size of at least 95% passing 0.044mm, which was consistent with historical results. Significantly higher iron and weight recoveries were achieved with composite 1. This may be mostly attributed to the fact that it contained a higher magnetite content than composite 2 and that a significantly lower concentrate grade was produced (65.4% iron for composite 1 versus 68.3% iron for composite 2). The results for composite 2 were consistent with historical results, but showed slightly higher weight and iron recoveries than expected.

13.1.2.3.3 Shaking Table and DT versus DT Alone

Combined middling and tails fractions from the shaking table tests were subjected to further upgrading by magnetic separation. The overall results showed that gravity separation provides no additional benefit in terms of weight, iron, or magnetite recovery. Therefore, it was recommended that the Black Iron flowsheet consist solely of magnetic separation.

13.1.2.3.4 Laboratory LIMS Cobbing Tests

QEMSCAN™ analyses of composite samples 1 and 2 indicated that magnetite content increases with accumulative fineness so that proper magnetite liberation can be achieved, even at the coarser size ranges. Laboratory magnetic separation tests were performed using an Eriez wet magnetic separator (LIMS type) to determine if an effective cobbing step could be carried out at coarser grind sizes. The results of cobbing steps carried out at minus 20 Mesh (0.841 mm) and minus 35 Mesh (0.420 mm) on composite sample 2 showed that there is not a significant difference between grind sizes of minus 20 Mesh and minus 35 Mesh. The results also showed that an effective cobbing step with at least 95% magnetite recovery can be carried out at the coarser grind size, while eliminating at least 30% feed weight.

13.1.2.3.5 Ore Grindability

The following grindability tests were carried out in the PEA study:

- SAG Mill Comminution (SMC); and
- Bond Rod and Ball Mill Grindability Tests.

Bond Ball Mill Grindability Tests were conducted at 100 and 325 Mesh (0.149 mm and 0.044 mm, respectively).

The results of these tests are summarized in Table 13.5 and Table 13.6.

Table 13.5: PEA Grindability Test Result Summary

Sample Name	Relative Density	JK Parameters		RWI kWh/t	BWI (kWh/t)	
		Axb	ta		100 M	325M
Comp. 1	3.5	35.2	0.26	16.7	13.1	15.7
Comp. 2	3.36	28	0.22	16.4	12.2	16.4

Table 13.6: SMC Test Summary

Sample Name	A	b	Axb	ta	DWI kWh/m^2	Mia	Mm	Mic	Relative
Comp. 1	76.5	0.46	35.2	0.26	9.84	20.4	16.3	8.4	3.5
Comp. 2	100	0.28	28	0.22	11.9	24.7	20.5	10.6	3.36

These results were used to perform preliminary sizing and power evaluation of the grinding circuit. The SMC results were used to perform JKSimMet simulations of the SAG mill grinding circuit.

13.2 Feasibility Study Metallurgical Testwork

A comprehensive metallurgical test program was conducted by WorleyParsons as part of this Feasibility Study.

Testing involved comminution, magnetite recovery and sulphur removal characterization sufficient to provide a process flow sheet and criteria required for detailed plant design. Testing was conducted according to industry best practice.

Several samples of diamond drill core were selected from drillhole intervals located throughout the Shymanivske mineralization zone and tested at ALS AMMTEC in Perth, Australia.

The testwork program consisted of the following:

- Log and sort samples to provide the following composites:
- SAGDesign composite samples (x10), SDT01 to SDT10
- CWi composite samples (x30), CWi01 to CWi30
- BWi composite samples (x30), BWi01 to BWi30
- Beneficiation composite samples (x5), BC1 to BC5
- Formation of three composites for flotation testwork

- Comminution testwork on SAGDesign, CWi and BWi composites (x70) samples:
- Crushing Work index (CWi) determination
- Apparent relative density (SG) determination
- SMC test
- Abrasion Index (Ai) determination
- SAGDesign test
- Fibrous analysis
- Bond rod mill work index determination
- Bond ball mill work index determination
- Head assay
- Davis Tube Recovery (DTR) on BWi composite samples at P80 of 38 µm
- LIMS separation on BWi composite samples at P80 of 38 µm
- Grind liberation and magnetic separation testwork on Beneficiation composites (x5):
- Control crush to four sizes: -5.0, -3.35, -2.0 and -1.0 mm
- Particle size distribution on ground samples
- Davis Tube Wash (DTW) on 13 ground / crushed sizes
- LIMS separation on beneficiation composite samples at 13 ground/crushed sizes
- Davis Tube Recovery (DTR) at P80 of 38 µm on LIMS non-magnetics
- Dry LIMS separation at four crushed sizes
- Davis Tube Recovery (DTR) at P80 of 38 µm on DMS non-magnetic
- Bulk magnetic separation on composites 1, 2 and 3 and reverse flotation optimization on composite 3:
- Grind 3 composites to P80 of 45 and 32 µm
- Bulk LIMS separation at 900 Gauss and P80 of 45 µm
- Flotation optimization on composite 3
- Additional tests on samples generated from the testwork

13.2.1 Sample Selection and Preparation

13.2.1.1 Sample Selection

Based on the geological studies of the Shymanivske deposit, there are three main rock types. They are identified by rock type F1, F2 and F4.

Historical mineralogical studies and metallurgical test work have shown that rock type F2 and F4 have the same mineralogical structure and the same response to the beneficiation and can be counted as one geo-metallurgical unit. These rocks form about 84% of the mineralization in the Shymanivske deposit.

Given this assemblage of the deposit, a total of 2,300 kg of samples from drill cores were selected from 16 drillholes and supplied to ALS AMMTEC in Perth, Australia.

The selected drillholes were from the Twin Drilling Program, which is explained in Section 10.2.1 of this report.

A list of the drillholes and a number of samples taken from each drillhole are shown in Table 13.7.

As shown in this Table, a total of 240 samples were sorted into five composites (BC1 to BC5) to represent the rock types in the Shymanivske deposit through the beneficiation testwork. BC1 to BC4 were sorted from samples of rock types F2 and F4, while BC5 was sorted from the samples of rock type F1.

For the flotation tests, three composites (composite 1 to composite 3) were sorted from composites BC1 to BC5.

A total of 279 samples were sorted into 30 composites (BWi01 to BWi30) for use in the Bond grinding tests and determination of the hardness profile of the deposit.

Additional 43 samples were sorted into 10 composites (SDT01 to SDT10) for SAGDesign testing. From these 10 samples, eight composites represented one-eighth of the mineable depth. One sample represented the hardest material in the deposit and one sample represented the waste adjacent to the ore, to estimate the effect of dilution of the mill feed with waste. In addition to the aforementioned composite samples, 30 samples (CWi01 to CWi30) from full HQ cores were selected and shipped to ALS Ammtec for use in the Bond abrasion and crushing work indices and SMC tests.

Table 13.7: Sample List Used in the Metallurgical Tests

Drillhole ID	Interval (m)		Count of Samples Used in Beneficiation Tests	Count of Samples Used in Bond Grinding Tests	Count of Samples Used in SAGDesign Tests
	From	To			
12009-T	118.5	311.6	14	10	4
12850-T	17	142.5	6	13	4
13302-T	19.1	260	21	19	6
20291-T	25.5	228	20	22	
20342-T	24	271	23	20	7
20349-T	98	391	10	9	5
21668-T	25	109	3	5	
21674-T	22	155	9	15	1
21687-T	24	240	4	3	7
21689-T	125	169	2	8	
21704-T	170	348	19	23	
21707-T	27	267	35	28	
21711-T	53	327	18	33	7
21732-T	16.5	216	15	30	
21733-T	18.5	201	20	23	2
5485-T	17.3	185.3	21	18	
Sub-Total			240	279	43
Total	562				

13.2.1.2 SAMPLE PREPARATION

Sample preparation for Composites BWi1 to 30 was as follows:

- Mix/split-out portions for crushing to minus 19 and minus 3.35 mm; and
- Mix/split-out portions for head assay, Bond ball work index, DTR, wet LIMS and fibrous assay.

The sample preparation for Composites BC 1 to BC 5 (beneficiation samples) was as follows:

- Mix/split-out portions for crushing to minus 5.0 and minus 3.35 mm; and
- Mix/split-out portions for head assay, DTW, wet LIMS, dry LIMS and compositing.

The sample preparation for composites 1 to 3 (flotation samples) was as follows:

- Mix/split-out portions for grinding to P80 of 45 µm; and
- Mix/split-out portions for wet LIMS and flotation testwork.

The sample preparation and metallurgical test plan are illustrated in the flowsheets shown in Figure 13.1 to Figure 13.4.

Figure 13.1: Sample Preparation for CWi, Ai and SAGDesign Tests

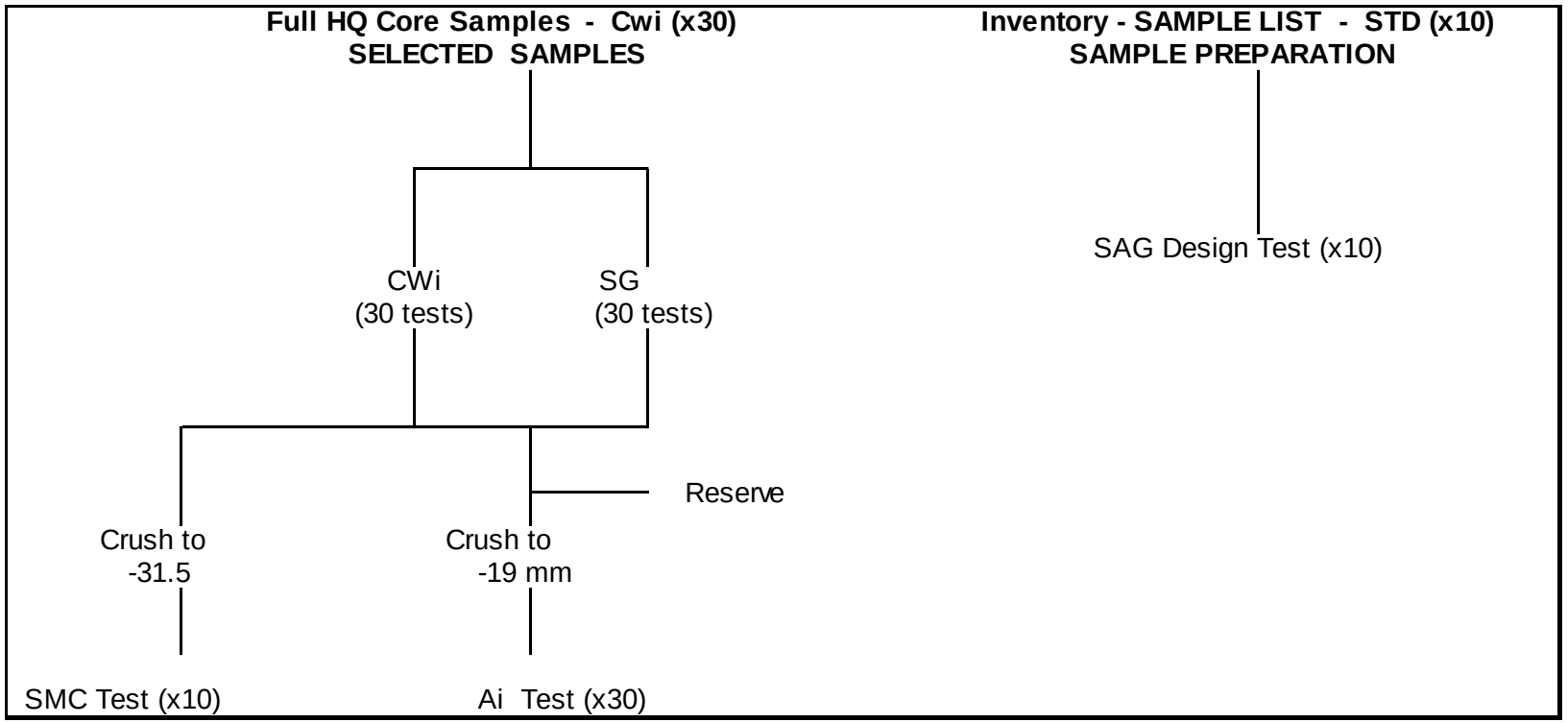


Figure 13.2: Sample Preparation and Metallurgical Test Plan for Beneficiation and Bond Grindability Tests

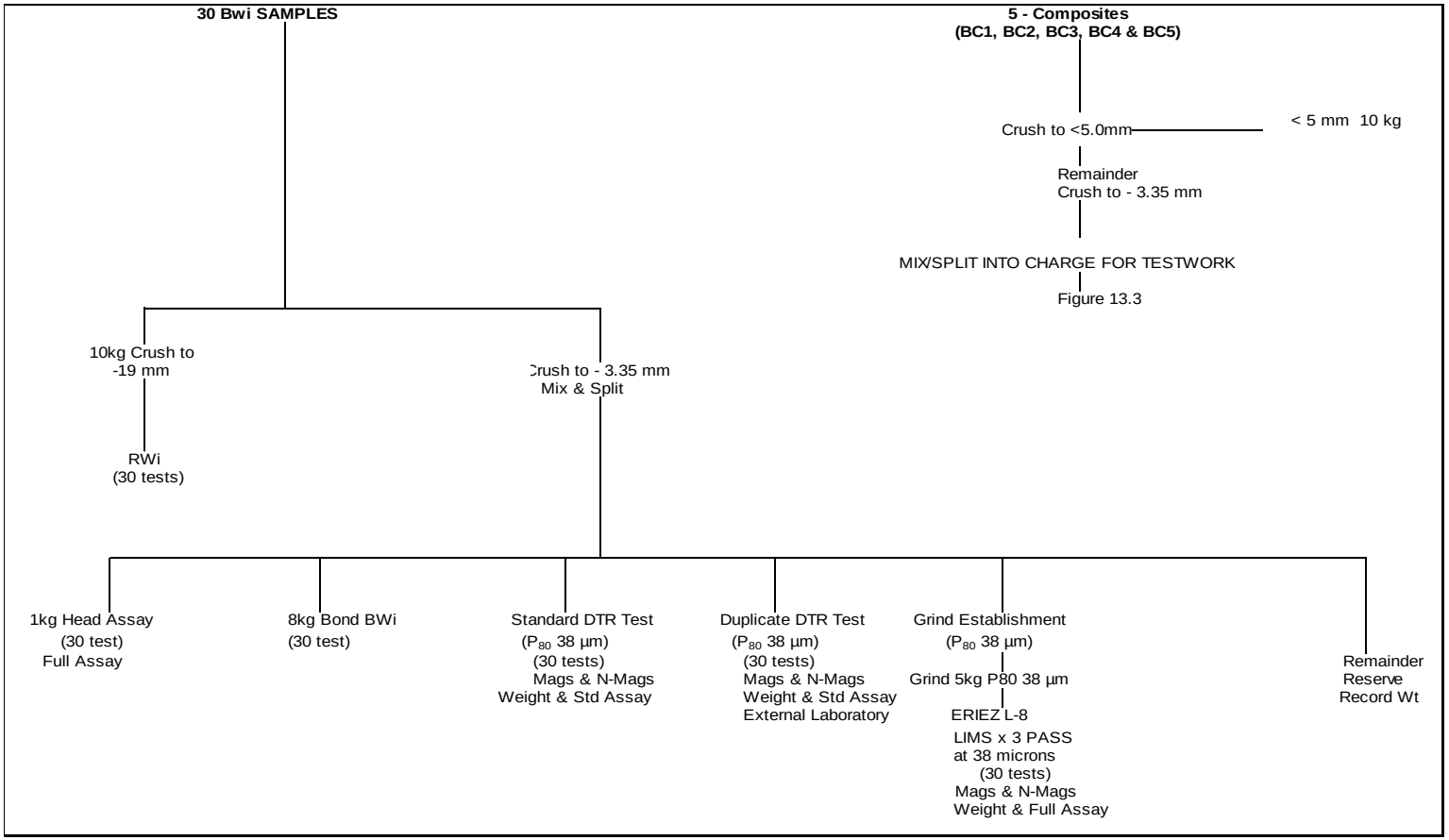


Figure 13.3: Sample Preparation and Metallurgical Test Plan for Beneficiation Tests

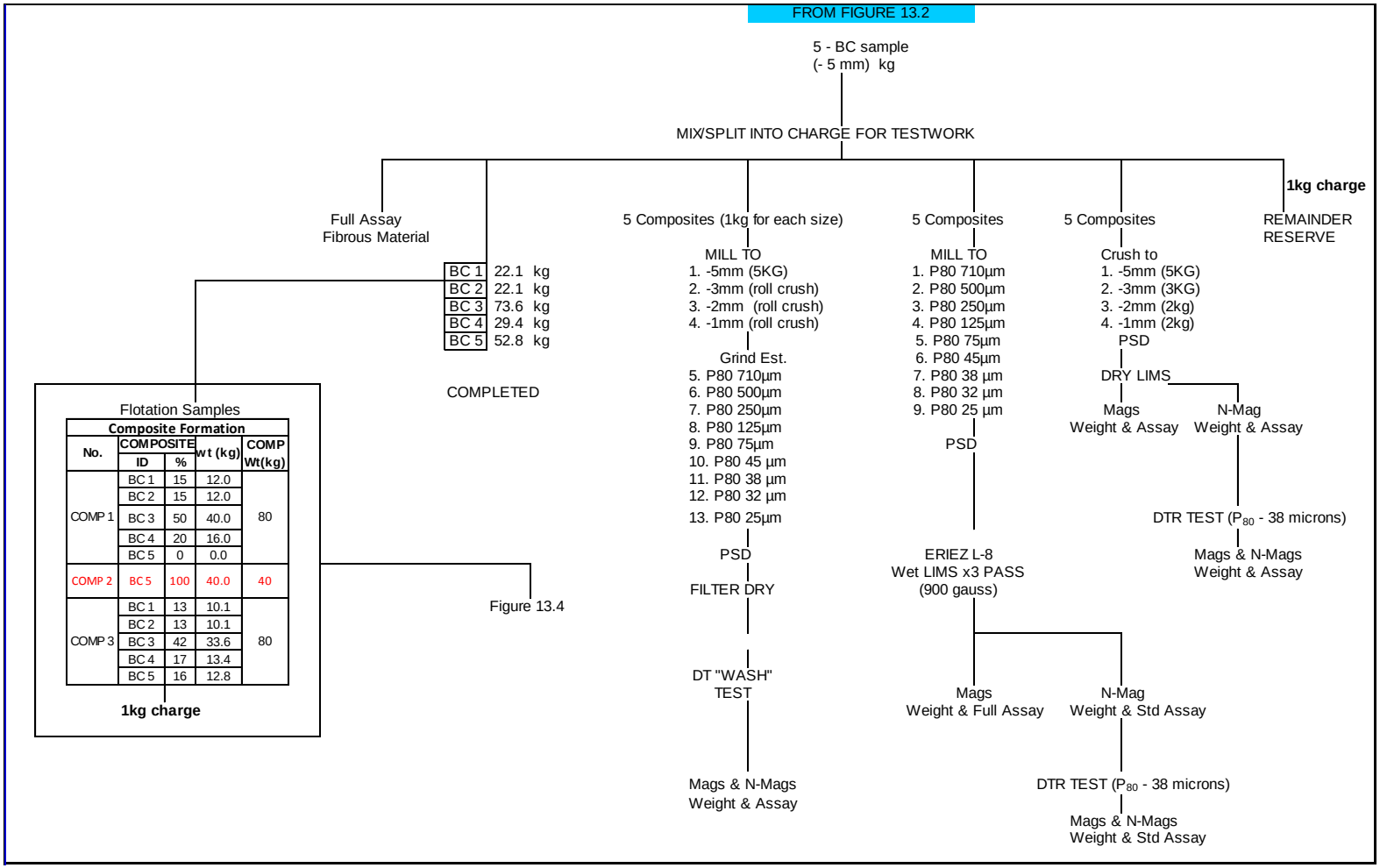
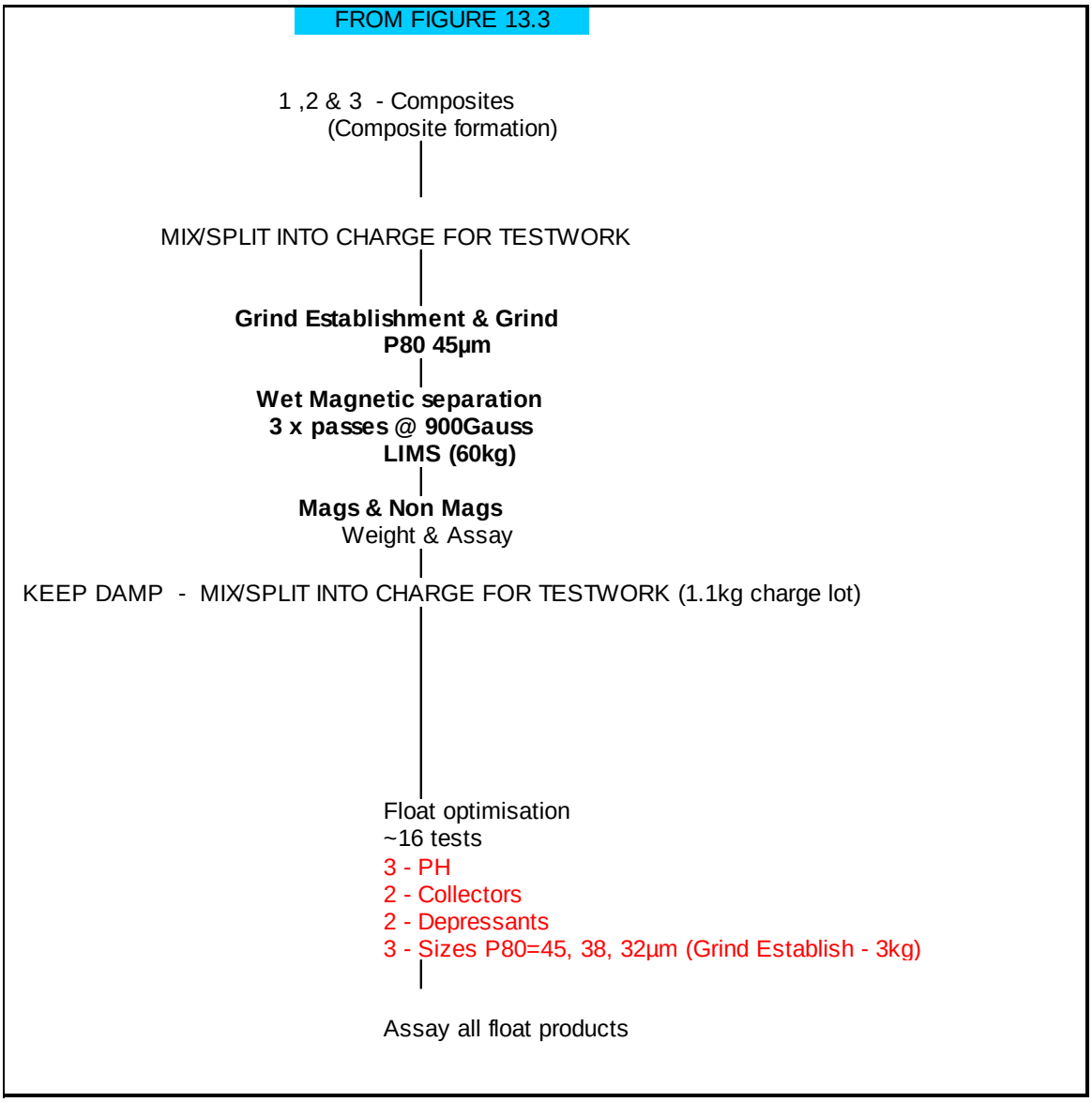


Figure 13.4: Sample Preparation and Metallurgical Test Plan for FlotationTests



13.2.2 Head Assay Analysis

All chemical analysis were carried out at ALS analytical laboratories in Balcatta, Western Australia, and Malaga, Western Australia. The analysis was conducted by XRF, with the exception of magnetite, which was measured by Satmagan and sulphur, which was measured by LECO.

The results of the head assays for different samples are summarized in Table 13.8.

Table 13.8: Head Assay Analysis

Sample ID	Fe_{tot} (%)	Fe_{mag} (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	Magnetite (%)	LOI 1000 (%)
BWi 1	32.1	23.55	48.4	1.23	0.08	0.1	32.53	-0.19
BWi 2	33.2	23.30	44.9	1.91	0.08	0.14	32.18	0.16
BWi 3	35.1	27.44	43.2	1.53	0.09	0.08	37.9	-0.2
BWi 4	32.9	22.90	46.1	1.92	0.08	0.11	31.63	-0.37
BWi 5	33	22.64	46.9	1.4	0.09	0.08	31.27	-0.31
BWi 6	32.1	22.58	47.5	2.03	0.09	0.13	31.19	-0.15
BWi 7	31.7	21.47	47.1	1.94	0.09	0.1	29.65	-0.04
BWi 8	31.9	22.98	47.1	1.43	0.08	0.08	31.74	0.17
BWi 9	33.2	23.66	46.4	1.84	0.08	0.17	32.68	-0.46
BWi 10	33.1	22.68	45.7	1.64	0.07	0.14	31.32	0.15
BWi 11	32.4	20.55	46.3	1.73	0.09	0.06	28.38	-0.08
BWi 12	34.4	25.86	45.2	1.32	0.08	0.07	35.72	-0.44
BWi 13	33.7	25.13	44.7	1.53	0.09	0.11	34.71	0.07
BWi 14	34.3	26.87	44.6	1.35	0.08	0.09	37.11	-0.24
BWi 15	32.3	20.69	46.2	1.89	0.08	0.11	28.58	-0.28
BWi 16	33.1	23.83	45.6	1.65	0.08	0.12	32.91	-0.23
BWi 17	32.2	21.88	46.4	1.75	0.09	0.08	30.22	-0.02
BWi 18	34.7	26.23	44.8	1.6	0.07	0.08	36.23	-0.21
BWi 19	34	24.93	44.9	1.11	0.08	0.09	34.43	0.05
BWi 20	33.2	25.81	46.2	1.32	0.08	0.06	35.65	0.23
BWi 21	29.7	14.06	48	3.62	0.09	0.12	19.42	0.2
BWi 22	29.8	20.34	49.5	2.41	0.09	0.09	28.09	-0.16
BWi 23	31.2	20.53	48.1	2.59	0.1	0.07	28.36	-0.08

Sample ID	Fe_{tot} (%)	Fe_{mag} (%)	SiO2 (%)	Al2O3 (%)	P (%)	S (%)	Magnetite (%)	LOI 1000 (%)
BWi 24	30.7	18.59	47.9	1.83	0.08	0.09	25.68	0.4
BWi 25	32.7	25.46	47.6	1.17	0.09	0.08	35.17	-0.12
BWi 26	33.2	23.55	45.8	1.49	0.08	0.07	32.53	0.09
BWi 27	28.7	12.94	49.2	3.82	0.08	0.15	17.87	0.2
BWi 28	29.1	13.03	48.9	3.03	0.08	0.25	18	0.22
BWi 29	29.9	14.10	49.8	2.14	0.09	0.18	19.47	-0.22
BWi 30	30.1	14.05	48.5	3.16	0.08	0.27	19.41	-0.25
BC 1	29.7	22.98	49.4	1.78	0.07	0.12	31.74	0.18
BC 2	32.3	25.67	46.4	1.66	0.08	0.1	35.45	0.1
BC 3	33.1	29.84	46.7	1.22	0.07	0.09	41.21	-0.14
BC 4	35.2	~35.0	44.5	0.97	0.07	0.05	50.45	-0.47
BC 5	31.5	26.74	47.5	2.84	0.1	0.08	36.94	-0.24
Flotation Composite 1	33.4		45.6	1.52	0.08	0.09		-0.19
Flotation Composite 2	31.5		47.5	2.84	0.1	0.08		-0.24
Flotation Composite 3	33.9		44.1	1.81	0.09	0.09	84.53	0.01

As shown in the above Table, for the samples used in the beneficiation tests (BC1 to BC5), iron content in the head ore varied from 29.7% to 35.2% and sulphur content varied from 0.05% to 0.12%. The iron associated with magnetite (i.e., Fe_{mag}) calculated from the Satmagan varied from 23.0% to 35.0%.

13.2.3 Comminution Tests

13.2.3.1 Bond Ball and Rod Mill Grindability Tests

A total of 30 samples (BWi 1 to BWi 30) were submitted to grindability tests using the Bond ball and rod mill grindability tests.

A summary of the results of Bond ball mill grindability tests is shown in Table 13.9 and the results of Bond rod mill grindability tests are shown in Table 13.10.

Table 13.9: Bond Ball Mill Grindability Tests Results

Sample ID	Test ID	Sizing (µm)		Grp (g/rev)	Test Aperture (µm)	Bond Ball Mill Work Index (kWh/t)
		F_{80}	P_{80}			
BWi 17	BBWi 17	2668	36	0.64	45	20.1
BWi 18	BBWi 18	2557	39	0.73		18.7
BWi 19	BBWi 19	2643	38	0.69		19.4
BWi 19	BBWi 19 (Rpt)	2643	39	0.74		18.5
BWi 20	BBWi 20	2608	40	0.74		18.8
BWi 23	BBWi 23	2610	37	0.72		18.6
BWi 26	BBWi 26	2523	37	0.7		18.9
BWi 27	BBWi 27	2604	33	0.65		19
BWi 28	BBWi 28	2561	34	0.69		18.4
BWi 29	BBWi 29	2618	33	0.66		18.4
BWi 30	BBWi 30	2565	39	0.71		19.5
BWi 09	BBWi 09	2590	119	1.44	150	15.9
BWi 10	BBWi 10	2603	101	1.37		15
BWi 11	BBWi 11	2611	111	1.33		16.3
BWi 12	BBWi 12	2609	111	1.46		15.1
BWi 13	BBWi 13	2582	112	1.34		16.3
BWi 14	BBWi 14	2593	114	1.35		16.4
BWi 15	BBWi 15	2585	106	1.26		16.6
BWi 16	BBWi 16	2666	107	1.18		17.5
BWi 16	BBWi 16 (Rpt)	2666	116	1.24		17.7
BWi 22	BBWi 22	2516	116	1.57		14.7
BWi 25	BBWi 25	2551	112	1.53		14.7
BWi 01	BBWi 01	2454	681	3.4	850	21
BWi 02	BBWi 02	2662	668	2.42		26.1
BWi 02	BBWi 02 (Rpt)	2583	685	2.5		26.4
BWi 03	BBWi 03	2699	667	2.61		24.3
BWi 04	BBWi 04	2713	699	2.57		25.7
BWi 05	BBWi 05	2644	679	2.58		25.3
BWi 06	BBWi 06	2667	627	2.36		25

Sample ID	Test ID	Sizing (µm)		Grp (g/rev)	Test Aperture (µm)	Bond Ball Mill Work Index
		F_{80}	P_{80}			(kWh/t)
BWi 07	BBWi 07	2614	649	2.53		24.6
BWi 08	BBWi 08	2615	666	2.47		25.8
BWi 21	BBWi 21	2611	627	2.27		26.1
BWi 24	BBWi 24	2534	643	2.73		23.3

Table 13.10: Bond Rod Mill Grindability Tests Results

Sample ID	Test ID	Sizing (µm)		Grp (g/rev)	Test Aperture (µm)	Bond Rod Mill Work Index
		F_{80}	P_{80}			(kWh/t)
BWi 01	BRWi 01	9626	866	5.73	1180	19
BWi 02	BRWi 02	9454	812	4.13		22.3
BWi 03	BRWi 03	9840	884	4.68		21.7
BWi 04	BRWi 04	9622	833	4.64		21
BWi 05	BRWi 05	10350	872	4.51		21.8
BWi 06	BRWi 06	9990	848	4.39		21.9
BWi 07	BRWi 07	10007	849	4.4		21.9
BWi 08	BRWi 08	9563	859	4.49		22
BWi 09	BRWi 09	9223	823	4.56		21.3
BWi 10	BRWi 10	9474	880	4.38		22.8
BWi 11	BRWi 11	8992	888	4.47		22.9
BWi 12	BRWi 12	9647	870	4.7		21.5
BWi 13	BRWi 13	9415	924	4.56		23
BWi 14	BRWi 14	9562	903	4.39		23.1
BWi 15	BRWi 15	9733	884	4.83		21.4
BWi 16	BRWi 16	9494	899	4.33		23.3
BWi 17	BRWi 17	8967	885	4.98		21.4
BWi 18	BRWi 18	9753	883	5.64		19.4
BWi 19	BRWi 19	9771	848	4.33		22.2
BWi 20	BRWi 20	9500	870	4.41		22.5
BWi 21	BRWi 21	9394	868	5.2		20.3
BWi 22	BRWi 22	9558	900	4.89		21.6

Sample ID	Test ID	Sizing (µm)		Grp (g/rev)	Test Aperture (µm)	Bond Rod Mill Work Index
		F_{80}	P_{80}			(kWh/t)
BWi 23	BRWi 23	8460	934	5.49		21.2
BWi 24	BRWi 24	8821	886	5.12		21.1
BWi 25	BRWi 25	9472	862	4.53		22
BWi 26	BRWi 26	9626	860	4.34		22.4
BWi 27	BRWi 27	9510	887	4.63		22.1
BWi 28	BRWi 28	9634	882	4.47		22.4
BWi 29	BRWi 29	9049	900	4.49		23
BWi 30	BRWi 30	9412	897	4.45		22.9

From the results, the average Bond ball and rod mill work index values indicate the ore is in the hard rocks category.

Since there was a significant difference between the Bond ball mill grindability test results as compared to the results reported in the PEA study, four duplicate samples were submitted to the SGS lab in Australia. The SGS Bond ball mill grindability tests were conducted at a closing screen site of 150 mm. The results reported by SGS, which are shown below, confirmed that the ore is in the hard category.

Table 13.11 – Bond Ball Mill Grindability Test Results from SGS

Sample ID	F80 (mm)	P80 (mm)	g/rev.	Work Index (kWh/t)
BKI 1	2.637	0.105	1.157	17.63
BKI 2	2.65	0.108	1.22	17.18
BKI 3	2.663	0.111	1.11	18.87
BKI 4	2.635	0.114	1.153	18.56

Considering the results of ball mill grindability tests and the abundance of different rock types in the Shymanivske deposit, a Bond ball mill work index of 15.9 kWh/t was used. This value is a weighted average of Ammtec test results which were completed at the closing screen size of 150 µm and represents the abundance of each rock type in the mine deposit. This value is higher than 84% of the highest Wi value reported by SGS and equals the weighted average values reported by Ammtec.

13.2.3.2 Bond Crushing and Abrasion Index Tests

The crushing-work index determination was carried out on specimens selected from the full HQ core samples. A set of more than ten suitable specimens from each core was selected and the crushing index was determined with an impact crushability test unit. The twin-pendulum impact crushability test unit used at ALS Ammtec was built by Nordberg, USA, and is designed to copy the traditional Bond impact crushability test unit.

A summary of results of the crushing work index determination is shown in Table 13.12.

Table 13.12: Crushing Work Index Test Results

Sample ID	Sample SG (kg/l)	Crushing Work Index (kWh/t)			
		Maximum	Minimum	SD	Average
CWi 1	3.75	21	13.3	2.3	18.2
CWi 2	3.58	29.5	13.2	5.1	18.8
CWi 3	3.87	53.3	9.5	12.1	33.5
CWi 4	3.57	27.7	13	4.1	18.7
CWi 5	3.37	69.5	31.7	11.4	49.8
CWi 6	3.59	60.8	25.5	10.1	41.4
CWi 7	3.19	34.2	5.9	7.1	18.4
CWi 8	3.48	25.2	12.6	4	20.5
CWi 9	3.46	32.3	18.6	3.9	24.5
CWi 10	3.5	30.4	13.7	5.9	20.4
CWi 11	3.53	32.9	8.1	6.1	21.6
CWi 12	3.44	37.4	11.7	6.4	22.7
CWi 13	3.42	32.3	11.4	6	17.9
CWi 14	3.51	30.1	12.8	4	22.6
CWi 15	3.44	27.8	15.9	4.7	20.1
CWi 16	3.25	43.6	18.7	7	23.6
CWi 17	3.36	43.7	12.3	8.1	21.2
CWi 18	3.49	29.3	16	3.9	21.7
CWi 19	3.42	30.9	11	6.3	22.3
CWi 20	3.42	39.6	19	6.6	26.1
CWi 21	3.39	28.6	13.4	4.2	20.7
CWi 22	3.55	24.4	12.3	3.5	18.1
CWi 23	3.54	33.3	13.6	5.9	23.2
CWi 24	3.15	38.1	14	5.9	23.1
CWi 25	3.37	29.9	7.3	6.3	16.5

Sample ID	Sample SG (kg/l)	Crushing Work Index (kWh/t)			
		Maximum	Minimum	SD	Average
CWi 26	3.21	29	4.2	7.5	16
CWi 27	3.42	57.1	7.1	10.8	16.5
CWi 28	3.38	37.8	22.2	4.6	28.9
CWi 29	3.52	45.2	8	9.5	19.4
CWi 30	3.38	36.3	15.8	5.4	22.2

The results determined that the ore can be categorized as hard in the crushing process.

An average of 23 kWh/t for the crushing work index was used in this study.

For the abrasion index, a sub-sample of each composite in the size fraction of -19/+12.5 mm was sorted and subjected to the abrasion index test, using the standard procedure developed by F.C. Bond.

The results of abrasion index tests are summarized in Table 13.13.

Table 13.13: Abrasion Index Test Results

Sample ID	Abrasion Index (Ai)	Sample ID	Abrasion Index (Ai)
BWi 1	0.42	BWi 16	0.48
BWi 2	0.49	BWi 17	0.37
BWi 3	0.4	BWi 18	0.43
BWi 4	0.47	BWi 19	0.45
BWi 5	0.47	BWi 20	0.39
BWi 6	0.39	BWi 21	0.45
BWi 7	0.5	BWi 22	0.31
BWi 8	0.42	BWi 23	0.49
BWi 9	0.51	BWi 24	0.38
BWi 10	0.42	BWi 25	0.31
BWi 11	0.55	BWi 26	0.54
BWi 12	0.45	BWi 27	0.57
BWi 13	0.47	BWi 28	0.41
BWi 14	0.33	BWi 29	0.49
BWi 15	0.59	BWi 30	0.46

Abrasion test results determined that the ore is in the medium abrasive category (0.4 – 0.6).

An average of 0.43 for the abrasion index was used in this study.

13.2.3.3 SAGDESIGN TEST

SAGDesign test was conducted at ALS Ammtec on ten crushed ore samples from the drill cores of Shymanivske ore deposit. Table 13.14 presents the SAGDesign test work results as well as the comminution circuit analysis, which has been done by Starkey & Associates Inc. (S&A) to predict grinding requirements for the project.

Figure 13.5 and Figure 13.6 present the cumulative frequency curves for SAG mill pinion energy (WSAG and BWI on SAG ground ore, respectively). The yellow points represent the Black Iron Shymanivske Project samples. The red points represent the average WSAG and BWI of the Shymanivske samples tested in this study.

Figure 13.5: WSAG, kWh/t (from F80 152 mm to T80 1.7 mm) Cumulative Frequency Curve

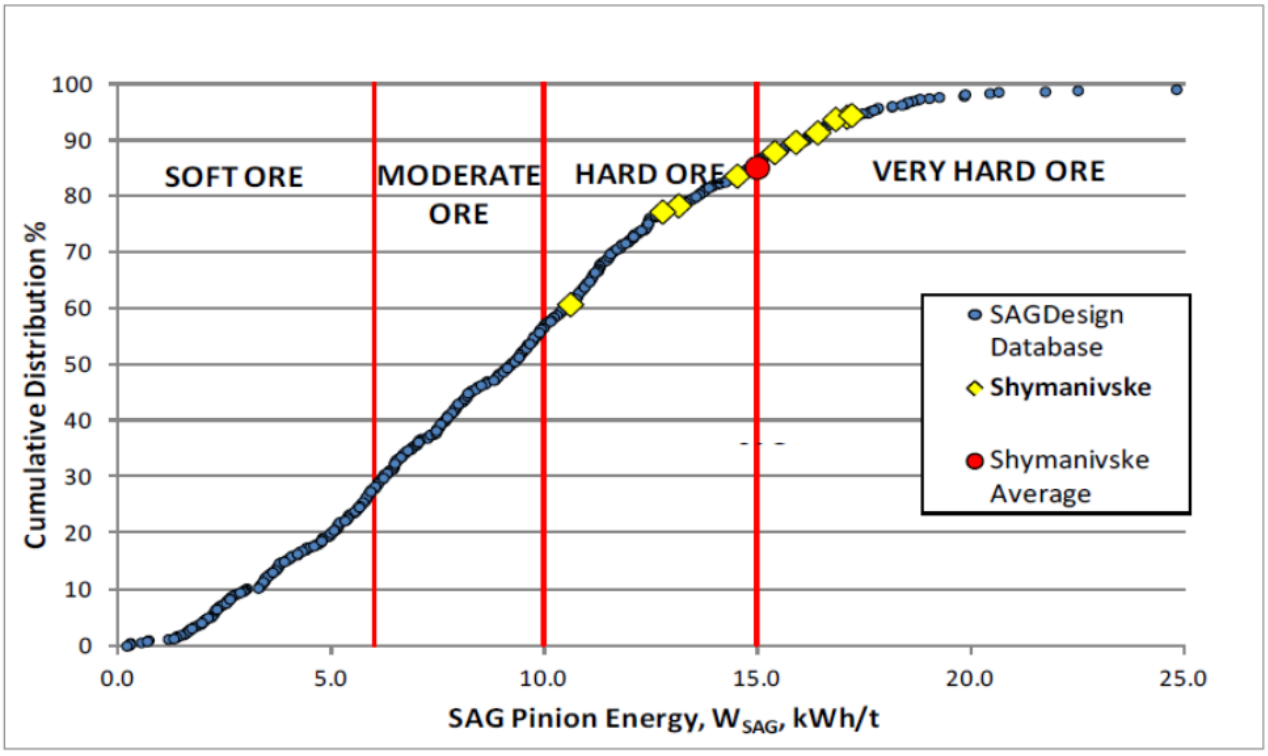
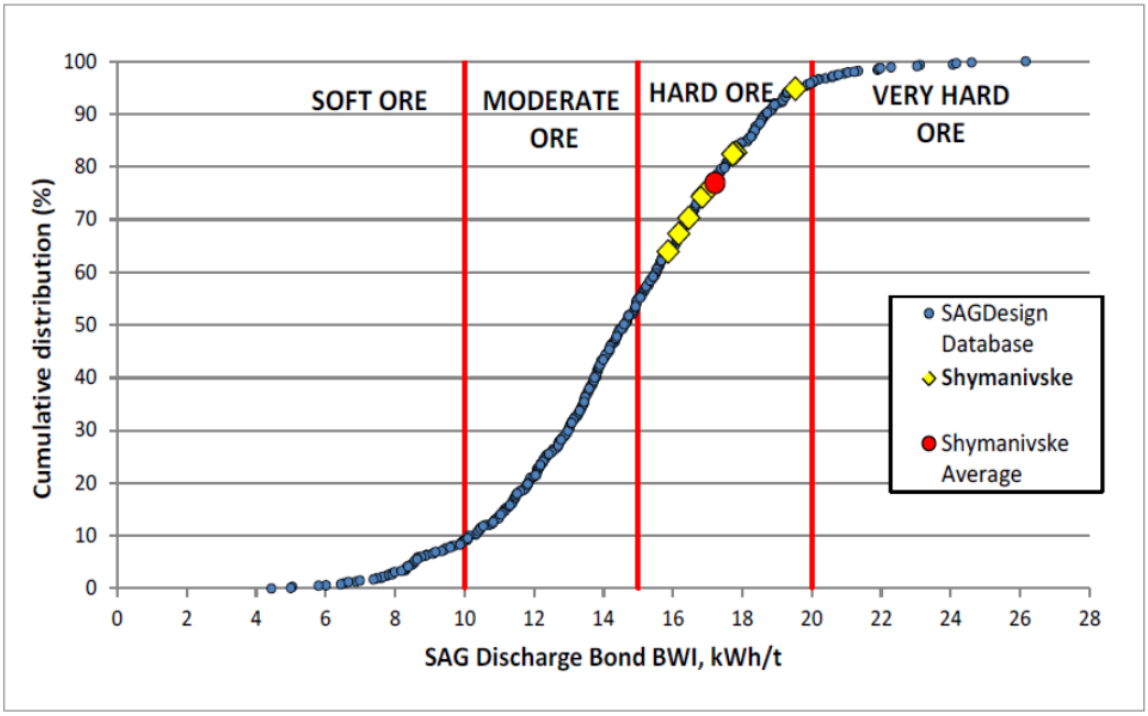


Figure 13.6: SAG discharge BWI Cumulative Frequency Curve



The datasets for each mill design parameter, namely the WSAG, the Sd-BWI, and the total pinion energy (Wtot), as well as the ore specific gravity (SG), were sorted to determine the sample distribution. The overall testwork statistical distribution is presented in Table 13.14. The testwork parameter and pinion energy hardness variability diagrams are illustrated in Figure 13.7 and Figure 13.8, respectively.

Table 13.14: Summary of SAGDesign Test Work Results and Calculated Parameters

Sample	Count	Statistics	Specific gravity	Calc SAG W_{SAG} to 1.7mm (kWh/t)	S_d-BWI *150 µm (kWh/t)	Calc BM W_{BM} to P_{80} (kWh/t)	Calc Total W_{tot} to P_{80} (kWh/t)
Design Samples	**10**	Min	2.99	10.60	15.87	9.20	19.79
		20th %	3.31	12.94	16.32	9.45	23.29
		50th %	3.44	15.63	17.00	9.85	25.90
		80th %	3.57	16.94	17.77	10.30	26.79
	Design	**85th %**	3.65	**17.07**	**16.89**	**9.78**	**26.86**
		Max	3.72	17.19	19.53	11.32	27.13
		Average	**3.42**	14.97	17.22	9.98	24.95
		Std. Dev	0.20	2.2	1.1	0.6	2.3

**closing screen for S_d-BWI test, P_{80} 148 µm*

Figure 13.7: Test Work Parameter Variability Diagram for Ore Specific Gravity, WSAG and Sd-BWI

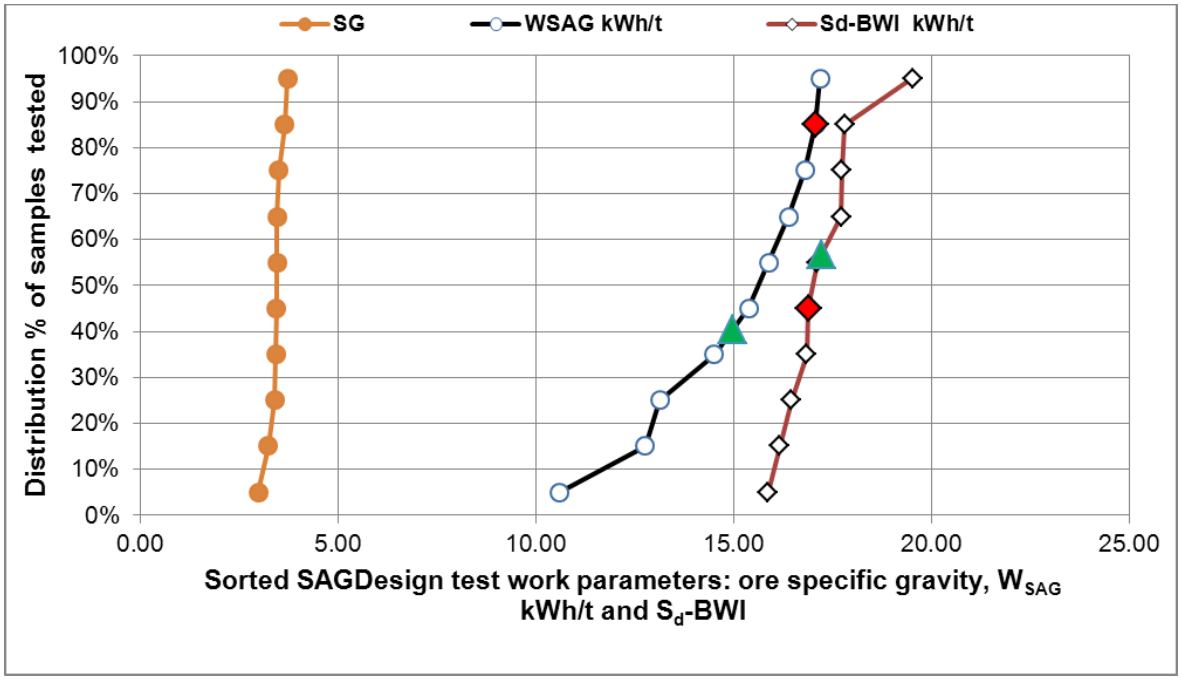
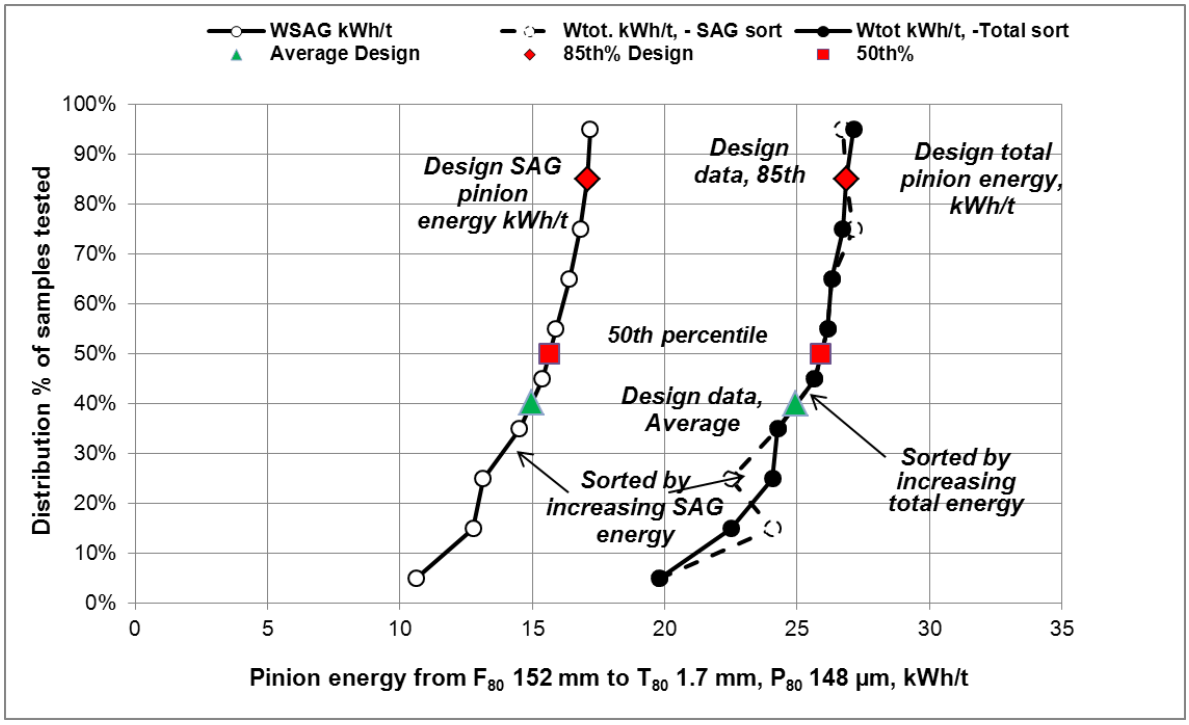


Figure 13.8: *Pinion Energy Hardness Variability Diagram*



On the basis of the ten SAGDesign testwork results, it has been determined that the average SAG mill pinion energy hardness of the Shymanivske ore is 14.97 kWh/t. This compares to the SAGDesign database at the 87th percentile, indicating that the ore is classified as hard. In addition to this, the average SAG discharge Bond ball mill work index (Sd-BWI) was determined to be 17.22 kWh/t, which compares to the SAGDesign database at the 78th percentile.

The throughput and mill-sizing analysis evaluated the grinding circuits with SAG mill grinding in closed circuit with pebble crushers, followed by three stages of ball mill grinding. As this is an iron ore beneficiation project, magnetic separation would be performed on the SAG-discharged product and also on the subsequent primary and secondary ball mill grinding stage products. This results in a different power requirement at each stage of grinding.

The mill sizing calculations focused on two ore hardness percentile levels, namely, the 85th percentile and the average of testwork results. The 85th percentile hardness level was considered as the design point in the analysis, while a mill sizing case based on average ore was presented for comparison.

Based on the SAGDesign test results, the following mill sizes and installed power are recommended.

OPTION FOR 85th PERCENTILE HARDNESS DESIGN

SAG Mills (x4):

The recommendation for this grinding circuit would be to have four SAG mills in parallel. Each SAG mill would be specified as 36.0 ft (11.0 m) diameter x 16.23 ft (5.0 m) Effective Grinding Length (EGL), having an aspect ratio (D/L) of 2.22 and being equipped with 13,300 kW twin pinion (6,650 kW per pinion) fixed-speed synchronous motor drives to produce a product P80 of 3.3 mm. Pebble crushing is required and three 600 kW cone crushers operating from a common feed bin are recommended. An alternative option is to use four pebble crushers and place one in each SAG mill circuit.

Primary Ball Mill (x1)

The grinding circuit would be designed with one primary ball mill to follow the four SAG mills. The primary ball mill would be 26.0 ft (7.9 m) diameter x 36.8 ft (11.2 m), having an aspect ratio (L/D) of 1.42 and being equipped with a 14,800 kW twin pinion (7,400 kW per pinion) fixed-speed synchronous motor drives, to produce a product P80 of 484 µm.

Secondary Ball Mill (x1)

One secondary ball mill is required to follow the primary ball mill in the circuit. The specification for the secondary ball mill is the same as that given above for the primary ball mill. The discharge product from the secondary ball mill is calculated to have a P80 of 150 µm.

Tertiary Ball Mills (x2)

Two equal-sized ball mills would be required in the circuit to produce a final grind size P80 of 38 µm. The required ball mill size is calculated to be 24.0 ft. (7.3 m) diameter x 38.8 ft (11.8 m), having an aspect ratio

(L/D) of 1.62 and being equipped with a 12,700 kW twin pinion (6,350 kW per pinion) fixed-speed synchronous motor drives.

Option for Average Ore Hardness Design

SAG Mills (x3):

The mill-sizing analysis showed that an option to using three SAG mills in identical circuit configuration, as outlined above, is possible if the design is based on average ore. In that case, each of the three required SAG mills is specified as 36.0 ft (11.0 m) diameter x 18.7 ft (5.7 m) EGL mill, having an aspect ratio (D/L) of 1.93 and being equipped with 15,300 kW twin pinion (7,650 kW per pinion) fixed-speed synchronous motor drives to produce a product P80 of 3,300 µm.

In the average design case, the two equal-sized ball mills for primary and secondary grinding are calculated to be slightly longer (~2%) than those specified for the 85th percentile design case. This is due to the difference in the Sd-BWI values at the average and 85th ore hardness. The tertiary ball mills for the average design are the same as specified for the 85th design.

13.2.3.4 SMC TESTWORK

SMC test is used to determine the drop-weight index (DWi), which is a measure of the strength of the ore sample when broken under impact conditions. The DWi is directly related to the JKTech rock breakage parameters A and b, and can be used to determine the values of these parameters. SMC testing was conducted on 10 CWi Composites crushed to minus 31.5 mm.

The results of SMC tests are shown in Table 13.15 and Table 13.16.

Table 13.15: SMC Test Results-A x b values

Sample ID	DWi (kWh/m^3)	SG	Derived Values (kWh/t)			A x b (measure of resistance to impact breakage)		
			Mia	A	b	A x b Value	Category	%
CWi 01	9.36	3.43	20	66.7	0.55	36.7	Hard	28.7
CWi 02	9.6	3.4	20.6	90.1	0.39	35.1		25.2
CWi 03	9.49	3.36	20.7	86.3	0.41	35.4		25.7
CWi 04	9.54	3.42	20.4	68.7	0.52	35.7		26.5
CWi 05	9.62	3.34	21	67.2	0.52	34.9		24.6
CWi 12	9.83	3.39	21.1	85.1	0.41	34.9		24.4
CWi 18	9.82	3.49	20.5	77.3	0.46	35.6		26.1
CWi 19	9.85	3.39	21.1	75.2	0.46	34.6		23.8
CWi 23	10.8	3.47	22.1	89.7	0.36	32.3		18.8
CWi 24	9.94	3.42	21.1	77.5	0.44	34.1		22.8

Table 13.16:SMC Test Results- t10 Values

Sample ID	Particle Size (mm)								
	t10 Value Requirement Related to Particle Size (kWh/t)								
	10	20	30	10	20	30	10	20	30
CWi 01	0.39	0.85	1.41	0.29	0.62	1	0.22	0.46	0.72
CWi 02	0.41	0.89	1.46	0.3	0.65	1.03	0.23	0.48	0.75
CWi 03	0.41	0.89	1.46	0.3	0.65	1.03	0.23	0.48	0.75
CWi 04	0.4	0.88	1.45	0.3	0.64	1.02	0.23	0.47	0.74
CWi 05	0.42	0.9	1.49	0.31	0.66	1.05	0.23	0.48	0.76
CWi 12	0.42	0.91	1.5	0.31	0.66	1.06	0.23	0.49	0.77
CWi 18	0.41	0.88	1.46	0.3	0.64	1.03	0.23	0.47	0.74
CWi 19	0.42	0.91	1.5	0.31	0.66	1.06	0.23	0.49	0.77
CWi 23	0.45	0.97	1.61	0.33	0.71	1.14	0.25	0.52	0.82
CWi 24	0.42	0.91	1.5	0.31	0.66	1.06	0.23	0.49	0.77

The value of A*b, which is also a measure of resistance to impact breakage, is calculated and presented in Table 13.17 along with indicators of how each A*b value compares with the accumulated values in the JK Drop-Weight database (from full JK Drop-Weight testing). These indicators are the Category (e.g., “soft” etc.), the Rank (i.e., the number out of 3,856 recordings in the database that are harder) and the percent of database values that are harder. Note that in contrast to the DWi, a high value of A*b means that an ore is soft, whilst a low value means that it is hard.

Table 13.17: Comparison between Shymanivske SMC Test Results and JK Drop-Weight database

Sample ID	A*b				t10@1 kWh/t			
	Value	Category	Rank	%	Value	Category	Rank	%
CWI#01	36.7	hard	1107	28.70	28.2	moderately hard	1239	32.10
CWI#02	35.1	hard	973	25.20	29.1	moderately hard	1368	35.50
CWI#03	35.4	hard	992	25.70	29	moderately hard	1361	35.30
CWI#04	35.7	hard	1023	26.50	27.9	moderately hard	1170	30.30
CWI#05	34.9	hard	950	24.60	27.2	hard	1066	27.60
CWI#12	34.9	hard	942	24.40	28.6	moderately hard	1302	33.80
CWI#18	35.6	hard	1008	26.10	28.5	moderately hard	1285	33.30
CWI#19	34.6	hard	918	23.80	27.7	hard	1148	29.80
CWI#23	32.3	hard	724	18.80	27.1	hard	1051	27.30
CWI#24	34.1	hard	880	22.80	27.6	hard	1128	29.30

The calculated value of t10 at an Ecs of 1kWh/t is also shown in Table 13.17 Table 13.17. This is again accompanied by category, rank and the precent of values in the database that are harder, so that each can be compared against all other samples in the JKTech database.

13.2.3.5 General Conclusion From Comminution Tests

The conclusion on comminution tests is that the Shymanivske ore is competent and hard in both macro and micro grinding. To determine the optimum flowsheet, a trade-off study between SAG mill and HPGR was completed. This study reviewed the comminution and recovery data and compared alternative comminution flowsheets incorporating High Pressure Grinding Rolls (HPGR), Autogenous Grinding (AG) or Semi-Autogenous Grinding (SAG) circuits. Each of the alternatives was reviewed in terms of total energy requirements and capital and operating costs, with preliminary flowsheets developed for each.

From a total of seven options, two options of HPGR and SAG mills were selected. The flowsheet used in the PEA study was also retained for comparison.

A summary of the capital cost expenditure (CAPEX) and operating cost expenditure (OPEX) was calculated for the different options. Net Present Value (NPV) calculations were also completed for comparison of the options.

The software used for modelling of the comminution circuits was proprietary software developed by Metso Minerals Limited which is used in preliminary selection of comminution equipment globally.

A combination of the WorleyParsons' in house comminution models and database, and other verified published models such as SMC, Bond, and Rowland were used to determine the optimum circuit, transfer sizes, and the specific energy at different stages of the comminution circuits.

Based on the aforementioned review on the three alternative flowsheets and the capital and operating costs associated with each scenario, the recommendation from WorleyParsons was to proceed with the HPGR flowsheet.

The HPGR flowsheet had lower operating costs, when compared with the other options. As a result, this option had the highest NPV value and was selected for the feasibility study.

There were significant benefits in operating costs gained by the elimination of SAG mill liners, grinding media and reduced power requirements associated with the HPGR technology. Also this option provides opportunities to reduce the construction time due to faster equipment delivery.

On the basis of the trade-off study, it was decided to substitute HPGRs for the SAG mills use HPGR iis instead of the SAG mills that had been selected for the PEA design.

The hardness of the Shymanivske ore required two ball mills for the tertiary grinding stage of the same size as the primary and secondary ball mills. Since ball mills are inefficient in the fine grinding stage, it was also decided to use vertical mills at the final stage of the grinding circuit. From similar operations it has been demonstrated that using vertical mills could reduce the energy requirements by as much as 30%

compared to ball mills. The following parameters associated with the vertical mills were also considered in the selection process:

- Lower installation cost and reduced floor space requirement
- Lower operation cost due to reduced energy requirements
- Less overgrinding
- Lower noise levels

A trade-off study determined that the higher capital and lower operating cost of the vertical mill option resulted in a higher NPV compared to the ball mill option.

13.2.4 Beneficiation Testing

The standard processing route for magnetite beneficiation is Low Intensity Magnetic Separation (LIMS). The Shymanivske flowsheet also includes a sulphur reduction step in the form of reverse sulphide flotation. The test program investigated the following:

- Magnetic separation tests by Davis Tube and wet LIMS to establish the liberation size of magnetite and determine the recovery and yield.
- Flotation tests to establish the parameters for sulphide removal and determine the recovery and yield.
- Verification of the effectiveness of the selected flowsheet in upgrading the ore and establishing the overall mass balance.
- Dry Coarse cobbing to investigate early coarse gangue rejection and minimize grinding energy requirements. Coarse cobbing reduces downstream grinding costs and equipment requirements and also allows for a more consistent feed composition to the beneficiation plant and the control of mining dilution.
- A sub-sample of each BC Composite was submitted for dry magnetic separation (DMS) at 100% passing minus 5.0, 3.35, 2.0, and 1.0 mm, and was tested with a small pilot dry magnetic separator (Eriez 350 mm). The results of the tests are shown in Table 13.18 and Table 13.19.

Table 13.18: Dry Magnetic Separation Results- Concentrates Specifications

Sample ID	Size (mm)	Mass Yield (%)	Fe Grade (%)	SiO_2 Grade (%)	Al_2O_3 Grade (%)	LOI-1000 (%)
BC 1	-5	81.3	34	44.2	1.79	-0.33
	-3.35	74.7	35	42.8	1.87	-0.28
	-2	74.4	33.3	44.9	1.99	-0.18
	-1	71.3	36.2	40.9	2.01	-0.37
BC 2	-5	87.2	34.9	43.1	1.76	-0.25
	-3.35	84.7	35	43.2	1.65	-0.26
	-2	84	35.3	42.5	1.64	-0.24
	-1	81.3	36.6	41	1.72	-0.33
BC 3	-5	93.2	34.1	45.3	1.47	-0.16
	-3.35	91.3	35.4	43.7	1.35	-0.31
	-2	90.5	36.5	41.8	1.45	-0.4
	-1	88.6	36.9	41.2	1.42	-0.43
BC 4	-5	95.9	34.2	46	0.97	-0.38
	-3.35	95.3	37	42.2	0.95	-0.53
	-2	94.7	36.5	42.7	1.01	-0.54
	-1	93.4	37.9	41	1.01	-0.59
BC 5	-5	75.3	36	42.2	2.22	-0.65
	-3.35	75.3	36.3	41.5	2.44	-0.7
	-2	75.2	37.1	40.4	2.33	-0.78
	-1	73.5	37.2	40.7	2.33	-0.79

Table 13.19: Dry Magnetic Separation Results- Tailings Specifications

Sample ID	Size (mm)	Mass Yield (%)	Fe Grade (%)	SiO_2 Grade (%)	Al_2O_3 Grade (%)	LOI-1000 (%)
BC 1	-5	18.7	17.2	65.1	2.34	1.4
	-3.35	25.3	17.4	64.7	2.49	1.28
	-2	25.6	17.1	65.1	2.27	1.36
	-1	28.7	17.1	65.6	2.16	1.21
BC 2	-5	12.8	16.6	65.4	2.47	1.48
	-3.35	15.3	15.8	66.6	2.05	1.38
	-2	16	15.2	68.5	1.86	1.23
	-1	18.7	15.1	68.8	1.72	1.34
BC 3	-5	6.8	15.7	65.3	2.05	2.54
	-3.35	8.7	15.1	67.6	2.06	2.23
	-2	9.5	14	69.8	1.78	2.08
	-1	11.4	13.3	71.5	1.48	1.9
BC 4	-5	4.1	12.2	70.5	1.94	2.91
	-3.35	4.7	10.9	72.6	1.46	2.89
	-2	5.3	10.4	75.8	1.24	1.99
	-1	6.6	10.1	75.3	1.12	2.32
BC 5	-5	24.7	18.5	61.6	4.76	0.89
	-3.35	24.7	17.9	62.6	4.57	0.95
	-2	24.8	17.4	64.2	4.28	0.87
	-1	26.5	17	64.9	4.08	0.9

Target particle size for dry cobbing is 80% passing 3.35 mm, with a 10% gangue rejection. This size was selected on the basis of benchmarking with existing operations and after discussions with vendors.

As shown in Table 13.20, for all samples with the exception of BC3 and BC4, gangue rejection was higher than 10% with a weighted average of 15.3%. A conservative average of 10% was used for design purposes.

Table 13.20: Dry Magnetic Separation Results at minus 3.35 mm

Sample ID	Head		Concentrate			Tailings		
	Fe (%)	SiO_2 (%)	Mass Yield (%)	Fe (%)	SiO_2 (%)	Mass Yield (%)	Fe (%)	SiO_2 (%)
BC 1	29.7	49.4	74.7	35	42.8	25.3	17.4	64.7
BC 2	32.3	46.4	84.7	35	43.2	15.3	15.8	66.6
BC 3	33.1	46.7	91.3	35.4	43.7	8.7	15.1	67.6
BC 4	35.2	44.5	95.3	37	42.2	4.7	10.9	72.6
BC 5	31.5	47.5	75.3	36.3	41.5	24.7	17.9	62.6

13.2.4.1 DAVIS TUBE TESTING

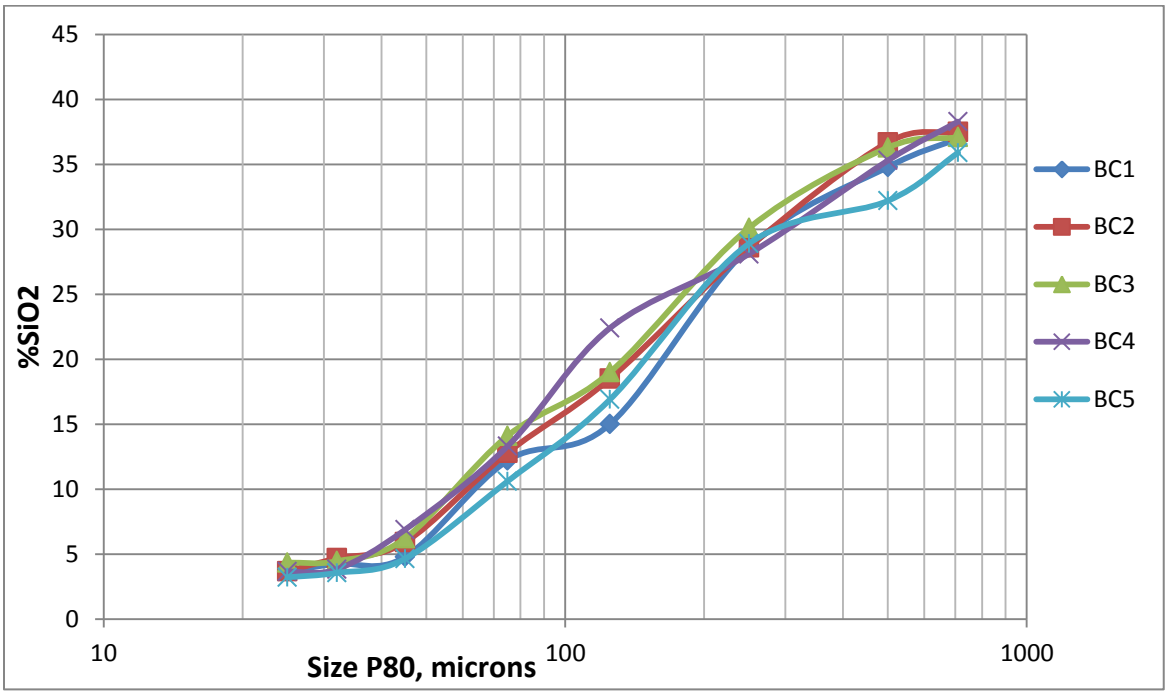
The Davis Tube test was used to evaluate the effect of grind size on concentrate quality, and to establish grind requirements for the confirmatory wet LIMS testing. All composites BC1 to BC5 were submitted to the Davis Tube test.

Each composite was crushed or crushed / ground (in the case of finer sizes) to 13 different sizes, with 100% passing 5.0, 3.0, 2.0, 1.0 mm, and 80% passing 710, 500, 250, 125, 75, 45, 38, 32 and 25 µm. Particle size analysis was performed on a split of each sample. A sub-sample weighing 20 g of each composite was pulverized and submitted for the Davis Tube test.

The variations in SiO2 content by size are presented in Figure 13.9.

SiO2 content of the concentrates sharply decreased with finer grinds and at sizes of P80 of 45 µm and P80 of 32 µm, 5.7% and 4.1% SiO2 were achieved respectively.

Figure 13.9: Size-by-size SiO_2 Analyses on Davis Tube Concentrates



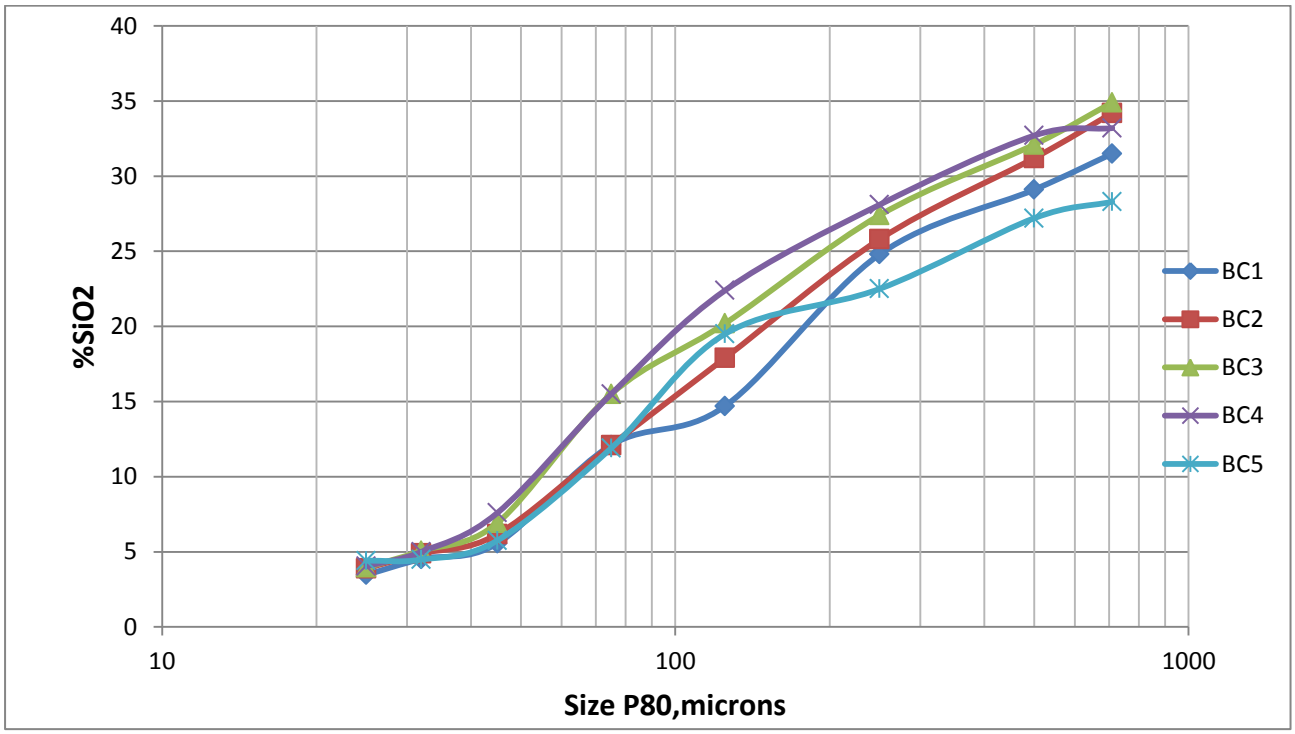
13.2.4.2 WET LOW INTENSITY MAGNETIC SEPARATION TESTS (LIMS)

A sub-sample of each ground BC Composite was submitted for the LIMS test, using an Eriez L8 separator set at 900 Gauss (operated concurrently) and at the following P80 grind sizes: 710, 500, 250, 125, 75, 45, 38, 32 and 25 µm.

The variations in silica content by size are presented in Figure 13.10.

Similar to the Davis Tube results, silica sharply decreased with finer grind sizes, while at P80 of 45µm and P80 of 32 µm, 6.4% and 4.8% silica were achieved respectively.

Figure 13.10: Size-by-size SiO2 Analyses on LIMS Concentrates



Specifications of the concentrate produced by Davis Tube and LIMS are compared in Table 13.21.

Table 13.21: Comparison between Davis Tube and LIMS Results

Passing Size(P80)	Yield%		Fe Grade		SiO2 Grade	
	LIMS	DT	LIMS	DT	LIMS	DT
um	%	%	%	%	%	%
710	57.27	69.4	44.49	40.27	32.63	37.22
500	55.25	64.31	46.09	41.94	30.62	35.2
250	48.92	52.98	50.04	47.21	25.88	28.86
125	42.2	42.34	55.95	56.03	18.91	18.43
75	38.37	37.95	60.43	61.48	13.5	12.7
45	34.22	34.32	66.42	67.48	6.43	5.74
38	33.8	33.7	67.34	68.39	5.15	4.68
32	33.54	33.03	67.82	68.86	4.81	4.18
25	32.87	32.24	68.66	69.24	3.93	3.74

In order to predict the specifications of the concentrate in the plant scale operation, the correlations between Davis Tube and LIMS results were made which are shown in Figure 13.11 and Figure 13.12.

By using the correlation between Davis Tube and LIMS results, yield, iron content and Silica content in the concentrate which will be produced in the plant scale operations are projected and shown in Table 13.22.

Figure 13.11: Correlations between Davis Tube and LIMS Test Results in the Fine Grind Zone

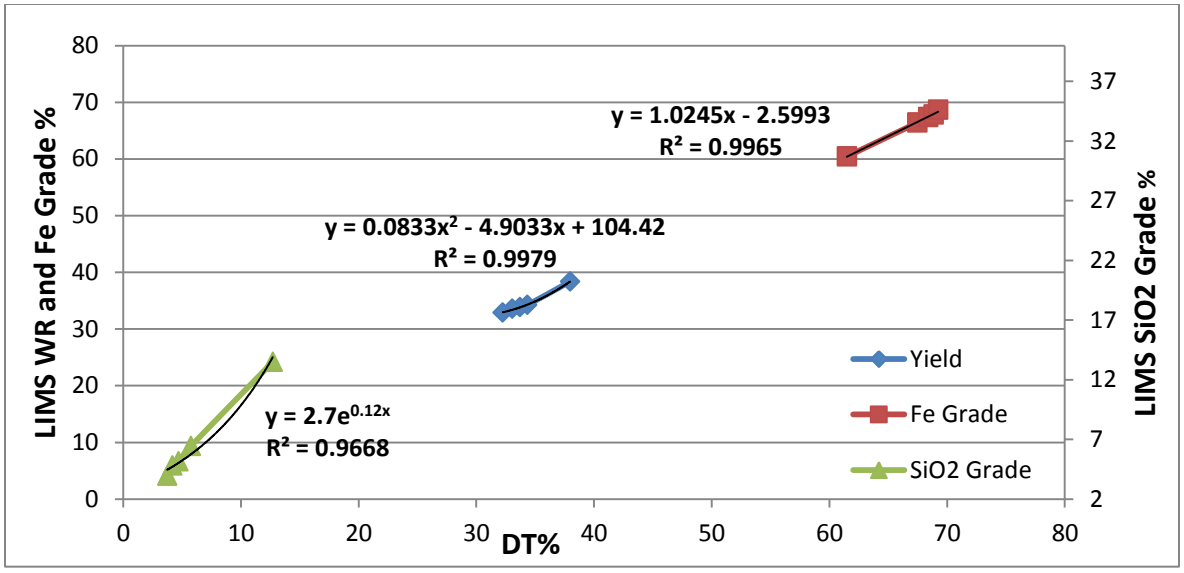


Figure 13.12: Correlations between Davis Tube and LIMS Test Results in the Coarse Grind Zone

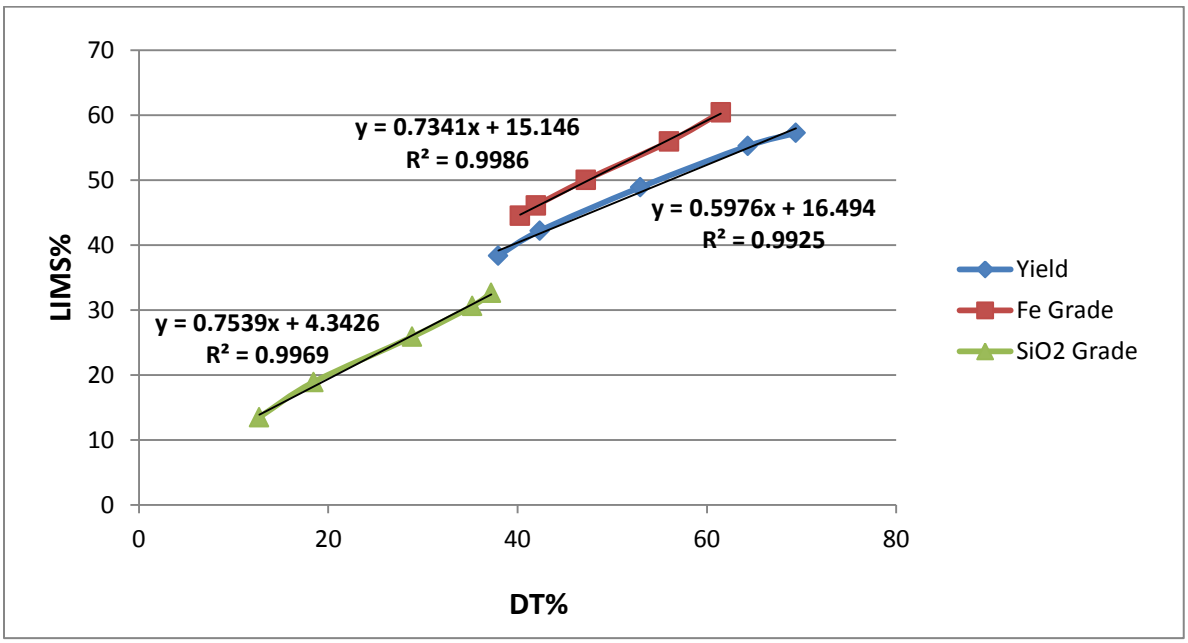


Table 13.22: Projected Specification of Magnetic Separation concentrate

Passing Size(P80) µm	Yield %	Fe %	SiO2 %
710	57.97	44.71	32.41
500	54.93	45.94	30.88
250	48.15	49.8	26.1
125	41.8	56.27	18.24
75	39.18	60.28	13.92
45	34.26	66.54	5.37
38	33.78	67.46	4.73
32	33.34	67.95	4.46
25	32.92	68.34	4.23

On the basis of the predicted results of magnetic separation, the size of P80 of 32 µm was selected as the final grind size to reach the silica content of less than 4.5% in the final concentrate.

13.2.4.3 FLOTATION TESTS

Testwork determined that the sulphur content in the Shymanivske magnetite ore, after magnetic separation stages, exceeded the target of 0.05%. Mineralogical analysis suggested that sulphur in the ore is primarily iron sulphides, pyrite and pyrrhotite. As pyrrhotite is ferromagnetic, it will primarily be recovered to concentrate during low intensity magnetic separation. As a result, it was decided to remove the sulphides via froth flotation, and reduce the sulphur content to the target value of 0.05% in the final concentrate.

Reverse sulphide flotation testwork was completed on a master composite (composite No. 3) at different particle sizes. This sample had been upgraded by LIMS at P80 of 45 µm prior to the flotation tests.

In addition to sulphide flotation, some of the tests were designed and carried out on both sulphide and silica flotation in order to understand the efficiency of flotation on the reduction of Silica content in the final concentrate.

In total, 16 flotation tests were completed. Each test was carried out on a 1,000 g sample in a laboratory Agitair LA500 flotation machine (2.2-litre cell), where local tap water of Perth, Australia, was added to achieve a pulp density of approximately 30% solids by weight.

The results of the flotation tests are summarized in Table 13.23

As indicated in the tests results, although it was possible to reduce the sulphur to less than 0.05% at a P80 of 45 µm, the Silica grade averaged 6.04% and 6.67% in tests LH0649 and LH0647 respectively. Further flotation to reduce Silica content to less than 4.5% at P80 of 45 µm, reduced iron recovery from 98% to 88.7% and 80.9% in tests LH0651 and LH0652, respectively.

Consequently, it was decided to maintain a final grind size at P80 of 32 µm to achieve the target Silica, and to utilize sulphide flotation only for sulphur reduction.

The relationship between Fe_{mag} in the head are and global yield could be formulated as the following: Yield = (FE_{mag} x 1.4899) + 3.796.

Table 13.23: Flotation Tests Results

Test ID	Grind P_{80}	Wt	Fe		SiO_2		S	
	(µm)	(%)	Grade	Recovery	Grade	Recovery	Grade	Recovery
		(%)	%	%	%	%	%	%
LH0637	45	98.9	66	99	6.69	98.1	0.11	84.5
LH0638	45	99.2	66.1	99.3	6.69	98.1	0.13	90.8
LH0639	45	99	65.9	99.1	6.64	98.3	0.11	86
LH0640	45	98.8	65.9	98.9	6.64	97.3	0.12	89.6
LH0641	45	91.6	67.6	93.9	4.73	64.5	0.14	88.2
LH0642	45	98.7	66.3	98.9	9.73	97.6	0.07	51.5
LH0643	45	99	66.3	99.2	6.5	97.6	0.12	83.1
LH0644	38	97.5	67	98.1	6.19	91.6	0.09	57.5
LH0645	32	97.2	66	97.9	6.39	89.7	0.08	55.5
LH0646	45	66	70.5	70.2	1.86	18.1	0.1	43.6
LH0647	45	97.8	66.3	98	6.67	96.5	0.04	34.1
LH0648	32	86.2	70.2	90.9	2.42	30.8	0.08	46.6
LH0649	32	95.9	67.1	96.8	6.04	86.6	0.05	35.1
LH0650	45	89.7	68.2	92	4.82	64.5	0.02	16.5
LH0651	45	86.3	68.1	88.7	4.5	58.3	0.03	15.7
LH0652	45	78.2	68.6	80.9	3.4	39.6	0.04	21.1

14 MINERAL RESOURCE ESTIMATES

14.1 Mineral Resource Estimate Statement

Following the completion of additional drilling in December 2011, Farshid Ghazanfari, P.Geo. and Chief Geologist at Black Iron, prepared an updated Mineral Resource estimate for the Shymanivske Deposit. WGM was retained by Black Iron to audit this in-house estimate. The most recent Mineral Resource estimate for the Shymanivske Deposit was completed in May, 2011, for a PEA by Black Iron and then verified and audited by Hugh De Corta, P.Geo., an independent consulting geologist. Additional confirmation and infill drilling by Black Iron, which commenced in April, 2011, led to the compilation of this data, and the subsequent drilling density allowed for the upgrading of the Mineral Resource estimates for the Project. Information used for this update included historical drillhole data, in addition to Black Iron twin drilling and definition drilling programs.

Although WGM cannot verify the quality assurance and quality control processes and methods used in compiling the historical technical data, WGM believes that the historical technical data is relevant to the overall potential of the Shymanivske Project and to the establishment of updated Mineral Resources. The accuracy and validity of the historical data used was verified to the best of Black Iron's abilities and is explained in detail by WGM in Section 12 of this Report.

The current Mineral Resources are categorized as Measured, Indicated and Inferred and the categories are based on drillhole spacing, data quality (and confidence) and search ellipse distances. Resources are interpolated out to a maximum of 675m (approx.) on the ends/edges and at depth, when supporting information from adjacent cross-sections was available. The resources are reported above -440m elevation level (about 500 m from surface), which is the same pit shell depth used in the previous PEA.

A summary of the Mineral Resources is provided in Table 14.1

Table 14.1: Mineral Resource Estimate for the Shymanivske Iron Ore Deposit (Cut-off Grade of 10% Fe_{mag})

Category	Tonnes (Million) *	Fe_{tot} %	Fe_{mag} %
Measured	355.1	32.0	19.5
Indicated	290.7	31.1	17.9
Total M&I	**645.8**	**31.6**	**18.8**
Inferred	188.3	30.1	18.4

*Tonnage and grade numbers rounded to the first decimal

The classification of Mineral Resources used in this report conforms to the definitions provided in the final version of NI 43-101, which came into effect on February 1, 2001, and was revised on June 30, 2011. WGM further confirms that, in arriving at the classification, it has followed the guidelines adopted by the Council of the Canadian Institute of Mining Metallurgy and Petroleum ("**CIM**") Standards. The relevant definitions for the CIM Standards/NI 43-101 are as follows:

- A Mineral Resource is a concentration or occurrence of diamonds, natural, solid, inorganic or fossilized organic material including base and precious metals, coal, and industrial minerals in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge.
- An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes.
- An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics, can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes that are spaced closely enough for geological and grade continuity to be reasonably assumed.
- A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes that are spaced closely enough to confirm both geological and grade continuity.
- A Mineral Reserve is the economically mineable part of a Measured or Indicated Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A Mineral Reserve includes diluting materials and allowances for losses that may occur when the material is mined.
- A Probable Mineral Reserve is the economically mineable part of an Indicated, and in some circumstances a Measured Mineral Resource demonstrated by at least a Preliminary Feasibility

Study. This Study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified.

- A Proven Mineral Reserve is the economically mineable part of a Measured Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction is justified.

Mineral Resource classification is based on certainty and continuity of geology and grades. In most deposits, there are areas where the uncertainty is greater than in others. The majority of the time, this is directly related to the drilling density. Areas more densely drilled are usually better known and understood than areas with sparser drilling. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

14.2 General Mineral Resource Estimation Procedures

Black Iron's block model Mineral Resource estimate procedure included:

- Validation of digital data in the geological software package of Gemcom Software International Inc. (Gemcom™);The data was transferred to WGM from Black Iron in Gemcom™ format for the WGM audit and it was validated both within MSAccess and Gemcom™;
- Generation of cross-sections to be used for geological interpretations;
- Basic statistical analyses to assess cut-off grades, compositing and cutting (capping) factors, if required;
- Development of 3-D wireframe models for the different ore horizons within the Shymanivske Property that had sufficient continuity of geology/mineralization, using available geochemical assays for each drillhole sample interval; and
- Generation of block models for the Mineral Resource estimates and categorization of the results, according to NI 43-101 and CIM definitions.

14.3 Database

14.3.1 Drillhole Data

Data used to update the Mineral Resource estimates for Shymanivske originated from a dataset generated by Black Iron technical personnel and supplied to WGM for an audit. Gemcom™ Software (GEMS Version 6.2) was utilized to hold all the requisite data to be used for any manipulations necessary and for completion of the geological and grade modelling for the Mineral Resource estimate.

The database, which was created for previous Mineral Resource estimates and utilized in the PEA (May 2011), has been used for the purpose of updating the current estimate. This database was originally created by Genivar (January 2011), by incorporating all historical data from tables including ASSAY, LITHO, COLLAR, SURVEY, COORD, BULK ASSAY, GEOTECH and Summary_Ore_Characteristics, which were extracted from the 2005 database. The 2005 database was compiled by GIC (see Section 6.1 for more details). The original Gemcom™ drillhole database consisted of 215 historical diamond drillholes. The database was updated with the results from the recent twin-hole program (totalling 6,041.8m in 22 holes) and the definition-drilling program (totalling 10,740m in 41 holes). The raw-sample intervals totalled 5,669 within the mineralized zones (including internal waste) and ranged from 0.3m to 22.1m, averaging 3.9m.

Black Iron's drilling programs are summarized in Section 10.2 of this Report. The drillholes are dispersed along the Banded Iron Formation (BIF) horizons for approximately 2,150 m of strike length and 900m of width of the Shymanivske Deposit.

The current database has adequate drillhole density to better understand the structure, geology and mineralization in these areas. Therefore, the categorization of the Mineral Resources could be upgraded from the previous resource estimates.

Additional information, which included copies of the geological logs, summary reports and internal geological interpretations, was supplied to WGM digitally or as hard copies.

14.3.2 Data Validation

Upon receipt of the data, WGM performed the following validation steps:

1. Checking for location and elevation discrepancies by comparing collar coordinates with the copies of the original drill logs received from the site;
2. Checking minimum and maximum values for each quality value field and confirming/modifying those outside of expected ranges;
3. Checking for inconsistency in lithological unit terminology and/or gaps in the lithological code;
4. Spot-checking original assay certificates against information entered in the database; and
5. Checking gaps, overlaps and out-of-sequence intervals for both assays and lithology tables.

The database tables, as originally supplied, contained some minor errors that were corrected and confirmed by Black Iron before proceeding with the audit of the Mineral Resource estimate. WGM was kept up to date on the database revisions and geological interpretation that Black Iron was generating.

The database was also validated by Black Iron with the internal validation tools of Gemcom™. In general, WGM found the database to be in good order and no database issues were identified that would have a material impact on the Mineral Resource estimate.

14.3.3 Database Management

The drillhole data were stored in a Gemcom™ multi-tabled workspace, specifically designed to manage collar and interval data. The line work for the geological interpretations and the resultant 3-D wireframes were also stored within the Gemcom™ Project. The Project database stored cross-section and level plan definitions along with the block models, so that all data pertaining to the Project are contained within the same Project database.

14.4 Geological Modelling Procedures

14.4.1 Cross Section and Level Plan Definition

Two geology level (plan) maps and a surface topographic map as DXFs (Drawing Exchange Format) were directly imported into the Gemcom Project. Furthermore, the two geology level maps were scanned and digitized, along with 13 cross-sections with drillhole locations and the original Soviet geological interpretations. Figure 7.2 (shown previously) illustrates the geological interpretation at surface. The position and the name of the cross-sections are also presented on this Figure. The sections are unevenly spaced and perpendicular to the general strike of the iron formations and are oriented at 111.5°N. Some cross-sections have geological interpretations down to the -600m level, while others stop at the -250m level. Typical cross-sections illustrating the geology and mineralization are presented in Figure 7.5 and Figure 7.6, in Section 7 of this Report.

Drillholes on cross-sections were variably spaced with vertical or near vertical dips for historical drillholes and twin drillholes and flatter dips (~70°) for Black Iron definition drillholes. The drilling was done on sections perpendicular to the strike of the formations with spacing varying from 30m to 130m along sections, and from 80m to 300 m along strike with vertical depths of 250m to 550m. The mineralized zones in the central and south parts of the Shymanivske Property are drilled with tighter spacing (denser drilling pattern) to allow better definition of the Mineral Resources; however, the northern part of the Property (north of Cross-Section 6) has wider spaced drilling (up to 300m spacing) because of the interruption in the Black Iron definition drilling program in 2011, for which reason all planned holes were not completed.

Because of the variable drilling pattern, most cross-sections contained at least three holes, and some had as many as 20 holes, passing through the mineralized zones. However, there are two cross-sections (6A and 7A) in the northern extremity of the Property with no drillholes. See Figure 7.2, Section 7 for the locations of the drillholes in the Mineral Resource area and the cross-section orientations.

14.4.2 Geological Interpretation and 3-D Wireframe Creation

The initial, interpreted mineralized units were first hand drawn on paper cross-sections by WGM based on lithological characteristics and head assay grades. The modeling cut-off grade for the domains was set at 10% Fe_{mag}, which is essentially a natural cut-off grade for the mineralization. These outlines were then digitized on each section as closed polygons in Gemcom™ and appropriately labeled. The digitized lines

were “snapped” to drillhole intervals to ensure that the resulting wireframes honoured the 3-D position of the drillhole interval.

Simplification of some of the outlines needed to be done for ease of 3-D modeling. WGM’s and Black Iron’s final geological interpretations were slightly different when compared, but the differences would have minimal material effect on the overall tonnage or grade of the deposit. Discussions were held in order to approve any changes, and some revisions were made over the course of the work.

Although the lithological domains are somewhat similar to the ones used in the 1989 interpretation and were related to each of the previously identified BIF horizons, they were unified and/or separated to show the regional and deposit scale folded structures (Table 14.2). The 3-D zone solids/wireframes (Figure 14.1) were built by extruding the polygons at mid-section, which were drawn on the cross-sections for each lithological domain.

The overburden surface was extracted from the previous Mineral Resource estimate (BBA, December 2011) and adopted for the overburden contact for the current estimate. In most cases, the recent drilling validates the overburden surface and small errors occur only in one of the interpreted sections, which is between the existing overburden surface and recent drillhole collars. An updated topography wireframe, derived from a gridded digital elevation model from the 2011-ground gravity survey, replaced the previous topography surface. These surfaces were used to limit the upper boundary of the geological block model (i.e., the Mineral Resources were defined up to the surface representing the bottom of the overburden). Black Iron ensured that the Mineral Resource estimate stayed below this overburden surface.

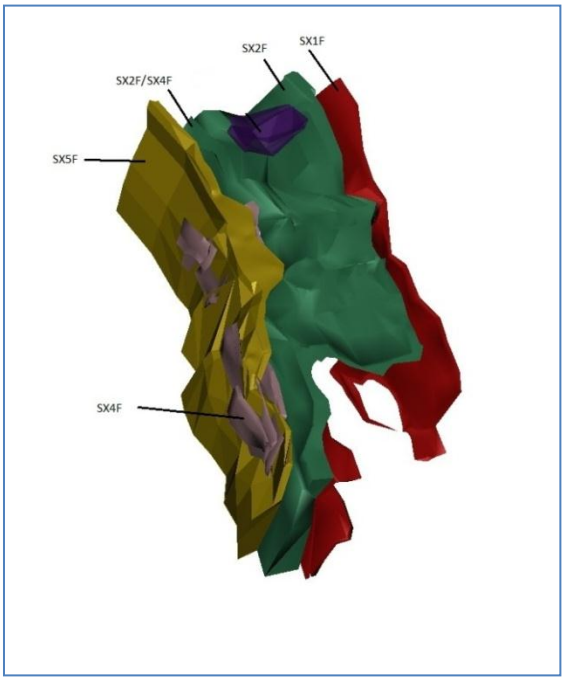
Table 14.2: Lithological Domains

Domains	DB Rock Code	Waste/Ore	Density from 2005 Database (g/sm^3)	Lithology
FOX	121	o	3.00	Altered Ore
OX	21	w	2.50	Altered Waste
NKA	2	w	2.80	Amphibolite
NKM	1	w	2.70	Migmatite
GD1_2S	20	w	2.52	Sandstone
SK2	4	w	2.85	Schist
SK3	3	w	2.85	Conglomerate
SX1F	8	o	3.40	Magnetite-Quartzite
SX1S	6	w	3.07	Quartzite Schist
SX1T	5	w	3.07	Talc-Chlorite Schist
SX2F	11	o	3.42	Magnetite Quartzite

Domains	DB Rock Code	Waste/Ore	Density from 2005 Database (g/sm^3)	Lithology
SX2S	9	w	3.08	Quartzite Schist
SX4F	14	o	3.39	Magnetite Quartzite
SX4S	12	w	3.13	Quartzite Schist
SX5F	18	w	3.31	Martite-Magnetite-Qz
SX5S	15	w	3.17	Quartzite Schist

Note: Densities for FOX, OX, NKM and NKA are from geological knowledge since no data were provided.

Figure 14.1: 3-D solid models (as viewed from the upper southwest)



The upper elevations of the models were limited to the bedrock-overburden contact, while maximum depths were limited to 45m relative to sea level (RSL) based on maximum depths of drilling. Mineralized boundaries extended to a maximum of 600m (approx.) on the ends of the zones and at depth where there was no/little drillhole information, but only if the interpretation was supported by drillhole information on adjacent cross-sections or solid geological inference.

Alteration products in the form of martite, hematite, limonite and goethite are dominant features in the Oxide Zone (SX5F), which developed along the sheared limb of the anticline (thrust fault zones) on the west side of the Property. This zone was modelled on 120m-spaced sections: it shows a similar strike with other mineralized zones (N22°E) and it dips about -70°SW. There is also an Oxide/altered blanket

zone which covers only the SX2F and SX4F horizons and appears underneath the overburden with a thickness of up to 12m. The latter zone is considered to be a result of weathering and is not related to any specific fault zones. This Oxide Zone was interpolated with grades, but was excluded from the Mineral Resource estimate at this time because of the lack of drilling and metallurgical information.

According to the results of the recent drilling, the continuity of the mineralization as a whole appeared to be quite good, giving WGM the confidence to extend the interpretation beyond the 300-m distance in some cases. As long as there was drillhole information and supporting data from adjacent sections, Black Iron continued at depth with the 3-D model for the Shymanivske Deposit mineralized domains and the Oxide/Waste Domain (SX5F). Since the drilling density was lower in the deeper parts of the deposits, the drillhole spacing was taken into consideration when classifying the Mineral Resources, and these areas were given a lower confidence category. Even though the wireframe continued to a maximum depth of -600m (approximately 675m vertically below surface and extending 200m past the deepest drilling), no Mineral Resources were defined/considered at this time that were below -440 m elevation in the Shymanivske Deposit.

Figure 14.2 to Figure 14.4 show two representative cross-sections through the deposit and a level plan, illustrating the zone/unit boundaries and $\%Fe_{mag}$ block model.

Figure 14.2: Cross-section 2 showing %Fe_{mag} block model

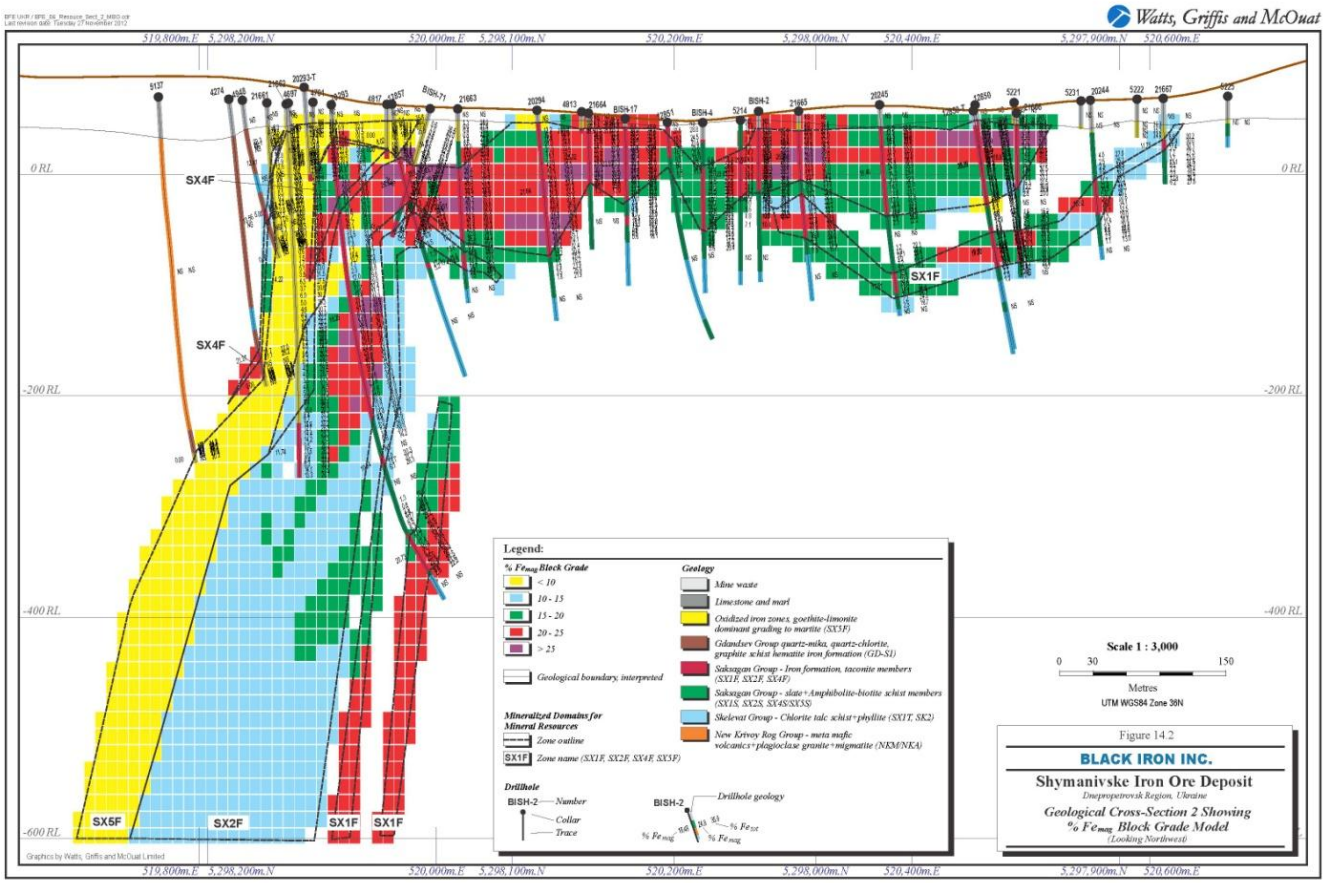


Figure 14.3: Cross-section 5 showing %Fe_{mag} block model

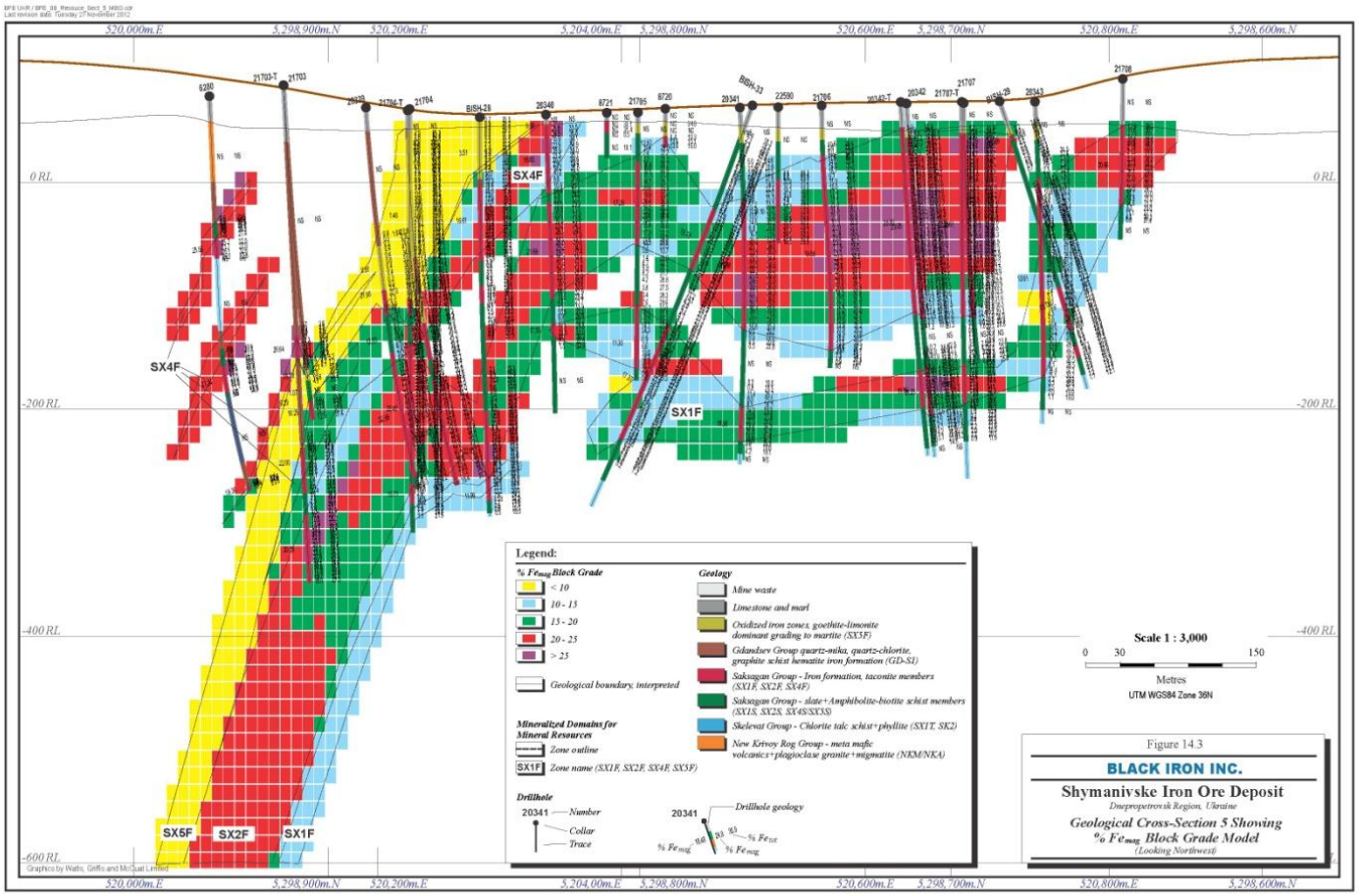
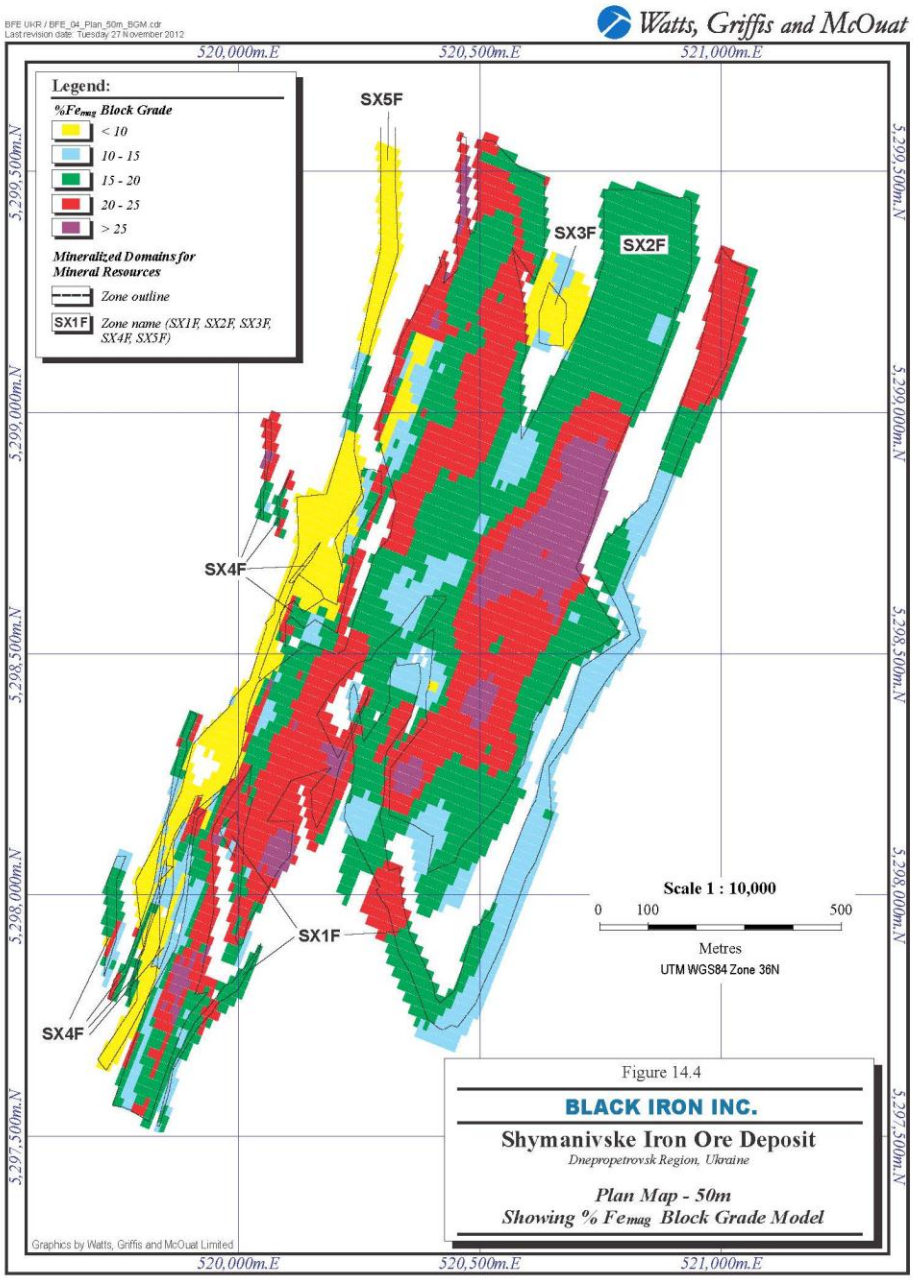


Figure 14.4: Level plan -50m showing $\%Fe_{mag}$ block model



14.5 Statistical Analysis, Compositing, Capping and Specific Gravity

14.5.1 Back-coding of Rock-Code Field

The 3-D wireframes/solids that represented the interpreted mineralized zones were used to back-code a rock code field into the drillhole workspace, and these were checked against the logs and the final geological interpretation. Each interval in the original assay Table and the composite Table was assigned a rock-code value based on the rock-type wireframe that the interval midpoint fell within.

14.5.2 Statistical Analysis and Compositing

Univariate statistical analysis was performed, using Snowden's Supervisor™ software. The $\%Fe_{tot}$ and $\%Fe_{mag}$ values were extracted from the Gemcom™ database for all three major mineralized domains (SX1F, SX2F and SX4F) and the Oxide Domain (SX5F), which is considered waste in the current Mineral Resource estimate. The histograms are shown as Figure 14.5 through Figure 14.8 with univariate statistical data for the raw assays. These values are representative of the uncut and non-composited assay data in the SX1F, SX2F, SX4F and SX5F domains and are weighted on the basis of the length of the representative intervals.

Figure 14.5: Histogram for assays in SX1F Domain

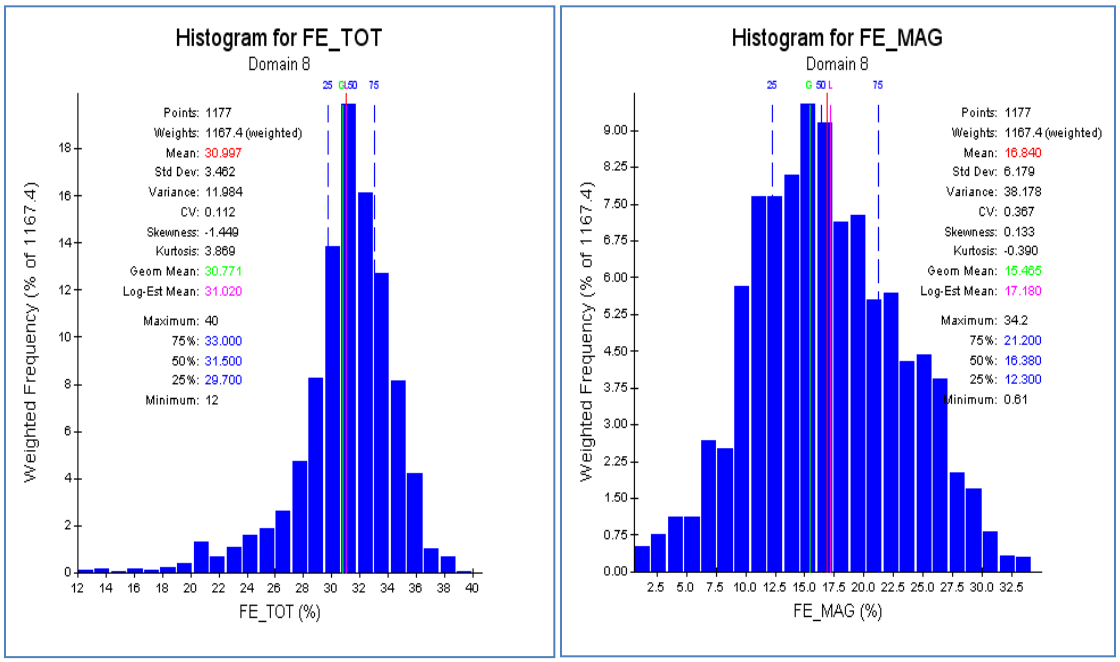


Figure 14.6: Histogram for assays in SX2F Domain

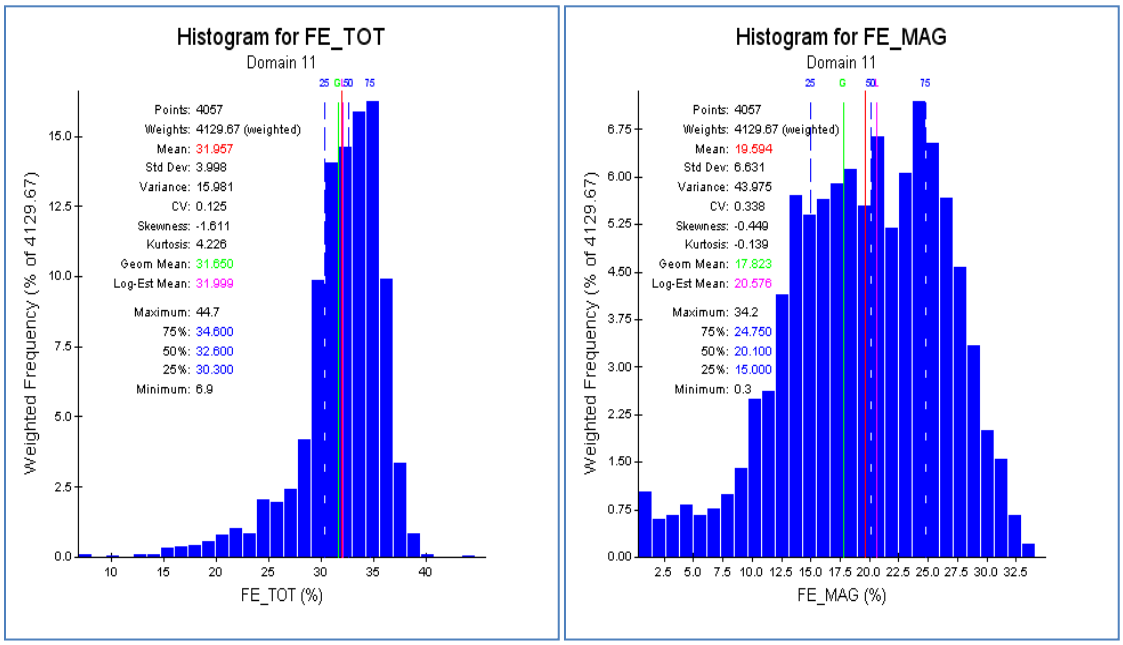


Figure 14.7: Histogram for assays in SX4F Domain

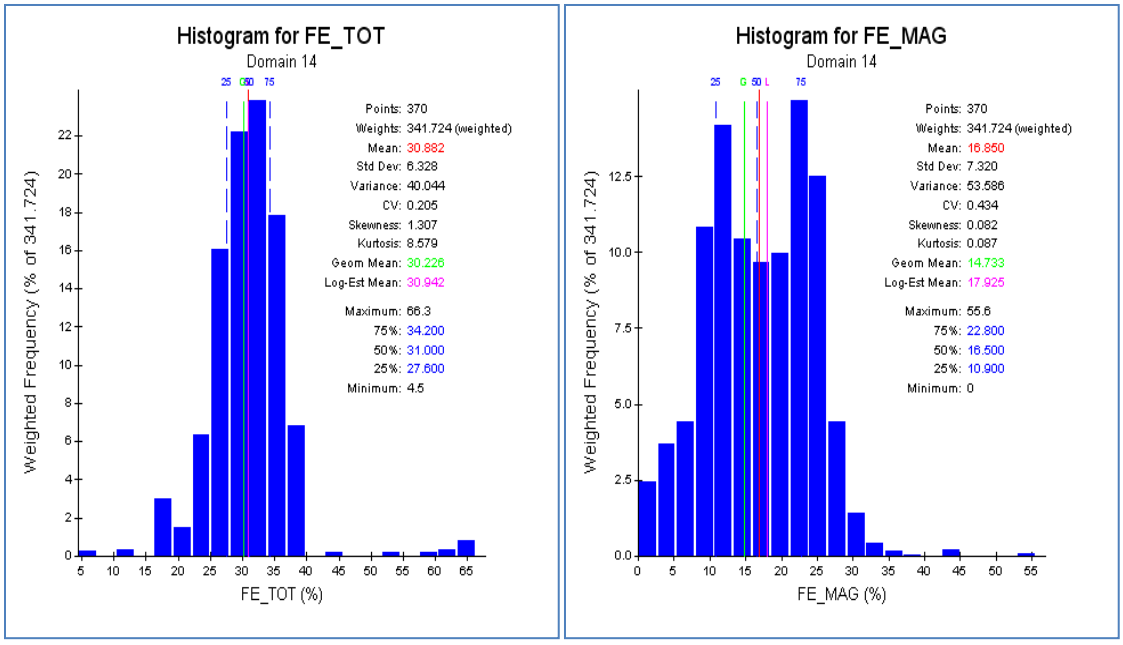
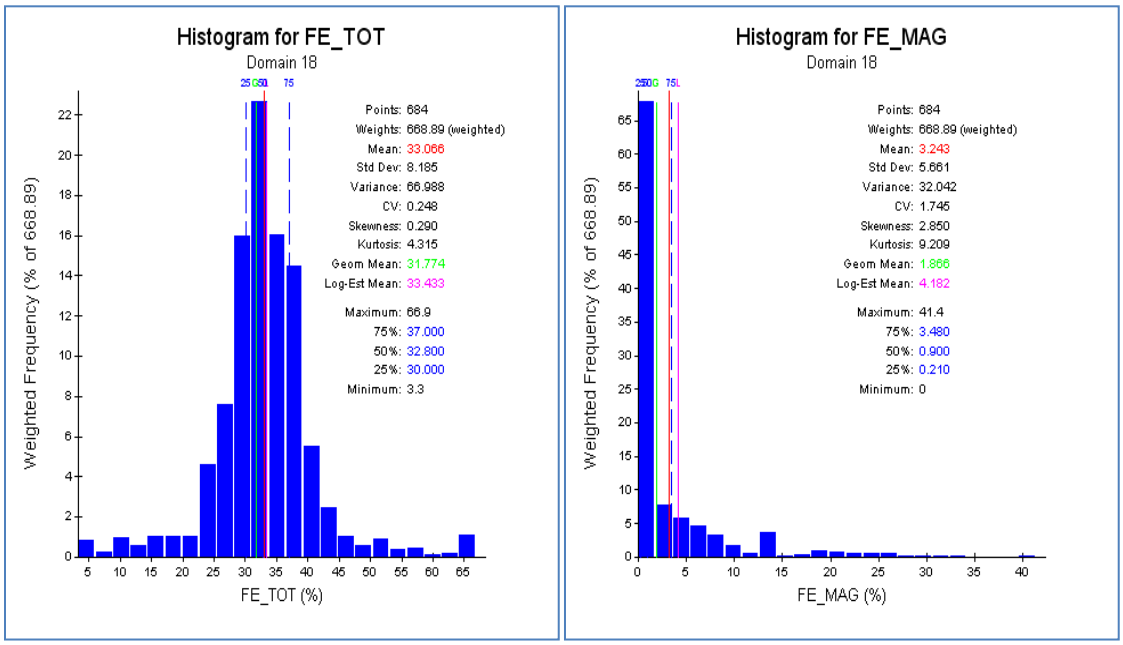


Figure 14.8: Histogram for assays in SX5F Domain



The original assay intervals have different lengths and, in order to carry out the Mineral Resource grade interpolation, these intervals required normalization to a consistent length. A 5m composite length was chosen and generated from the raw assays, to ensure that more than one composite would be used for grade interpolation for each block in the model. Regular down-the-drillhole compositing was used. For the purpose of resource estimation, only composites greater than 0.50m were used in the grade interpolation. This was done to prevent short sample bias and any samples falling below this threshold length were discarded for grade interpolation.

Univariate statistics and variogram analysis were completed for the composited (5m) drillhole assay data, and the histograms are shown as Figure 14.9 through Figure 14.12 for the units SX1F, SX2F, SX4F (mineralized domains) and SX5F (Oxide-Waste) Domain.

Figure 14.9: Histogram for composites in SX1F Domain

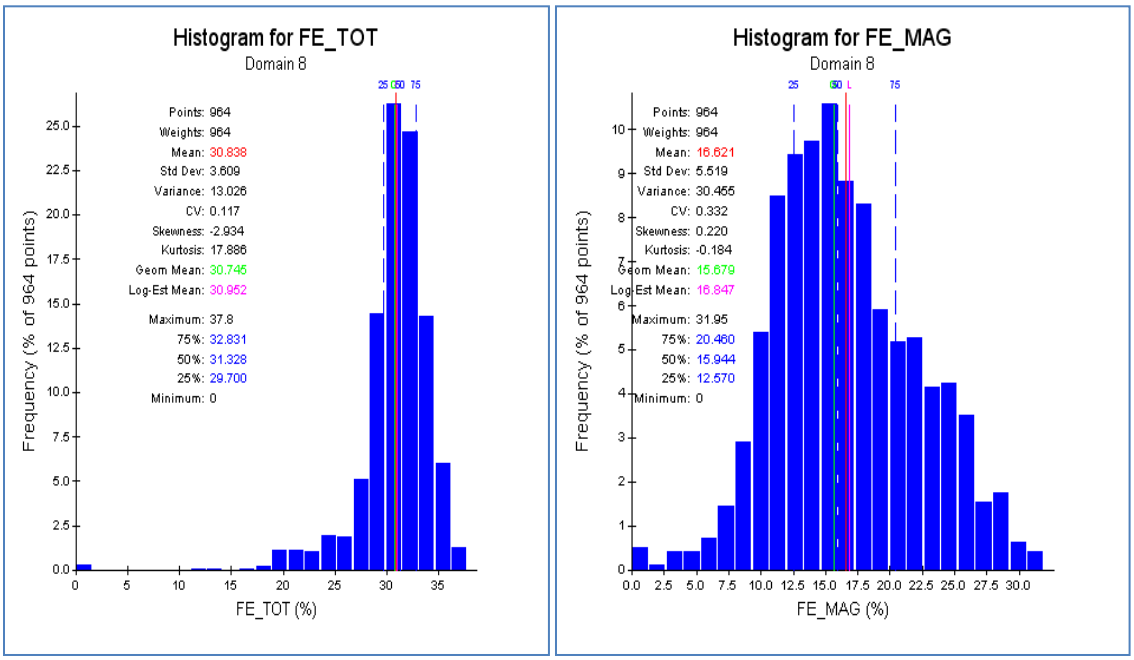


Figure 14.10: Histogram for composites in SX2F Domain

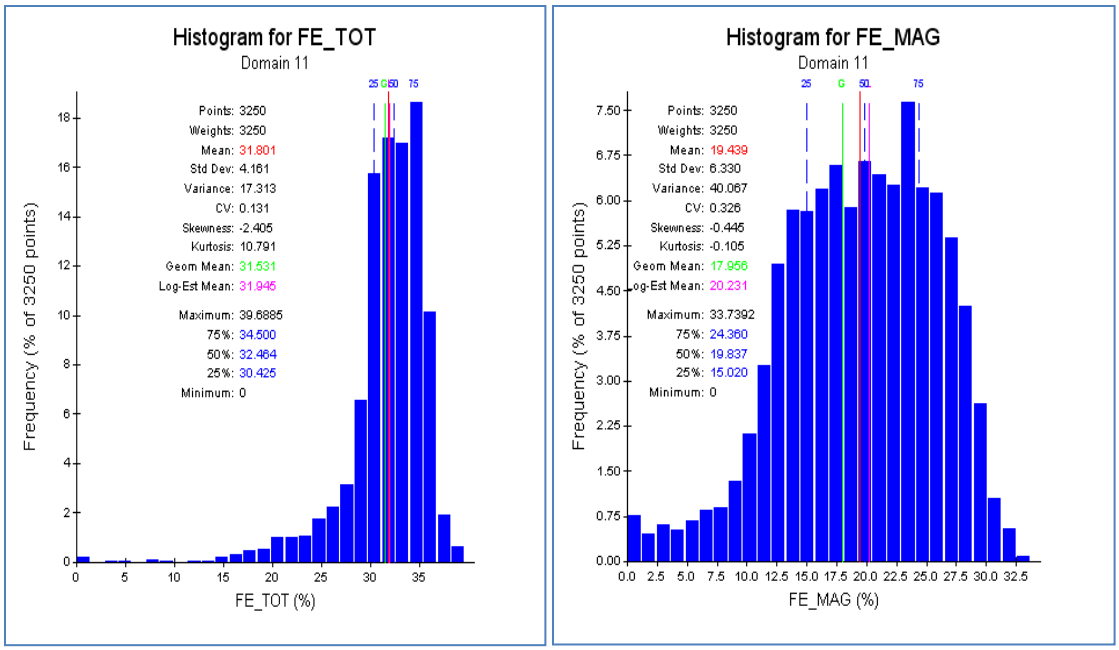


Figure 14.11: Histograms for composites in SX4F Domain

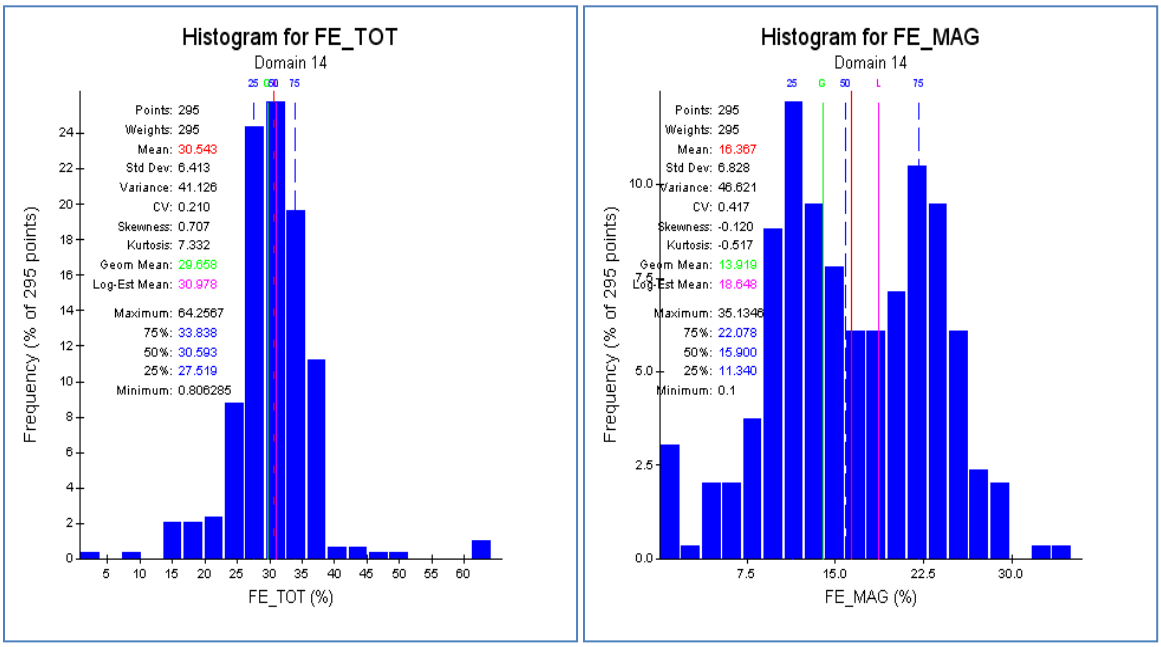


Figure 14.12: Histograms for composites in SX5F Domain

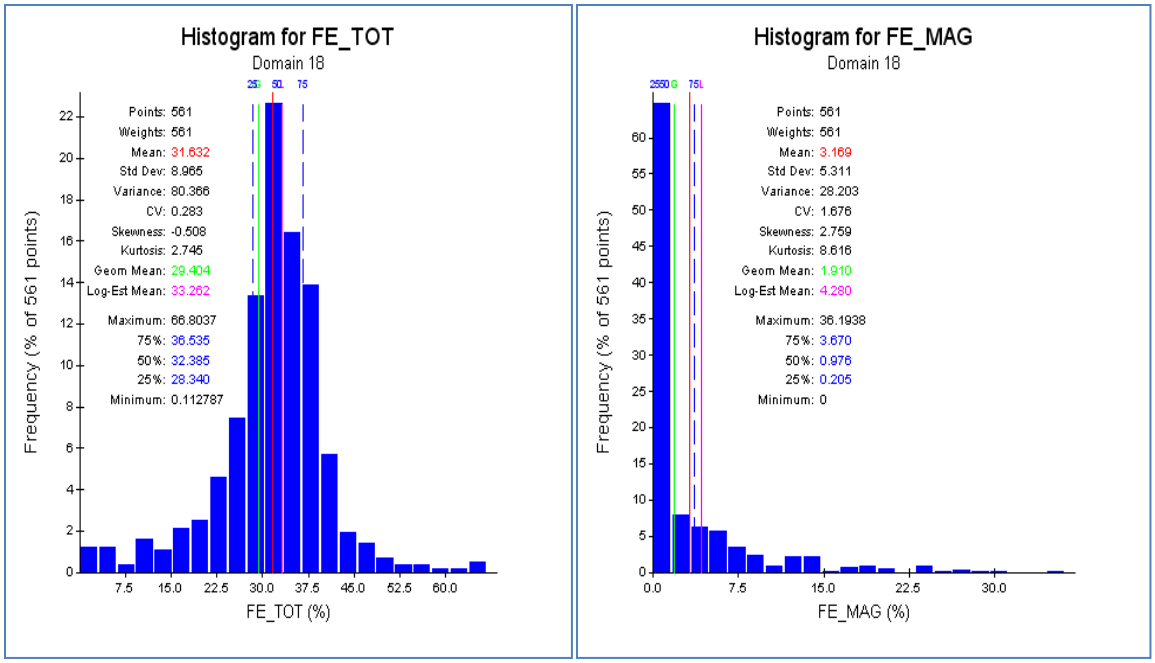


Table 14.3 summarizes the statistics of the 5m composites inside the major mineralized domains for the Shymanivske Property that was used to create the histograms illustrated above.

Table 14.3: Basic Statistics of 5 m Composites

Element	Number	Minimum	Maximum	Average	C.O.V.
SX1F- % Fe_{tot} _H	964	0	37.8	30.8	0.12
SX2F - % Fe_{tot} _H	3250	0	39.7	31.8	0.13
SX3F - % Fe_{tot} _H	36	16.4	37.1	29.5	0.17
SX4F - % Fe_{tot} _H	295	0.8	64.3	30.5	0.21
SX1F - %Fe_{mag} _H	964	0	37.8	16.6	0.33
SX2F - %Fe_{mag} _H	3250	0	33.7	19.4	0.33
SX3F - %Fe_{mag} _H	36	3.5	29.7	14.6	0.53
SX4F - %Fe_{mag} _H	295	0.1	35.1	16.4	0.42

14.5.3 Grade Capping

The statistical distribution of the %Fe_{tot} samples showed good normal distributions in all mineralized zones for both the composites and the raw assays. Grade capping, sometimes referred to as top cutting, is commonly used in the Mineral Resource estimation process to limit the effect (risk) associated with extremely high assay values. Black Iron considered the nature of the mineralization and the continuity of the zones and determined that capping was not required for the Shymanivske Deposit and therefore it applied no grade capping or top cut to Fe_{tot} and Fe_{mag}. WGM agrees with this assessment.

14.5.4 Density, Specific Gravity

Specific gravity (SG) was previously discussed in detail in Section 7.3, “Mineralization,” of this Report.

SG was measured and reported in previous Soviet/Russian reports dating back to 1985 and 1989. The measured data for about 710 samples is available for selected drillholes in different intervals, and for each rock type. A review of this data indicates it is more or less valid and consistent with the logged and recorded lithology. A version of similar density data measurements was compiled and summarized in 2005 by GIC.

WGM conducted SG measurements using bulk density and pycnometer data at both the MCM laboratory in Ukraine and, for validation purposes, at SGS-Lakefield in Canada. The resultant plots from both labs show that SG by pycnometer measurements correlates strongly with %Fe_{mag} on the selected samples. WGM’s experience with these types of deposits reveals that the SGs generally correlate well with iron grade. In the case of the Shymanivske Deposit, a good relationship between %Fe_{mag} and SG can be

expected, as most of the hematite is interstitial to the magnetite and appears to be consistently distributed throughout the mineralization, except in the Oxide Zone. Alteration products, such as limonite/goethite and martite, have developed, particularly in the Oxide Zone, but the extent and distribution of these secondary iron-bearing minerals are not completely understood, particularly at depth. This leads to some uncertainty regarding the determination of density and recoverable Fe for this Mineral Resource estimate, and the Oxide Zone has been considered as waste.

For the purpose of tonnage estimates in this report, Black Iron used a best-fit correlation line based on SGS-Lakefield confirmatory pycnometer data (see Sections 7 and 12 of this Report for more detailed explanation). In order to obtain the density of each block in the model, a variable density model was created to relate the SGs with the iron grades. The adopted formula *($y=-0.00042* Fe_{mag}^2+0.0295* Fe_{mag}+3.07$)* was adjusted for too low and too high values by WGM and a new best-fit line was modeled to be close to polynomial values. Using the variable density model, a 20% Fe_{mag} gives a SG of approximately 3.49.

14.6 Block Model Parameters, Grade Interpolation and Categorization of Mineral Resources

14.6.1 General

The previous Shymanivske Deposit Mineral Resource estimates were completed using a block modelling method and the grades were interpolated using an Inverse Distance (ID) estimation technique. ID belongs to a distance-weighted interpolation class of methods, similar to Kriging, in which the grade of a block is interpolated from several composites within a defined distance range of that block. ID uses the inverse of the distance (to the selected power) between a composite and the block as the weighting factor.

Black Iron used an ID^2 interpolation method and WGM audited the results. In WGM's experience with similar types of deposits, most interpolation methods (ID, Nearest Neighbour and geostatistical techniques, such as Kriging) give similar results, as long as the iron grades are well constrained within the wireframes and the grade interpolation search ellipses are properly oriented. In this case, the results of the interpolation approximated the average grade of all the composites used for the estimate. WGM is of the opinion that ID interpolation is appropriate and accepted Black Iron's grade interpolation, as supplied.

14.6.2 Block Model Setup / Parameters

The block model was created using the Gemcom™ software package to create a grid of regular blocks to estimate tonnes and grades. The parameters used for the block modelling are summarized below.

The block sizes used were:

Width of columns = 10m

Width of rows = 20m

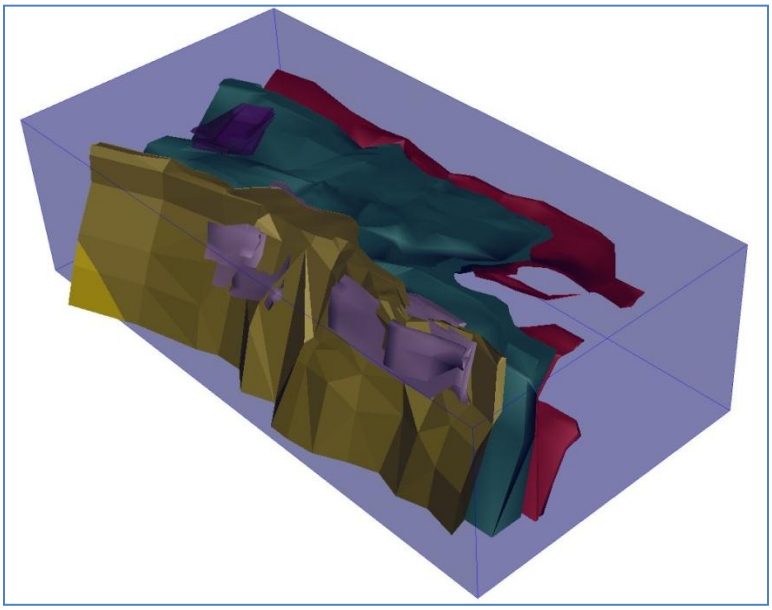
Height of blocks = 15m

The specific parameters for the block model are as follows:

Easting coordinates of model (WGS84 – Upper SW corner):	519317.00
Northing coordinates of model (WGS84 – Upper SW corner):	5297560.00
Datum elevation of top of model:	130.00 m
Model rotation (anti-clockwise around Origin):	-21.50
Number of columns in model:	130
Number of rows in model:	130
Number of levels:	50

The block model coverage is shown in Figure 14.13 and was large enough to encompass the Property area, as well as any historical projected pit area, down to the -600m level.

Figure 14.13: Block model grid coverage (pale blue) with the 5 wireframed domains shown from the upper SW (SX1F in red, 2F in green, 3F in purple, 4F in pink and 5F in yellow)



For the previous Mineral Resource estimates in 2011, Genivar and Black Iron used smaller blocks (10m x 10m x 10m), which was suitable for historical drillhole spacing but may not have been suitable for the envisioned mining method (large open pit). For the purpose of this more advanced study and to aid in mine design and have a more realistic block size as would benefit a large open pit operation, WP requested that Black Iron use a bigger block geometry (10m x 20m x 15m height) for the Shymanivske block model. WGM believes that the concept of using larger blocks has merit and does not detrimentally affect the resolution of grade interpolations.

14.6.3 Grade Interpolation

The Shymanivske Project Mineral Resource estimates were completed using a block modelling method and, for the purpose of this study, the grades were interpolated by the Inverse Squared Distance (ID^2) estimation technique. The ID^2 method uses the inverse of the distance (to the selected power) between a composite, and the block as the weighting factor.

Experimental variograms were prepared for all three major mineralized domains, using the composited assay dataset for Fe_{tot}. The variograms were constructed by applying an average strike (N21ºE) for the deposit and the other two mutually orthogonal directions. The variograms are traditional and are log transformed. The $\%Fe_{tot}$ Head grade (interpolated from 5m composites) was used as the primary grade element for the statistical and geostatistical assessment; however, $\% Fe_{mag}$ was also interpolated into the grade block model and was used for the determining cut-off for the Mineral Resource estimate.

Based on the results of these variograms, a 4-step method was used to estimate grades. Three directions of continuity (strike range, dip range and across dip range) were determined for all three major mineralized domains. Gemcom ADA (Azimuth-Dip-Azimuth) angles were extracted from the positive axis rotation to apply to the search ellipsoid for interpolating grades (Table 14.4 toTable14.7).

These search radii are determined by the maximum range of the variograms for the first pass, which applied to the first search ellipsoid and then extended empirically for the second search. The blocks tagged from the first pass search radius can then be considered for classification in the Measured and Indicated categories.

Since part of both SX1F and SX2F domains are dipping about 70ºSW, two more search ellipsoid profiles were set up to properly interpolate grade in the western limb of the anticline. First, the steep limb was sub-domained with an overprinting wireframe and then all the blocks within this wireframe were set to a "null value." Then a third and fourth set of search ellipsoids was prepared to run for interpolating grades within this steep sub-domain only. The search parameters were similar to the ones which have been used for SX4F and SX5F domains.

A 4-step search ellipsoid approach was established and based on results of the variography of Fe_{tot} grade for the Shymanivske mineralized zones. This approach also enabled grade to be interpolated within the mineralized wireframes, where a steep angle of the search ellipsoid was required in the western part of wireframed zones. The first search was based on the range of the variograms; the second search was based on twice (2x) the range of the variograms; the third search was based on the range of variograms and only applied to the steeply dipping part of the mineralized zone after "initializing" or re-stating the previous values to zeros; and the fourth search ellipsoid was based on twice (2x) the range of the variograms, again to interpolate grade only for the steep part of the zones. These ranges were established for all interpolated domains. This 4-step approach was used in order to inform all the blocks in the block model with grade; however, the classification of the Mineral Resources (see below) was based on drillhole density (or drilling pattern); geological knowledge/interpretation of the geology; and some other constraints, such as the presence of alteration (Martite-Oxide zone). The Fe_{tot} grade, interpolated from 5m composites, was used for the Mineral Resource estimate; however, Fe_{mag} was also interpolated into the grade block model.

Table 14.4: ID² Interpolation Parameters, First Search Ellipsoid

Domain	Principal Azimuth (º)	Dip (º)	Intermediate Azimuth (º)	Intermediate Continuity (m, Y)	Maximum Continuity (m, X)	Minimum Continuity (m, Z)	Max. No. Per Hole	Min. No. Samples	Max. No. Samples
8	22	0	-	150	260	60	2	3	10
11	22	0	-	150	260	60	2	3	10
12	22	0	-	150	260	60	2	3	10
14	82.7	67.7	16.5	130	200	60	2	3	10
18	82.7	67.7	16.5	130	200	60	2	3	10

Table 14.5: ID² Interpolation Parameters, Second Search Ellipsoid

Domain	Principal Azimuth (º)	Dip (º)	Intermediate Azimuth (º)	Intermediate Continuity (m, X)	Maximum Continuity (m, Y)	Minimum Continuity (m, Z)	Max. No. Per Hole	Min. No. Samples	Max. No. Samples
8	22	0	-	300	520	180	None	2	10
11	22	0	-	300	520	180	None	2	10
12	22	0	-	300	520	180	None	2	10
14	82.7	67.7	16.5	260	400	180	None	2	10
18	82.7	67.7	16.5	260	400	180	None	2	10

Table 14.6: ID² Interpolation Parameters, Third Search Ellipsoid

Domain	Principal Azimuth (º)	Dip (º)	Intermediate Azimuth (º)	Intermediate Continuity (m, Y)	Maximum Continuity (m, X)	Minimum Continuity (m, Z)	Max. No. Per Hole	Min. No. Samples	Max. No. Samples
8	82.7	67.7	16.5	150	260	60	2	3	10
11	82.7	67.7	16.5	150	260	60	2	3	10
12	22	0	-	150	260	60	2	3	10
14	82.7	67.7	16.5	130	200	60	2	3	10
18	82.7	67.7	16.5	130	200	60	2	3	10

Table 14.7: ID² Interpolation Parameters, Fourth Search Ellipsoid

Domain	Principal Azimuth (º)	Dip (º)	Intermediate Azimuth (º)	Intermediate Continuity (m, X)	Maximum Continuity (m, Y)	Minimum Continuity (m, Z)	Max. No. Per Hole	Min. No. Samples	Max. No. Samples
8	82.7	67.7	16.5	300	520	180	None	2	10
11	82.7	67.7	16.5	300	520	180	None	2	10
12	22	0	-	300	520	180	None	2	10
14	82.7	67.7	16.5	260	400	180	None	2	10
18	82.7	67.7	16.5	260	400	180	None	2	10

As previously mentioned, ID^2 was the method by which the mineralized domains were interpolated for Fe_{tot} and $Fe_{mag.}$ Ellipsoid search anisotropy was applied with search volume limits along the X, Y, and Z directions set at the range of the variograms and then at two or three times the range to determine the appropriate category. The orientation of the search ellipsoid was the same as that of the variogram model.

The minimum number and the maximum number of samples used to estimate a block in the first pass were three and ten, respectively, which were based on the drilling density and the degree of confidence. The maximum number of samples to be selected per drillhole was limited to two. The minimum number and maximum number of samples used to estimate a block in the second pass were two and ten, respectively, which were based on the drilling density and the degree of confidence (see Table 14.4 to Table 14.7).

A coding precedence was applied in order to resolve overlap in boundary interpretations between the different mineralized domains. Where solids overlapped, a domain code was assigned in Gemcom, according to the order of precedence (Table 14.8).

Table 14.8: Solid and Domain Precedence for Block Modelling of the Shymanivske Deposit

Precedence Order	Rock Type	Rock Code	Geology
1	SX3F	12	Magnetite-Quartzite
2	SX4F	14	Magnetite-Quartzite
3	SX1F	8	Magnetite-Quartzite
4	SX2F	11	Magnetite-Quartzite
5	SX5F	18	Martite/Magnetite-Quartzite

14.6.4 Mineral Resources Categorization

The Mineral Resource classification is based on certainty and continuity of geology and grades, and this is almost always directly related to the drilling density. Areas more densely drilled are usually better known and understood than areas with sparser drilling, which would be considered to have greater uncertainty, and hence lower confidence.

The historic drilling was not evenly distributed on the Property, and most of the drilling was concentrated in the central part of the deposit. Therefore, the majority of the resources classified as Measured Resources in previous estimates were concentrated in this central part, whereas the northern and southern extensions of the deposit remained predominantly Inferred Mineral Resources. The Black Iron definition drilling program in 2011 (see Section 11 in this Report) was designed to increase the density of drilling throughout the deposit, which would not only help to upgrade resources from the Indicated to the Measured category in the central part of the deposit, but would also upgrade a large portion of the resources in the southern and northern part to the Indicated category. This program was mostly successful in achieving the above tasks; however, Black Iron could not complete the planned definition drilling program on the northern part of the deposit because of a work stoppage and the existence of a maintenance facility still in use by a third party. Some of the Mineral Resources in this area are still classified as Inferred because of a lack of additional information and the impossibility of increasing the drilling density and therefore the confidence of the resources in this area.

The classification of the Mineral Resources relied on a 2-step process. In the first step, blocks were assigned a tag based on the criteria of the search ellipse process (see previous Section in this report for the explanation on the search ellipse parameters). The blocks tagged from the first and third passes of the search radii were considered for classification in the Measured and Indicated categories. The blocks tagged from the second and fourth passes search radii were considered for classification in the Inferred category. The second step was to manually construct “resource category wireframes” by assessing the distribution of tagged blocks and by applying other geological and drilling criteria, such as the Distance Model. The wireframes were first constructed from 3-D rings on the vertical cross-sections and then meshed together to define the 3-D solids. Finally, all blocks falling inside each category wireframe were assigned to the Measured, Indicated or Inferred classification. The initial tagging by search ellipses was used to help in the definition of the wireframes only. The blocks still remaining outside of any bounding polylines were also categorized as Inferred.

Because the search ellipses were large enough to ensure that all the blocks in the 3-D model were interpolated with grade, Black Iron generated a Distance Model, which represented the distance from the actual data point in the drillhole to the block centroid, and reported the estimated Mineral Resources by distances that represented the category or classification. Due to the steeply dipping mineralization along the west sheared limb of the anticline and the lower drilling density producing greater uncertainty for the boundaries of this mineralization, it was decided to reduce the Indicated Resources from this steeply dipping part of the mineralization in some sections. The down-dip distance for the Indicated category was

reduced to 60m along this limb of the anticline. Table 14.9 shows different distance parameters which were used to classify the Mineral Resources in the Shymanivske Deposit. The distance criteria came from the variogram ranges and also visual judgment, which was based on the density of drilling in plans and cross-sections.

Table 14.9: Distance Criteria for Classification of Resources Based on Range of Variograms and Density of Drilling

Class	Down Dip (m)	Along Strike (m)
Measured	<100	<100
Indicated	60-150	100-150
Inferred	>150	>150

WGM has abundant experience with types of mineralization similar to the Shymanivske Project; therefore, it used this knowledge to assist Black Iron with the categorization of the Mineral Resources. The continuity of the mineralization in general was quite good; however, the internal continuity of some zones and some waste units is poorly understood because of the folding/geometric complexity. WGM was of the opinion that extending the geological interpretation beyond the more densely drilled parts of the deposit was appropriate, as long as there was supporting data from adjacent sections. This extension was taken into consideration when classifying the Mineral Resources, and these areas were given a lower confidence category, which generally represented the deeper mineralization.

Inferred Mineral Resources are interpolated to a maximum of 650m (approx.) on the ends/edges and at depth, when supporting information from adjacent cross-sections was available. The average distance for the total Measured, Indicated and Inferred Mineral Resources was approximately 60m, 100m and 200m, respectively. The majority of the deeper mineralization was categorized as Inferred because of the sparse drillhole information over the west limb of the anticline and below about 400m from surface; the maximum depth that the mineralization was taken to is 600m elevation (approximately 675m vertically from surface).

WGM worked with Black Iron extensively on this categorization, and endorses it. With respect to mitigating the remaining concerns, WGM is in further discussions with Black Iron on how to upgrade the classification of the Mineral Resources in areas of lower confidence.

Figure 14.14t o Figure 14.16 illustrate two representative cross sections and a plan view showing zone outlines and the Mineral Resource categorization for the Shymanivske Deposit

Figure 14.14: Cross-section 2 showing mineral resource category block model

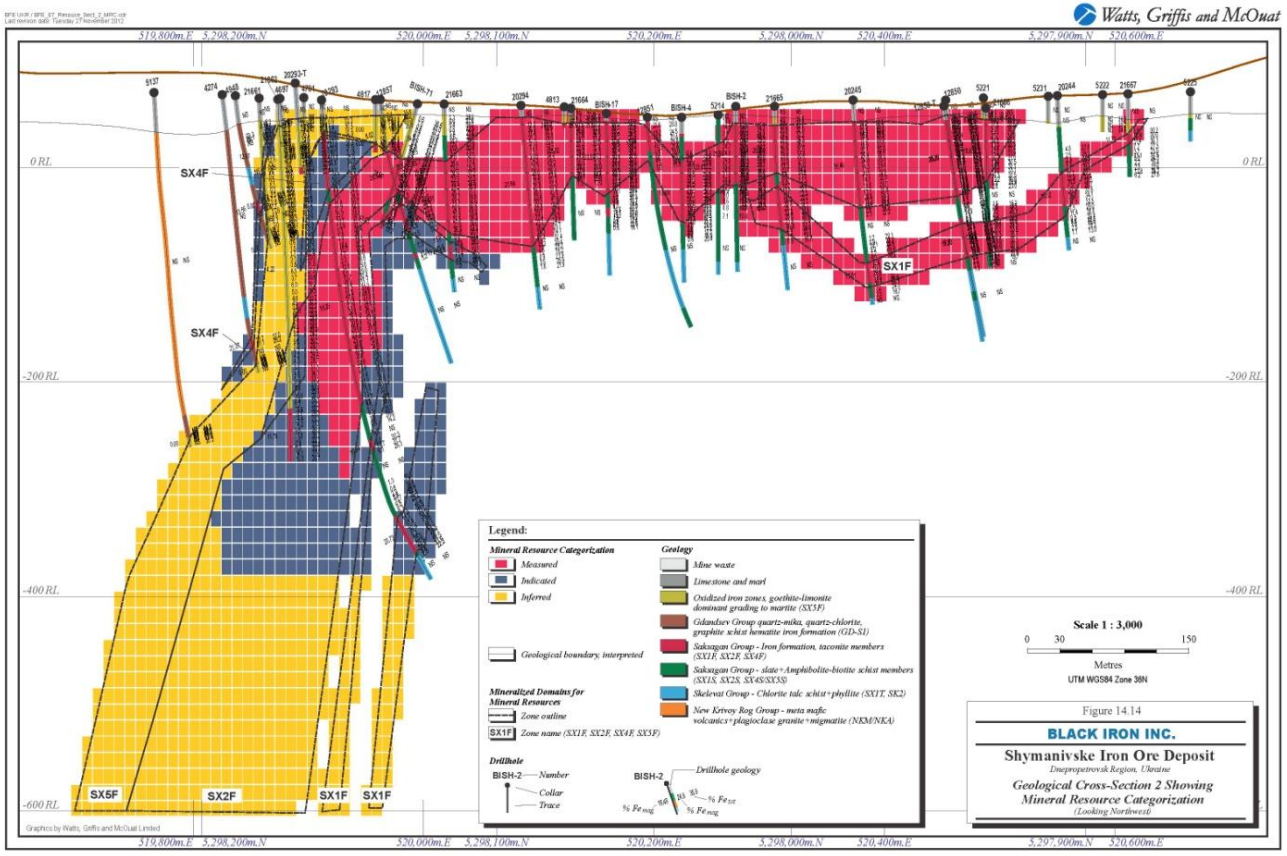


Figure 14.15: Cross-section 5 showing mineral resource category block model

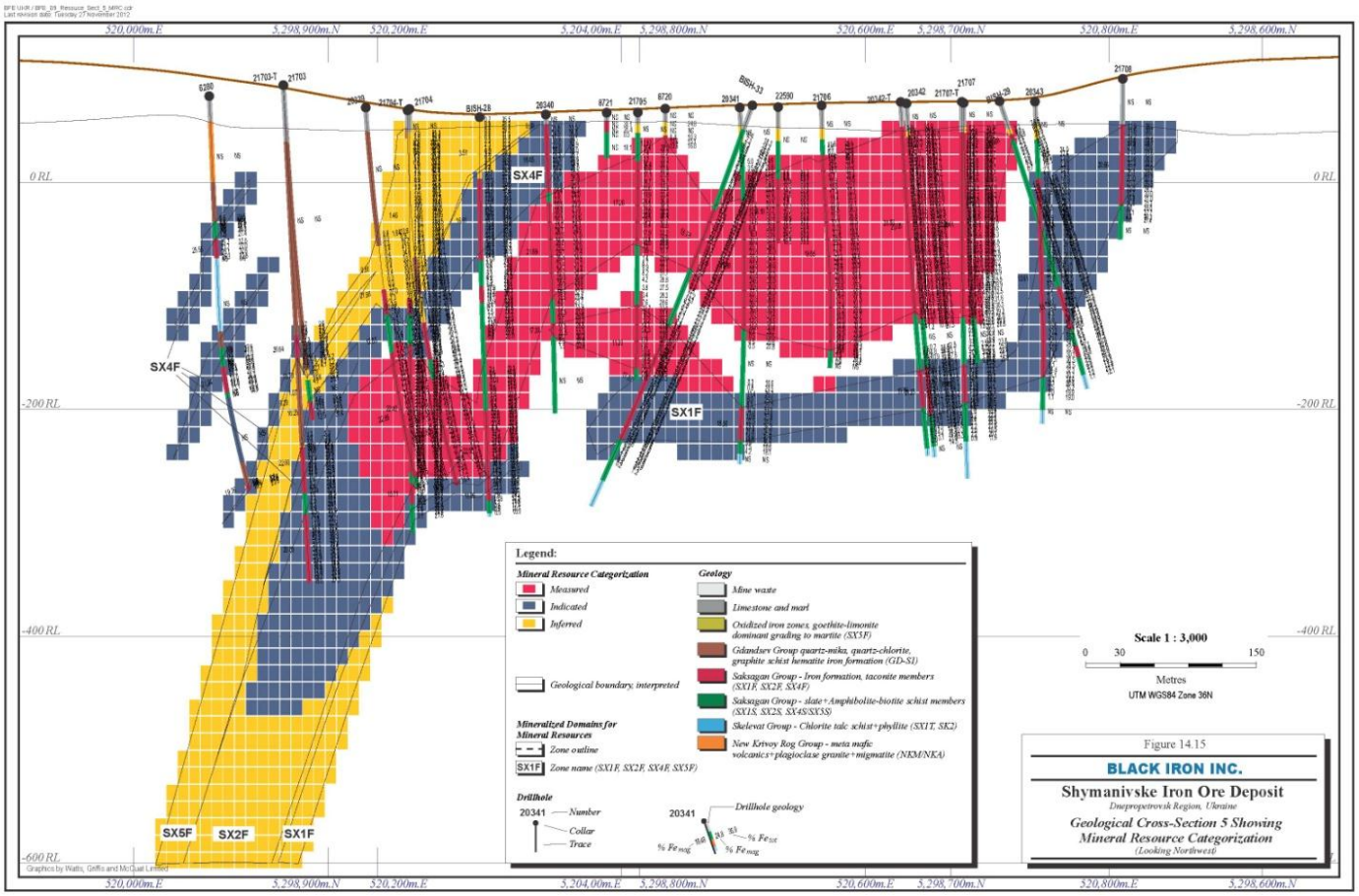
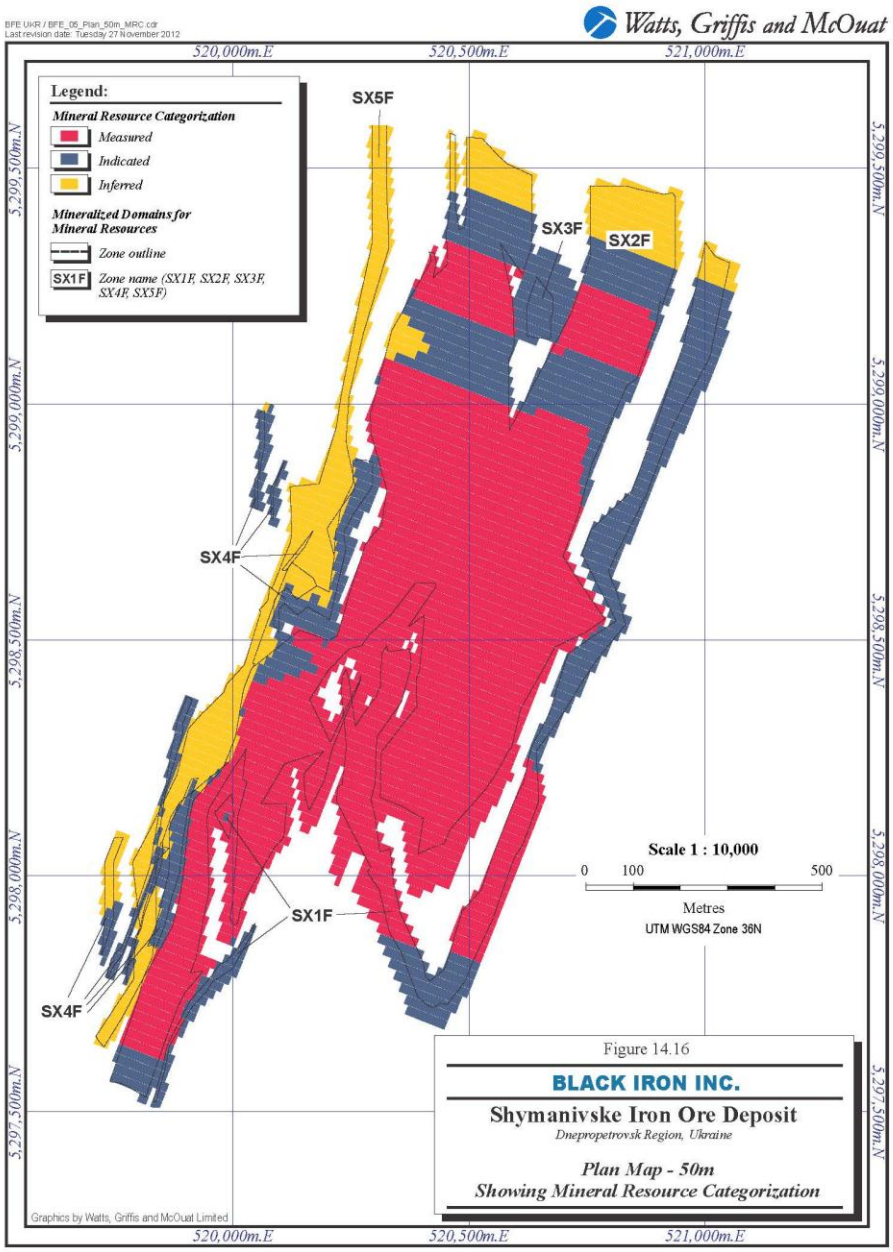


Figure 14.16: Level plan -50m showing mineral resource category block model



14.6.5 Mineral Resources Reporting

For the Mineral Resource estimate, a cut-off of 10% Fe_{mag} was determined to be appropriate at this stage of the Project. This cut-off was chosen on the basis of a preliminary review of the parameters that would likely determine the economic viability of a large open pit operation and compares well to similar projects

and to projects that are currently at a more advanced stage of study. As a further check on the veracity of this resource cut-off grade, the pit designed for this study was based on a cut-off that was slightly higher than the Mineral Resource estimate cut-off grade. This was done to produce a desired average head grade (to give the required concentrate grade). In reality, the economic cut-off grade would be slightly lower, and the desired head grade would not be achieved (see Sections 15 and 16 in this Report). To produce the required concentrate grade, the target mill feed average head grade had to be in the range of 19% to 20% $Fe_{mag.}$ To provide an overall tonnage with this average grade, it was necessary to use a production cut-off grade of about 13% Fe_{mag}, which is slightly above the current Mineral Resource cut-off grade of 10% Fe_{mag}.

The Mineral Resource estimate was classified in accordance with CIM Standards and Definitions, taking into account drillhole spacing, data quality (and attendant confidence), variogram ranges and search volume and grade interpolation. The categorized Mineral Resource estimate for the Shymanivske Deposit is presented in Table 14.10 and Table 14.11.

Table 14.10: Mineral Resource Estimate for Shymanivske Deposit Measured and Indicated Categories (Cutoff of 10% Fe_{mag})

Category	Horizon	Tonnes (Million) *	$\%Fe_{tot}$	$\%Fe_{mag}$
Measured	SX1F	44.0	31.0	17.0
	SX2F	311.1	32.1	19.9
Total		**355.1**	**32.0**	**19.5**
Indicated	SX1F	101.6	30.7	16.3
	SX2F	163.8	31.3	19.0
	SX3F	6.1	30.7	16.7
	SX4F	19.2	30.9	17.4
Total		**290.7**	**31.1**	**17.9**
Total Measured & Indicated		**645.8**	**31.6**	**18.8**

*Tonnage and grade numbers are rounded to the first decimal

Table 14.11: Mineral Resource Estimate for Shymanivske Deposit Inferred Category (Cutoff of 10% Fe_{mag})

Category	Horizon	Tonnes (Million) *	$\%Fe_{tot}$	$\%Fe_{mag}$
Inferred	SX1F	17.4	32.0	17.1
	SX2F	169.4	30.0	18.6
	SX4F	1.5	23.6	16.1
Total		**188.3**	**30.1**	**18.4**

*Tonnage and grade numbers are rounded to the first decimal

Due to the uncertainty that may be attached to Inferred Mineral Resources, it cannot be assumed that all or any part of an Inferred Mineral Resource will be upgraded to an Indicated or Measured Mineral Resource as a result of continued exploration. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.

14.6.6 Cutoff Grade Sensitivity Analysis

The Mineral Resources for the Shymanivske Deposit were estimated cumulatively for consecutive grade groups by the ID^2 method. This allows for the results to be reported cumulatively for different cut-off grades (COG) and presented in a sensitivity analysis for comparison purposes. Table 14.12 and Table 14.13 present the results of this analysis for the Measured, Indicated and Inferred Mineral Resources, with respect to varying Fe_{mag} COGs.

Table 14.12: Sensitivity Table, Measured and Indicated Mineral Resources Shymanivske Deposit

COG Fe_{mag} %	Tonnage* (Million)	Fe_{tot} (%)	Fe_{mag} (%)
25	50.9	34.9	26.4
22.5	135.6	34.1	24.7
20	251.2	33.4	23.1
17.5	382.0	32.9	21.6
15	509.1	32.3	20.3
12.5	605.3	31.8	19.3
10	645.8	31.6	18.8
Total	**645.8**	**31.6**	**18.8**

*Tonnage and grade numbers rounded to first decimals

Table 14.13: Sensitivity Table, Inferred Mineral ResourcesShymanivske Deposit

COG Fe_{mag}	Tonnage*	Fe_{tot}	Fe_{mag}
%	(Million)	(%)	(%)
25	20.6	34.2	26.5
22.5	44.3	32.7	24.9
20	69.7	32.4	23.6
17.5	104.1	31.9	22.0
15	132.1	31.3	20.8
12.5	166.1	30.4	19.3
10	188.3	30.1	18.4
Total	**188.3**	**30.1**	**18.4**

*Tonnage and grade numbers rounded to first decimals

14.6.7 Block Model Validation

The validation of the Mineral Resource estimate of the Shymanivske Deposit was carried out in two separate steps.

For the first step, block grades (Fe_{tot} and $\%Fe_{mag}$) were compared visually against drillhole assay data and composite data for each section and on plan views. The global validation of the block model results, when compared with the grade of the assay and composite intervals, were confirmed with this visual comparison.

For the second step, the average of the block grades was reported at 0.01% Fe_{tot} cut-off when blocks in all classifications were totalled. This average is the average grade of all blocks within the mineralized domain. The values of the interpolated grades for the block model were compared to the average grade of head assays and the average grade of composites of all samples from within the domain (Table 14.14).

Table 14.14: Comparison of Average Grade of Raw Assays and Composites with Total Block Model Average Grades for Major Mineralized Domains

SX1F	$\%Fe_{tot}$	$\%Fe_{mag}$
Assays	31.0	16.8
Composites	30.8	16.6
Blocks	30.8	16.5
SX2F	$\%Fe_{tot}$	$\%Fe_{mag}$
Assays	32.0	19.6
Composites	31.8	19.4

Blocks	31.2	19.1
SX4F	**%Fe_{tot}**	**%Fe_{mag}**
Assays	30.9	16.9
Composites	30.5	16.4
Blocks	30.3	16.7

The comparisons above show the average grade of all the blocks in the constraining domains to be in close proximity of the average of all assays and composites used for grade estimation, and any variances observed were not considered to be material.

14.6.8 Interpretation and Conclusion

The Shymanivske Deposit, located in the Kryvyi Rih area of Ukraine, is part of an iron formation belt (KrivBass Belt) which hosts several iron ore deposits and active mining operations. It covers an area approximately 2km long by 1.2 km wide. The area has been explored since the middle of the 20th century by geophysical methods, drilling and metallurgical testing.

Mineralization on the Property comprises meta-taconite, similar to deposits of the Labrador Trough in the Canadian Shield. The deposit consists of four mineralized units, three of which (SX1F, SX2F and SX4F) are Magnetite-Quartzite and considered in the Mineral Resource estimate; the other unit is an oxide zone (SX5F) consisting of Magnetite-Martite-Quartizite and it is not included in the current resources. The mineralization is folded and faulted and quite structurally complex in some areas.

The drilling was done on cross-sections perpendicular to the strike of the formations with spacing, varying from 30m to 130m along sections and from 80m to 300m along strike, with vertical depths of 250m to 550m, for a total of 57,455.8m in 385 holes. The present Mineral Resource estimate was completed, by using all historical drilling and information from Black Iron's twin and definition drilling programs. The results for all non-oxidized horizons are summarized in Table 14.15.

Table 14.15: Mineral Resource Estimate for the Shymanivske Iron Ore Deposit (Cutoff Grade of 10% Fe_{mag})

Category	Tonnes (Million) *	Fe_{tot} %	Fe_{mag} %
Measured	355.1	32.0	19.5
Indicated	290.7	31.1	17.9
Total M&I	**645.8**	**31.6**	**18.8**
Inferred	188.3	30.1	18.4

*Tonnage and grade numbers are rounded to the first decimal

A cut-off grade of 10% Fe_{mag} was determined to be appropriate for the purposes of this report and was chosen on the basis of a preliminary review of the parameters that would likely determine the economic viability of a large open-pit operation. This cut-off compares well to similar projects and neighboring mines in the area. The selected COG is also a "natural COG" of the mineralization and was chosen for the wireframe modelling of mineralized domains; a sharp reduction in grade is evident at, or very near to, the contact of the mineralized horizons with barren quartzite.

The Fe_{tot} grades have been included in this Report, but in WGM's opinion, the total iron grades in the Mineral Resource estimate should not be relied upon as a basis for evaluating the Shymanivske Deposit. WGM questions the reliability of the Fe_{tot} assays for some historic drilling and this uncertainty is summarized in Sections 7 and 11 of this Report. Furthermore, because of the considerable Fe-silicate component of the iron mineralization, the Fe_{tot} assays and averages do not, in WGM's opinion, represent a truly meaningful measure of the deposit. To obtain truly meaningful measure of the deposit, Fe_{mag} is a much better basis as reported in the tables above.

The total Inferred Resource tonnage for the martite-rich quartzite horizon (SX5F) was historically estimated (111.5Mt @ 33% Fe_{tot} and 4.3% Fe_{mag}) in previous work from the Soviet era and in the Genivar report (January, 2011). For the current block model, Fe_{tot} and Fe_{mag} grades were interpolated within this SX5F martite domain and are comparable to past estimates, but due to a lack of drilling within this domain, drillholes being abandoned and intersecting this unit at shallow angles, and unknown Fe recoveries of this unit, the results of the SX5F Domain are not included in the current Mineral Resource estimates and it is considered waste for the purposes of this study. It is possible that this material will be brought into the resource estimate in the future, once further metallurgical testwork and additional drilling are completed.

Because of the lack of outcrops on the Shymanivske Property, the impact of the faulting and thrusting in the structural interpretation of the deposit is debatable and WGM and Black Iron have some differences in this regard. WGM agrees that faulting is important, but believes that a major unconformity is the principal reason for the Oxide Zone. WGM also believes that the stratigraphic assignment of SX5F to this zone and adjacent zones is not very reliable and that it would make less use of the Saksagan Group member stratigraphy in future.

Most of the previous drilling, including the Twin Drillhole program, is vertical or sub-vertical in nature. During the definition drilling, WGM proposed drilling with flatter angles to give more information about the location and orientation of faulted blocks and the existence of several projected faults within the deposit from south to north. Although this program partially achieved its goals in delineating some structural elements within the deposit, the program came up short in the steeply dipping areas close to the west limb of the main anticline structure, where some proposed holes were cancelled because of the position of collars on old waste dumps. These waste dumps belong to the neighbouring mines and, at the time of the definition drilling program, Black Iron had been asked to remove the drills from the waste dumps by the neighbouring mine operators. Completion of some of these holes certainly gives a better idea about the presence of major structures, which controls the boundary of the Oxide Horizon (SX5F) and the magnetite-bearing quartzite. In the western limb of the Shymanivske anticline, where magnetite-quartzite units dip approximately 70ºSW, swarms of cross-cutting structures dislocate members of the BIF horizons on different levels.

15 MINERAL RESERVE ESTIMATE

The Mineral Reserve is the portion of the mineral resource tonnage that has been identified as being economically extractable and which incorporates mining losses and the addition of waste dilution. The Mineral Reserve forms the basis for the production plan used in the Feasibility Study. No Inferred Resource is used in the estimation of the Mineral Reserve. The Mineral Reserves have been developed using best practices in accordance with CIM guidelines and National Instrument 43-101.

The Mineral Reserve is developed in a 3-step process:

i) Select the optimized open pit shell to be used as the operational pit planning basis.

ii) Develop an operational open pit design that incorporates benches and truck haulage ramps.

iii) Estimate the tonnage contained within the designed pit and apply the ore criteria (losses and dilution) to the *in situ* ore tonnage that meets or exceeds the Fe_{Mag} cut-off grade.

These steps are described in the following sections.

15.1 Reserve Statement

The following Mineral Reserve has been estimated for the Project and was derived from the block model developed by WGM as described in Section 14.

Table 15.1: Mineral Reserve

Category	Tonnes	$\%Fe_{mag}$	$\%Fe_{tot}$
Proven	311,951,000	19.54%	31.12%
Probable	136,244,000	18.99%	31.15%
Total	448,195,000	19.37%	31.13%

The Mineral Reserve shown in Table 15.1 is based on a cut-off grade of 13.1% Fe-Mag and incorporates an ore loss of 2% and dilution factor of 7.1%. The pit optimization process had originally used a dilution factor of 8% but the final Reserve is reported with a more precise 7.1% dilution factor.

15.2 Pit Optimization

The open pit has been optimized by using industry standard methods that are based on the criteria described in the following section.

The optimization method uses the Lerchs-Grossman algorithm in the Whittle-4X software. The procedure is applied on the resource block model using mining, processing and general administrative costs, selling prices, pit slopes, and process recoveries. Inferred resources are considered as waste material in the optimization process.

Many of the pit optimization costing parameters listed in Table 15.2 were preliminary estimates used to initiate the mine planning process. The Feasibility Study refined these cost estimates and utilized the updated costs in the final economic analysis for the Project.

Table 15.2: Pit Optimization Parameters

Mine Slopes	
Rock -East Wall	45º
Rock -South Wall	47º
Rock- West Wall	47º
Rock -North Wall	47º
Mining Loss Factor	2%
Dilution factor	8%
Mining cost/rock tonne	$1.85
Overburden cost/overburden tonne	$1.25
Incremental Vertical Haulage cost/15m bench	$0.02
Process cost /ore tonne	$5.25
Site Infrastructure cost/ore tonne	$0.22
Sales & General Admini cost/ore tonne	$0.38
Environmental & Tailings cost/ore tonne	$0.04
Rail Transportation cost/ore tonne	$1.73
Port Facility cost/rock tonne	$1.66
Total Process plus G&A, port, rail	**$9.28**
FOB Sale price/tonne of 67% concentrate	$115
Average Mass Recovery	32.1%
Process recovery	95%

In order to produce the required concentrate grade of 68% Fe, the target mill feed average head grade must be in the range of 19.4% Fe-Mag. To provide an overall tonnage with this average grade, it was necessary to boost the operating cost factors to produce a higher cut-off grade that results in the targeted Mill Feed average head grade. The resulting Fe-Mag cut-off grade is 13.1%.

A series of economic pit-shells were generated by the optimization software, using varying revenue factors, typically from 0.1 to 1.1, which represent different iron sales prices. Each revenue factor would

yield a different optimal pit shell, as higher concentrate prices would allow economically higher stripping ratios.

Waste and mineral quantities and head grades are produced for each incremental pit shell. As shown in Figure 15.1, the optimal pit size and strip ratio increase with increased revenue factors (bottom axis). At a certain point in time the pit becomes less efficient because added stripping yields incrementally less ore at higher cost, resulting in little change to the net present value

Figure 15.2 and Figure 15.3 present the NPV undiscounted and discounted at 7% for the varying pit shells. The charts show how the curve achieves a peak around pit shells #19 to #25. This indicates that, while the tonnage keeps expanding, there comes a point where the long-term cashflows become heavily discounted and do not add significant NPV.

The decision was made to select the #20 pit shell (highlighted in Figure 15.1, Figure 15.2, and Figure 15.3) as the basis for the open pit design. Pit Shell #20 represents a selection that maximizes the NPV of the investment and minimizes the geotechnical and operating-cost risk, rather than the Reserve size.

Pit shell #20 contains an estimated quantity of 445Mt of ore, at an average undiluted grade of 19.5% Fe-Mag and a corresponding waste quantity of 565Mt (1.27:1 strip ratio). These tonnages will change slightly once an operational pit is designed.

On the basis of the current resource model, it is believed that there will be opportunities to increase the size of the reserve at a later point in the mine life through a pit push-back to the boundary provided by Pit Shell # 25. The increase in ore tonnes would be about 93Mt, adding about three years of mine life. Additional investment in mobile equipment would be required to facilitate this mining plan. Figure 15.4 provides a cross-section, showing the increase in pit size presented by pit shell #25 over the currently designed pit.

- Pit #20: 445Mt at 19.5% Fe-Mag, Waste = 565 Mt, Strip ratio 1.27:1
- Pit #25: 538Mt at 19.0% Fe-Mag, Waste = 842 Mt, Strip ratio 1.56:1

Figure 15.1: Pit Optimization Tonnages and Strip Ratio

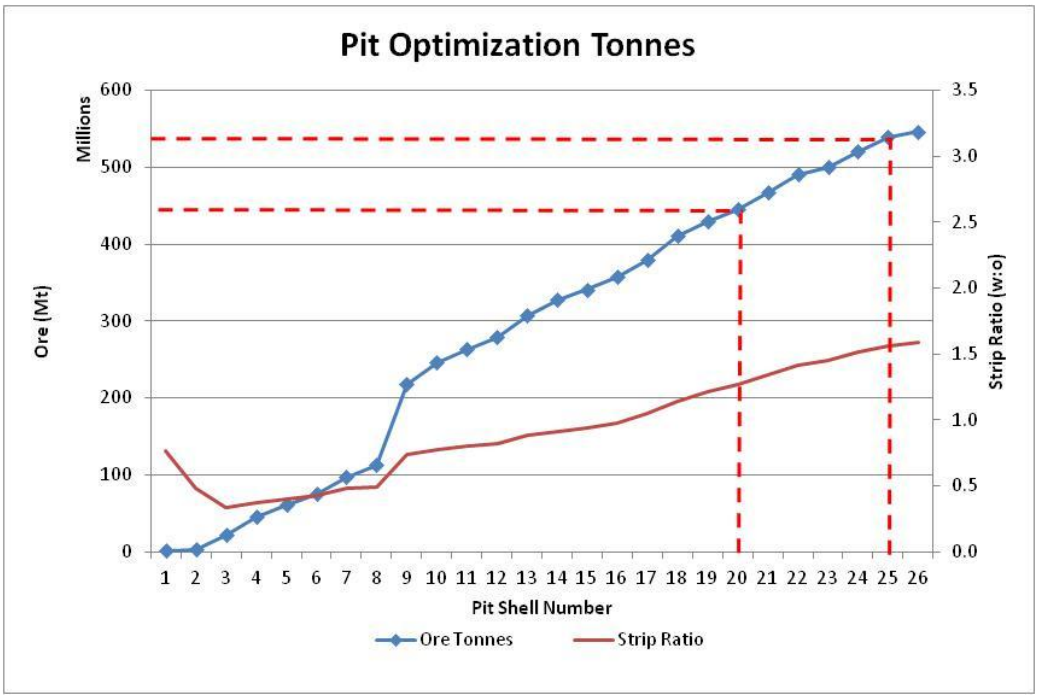


Figure 15.2: Pit Optimization Un-Discounted Values

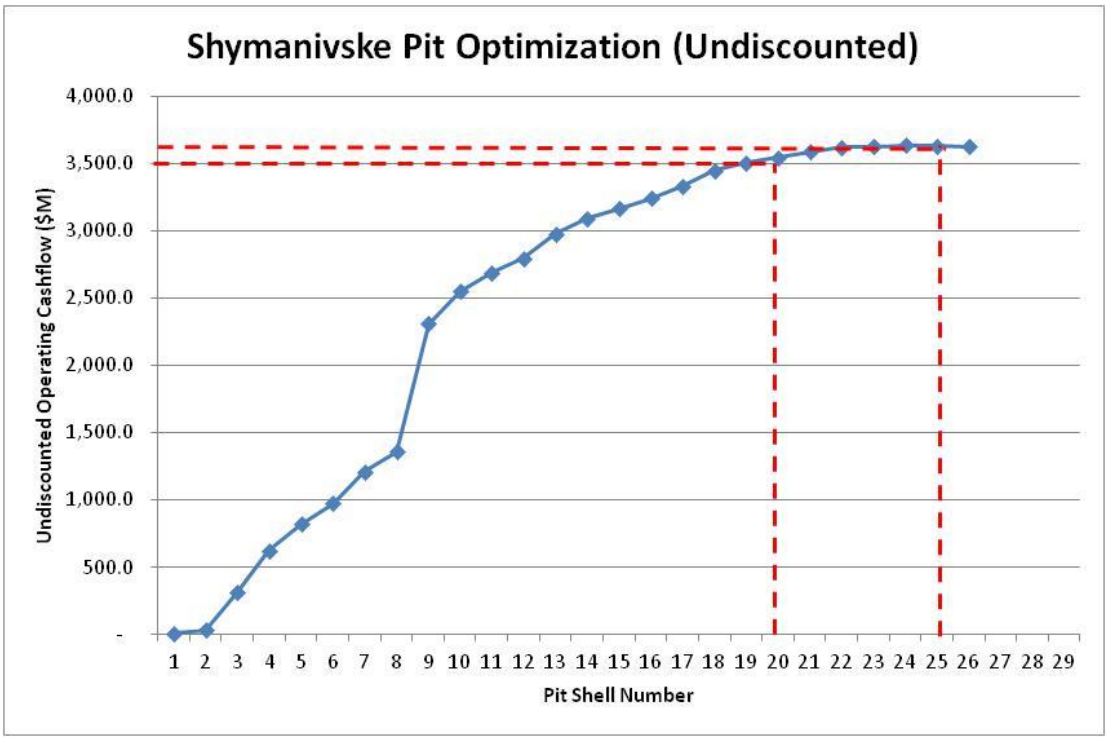


Figure 15.3: Pit Optimization Discounted $NPV_{7\%}$ Values

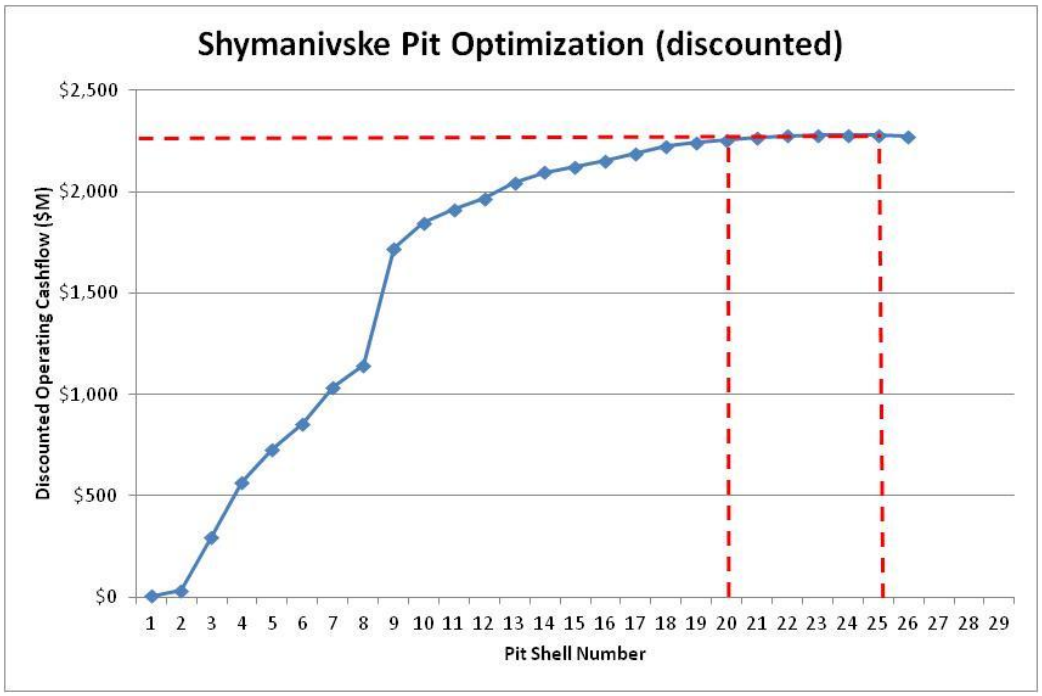
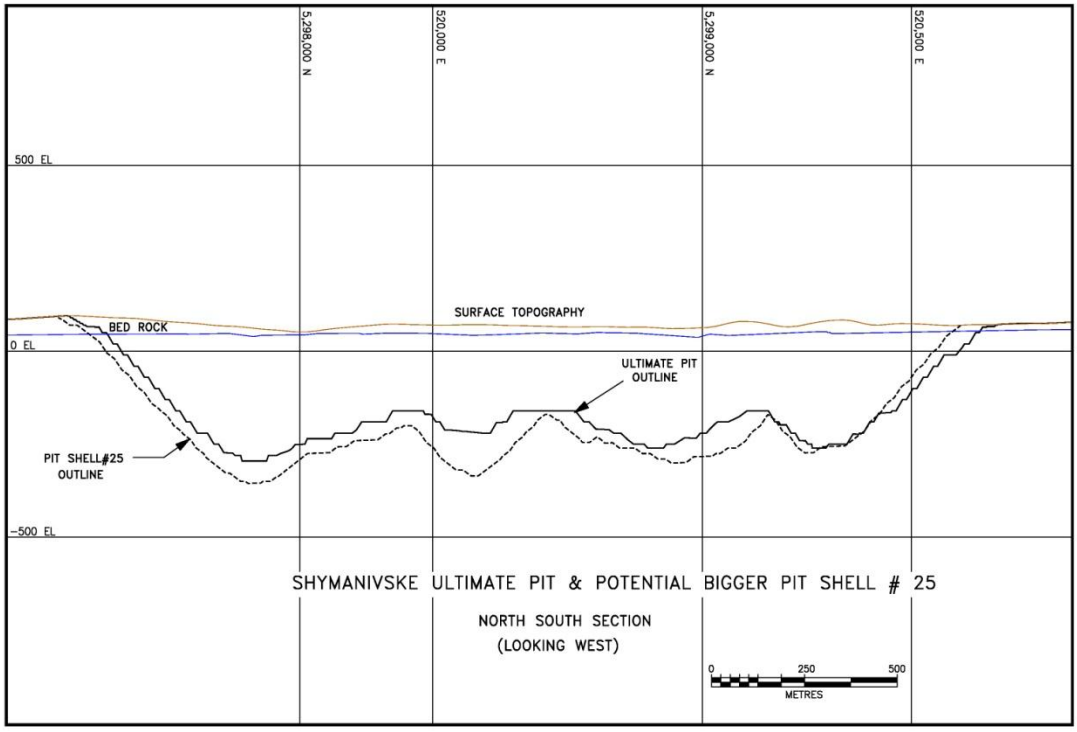


Figure 15.4: Pit Design versus Pit Shell #25 Expansion



15.3 Open Pit Design

The next step in the Reserve estimation process was to design an operational open pit that would form the basis for the production plan. This pit would later be sub-divided into mining phases for scheduling purposes; however, these phases do not affect the Reserve estimate contained within the ultimate pit. The pit phases and mine scheduling are described in Section 16-Mining Methods. The mine design and planning criteria used to design the operational pit are shown in Table 15.3. A pit wall schematic is shown in Figure 15.5 and the pit design is shown in Figure 15.6.

On the basis of a cut-off grade of 13.1% Fe-Mag, it is estimated that the total undiluted tonnage contained within the open pit design is 427.1Mt of ore at 20.05% Fe-Mag, 32.04% Fe-Total, and 749.6Mt of overburden and waste. These quantities are undiluted and are not yet considered a Reserve.

Table 15.3: Operational Pit Design Parameters

Historic Waste Dump: Inter-ramp angle	30º
Historic Waste Dump: Bench Height	5 m
Historic Waste Dump: Face Angle	50º
Historic Waste Dump: Catch bench width	4.2 m
Historic Waste Dump: Setback from Pit Edge	20 m
Soil / Limestone: Inter-ramp angle	37.5º
Soil / Limestone: Bench Height	15 m
Soil / Limestone: Face Angle	60º
Soil / Limestone: Catchbench width	10.9 m
Iron formation rock: Inter-ramp angle (E / NSW)	45 / 47º
Iron formation rock: Bench Height (double bench)	15 m (30 m)
Iron formation rock: Bench Face Angle	60º
Iron formation rock: Catchbench width (E / NSW)	12.7 m / 10.6 m
Haul road width	32 m
Haul road gradient	10%
Haul Road 0% Intervals for 50m length	Every 600 m

P&E's in-country liaison officer facilitated the interactions between P&E and several Ukrainian groups in order to procure costing and design data for this Feasibility Study. The mining costs in Table 15.2 were derived with the assistance of a local Ukrainian engineering consulting firm by the name of KOLO who provided labour, fuel, explosives and tire costs which formed the basis of the mine operating costs. The major mine equipment capital costs were derived from quotes provided by the Ukrainian dealers for

Caterpillar, Komatsu and Atlas Copso. P&E made two trips to Ukraine to intrerface with local mine engineering consulting firms in Kharkiv and Dnepropetrovsk in order to facilitate the selecton of appropriate pit design parameters described in Table 15.3 which conform to current Ukranian norms and mining regulations. The Ukrainian consulting firms reviewed the preliminary pit designs and confirmed they met the local requirements. In addition to the consulting firm visits, P&E visited the operating Yeristovo mine and observed their design practice insofar as Cat 793F haulage trucks were concerned.

Figure 15.5: East Wall Pit Slope Schematic

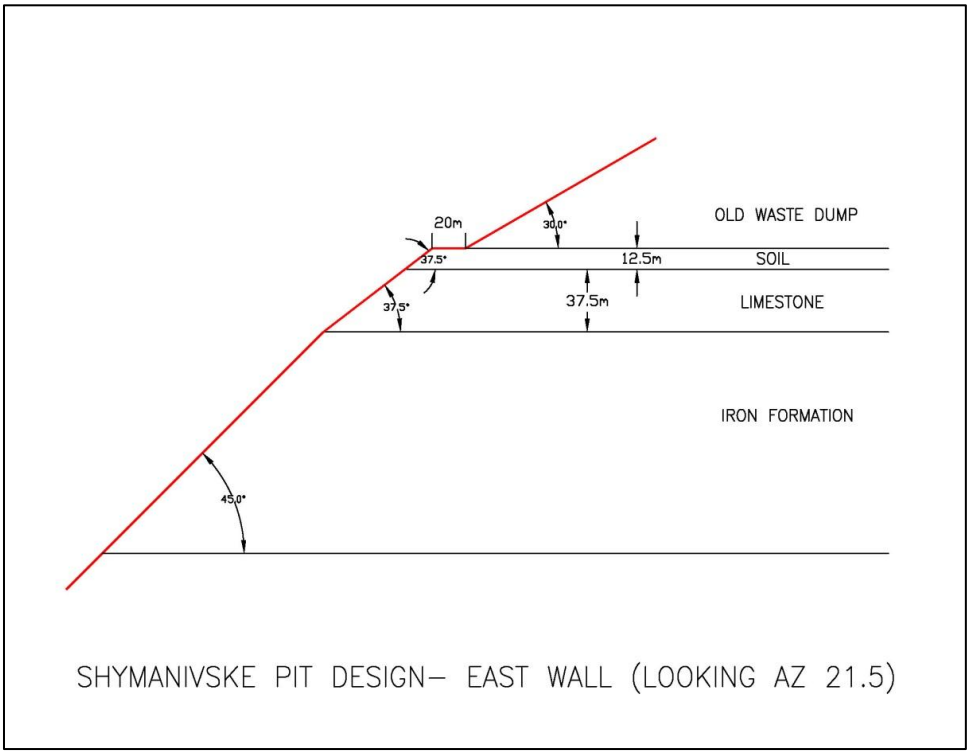
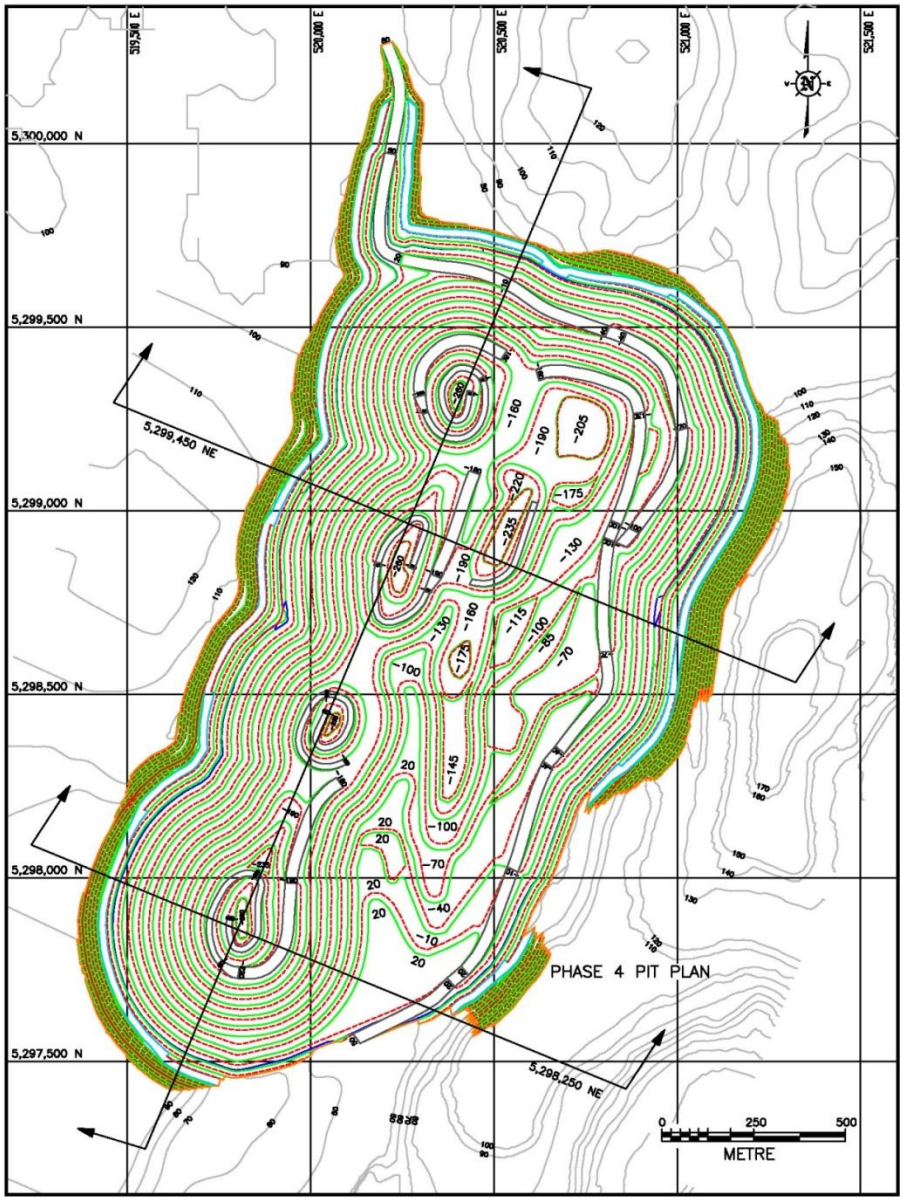


Figure 15.6: Final Pit Design



15.4 Ore Criteria and Reserves

In order to determine the Mineral Reserves, one must apply mining losses and dilution to the tonnages contained within the pit.

Ore Losses: Using P&E's mining experience, an ore loss factor of 2% was applied.

Dilution: A dilution factor of 7.1% was estimated, after examining the dimensions of the ore zones and assuming the presence of a dilution "skin" around those ore zones. It was estimated that the diluting material would have a grade of 9.8% Fe-Mag and 18.3% Fe-Total.

The dilution and ore losses were applied globally to the pit tonnage, in order to arrive at the Mineral Reserve previously described in Table 15.1. On the basis of a cut-off grade of 13.1% Fe-Mag, it is estimated that the total diluted tonnage contained within the operational pit design is 448.2 Mt ore at 19.4% Fe-Mag, 31.1% Fe-Total, and 728.5Mt of overburden and waste (waste to ore ratio of 1.63:1). This ore tonnage and grade is considered to constitute the Mineral Reserve.

15.5 Upside Reserve Potential

It must be noted that during the determination of the Mineral Reserve in the pit-optimization process, there existed the potential to add three to four years of mine life to the Shymanivske production schedule, albeit at a higher strip ratio that would have required a larger mine fleet and higher operating costs. It was decided to choose a somewhat smaller open pit that would require less mine capital and operating cost and deliver a robust 16-year mine life.

16 MINING METHODS

The Shymanivske Project will be developed as a large-scale, open pit operation. The approximate final dimension at surface will have a north-south length of 2,500m and east-west width of 1,250m.

The scale of production will require peak mining rates of up to 250,000t per day or 87Mtpa, in order to meet the iron ore processing rate of 28.34Mtpa.

The following sections describe the mining operation in greater detail.

16.1 Geotechnical and Hydrogeological

16.1.1 Mine Geotechnical Assessment

The geotechnical assessment for the pit slopes was completed by NTF SCIENCE AND TECHNOLOGY COMPANY FOR PRACTICAL ENGINEERING GEOLOGY, HYDRO-GEOLOGY AND TRANSPORT (PIGGIT) LLC in a report titled (translated) "*Substantiation of parameters of dump slopes and open pit mine flanks and steps to be taken to ensure their stability, May 29, 2012."* This report formed the basis for the pit slope design, which was reviewed by the WorleyParsons geotechnical engineering staff, who provided the pit slope design criteria presented previously in Table 15.3.

16.1.2 Mine Hydrogeological and Hydrological Assessment

The hydrogeological assessment for the open pit was completed by NTF PIGGIT LLC in a report titled (translated) "*Analysis of impact exerted by Shymanivske open pit mine, its dumps and industrial site on underground hydrosphere in affected area."*

At the completion of mining the total steady flow of groundwater into the Shymanivske open pit mine is estimated by PIGGIT to be approximately 170m^3/hr, which is anticipated to begin at a mining depth of 100m from surface.

16.2 Pit Phase Design

The pit design methodology is described in Section 15. For production scheduling purposes, in order to distribute the waste quantities over the life of the Project, a phased pit approach has been implemented. The pit has been subdivided into four phases, as shown in Figure 16.1, Figure 16.2, Figure 16.3, and Figure 16.4. Typical cross-sections through the pit are shown in Figures Figure 16.5, Figure 16.6, and Figure 16.7. Table 16.1 presents the ore and waste tonnages for each phase.

Table 16.1: Pit Phase Tonnages

	Ore	Fe-Mag	Fe- Total	Overburden	Waste	Total	Strip
	kt	%	%	kt	kt	kt	Ratio
Phase 1	108,340	20.01	31.3	30,289	52,282	190,912	0.76
Phase 2	157,356	18.8	31.1	46,335	144,507	348,199	1.21
Phase 3	87,111	19.5	30.9	36,297	179,664	303,072	2.48
Phase 4	95,388	19.4	31.2	36,319	202,757	334,463	2.51
Total	448,195	19.4	31.1	149,239	579,210	1,176,645	1.63

Each of the pit phases will utilize two exit points from the pit. There will be a north exit that will be used for all ore haulage to the primary crusher near the plant. The North ramp will also be used to haul overburden and waste to the north end of the waste storage facility; however, as this dump advances to the south, it will be more efficient to exit the pit with waste and overburden at the south end.

Figure 16.1: Phase 1 Pit Design

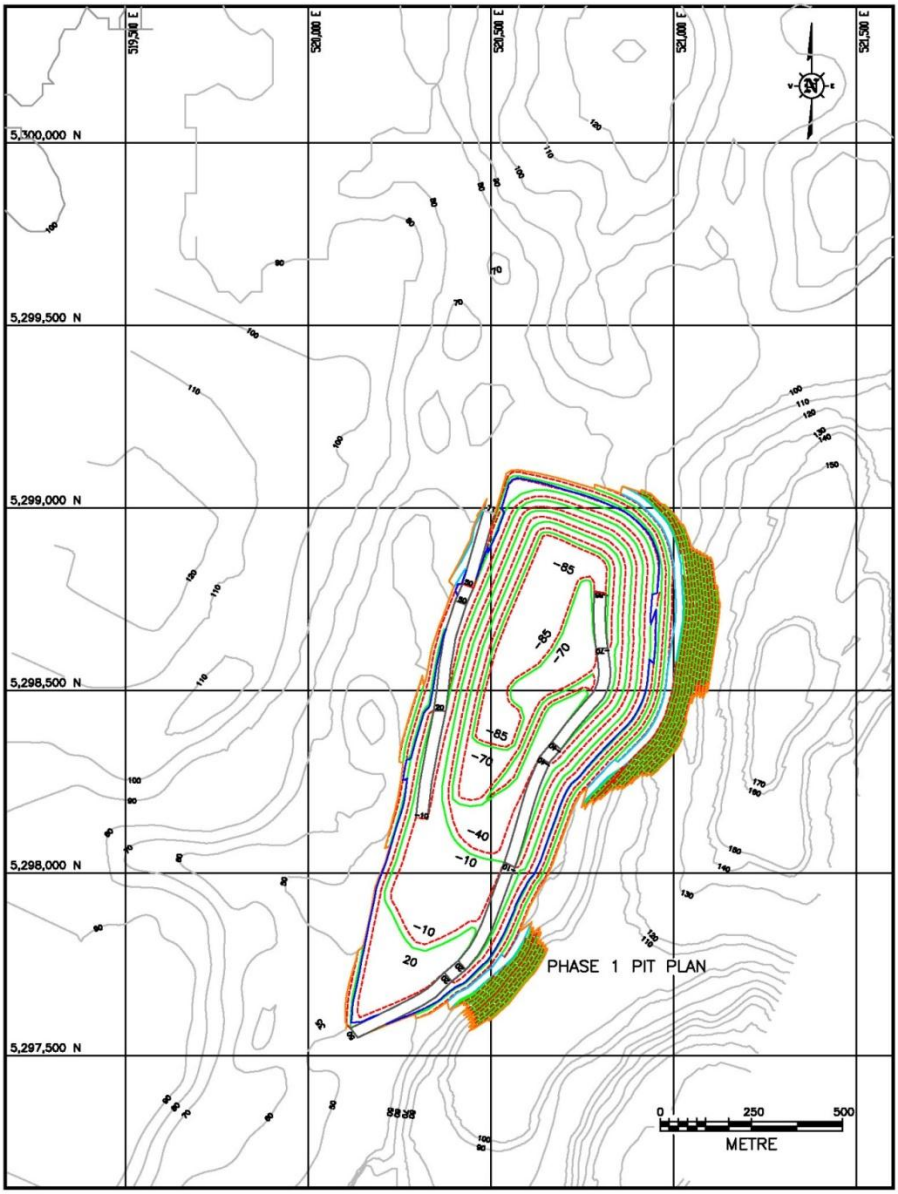


Figure 16.2: Phase 2 Pit Design

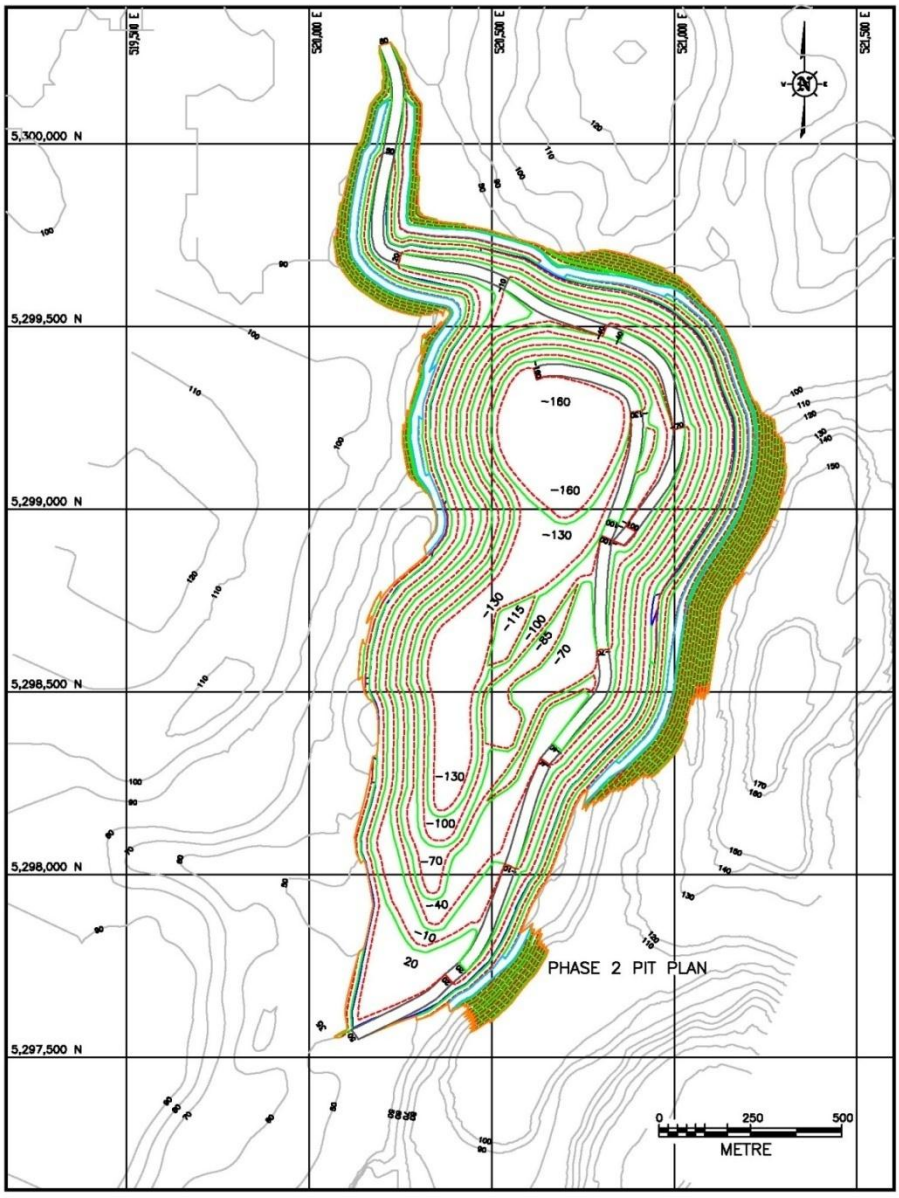


Figure 16.3: Phase 3 Pit Design

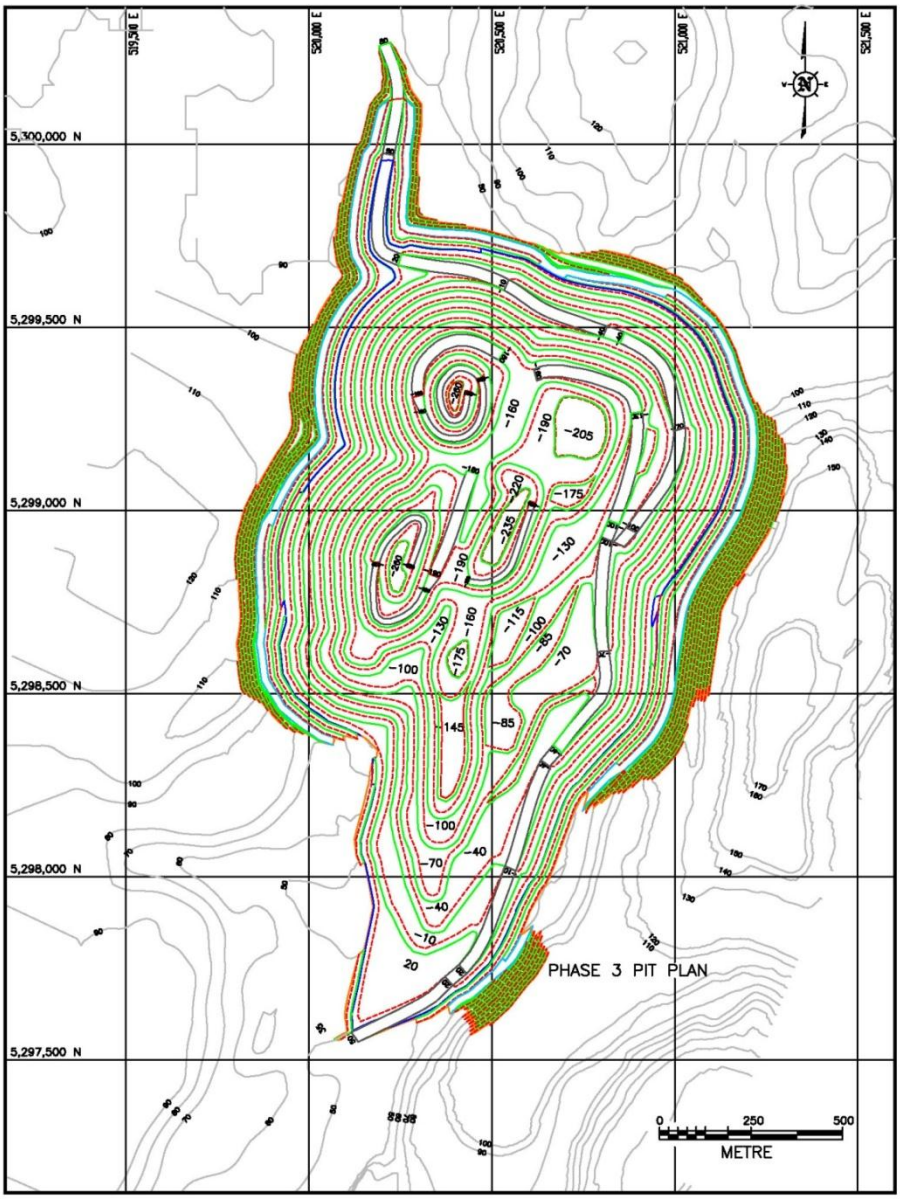


Figure 16.4: Phase 4 Final Pit Design

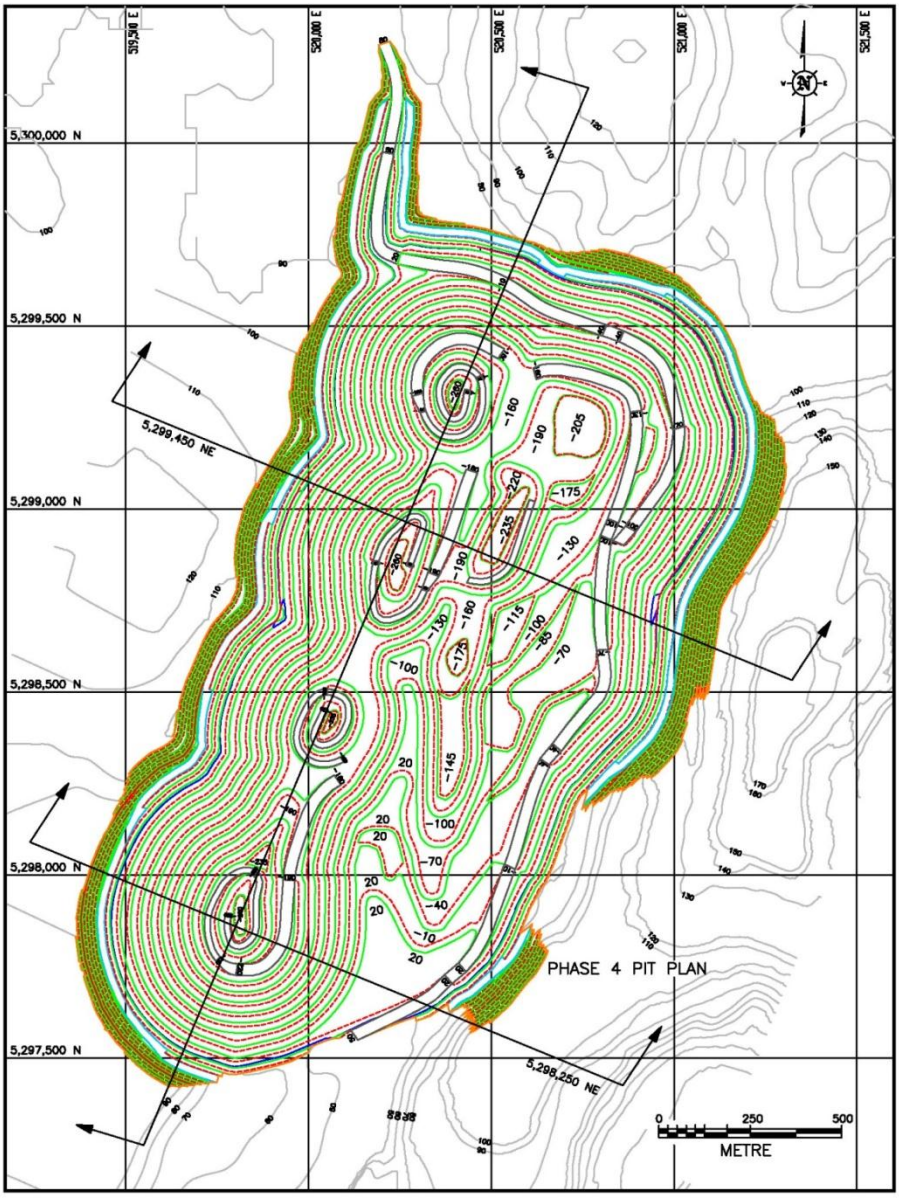


Figure 16.5: North-South Pit Design Cross-Section

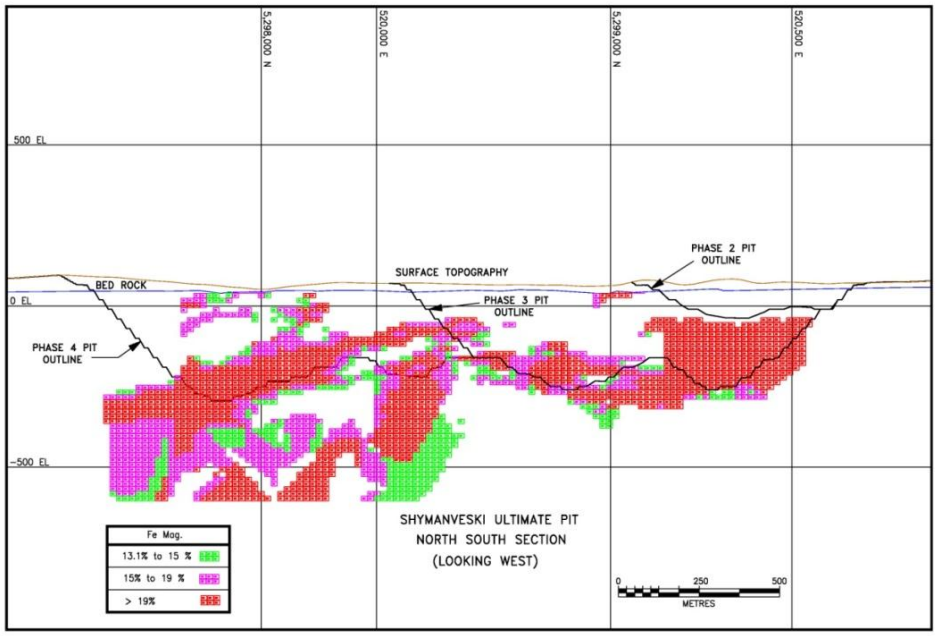


Figure 16.6: East-West Pit Design Cross-Section (5,298,250 NE)

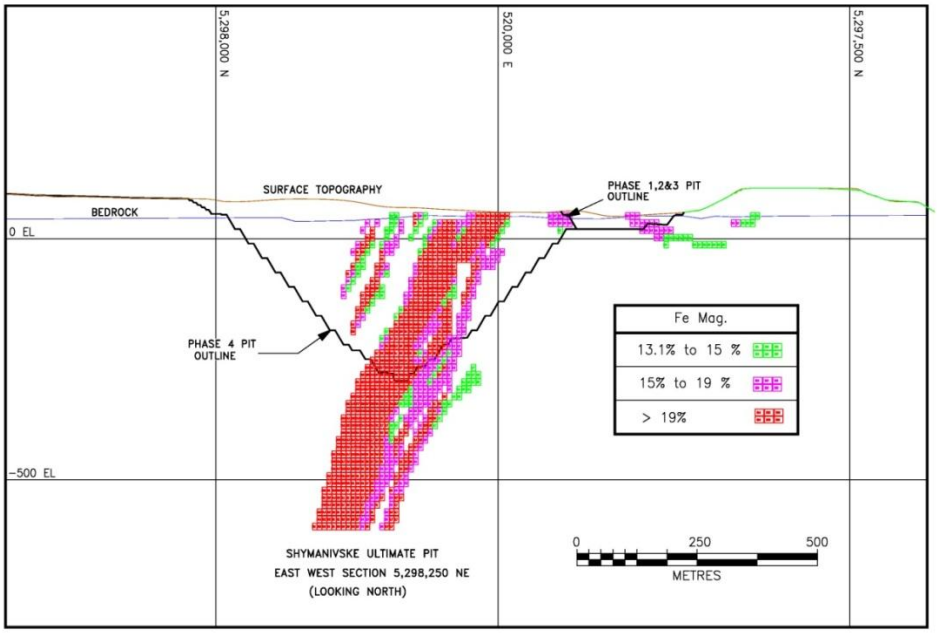
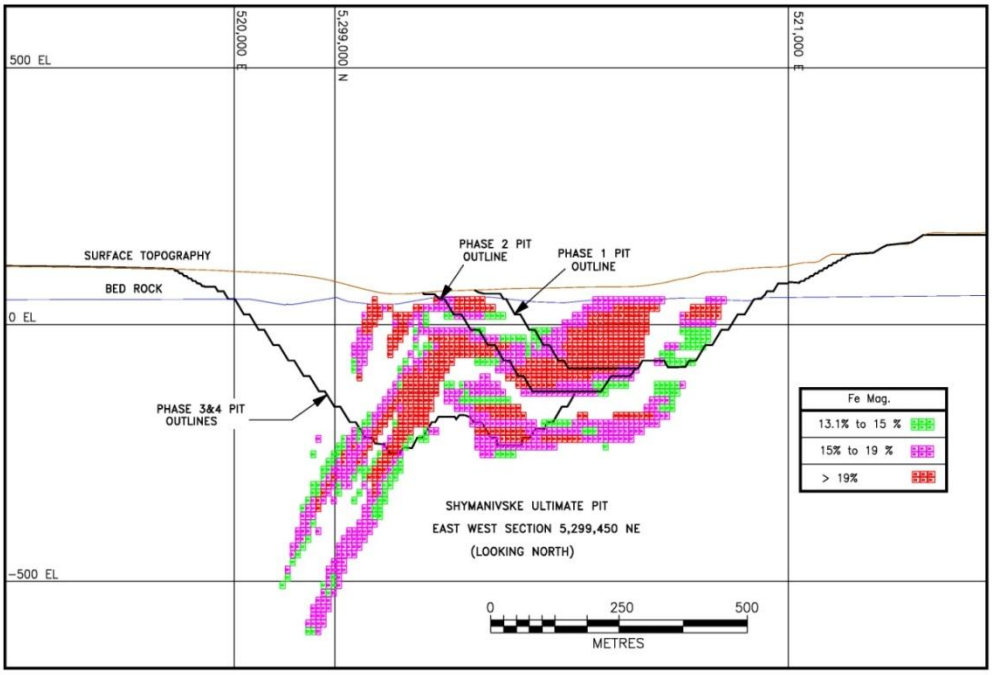


Figure 16.7: East-West Pit Design Cross-Section (5,299,450 NE)



16.3 Mine Production Schedule

The ultimate pit has been sub-divided into four phases to allow optimal sequencing of tonnes mined each year, thus avoiding large tonnage fluctuations from year to year. Mining may occur in multiple phases at the same time, whereby mining operations are mining the deeper parts of one phase while stripping in the upper parts of the next phase. Table 16.2 presents the life-of-mine production schedule. Note that mining tonnages are shown on a quarterly basis for Years -1 and +1 and on an annual basis thereafter.

Table 16.2: Mine Production Schedule

		Ore	Fe-Mag	Fe-Total	Overburden	Waste Rock	Total Material	Strip
		kt	%	%	kt	kt	kt	Ratio
Year -1 Pre-Strip	Q 1		0.0	0.0	6,990	5,010	12,000	
	Q 2		0.0	0.0	6,990	5,010	12,000	
	Q 3		0.0	0.0	5,990	6,010	12,000	
	Q 4		0.0	0.0	4,250	7,880	12,130	
Year 1	Q 1	4,457	16.9	30.7	4,330	5,490	14,277	2.20
	Q 2	6,200	20.2	31.2	9,790	4,140	20,130	2.25
	Q 3	7,085	19.2	30.5	10,410	4,460	21,955	2.10
	Q 4	7,085	19.3	30.8	4,690	9,330	21,105	1.98
Years	Y 2	28,340	19.5	31.1	19,390	21,220	68,950	1.43
	Y 3	28,340	19.1	31.3	23,460	16,610	68,410	1.41
	Y 4	28,340	19.6	31.1	11,650	29,010	69,000	1.43
	Y 5	28,340	19.1	31.0	-	39,780	68,120	1.40
	Y 6	28,340	18.6	31.3	7,500	27,870	63,710	1.25
	Y 7	28,340	19.8	31.0	9,600	26,300	64,240	1.27
	Y 8	28,340	19.1	31.1	-	35,350	63,690	1.25
	Y 9	28,340	19.3	31.2	-	44,780	73,120	1.58
	Y 10	28,340	19.9	31.3	-	43,210	71,550	1.52
	Y 11	28,340	19.2	30.8	12,460	33,780	74,580	1.63
	Y 12	28,340	19.6	30.6	11,740	38,930	79,010	1.79
	Y 13	28,340	19.4	31.2	-	51,120	79,460	1.80
	Y 14	28,340	19.5	31.2	-	58,260	86,600	2.06
	Y 15	28,340	19.0	31.2	-	59,070	87,410	2.08
	Y 16	26,608	20.2	31.8	-	6,590	33,198	0.25
	Total	448,195	19.4	31.1	149,240	579,210	1,176,645	1.63

The pre-stripping period in Year -1 will require the removal of 24.2Mt of overburden and 23.9Mt of waste rock. Some of the waste rock will be used in the construction of the tailings cells prior to the start of processing. Figure 16.8 presents a plan view of the pit after the pre-stripping period.

Figure 16.8: Pit Configuration at the End of Pre-Strip

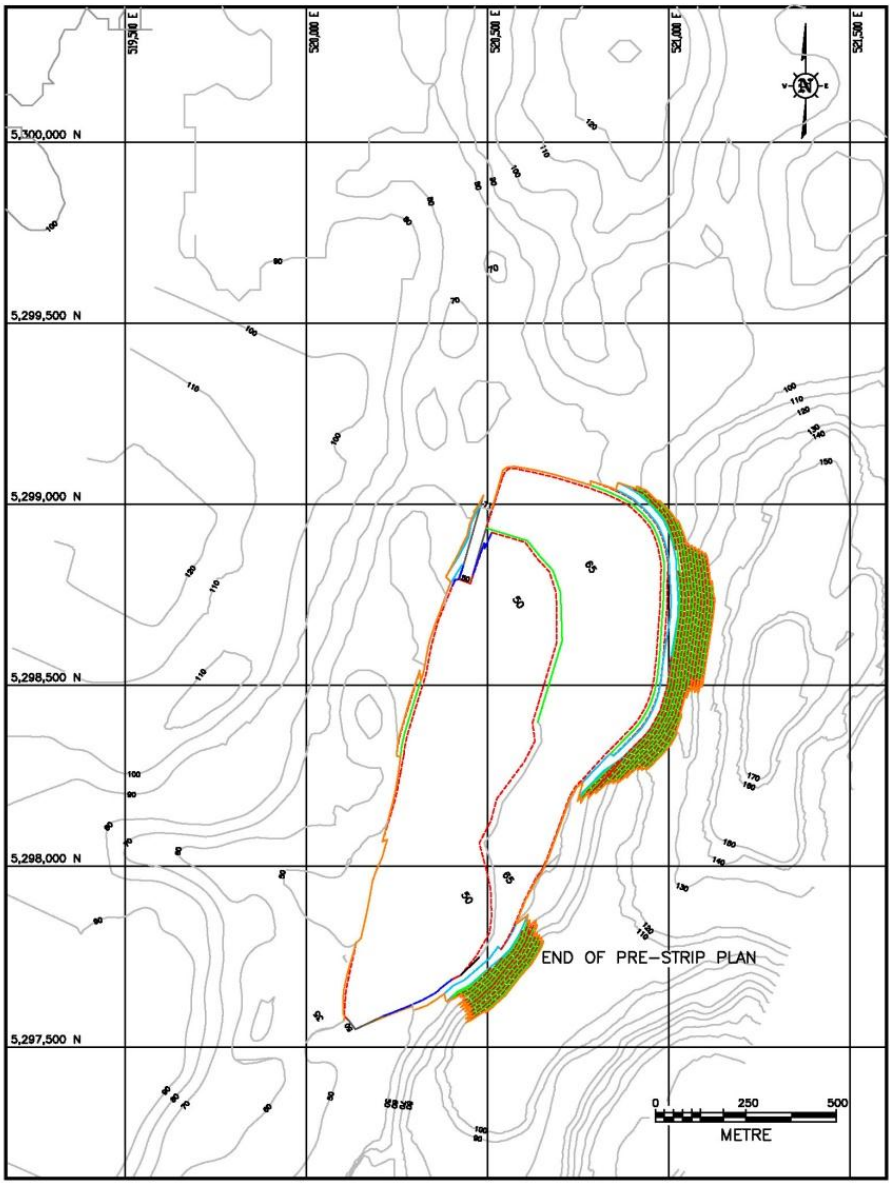
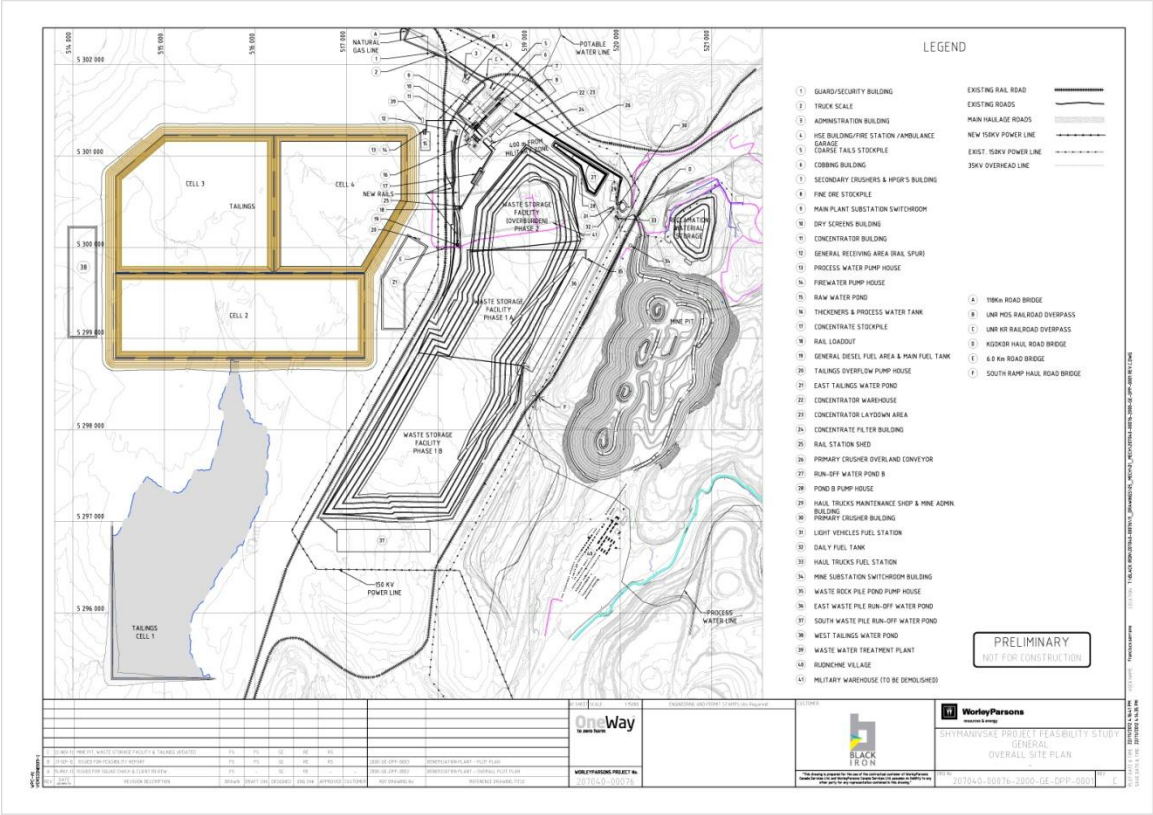


Figure 16.9: Mine Site Layout



16.4 Open Pit Mining Practices

The following sections describe the details of the various mining operation activities. These will be undertaken by the owner-operated fleet, unless specified as a contractor activity. Figure 16.8 provides general site layout, showing the locations of the pit, railway crossing bridges, and waste dumps.

Equipment and workforce productivity are based on working two 12-hour shifts per day with a hotseat change of shovel & haul truck operators during breaks, lunch and each shift change.

Table 16.3 presents the basis for the daily working hours and productive hours.

It is assumed that replacement operators will be made available for the major mining equipment, so as to allow for continuous operation. Some minor change-over delays are to be expected during breaks. The cost estimates include the additional workforce needed and assume that mine operations will proceed 360 days per year.

Table 16.3: Mine Manpower and Mine Equipment Productivity Basis

Hours per shift	12
Minutes per shift	720
Less fixed delays (minutes)	
Travel to workplace (hot change)	5.0
Pre-shift inspection	10.0
Lunch break (changeover time)	10.0
Breaks (2 total)	10.0
Refuel	15.0
Blast (shift average)	7.5
Net minutes per shift	662.5
Less variable delay allowance (min)	30.0
minutes	632.5
Operator efficiency	83%
minutes	525.0
Effective operating hours/shift	8.7
Shifts per day	2
Effective operating hours / day =	**17.5**

16.4.1 Topsoil Recovery and Stockpiling

The thin layer of topsoil covering the pit area will be recovered and stockpiled separately from the overburden and waste rock. The topsoil will eventually be used as a reclamation capping material on the waste dumps to allow the growth of vegetation.

It is estimated that the top 300mm to 500mm of the ground surface will contain 0.9 to 1.5 million cubic metres of topsoil. The reclamation material stockpile area (RMS) will be situated north of the pit, as shown in Figure 16.9.

16.4.2 Overburden Stripping

The term “overburden” is used to describe a combination of three different materials in the pit. The overburden volume includes variable amounts of:

a) Broken rock from historical waste dumps that will be encountered in the mine area;

b) *In situ* silts, sands and clay layers that underlie the topsoil; and

c) Limestone that underlies the silts, sands and clay layers and overlies the banded iron formation.

It is assumed that 12% of the overburden will require some degree of drilling and blasting, and that the remainder of the overburden will be mined by ripping and dozing or by free digging. The projected powder factor for limestone blasting is 0.13kg/t. Table 16.4 presents the drill and blast specifications.

The overburden material will be cleared by the owner’s mining fleet. It will be loaded onto the mine trucks and hauled to the disposal area.

16.4.3 Drilling and Blasting

The ore and the waste rock will require drilling and blasting.

Blasthole drilling will be done using conventional rotary drill rigs. The proposed blast holes have a diameter of 250mm and will be drilled to a depth of 16.8m.

Table 16.4 presents the blast design specifications for overburden, waste rock, and ore.

An allowance of 6% has been included for re-drills in rock. The secondary blasting cost allowances amount to approximately 3% for waste rock and 5% for ore.

Table 16.4: Drill and Blast Specifications

	Overburden	Waste Rock	Ore
Bench Height (m)	10.0	15.0	15.0
Sub-grade (m)	1.0	1.8	1.8
Total Hole Length (m)	11.0	16.8	16.8
Powder Factor (kg/t)	0.132	0.345	0.347
Blasthole diameter (mm)	178	250	250
Blast Pattern (m x m)	7 x 7	6 x 8	6 x 7
Tonnes per blasthole	1078	2088	2186
Net drill penetration rate (m/hr)	30	20	20
Drills required	2 to 6 drills		

16.4.4 Ore Grade Control

The blast holes will be used for grade control to define ore and waste contacts and to allow in-pit blending of the plant feed. Since no large run-of-mine ore stockpile is planned, the mining operation will be required to deliver an approximate blend of 19%-20% Fe-Mag grade to the beneficiation plant on an on-going basis.

The plant will have a fine-crushed ore stockpile, equivalent to about 75,000t or to 24 hours of production.

16.4.5 Loading and Hauling of Ore and Waste

The loading and hauling of the ore, waste rock, and overburden will be done by using the owner's mining equipment fleet.

Electric-powered, hydraulic front-loading shovels will be used to excavate and load the materials. The excavators will load the 226-tonne capacity off-highway haul trucks. Table 16.5 summarizes the productivity criteria for the hydraulic shovels in the different materials.

Loading operations will also be supported by a wheel loader with a 15m^3 rock bucket.

Table 16.5: Loading Productivity Criteria

	Overburden	Waste Rock	Ore
Insitu Density (t/m^3)	2.20	2.90	3.49*
Swell factor (%)	20%	40%	40%
Loose Density (t/m^3) dry	1.83	2.07	2.49
Moisture Content (%)	8%	3%	3%
Bucket Size (m^3)**	23	23	23
Fill Factor (%)	90%	90%	90%
Passes to Load Truck (#)	4	5	4
Time per pass (sec)	36	36	36
Cycle time to load truck (min)	3.7	3.7	3.1
Shovel Productivity (t/hour)	2,600	2,358	2,810

* Average Ore Density

** The mine operating cost estimates allow for the possible initial use of common size 23 m^3 buckets. It is expected that the mine will typically use 31m^3 buckets in overburden, and 23m^3 and 28m^3 buckets in ore and waste rock, respectively.

The truck fleet size will vary from 14 to 53 trucks near the end of the mine life, as haul distances change. In order to determine the annual trucking hours required, their productivity was estimated by calculating the average annual haul profiles for ore, waste rock, and overburden, and then estimating the truck-cycle times for each. The Caterpillar Fleet Production Calculation (FPC) was used for haul analysis: parameters are shown in Table 16.6.

Table 16.6: Hauling Productivity Criteria

Rolling resistance	2%
Maximum haul speed on flat surface	56 kph
Maximum speed on 10% grade	14.5 kph
Maximum down-gradient speed limit	40 kph
Maximum speed when crossing bridge	25 kph

In the early years, the haul distances are fairly short; however, in the later years when hauling waste rock from deep parts of the pit to the waste dump, the one-way haul distances will be in the range of 8km to 9km.

Table 16.9 shows the shovel and truck fleet requirements by year.

16.4.6 Open Pit Dewatering

The infrastructure costs include the operating and capital costs for a pit dewatering system, which will pump water from in-pit sumps. Details are included in Section 17, Infrastructure.

16.4.7 Mine Auxiliary Pit Services

The mining operations will be supported by a service equipment fleet. Table 16.9 shows the auxiliary equipment requirements by year.

Road graders will be used to maintain the various haul roads within the pit and out to the dump areas and beneficiation plant. The graders will operate on a 24-hour basis. Water trucks will be used to wet the roads during dry periods, to control dust.

Bulldozers will initially be used to rip and push overburden to the shovels. A rubber-tired dozer will be used on the waste dumps to push the dumped material. The dozer may also be needed in the mine to clean up around the shovels and assist in their operation.

Bulldozers will be used to clean up around the shovel faces, to prevent truck tire damage and for post-blast clean-up.

Mine operations will be supported by a mobile fuel and lube truck, to service the non-mobile equipment in the pit.

A 90-t crane will be at the site to assist with the repair and replacement of large-equipment components.

Miscellaneous maintenance and service vehicles will consist of crew buses, pick-up trucks, flatbed trucks, welding trucks, mechanical parts trucks, a tire handler, and other small equipment.

16.5 Waste Dumps

Over the 16-year life of the Project, three waste storage facilities (RMS, WSF, and WSF-2) will be required. They are shown in Figure 16.9 and consist of the following:

RMS: the first reclamation material stockpile (RMS) located north of the pit will contain 1.5 million cubic metres of topsoil from the open pit. The temporary footprint is about 32ha, and will be removed during closure.

WSF-1 and WSF-2: are located to the west of the open pit mine. They will store waste rock and overburden, and will contain approximately 265 million cubic metres. The footprint is approximately 650ha and will be built to a height of approximately 100m.

16.5.1 Waste Dump Design Criteria

The criteria used for the waste dump design is derived from the report "*Mine Waste Dump- Design Basis Memorandum, 207040-00076–5300-SS-REP-0001, 14 August 2012.*" Table 16.7 summarizes the design criteria used for all of the dumps,

Table 16.7: Waste Dump Design Criteria

Individual Dump Lift Height	25 metres
Bench Width	8 metres
Bench face Angle:	2:1 (H:V)
Overall Slope Angle:	2.3:1 (H:V)
Setback from roads, rail, buildings	100 metres
Truck ramp access	32 metres wide, 10% grade

16.5.2 Waste Material Balance

The waste-material balance is shown in Table 16.8. Some of the waste mined from the pit will be used to construct the tailings cell dykes and the remaining waste will be placed in the various waste-storage facilities. However the mine-waste dumps have been sized to contain 100% of the waste from the mine in the event that the tailings facility requires less construction material than planned.

Tailings cell construction will be done using a contracted equipment fleet to re-handle waste material drawn from the mine waste dump; therefore, the large mine trucks would not be required to transport waste directly to the tailings area.

Table 16.8: Waste Material Balance

Overburden from pit	88.2	Mm^3
Waste rock from pit	259.6	Mm^3
Topsoil from pit	1.5	Mm^3
Total Waste Mined	**349.3**	Mm^3
Waste to tailings cell	55.0	Mm^3
Limestone to tailings cell	6.0	Mm^3
WSF-1 and 2 storage	265	Mm^3
RMS storage	1.5	Mm^3
	349.3	Mm^3

16.6 Mine Equipment Fleet

The size of the mining fleet and service equipment fleet will change over time, as the mining volumes and haul distances vary. The production schedule endeavours to avoid large annual fluctuations in tonnage mined as best as possible; however, over the longer term, strip ratios will increase and haul distances will lengthen as the pit deepens and the waste dump increases in height. Table 16.9 presents the mine equipment fleet, by year.

Table 16.9: Mine Equipment Fleet by Year

EQUIPMENT FLEET	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Overburden drill	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Production drill	2	4	4	4	4	5	5	5	5	5	5	5	5	3	3	3	2
Pre-shear drill	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Shovels	3	5	5	5	5	5	5	5	5	5	6	7	7	7	7	7	2
Haul Trucks	14	28	28	28	28	28	28	28	28	30	38	44	44	46	47	53	29
Grader	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	2
Water truck	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	2
Cat D10T bulldozer	7	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	4
Cat 844 wheel dozer		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cat 994F wheel loader	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pick-up trucks	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	6
Fuel/lube truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Heavy duty field service trucks	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Light duty field service trucks	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Tow truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Boom truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field crane	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

16.7 Mine Support Facilities

The following will require additional facilities will be required to support the mining operation:

Truck Shop: a 5- bay, large-capacity truck shop will be used to service the equipment vehicle fleet. This will include a lube shop, tire shop, welding bay, and light-vehicle service bays.

Haul Roads: various haul roads will be required to travel from the pit area to the primary crusher and to the waste dumps. Two railway crossing bridges will be required to get to the waste dump area, one of which is currently in existence and requires upgrading and the other that is yet to be constructed.

Offices: the mine technical team and mine supervisors will require some office facilities. These are included as part of the main administration complex.

Mine Change House: the production crews will require a change and shower facility. This will be included as part of the main administration complex. It is expected that up to 200 mine personel would use this facility daily.

Fueling Depot: a diesel fuel storage facility and fueling station is included for the mine trucks, the details of which are included in Section 18 Infrastructure.

Warehouse: a warehouse facility will be required to house the various equipment components and spares.

Laydown Yards: a laydown yard area will be used for tire storage and large component storage and the details of which have been included in the Infrastruture Section 18.

Aggregate crusher: the mining operation will require an aggregate crusher and screening plant to provide road aggregate for on-going road construction and maintenance.

Explosive storage: note that no explosive storage will be required on site. The local blasting-material supplier has storage facilities in the vicinity and explosives will be delivered to site on a daily as-needed basis.

16.8 Mining Manpower

The mining operations manpower list includes all aspects of the open pit operations, including;

- Senior mine and maintenance supervision;
- Office technical staff, engineering, geology, surveying, etc;
- Clerical, maintenance planning, training;
- Mine operations crews;
- Mine support crews; and
- Mine maintenance crews.

Workforce requirements will vary over time as production rates increase or decrease. Tables Table 16.10 and Table 16.11 summarize the mine operations workforce by year. To maximise shovel and haul truck effective utilization rates, operators will be hot seat changed during breaks, lunch and at shift change.

Table 16.10: Mining Operating Manpower by Year

MANPOWER - MAINT	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maintenance Supervision																	
Mtce Gen Supervisor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mtce Shift Supervisor	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Maintenance Trainer (Expat)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Advisor (Expat)	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Mine Mtce Planner	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Lead Mechanic	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Electrical Specialist	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Electrical Tech	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Welder	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Field Crane Operator	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Tire Technician	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Mine Fuel Station Attendant	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Gas Mechanic	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Parts Person	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Wash Bay Attendant	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Labourer	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Maintenance Personnel																	
Bulldozer Mechanics	8	10	8	8	4	-	4	4	-	-	-	6	4	-	-	-	-
Drill Mechanics	5	9	9	7	9	10	8	8	10	10	10	10	10	12	12	12	6
Shovel Mechanics	12	15	18	15	15	15	15	15	12	15	18	18	18	18	21	21	12
Truck Mechanics	24	46	42	42	35	37	37	45	40	50	61	72	62	75	77	85	32

MANPOWER - MAINT	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ancillary Mechanics	14	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	13
Technical Services																	
Chief Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Senior Mine Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Mine Technician	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Geotechnical Engineer	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine Geologist	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Grade Control Geologist	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ore Control Technician	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Surveyor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Survey Technician	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4
Clerk	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Maint & Tech Personnel	124	172	168	163	154	153	155	163	153	166	180	197	186	196	201	209	121
Total Mining Personnel	**346**	**504**	**484**	**471**	**438**	**439**	**445**	**478**	**443**	**492**	**546**	**612**	**564**	**610**	**623**	**659**	**342**

Table 16.11: Mining Maintenance & Technical Services Manpower By Year

MANPOWER - OPS	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mine Supervision																	
Mine Superintendent	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mine General Supervisor (Local)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
General Superintendent (Expat)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine Shift Supervisor (Local)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4
Mine supervisor trainers (Expat)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mine Clerk	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine Operations																	
Rip bulldozer operators	16	20	16	16	8	-	8	8	-	-	-	12	8	-	-	-	-
Drillers	10	18	18	14	18	20	16	16	20	20	20	20	20	24	24	24	12
Shovel Operators	16	20	24	20	20	20	20	20	16	20	24	24	24	24	28	28	16
Truck Drivers	60	116	104	104	88	92	92	112	100	124	152	180	156	188	192	212	80
Spare Equipment Operators	28	40	36	36	32	36	36	40	36	44	52	60	52	60	60	68	32
Grader Operator	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	6
Water Truck Driver	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Bulldozer Operator	12	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	8
Wheel Dozer Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Wheel Loader Operator	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Fuel Truck Driver	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4
Utility Operator	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mine Safety / Training																	
Safety / Training Supervisor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine trainer	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	-
Assistants	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Blasting																	
Blasting Supervisor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Blaster	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Blaster Labourer	4	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	6
Blast Clerk	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Blasting Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Blasting Technician	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Explosive Supplier Personnel																	
Explosive Supplier Manager	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Lead hand	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Off-site Supplier Personnel	4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6
Mechanic / Spare Operator	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
Explosive delivery equipment operator	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6
Explosives records clerk	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Operations Personnel	222	332	316	308	284	286	290	314	290	326	366	414	378	414	422	450	221

MANPOWER - MAINT	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maintenance Supervision																	
Mtce Gen Supervisor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mtce Shift Supervisor	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Maintenance Trainer (Expat)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance Advisor (Expat)	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Mine Mtce Planner	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Lead Mechanic	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Electrical Specialist	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Electrical Tech	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Welder	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Field Crane Operator	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Tire Technician	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Mine Fuel Station Attendant	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Gas Mechanic	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Parts Person	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Wash Bay Attendant	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Labourer	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Maintenance Personnel																	
Bulldozer Mechanics	8	10	8	8	4	-	4	4	-	-	-	6	4	-	-	-	-
Drill Mechanics	5	9	9	7	9	10	8	8	10	10	10	10	10	12	12	12	6
Shovel Mechanics	12	15	18	15	15	15	15	15	12	15	18	18	18	18	21	21	12
Truck Mechanics	24	46	42	42	35	37	37	45	40	50	61	72	62	75	77	85	32
Ancillary Mechanics	14	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	13
Technical Services																	
Chief Engineer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Senior Mine Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine Engineer	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Mine Technician	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
Geotechnical Engineer	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mine Geologist	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Grade Control Geologist	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ore Control Technician	-	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Surveyor	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Survey Technician	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	4
Clerk	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total Maint & Tech Personnel	124	172	168	163	154	153	155	163	153	166	180	197	186	196	201	209	121
Total Mining Personnel	**346**	**504**	**484**	**471**	**438**	**439**	**445**	**478**	**443**	**492**	**546**	**612**	**564**	**610**	**623**	**659**	**342**

17 RECOVERY METHODS

Section 13 of this report discussed the metallurgical testwork as well as the results of testwork on the recoverability of iron and the amenability of the mineralization to the proposed processing methods. In the following section an assessment of the appropriate methodology for iron recovery from the Shymanivske ore is described in detail, through the Process Flow Diagrams (PFDs) and mass balance.

In addition, the projected requirements for utilities, plant services and the general beneficiation plant descriptions of various areas are presented in this section. This information, in conjunction with the developed plant General Arrangement (GA) drawings and plant 3D models, establish the basis of the Capital and Operating Cost Estimates defined in Section 21.

17.1 Overall Process Design Basis

The Shymanivske beneficiation plant has a nominal capacity to process 27.9 Mtpa of iron ore and to produce 9.1 Mtpa of iron ore concentrate on a dry basis, at an overall weight recovery of 32.7 %. However, based on the average composition and hardness of the ore, the average life of mine concentrate production, excluding start-up and ramp-down years, the production rate will be 9.2Mtpa.

The overall process and plant design criteria for the Shymanivske beneficiation plant are established on the following bases:

- The Process is engineered as inherently safe, which complies with the standard industry practices to maintain a sustainable operation and minimize the risk to the environment, employees, health and safety, and the community (SHEC);
- Safety features included in the plant design comprise:
    - Sump pumps;
    - Ventilation system;
    - Fire protection system; and
    - Safety shower and eyewash stations permanently connected to a source of potable water.
- The design is based on a 16-year Life of Mine (LOM) at nominal capacity;
- Equipment selection is based on achieving consistent concentrate (product) quality at low capital and operating costs;
- The beneficiation plant is designed to a capacity of ± 10% of nominal;
- Only proven, leading-edge technology for the mineral processing of iron ore is considered in the present design;

- The crushing-plant operating schedule is based on 71% utilization (6,220 hours), while the beneficiation plant operations are based on 91% utilization (7,972 hours);
- From the crushed ore stockpile to the tailings and concentrate thickener, the plant is conceived as a single production line;
- Fresh water usage has been optimized, as the water system includes several sources to maximize water recovery and recirculation;
- Supplemental factors have been incorporated into the nominal plant design to provide the equipment availability and to achieve the plant design capacity of 30.7 Mtpa iron ore. These factors include allowances for wear, surges, etc.

17.1.1 Process Design Criteria

Table 17.1 summarizes the general parameters upon which the beneficiation plant design has been based for the Shymanivske Iron Ore Project. Sizing of the selected equipment is based on these parameters and values.

Table 17.1: Process Design Criteria – Shymanivske Iron Ore Project

Description	Units	Nominal	Design
General Processing			
- Process facility service life	y	16+	
- Operating Schedule	d/y	365	365
	h/d	24	24
	shifts/d	2	2
	h/shift	12	12
ROM Ore Composition			
- Major Iron Oxide	-	Magnetite	
- Magnetite in Ore	%wt	26.8	
- Total Iron (Fe_{Tot})	%wt	31.3	
- Mag Iron (Fe_{Mag})	%wt	19.4	
- Ore Moisture	%wt	2	
- ROM Dry Density	t/m^3	3.43	
- Particle Size: Top size P80 (Cumulative Passing Size)	 mm mm	 1200 632	
Dry Processing Area			
- Utilization	%	71	
- Operating Time	h/y	6220	
- Throughput (dry)	Mtpa	27.9	30.7
- Target Size (P80, cum.	mm	3.3	

Description	Units	Nominal	Design
pass)			
Wet Processing Area			
- Utilization	%	91	
- Operating Time	h/y	7972	
- Feed Rate (dry)	Mtpa	25.1	27.6
- Concentrate Production	Mtpa	9.1	10.0
- Tailings	Mtpa	16.0	17.6
- Target Particle Size, P80 Primary Grinding Secondary grinding Tertiary Grinding	 µm µm µm	 500 150 32	 500 150 32
Overall Recovery			
- Mass Recovery to Concentrate	%wt	32.7	
- Total Iron Recovery	%wt	68.2	
Product Composition			
- Fe_{tot}	%wt	>68	
- Magnetite	%wt	> 84.4	
- Silica	%wt	< 4.5	
- Sulfur	%wt	<0.05	
- Alumina	%wt	<0.32	
- P2O5	%wt	<0.05	
- Moisture	%wt	<9	
- P80 (Cumulative Passing Size)	µm	32	

17.2 Process Flow Diagram and Mass and Water Balance

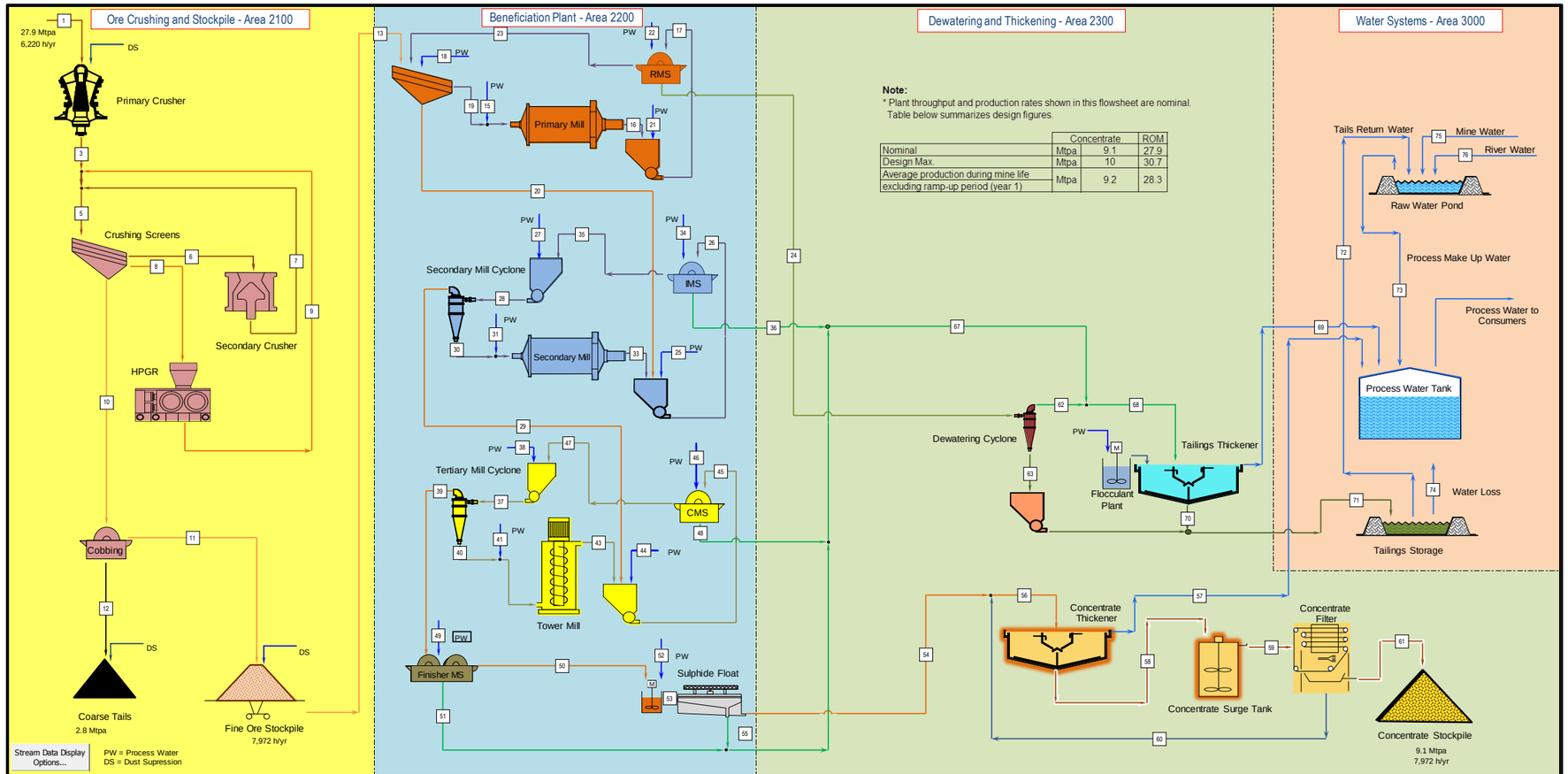
The overall PFD for the Shymanivske Iron Ore Project, including mass and water balances, are presented Figure 17.1, Table 17.2, Table 17.3 and Figure 17.2.

17.2.1 Overall PFD and Material Balance

The mass balance for the major process streams depicted in the overall PFD is based on parameters from the process design criteria. Figure 17.1 shows the overall material balance at the nominal capacity for the Project. In addition, the overall mass balance is a snapshot of the whole process at the steady-state conditions.

LIMN software has been used to model the process. Test result data have been used as the input for the model, and stream information from the model has been used in preparing the process mass balance.

Figure 17.1: Overall PFD and Material Balance



STREAM ID:	1	3	5	6	7	8	9	10	11	12	13	16	17	19	20	23	24	26	28	29	30	33	35	36	37	39	40	43	45	47	48	50	51	53	54	55	56	57	58	59	60	61	62	63	67	68	69	70	71	72
STREAM DATA																																																			
Solids t/h	4,478.6	4,478.6	16,535.2	5,217.2	5,217.2	6,839.4	6,839.4	4,478.6	4,030.7	447.9	3,144.9	3,880.4	3,880.4	3,880.4	2,496.0	3,231.5	648.9	6,277.2	5,312.9	1,531.6	3,781.3	3,781.3	5,312.9	964.3	3,296.5	1,181.3	2,115.1	2,115.1	3,646.8	3,296.5	350.3	1,163.3	18.0	1,163.3	1,141.5	21.8	1,254.4	0.0	1,254.4	1,254.4	112.9	1,141.5	112.8	536.1	1,354.5	1,467.3	0.0	1,467.3	2,003.4	0.0
Water t/h	91.4	114.8	424.0	133.8	133.8	175.4	175.4	114.8	103.4	11.5	80.6	1,435.2	7,206.5	1,293.5	4,138.3	2,154.3	5,292.1	14,646.9	4,525.8	3,254.7	1,271.1	1,398.6	3,541.9	11,364.9	2,873.2	2,298.6	574.6	774.6	11,010.0	2,147.6	9,122.4	772.7	2,305.8	2,171.5	2,130.8	40.8	2,555.5	2,017.9	537.6	537.6	424.7	112.9	5,003.5	288.7	22,833.9	27,837.4	27,047.3	790.1	1,078.7	377.6
w/w % Solids	98.0	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	97.5	73.0	35.0	75.0	37.6	60.0	10.9	30.0	54.0	32.0	74.8	73.0	60.0	7.8	53.4	33.9	78.6	73.2	24.9	60.6	3.7	60.1	0.8	34.9	34.9	34.9	32.9	0.0	70.0	70.0	21.0	91.0	2.2	65.0	5.6	5.0	0.0	65.0	65.0	0.0
P80 mm	632	146	47	139	35	33	5.1	3.3	3.3	3.3	3.3	1.1	1.1	2.8	0.5	1.1	0.9	0.4	0.4	0.1	0.5	0.4	0.4	0.4	0.09	0.032	0.12	0.06	0.09	0.09	0.08	0.015	0.032	0.03	0.03	0.03	0.03	0.032	0.032	0.032	0.032	0.032	0.024	1.023	0.299	0.283	0.3	0.3	0.5	0.0
Slurry SG t/m3												2.06	1.33	2.13	1.36	1.73	1.08	1.27	1.62	1.29	2.12	2.06	1.73	1.06	1.61	1.32	2.25	2.07	1.21	1.75	1.03	1.74	1.01	1.33	1.33	1.33	1.30	1.00	1.98	1.98	1.17	2.80	1.02	1.85	1.04	1.04	1.00	1.85	1.85	1.00
Slurry m3/h												2577	8348	2435	4872	3105	5483	16493	6088	3705	2383	2511	5105	11649	3843	2646	1197	1397	12083	3117	9225	1115	2311	2514	2467	47	2924	2018	907	907	458	449	5037	446	23232	28269	27047	1222	1668	378
STREAM NAME	ROM	Primary Crusher Product	Crusher Screen Feed	Secondary Crusher Feed	Secondary Crusher Product	HPGR Feed	HPGR Product	Crusher Screen Fines	Cobbing Magnetics	Cobbing Non-Magnetics	Stockpile Reclaim	Primary Mill Product	RMS Feed	Primary Mill Screen Oversize	Primary Mill Screen Undersize	RMS Magnetics	RMS Non-Magnetics	IMS Feed	Secondary Mill Cyclone Feed	Secondary Mill Cyclone Overflow	Secondary Mill Cyclone Underflow	Secondary Mill Product	IMS Magnetics	IMS Non-Magnetics	Tertiary Mill Cyclone Feed	Tertiary Mill Cyclone Overflow	Tertiary Mill Cyclone Underflow	Tertiary Mill Feed	CMS Feed	CMS Magnetics	CMS Non-Magnetics	FMS Magnetics	FMS Non-Magnetics	Sulphide Float Feed	Sulphide Float Product	Sulphide Float Rejects	Concentrate Thickener Feed	Concentrate Thickener Overflow	Concentrate Thickener Underflow	Concentrate Filter Feed	Concentrate Filter Filtrate	Final Concentrate	Dewatering Cyclone Overflow	Dewatering Cyclone Underflow	Dewatering Cyclone Underflow	Tailings Thickener Feed	Tailings Thickener Overflow	Tailings Thickener Underflow	Tailings Storage Feed	Tailings Return Water

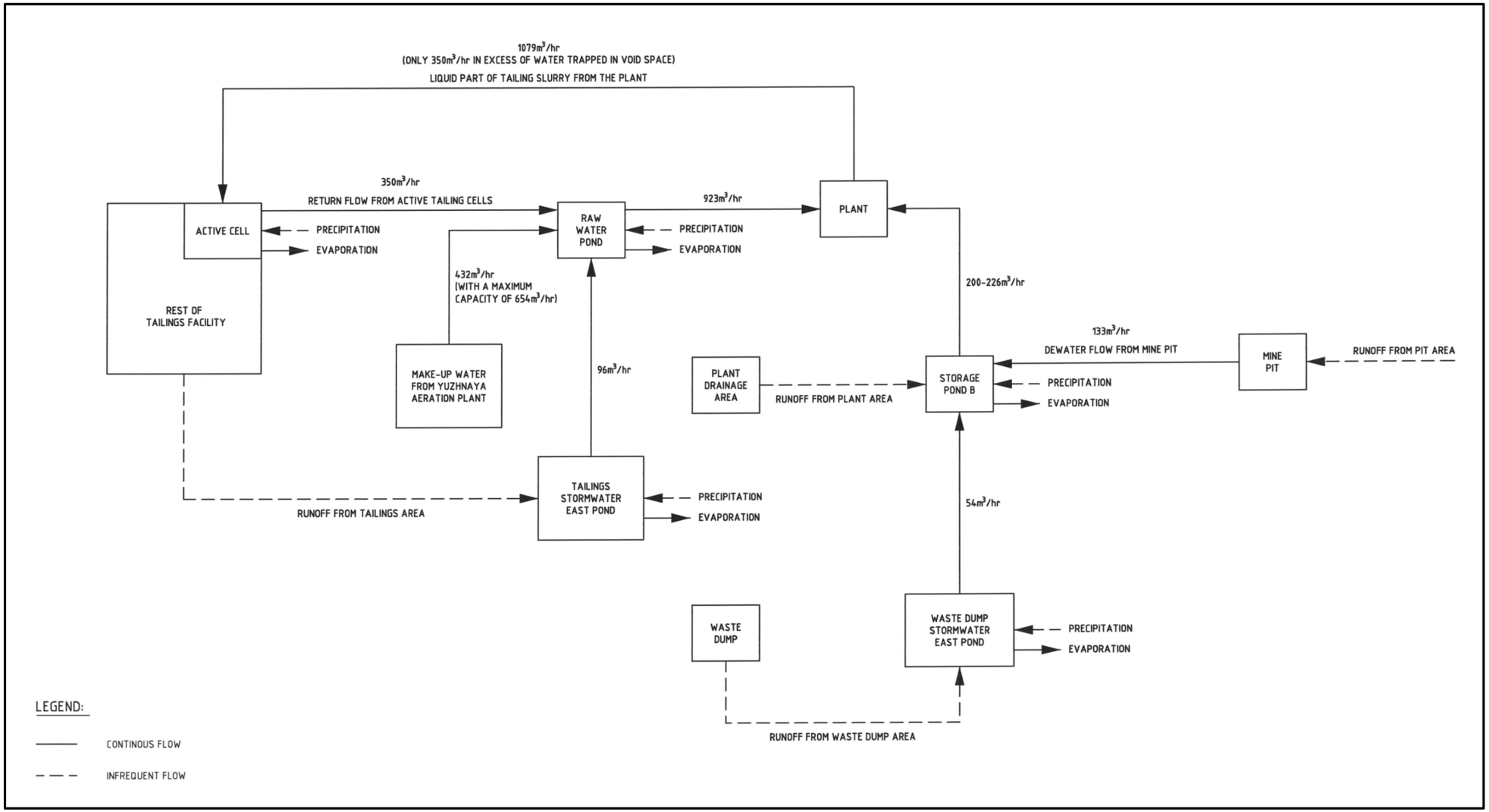
Table 17.2: Water Balance at the Beneficiation Plant

Stream No.	Stream Name	Water(t/h)
Process Water Tank		
Water Usage:		
15	Primary Mill Feed Dilution Water	142
18	Primary Mill Screen Water	3197
21	Primary Mill Discharge Pump Box Dilution Water	5771
22	RMS Spray Water	240
25	Secondary Mill Discharge Pump Box Dilution Water	9110
27	Secondary Cyclone Feed Dilution Water	984
31	Secondary Mill Feed Dilution Water	127
34	IMS Spray Water	260
38	Tertiary Mill Cyclone Feed Dilution Water	726
41	Tertiary Mill Feed Dilution	200
44	Tertiary Mill Discharge Pump Box Dilution Water	6981
46	CMS Spray Water	260
49	FMS Spray Water	780
52	Sulphide Flotation Conditioning Tank Dilution Water	1399
	Total	**30176**
Inflow Water:		
57	Concentrate Thickener Overflow	2018
69	Tailings Thickener Overflow	27047
	Process Make up Water	1111
	Total	**30176**

Table 17.3: Site Overall Water Balance

Water in:	**Flow Rate (m^3/h)**
Mine Water	133
Waste Pile Storm Water	54
Reclaimed Water from Tailing	350
Water from Aeration Plant	433
Tailings Storm Water	96
Ponds Direct Precipitation	45
Water in Ore	92
Total	**1203**
Water out:	
Water to Concentrate	113
Water to Tailings Storage	1079
Water to Cobbing Tails	11
Total	**1203**

Figure 17.2: Overall Site Water Flowsheet



17.3 Process Description

The following process description outlines the upgrading circuit on the basis of the results of the ore characterization test work, design criteria and the assumptions presented in this report.

Four main areas are identified in the beneficiation plant:

- Dry Processing (crushing, HPGR, screening, cobbing, and storage);
- Wet Processing (screening, grinding, re-grinding, magnetic separation, classification, and flotation);
- Concentrate and Tailings Thickening; and
- Concentrate dewatering, Storage and Handling.

The locations of different sections of the beneficiation plant are shown on the site plan developed in this study.

17.3.1 Area 2100 – Dry Processing

The Ore Crushing and Stockpile (Dry Processing) area is designed to receive the ore from the mine, and to prepare it through a crushing/HPGR and screening circuit for processing in the beneficiation plant. The dry processing area operates 6,220 h/y (71% utilization). This area processes Run-Of-Mine (ROM) ore at a nominal rate of 4,479 t/h. The product of the dry area is fine ore, which is passed through dry cobbing magnetic separation at P80 ~ 3.3 mm, and sent to the fine ore stockpile at a nominal rate of 4,031 t/h.

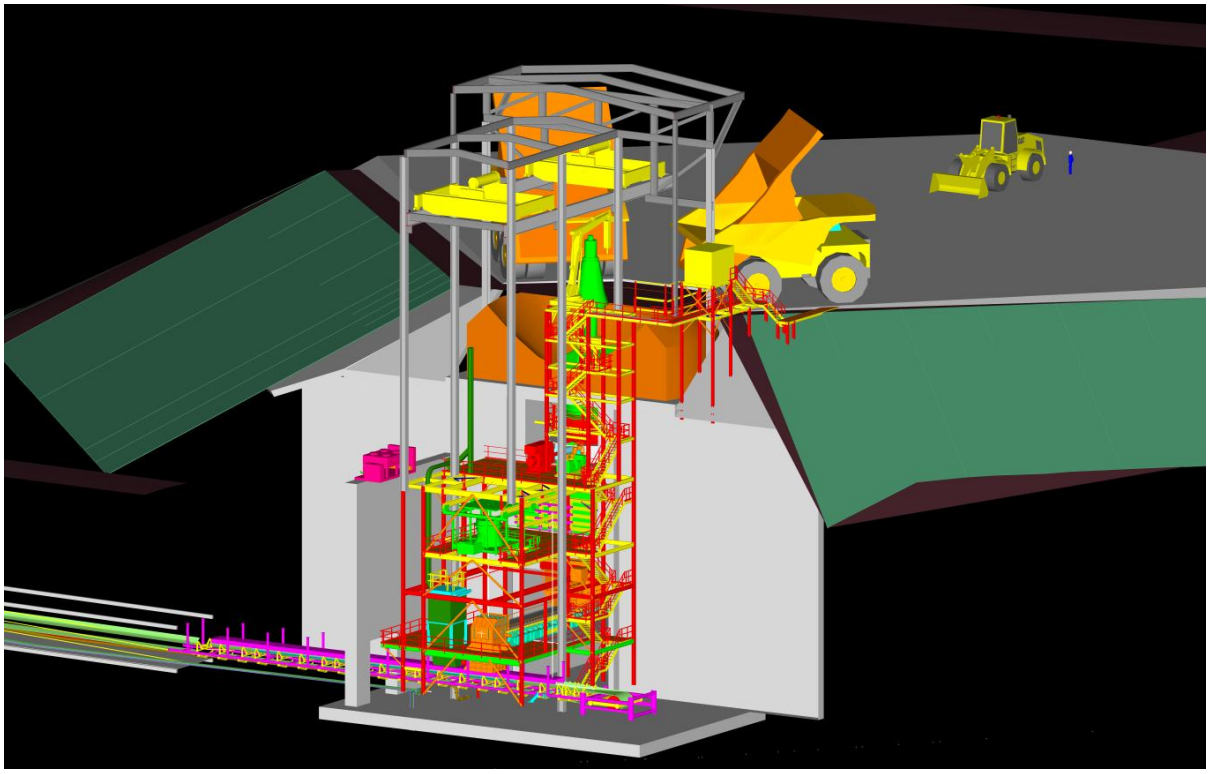
The Dry Processing Area consists of:

- A primary gyratory crusher;
- 10 double-deck screens;
- 30 coarse LIMS single drum-cobbing magnetic separators;
- 2 secondary cone crushers;
- 3 high-pressure grinding rolls modules (HPGRs);
- Transfer conveyors; and
- Fine ore stockpile.

ROM ore is transported to the primary crusher area by 226-tonne haul trucks at a P80 size of 632mm. The Primary Crusher dump pocket is able to receive ore from two haul trucks delivering ore at the rate of 16 trucks per hour, dumping simultaneously from both sides of the dump pocket. A hydraulic rock breaker is provided close to the dump pocket to break oversized or inadequately positioned rocks that could cause blocking at the dump pocket discharge. In addition, an overhead crane is located in the crusher area to service this equipment.

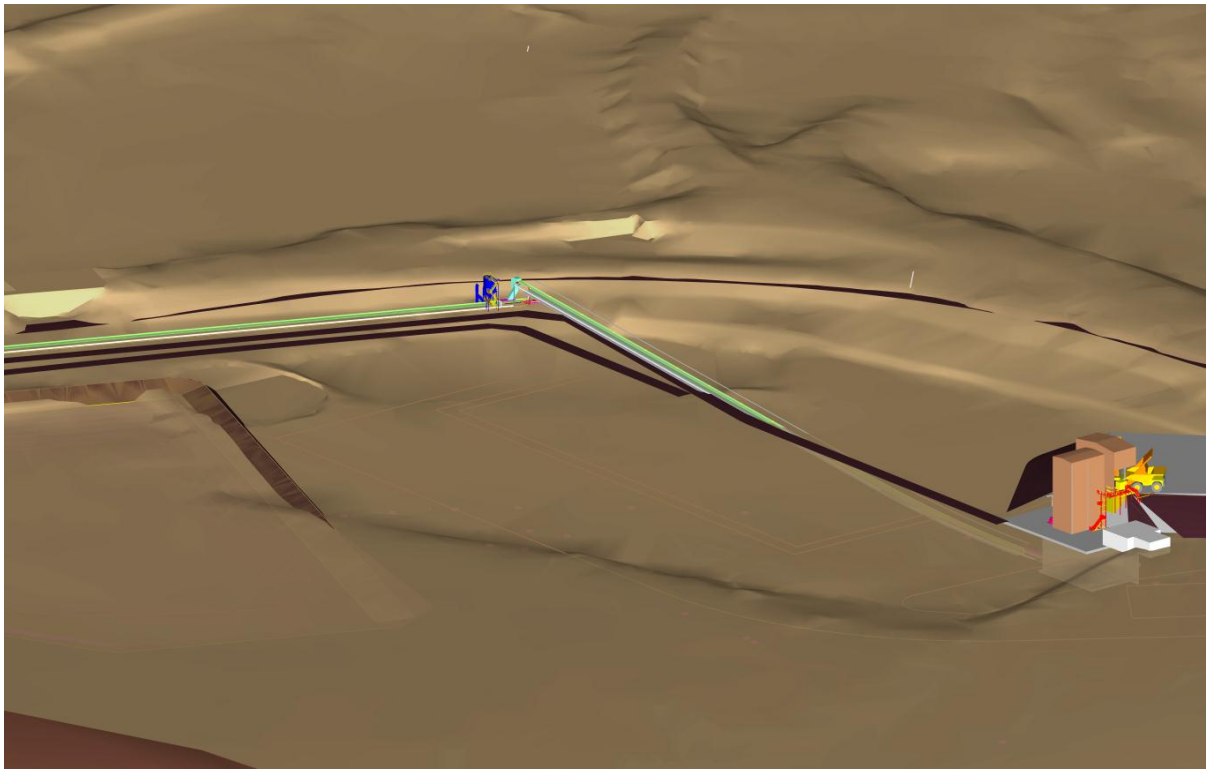
A single gyratory crusher (1,200 kW) reduces the ore to P80 ~ 146mm in size. This gyratory crusher has been selected on the basis of delivering a nominal rate of 4,479t/h crushed ore to the secondary crushing circuit. The primary crusher has a maximum capacity ranging from 4,500 to 5,017 t/h.

Figure 17.3: Primary Crusher



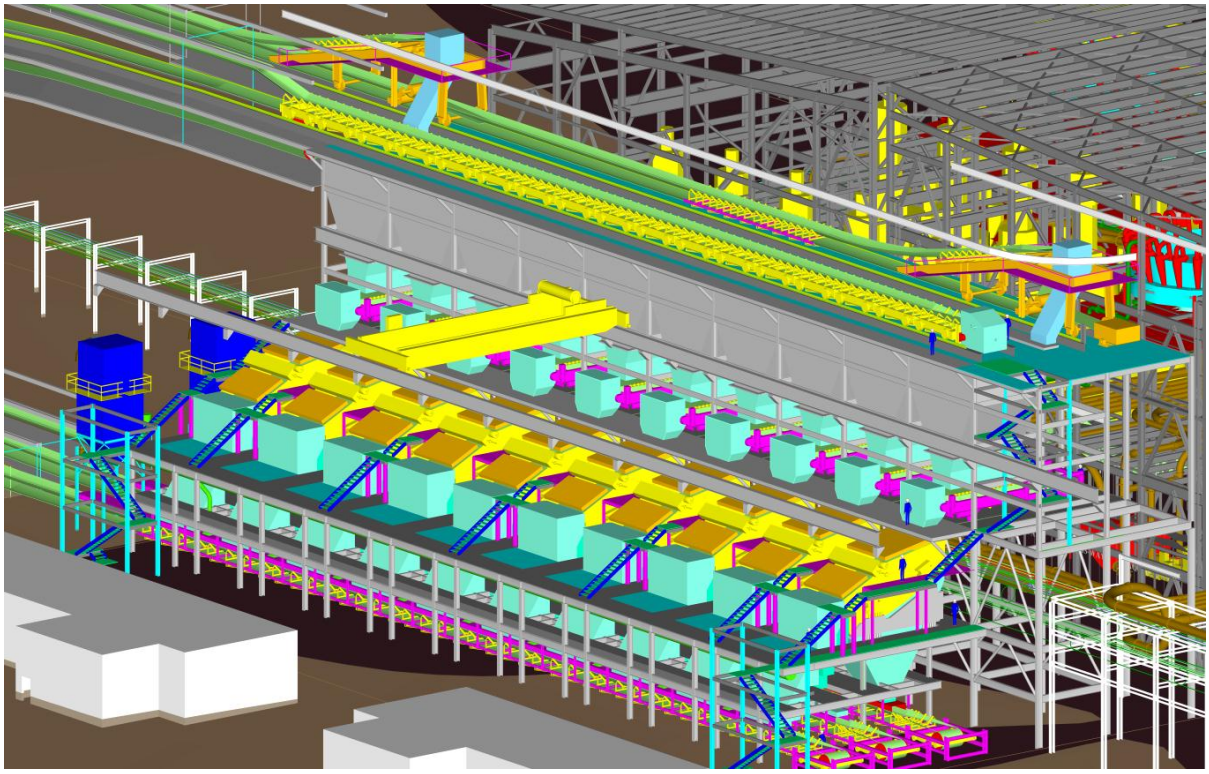
The discharge of the primary crusher is collected in a discharge pocket below the crusher. From the discharge pocket, the crushed ore is fed by an apron feeder onto two sequential belt conveyors. The second conveyor transfers the ore to a shuttle conveyor that feeds 10 surge bins at the screening building located almost 2km away, close to the beneficiation plant building.

Figure 17.4: Transfer Conveyors



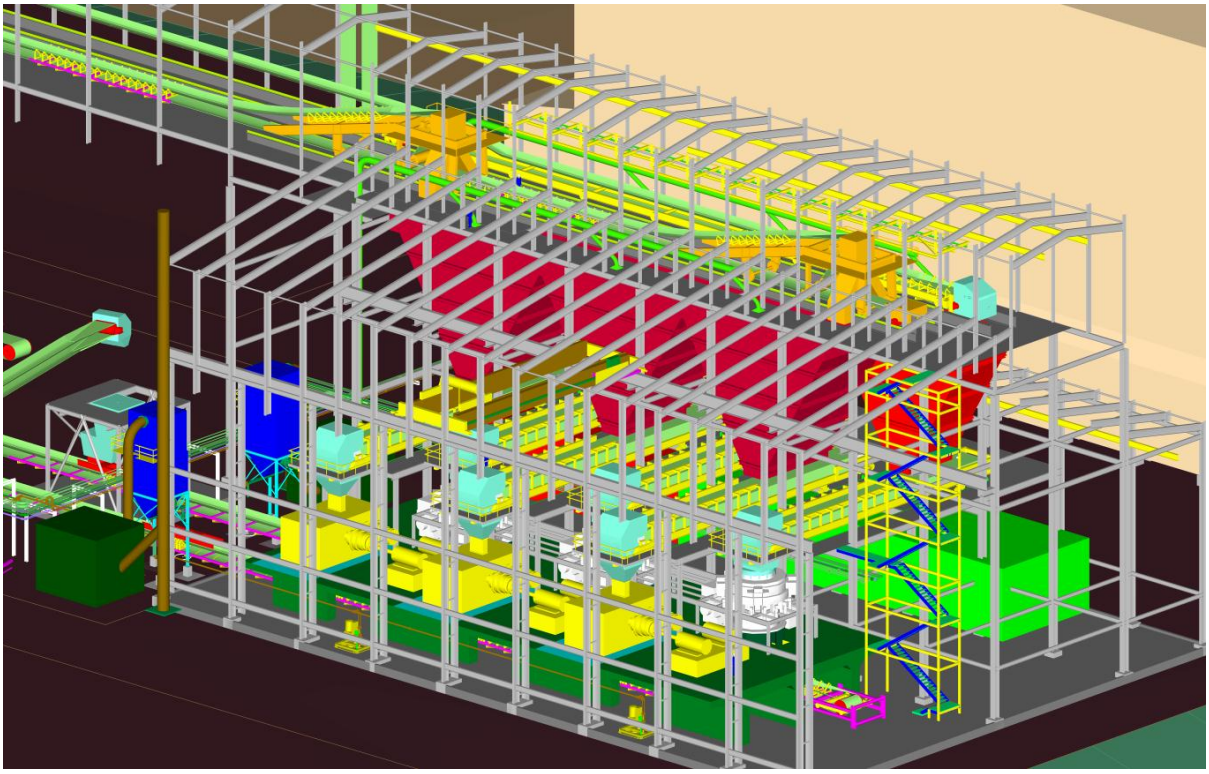
Each surge bin feeds an individual double-deck screen, with holding capacity of 20 minutes. Crushed ore is screened into oversized, mid-sized and fines, which are conveyed to secondary cone crushers, HPGRs, and dry cobbing magnetic separators, respectively.

Figure 17.5 Dry Screening



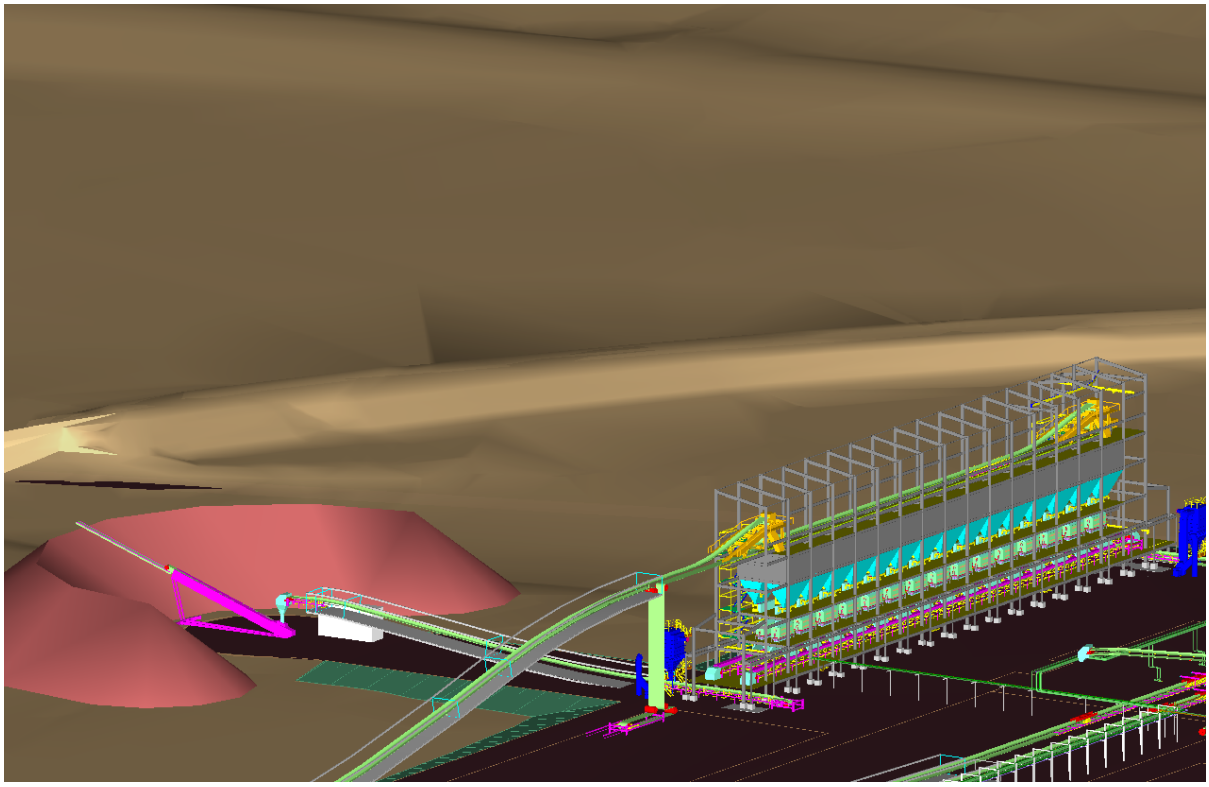
The oversize fraction feeds two 2,000 HP secondary cone crushers and the crushed ore from the cone crushers is recycled back to the double-deck screens. The mid-size fraction is conveyed via a tripper conveyor to three 3,700 kW HPGR units. Crushed ore from HPGR's discharges onto a "take-away" conveyor with a tripper head, and is recycled back to the screen feed bin. Metal detectors and removal devices are located ahead of the HPGRs and secondary crushers. These systems sense and separate metallic objects contaminating the ore and decrease the risk of substantial damage. Dust will be controlled along the dry circuit by dust collectors, exhaust fans and water sprays.

Figure 17.6: Secondary Crushers and HPGRs



Undersize fines from screens are fed to a battery of 15 bins. Each bin feeds two single-drum dry cobbing magnetic separators (1.22m dia x 3.05 m width). The magnetic product from dry cobbing is stocked in the fine ore stockpile. The non-magnetic material is stockpiled in the kidney shaped coarse tails stockpile via a radial stacker. The coarse tails are loaded onto trucks by front-end loader for use as a filtration layer in the tailings dyke construction.

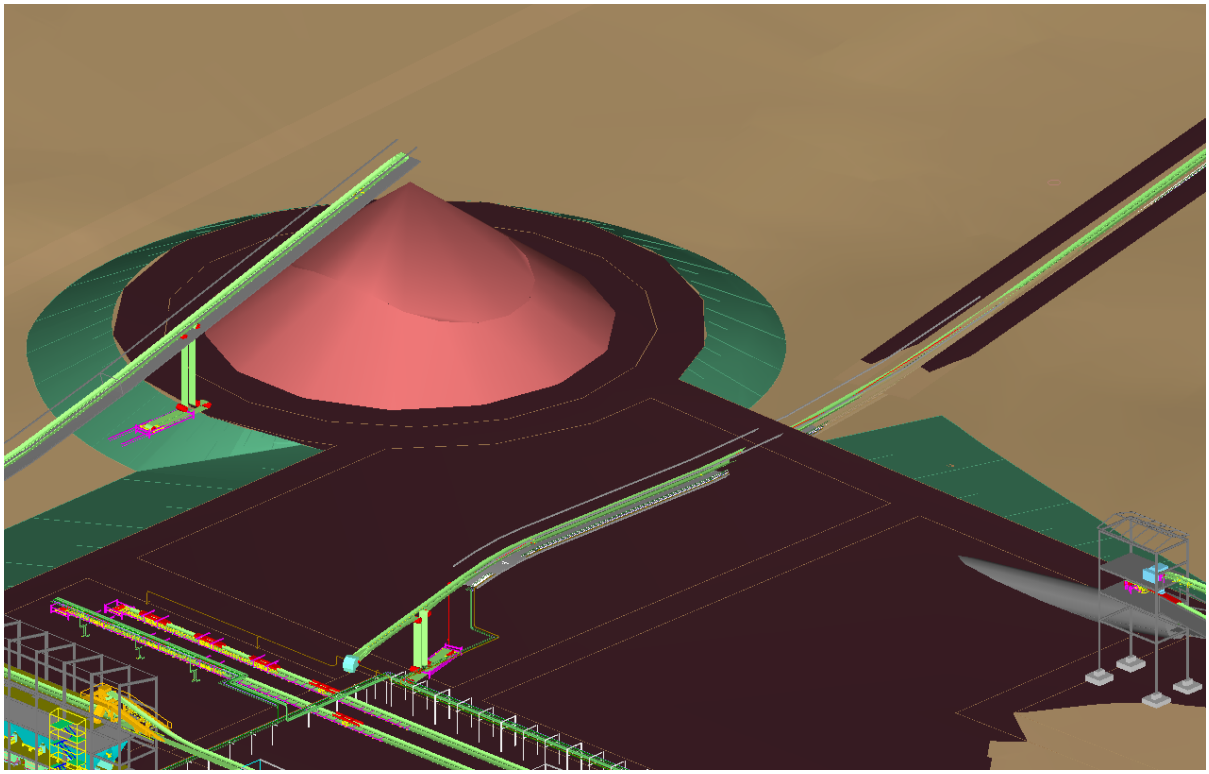
Figure 17.7: Cobbing and Coarse Tail Stockpile



The fine ore stockpile is a buffer zone with a 75,500 tonne live capacity, capable of sustaining one day of operation of the beneficiation plant. The fine ore stock pile is covered under a dome structure to protect the pile from the elements and for dust control. The fine ore stockpile is used to decouple the operation of the dry area from the wet area.

Fine ore from the stockpile is reclaimed through a tunnel equipped with four vibrating discharge hoppers and vibrating feeders. The vibrating feeders discharge the ore onto a conveyor. The conveyor feeds the fine crushed ore into the first stage of the wet processing area.

Figure 17.8: Fine Ore Stockpile



17.3.2 Area 2200 – Concentrator (Wet Processing area)

The wet area consists of five sections:

- Primary grinding;
- Secondary grinding;
- Tertiary grinding;
- Finisher magnetic separation and flotation; and
- Tailings and concentrate thickening and concentrate filtration.

This area is designed to process the ore from fine ore stockpile, at a nominal rate of 3,145 t/h. Based on the design operating hours of 7,972 per annum, the nominal concentrate production rate is 9.1Mtpa.

17.3.2.1 PRIMARY GRINDING STAGE

Primary grinding stage comprises:

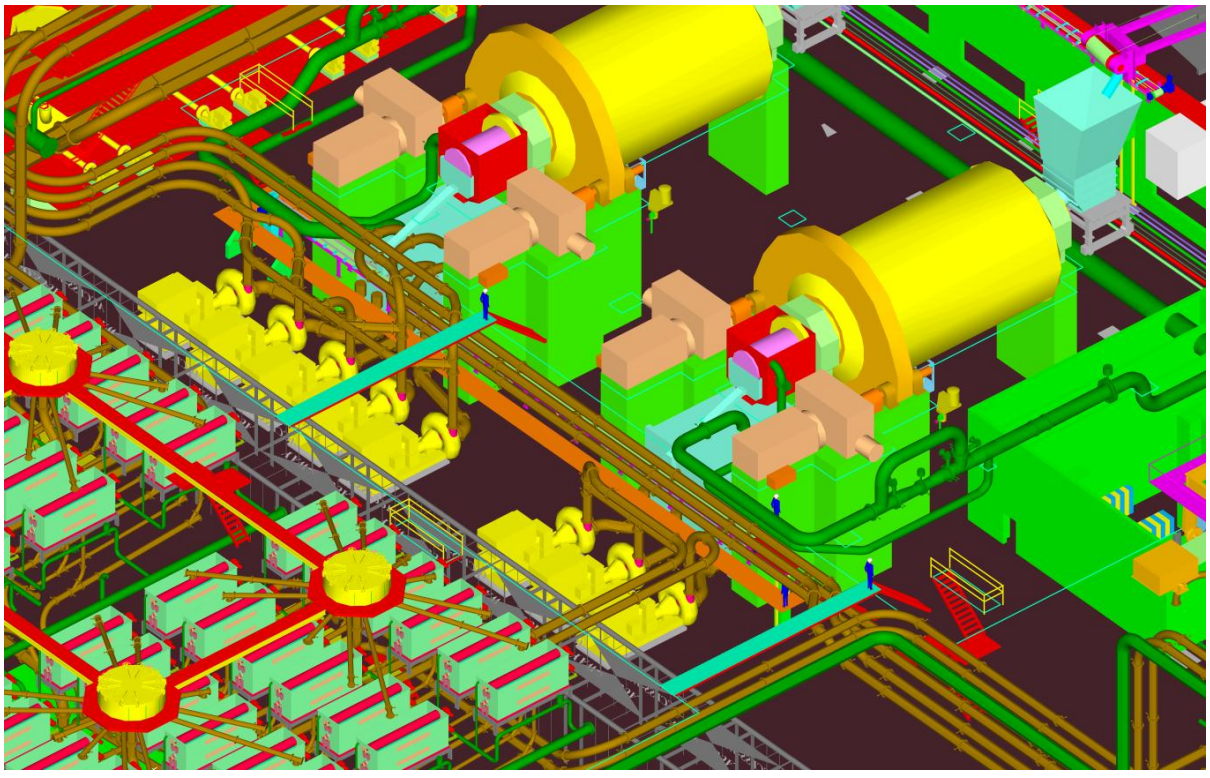
- 8 single-deck and multi-sloped (banana type) screens;
- One 7.9 m diameter by 13.6 m long ball mill; and

- A battery of 24 single-drum rougher magnetic separators (RMS).

Fine crushed ore conveyed from the stockpile is distributed among eight primary grinding screen feed bins. Screening the material prior to primary grinding reduces the quantity of fines feeding the primary ball mill, and increases grinding efficiency and reduces energy consumption.

The oversize from the primary grinding screens is fed to the primary grinding ball mill, via two sequential belt conveyors. The primary grinding ball mill is in a reverse closed circuit with the screens and RMS to minimize the recirculating load. The primary grinding mill product is discharged into a dedicated pump box equipped with three single-stage centrifugal pumps (two operating and one standby). Each operating pump feeds a 12-way gravity discharge distributor that evenly supplies the RMS with slurry at the targeted solids density. Tailings from the RMS are collected and pumped to a dewatering cyclone. In turn, the concentrate is collected and pumped back to the primary grinding screens for further classification. The concentrate slurry from RMS mixes with dry feed from bins in the pulping box prior to screening.

Figure 17.9 Primary and Secondary Ball Mills and RMS



Undersize of the primary grinding screens (P80 of 0.5mm) are collected in four pump boxes under the screens. Each pump box collects material from two screens, and is served by two single-stage centrifugal pumps (one operating and one standby). From each pump box, the material is pumped to the secondary grinding circuit at a feed rate of 2,496 t/h solids.

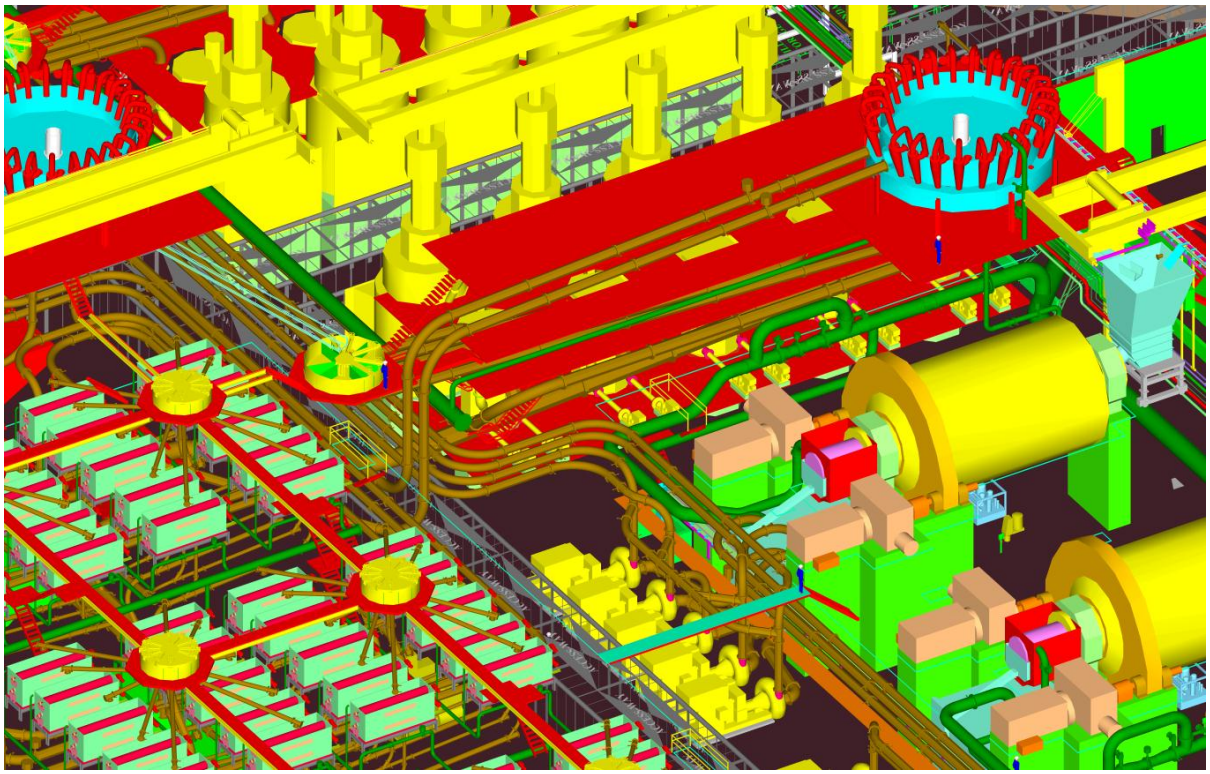
17.3.2.2 SECONDARY GRINDING STAGE

Secondary grinding stage consists of:

- One 7.9 m diameter by 13.6 m long ball mill (17,000 kW);
- Battery of 48 single-drum intermediate magnetic separators (IMS); and
- A classification hydrocyclone cluster (secondary grinding mill cyclone cluster).

The primary mill screen undersize is discharged into the secondary grinding mill pump box. This pump box is equipped with five single-stage centrifugal pumps (four operating and one standby). Each operating pump delivers slurry, at the targeted solids density, to four 12-way gravity discharge distributors, which in turn evenly feed the IMSs. The IMSs are in closed circuit with the secondary mill hydrocyclone cluster and the secondary ball mill. The IMS tailing is pumped to the tailings thickening area, while the concentrate is fed to the hydrocyclone cluster. The cyclone underflow gravitates back to the secondary ball mill via a box and feed chute. The discharge of the secondary grinding mill is pumped to the IMS for further separation. The cyclone overflow is carried to the tertiary grinding stage for further grinding. The product of the secondary grinding stage is at a rate of 1,532 t/h solids, with an average P80 of 0.150 mm.

Figure 17.10: Secondary Grinding Stage



17.3.2.3 TERTIARY GRINDING STAGE

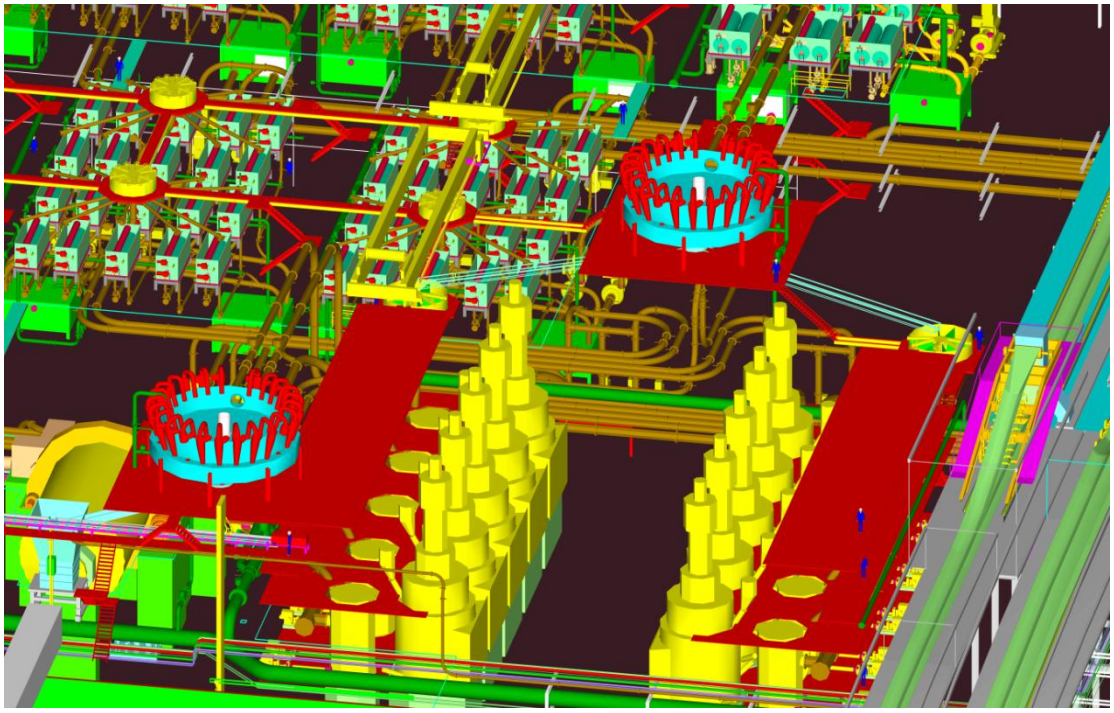
Testwork determined that a final grind size P80 of 32 µm is required to achieve target concentrate grades. If the ball mill option had been considered for this application at the third stage of grinding, two mills would have been required. This would have resulted in high energy consumption. For this Feasibility Study the use of vertical mills has been considered as an energy-efficient alternative for the fine grinding stage. Vertical mills typically result in a 30% energy reduction compared to ball milling. They are reliable and involve a more compact design. Ten vertical mills (2,200 kW) were selected as tertiary grinders for improved grinding efficiency at this stage.

In addition to the vertical mills, the tertiary grinding circuit comprises:

- Forty single-drum cleaner magnetic separators (CMS); and
- A classification hydrocyclone cluster.

The secondary grinding hydrocyclone cluster overflow is divided into two pump boxes. Each pump box is served by three single-stage centrifugal pumps (two operating and one standby). The slurry is then pumped to four 10-way gravity discharge distributors, which in turn evenly feed the cleaner magnetic separators. The CMS are in closed circuit with the tertiary mill hydrocyclone cluster and the vertical mills. The CMS tailings is pumped to the tailing thickening area, while the concentrate is pumped to the hydrocyclone cluster for classification. The cyclone underflow gravitates to the 10 vertical mills via a box and two 5-way gravity discharge distributors. The tertiary grinding vertical mills discharge is pumped to the CMS for further separation. The cyclone overflow is carried down to the next stage of finisher magnetic separators (FMS) and flotation. The product rate of the tertiary grinding circuit is 1,181 t/h solids with a P80 of 32 µm

Figure 17.11: Tertiary Grinding Mills



17.3.2.4 FINISHER MAGNETIC SEPARATION AND FLOTATION STAGE

The finisher magnetic separation and flotation stages consist of:

- Twelve double-drum finisher magnetic separators(FMS); and
- A bank of six flotation cells.

The Finisher magnetic separators (1.22m dia by 3.81m w) are fed from the overflow of the tertiary grinding hydrocyclone cluster through two 6-way gravity discharge distributors. Each distributor evenly feeds six FMS, where the concentrate is separated and pumped to the flotation cells via a pump box. The tailings are pumped to the tailings thickener.

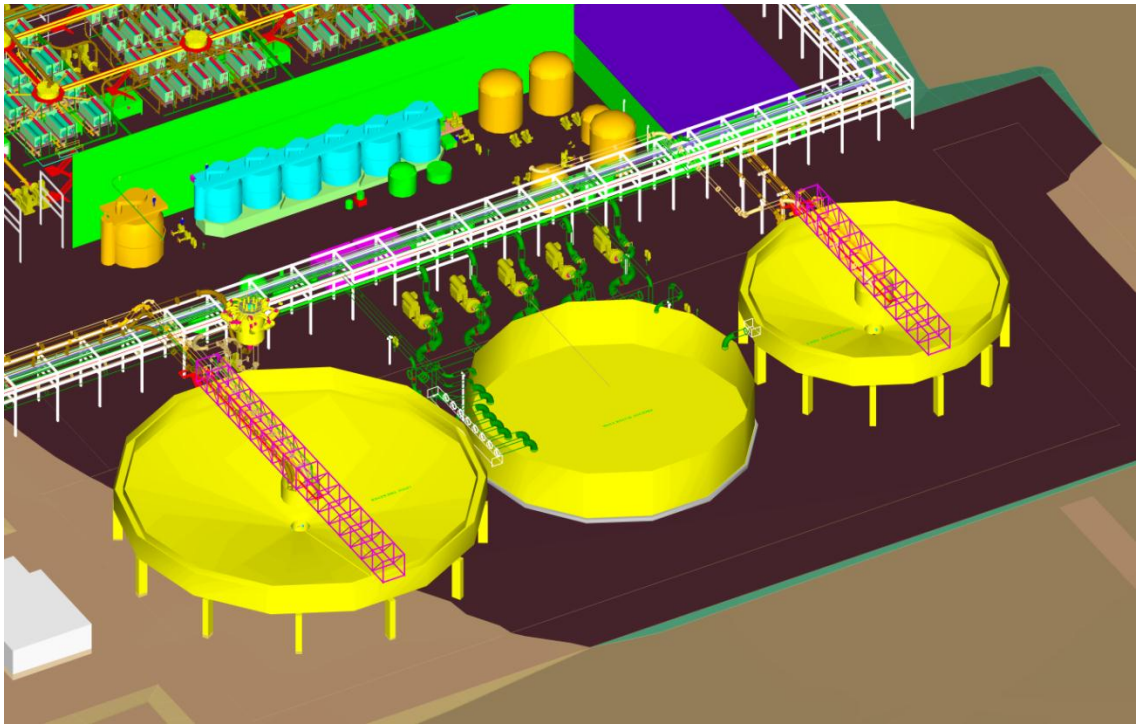
The metallurgical testwork determined that, after the magnetic separation stages, the sulphur content in the Shymanivske magnetite ore exceeded the target of 0.05%. Mineralogical analysis suggested that sulphur in the ore is primarily in the form of iron sulphides, pyrite and pyrrhotite. Pyrrhotite in the ore is ferromagnetic and will report to the concentrate during magnetic separation. It was decided to remove the sulphides by froth flotation, and reduce the sulphur content in the final concentrate to the target value of 0.05%.

The reverse sulphide flotation process comprises one row of six high-shear agitated cells (250m^3 each). This arrangement ensures enough residence time (about 40 min) to achieve the design sulphur content in the final concentrate.

The concentrate slurry generated at the FMS stage is pumped to the sulphur flotation conditioning tank (200m^3). The conditioning process in the tank involves the addition of an activator and a pH modifier. The high-shear agitation is provided to this conditioning tank in order to maximize the reagent adsorption by particles. The conditioned slurry is pumped to the flotation cells, where reagents, such as the activator, pH modifier, collector, and frother are added at various points within the flotation circuit. The air supply to the flotation cells is provided by dedicated blowers (one operating and one standby). The flotation process is able to nominally process 1,163 t/h solids.

After separation, the concentrate slurry (sinks) and rejected sulphides (float) are collected in the respective pump boxes and pumped to the thickeners area.

Figure 17.12: Flotation and Reagent Area



17.3.3 Area 2300 –Dewatering and Thickening

This area has two separate circuits:

- Concentrate thickening and filtration; and
- Tailings thickening.

The concentrate slurry from the sulphide flotation stage is de-watered in a process comprising:

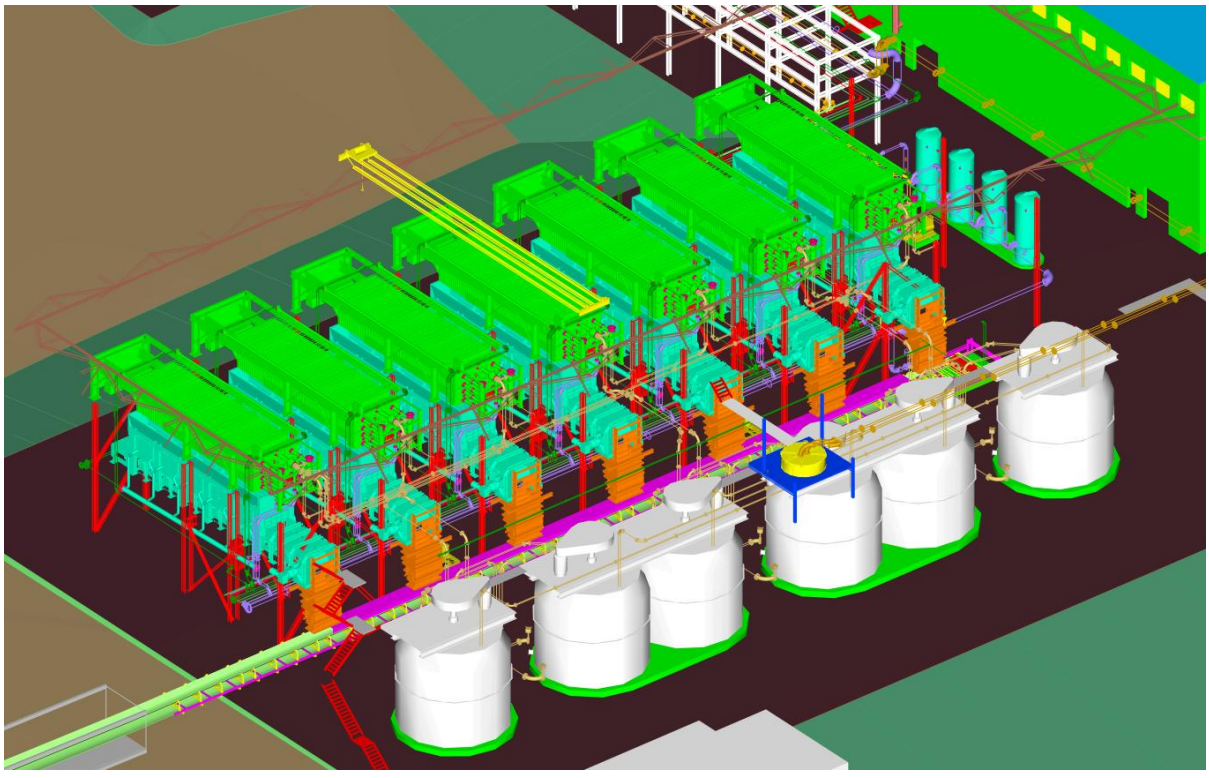
- Thickening in a single high-rate thickener (42 m dia and 7m h); and
- Filtration in plate and frame filter presses.

The sulphide flotation concentrate is pumped to the concentrate thickener launder, where it combines with the recycled filtrate of the filter presses. The design feed to the thickener has a solids content of 32.9% solid at a rate of 1,255 t/h solids.

The thickener overflow gravitates to the process water storage tank, while the underflow (70% solids) is pumped to six agitated concentrate storage tanks by a 6-way gravity distributor. The concentrate tanks serve as a collection point for the thickened concentrate slurry, and provide a 3hour surge capacity at design throughput. From these concentrate storage tanks, slurry is pumped to the dewatering filters

The concentrate filtration consists of seven plate and frame filter presses working in parallel (six operational and one standby). Each filter will process 300 t/h of concentrate slurry at 70% solid, with a P80 of 32 µm, at a target moisture content of 9% in the discharge product (filter cake). The operation of every filter press is a batch process and involves feeding, pressing, washing, air drying and cake discharge.

Figure 17.13: Filtration Building



The clear filtrate from each filter is collected in pump boxes, from where it is pumped back to the concentrate thickener launder. Filter cake is discharged from each filter by gravity and transported via two sequential conveyors to the concentrate stockpile for storage, at a nominal rate of 1,142t/h of solids.

The tailings from the beneficiation plant consist of RMS, IMS, CMS, and FMS tailings, as well as sulphide flotation circuit floats. The treatment of these tailings entails two main processes:

- Dewatering of coarse tailings (RMS stage tailings) through a cyclone cluster; and
- Thickening, using flocculant in a single high-rate thickener.

The RMS tailings are pumped to a coarse tailings dewatering cyclone. The overflow from the cyclone gravitates to the tailings thickener launder and underflow gravitates to a single tailings pump box collector.

The tailings from the IMS, CMS, FMS and sulphide flotation circuits are separately pumped from their respective pump boxes and discharged at the tailings thickener well via the thickener launder. Flocculant is added into the thickener to promote the settling of solids and to preserve overflow clarity. The thickener underflow is discharged into the tailings pump box collector, while the overflow (clarified water) is recycled by gravity to the process water storage tank.

At the tailings pump box collector, the dewatering cyclone underflow combines with the tailings thickener underflow. The combined slurry is the final beneficiation plant tailings, and it is pumped for storage to the Tailing Storage Facility (TSF). The tailings transportation is done by a single-stage pump system (two pumps, one operating and one standby) running through a single pipeline. The tailings are delivered to the TSF at a rate of 2,003 t/h of solids at 65% solids (1,079 t/h of water).

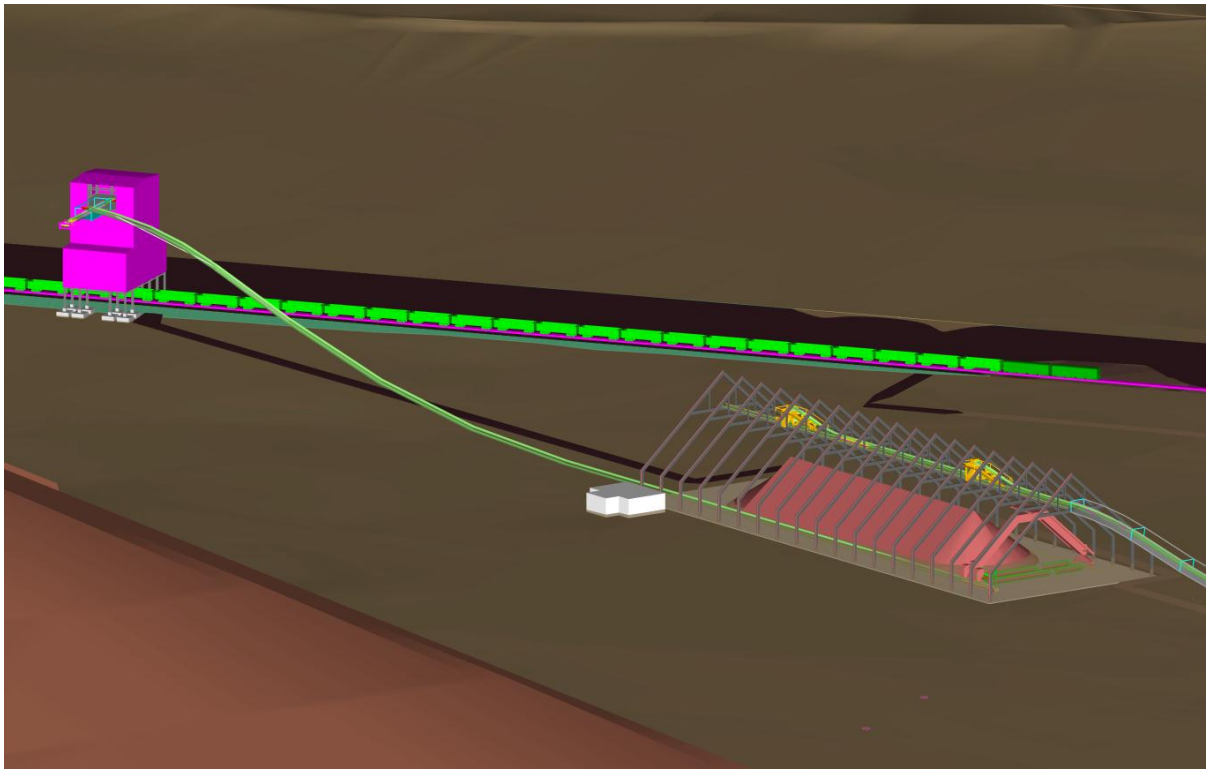
17.3.4 Area 2400 – Product Delivery

This area consists of:

- Product storage; and
- Rail load-out system.

The concentrate filter cake from filter presses is conveyed for stockpiling. The product is stored in a rectangular storage pile by a tripper conveyor. The storage pile has a 82,200t capacity (dry basis) equivalent to approximately three days of production. The concentrate is then reclaimed by a dual-boom portal scraper to the rail load-out station, via transfer conveyors. The reclaimed material is fed into the rail load-out bin. This bin is intended to be a surge bin only and has a holding capacity of only 420 t (six railcars). The rail load-out operation is a continuous process with volumetric measurement. Speed control for railcars, when combined with the rail scale on the tracks, ensures the proper loading of the railcars.

Figure 17.14: Product Storage and Rail Loadout



17.4 General Plant Utilities and Services

The plant utilities and services have been specifically quantified, based on:

- Developed mass and water balances; and
- Quotations from equipment vendors.

The capital costs have been estimated accordingly. The general utilities and services for the beneficiation plant are described below.

17.4.1 Reagents Storage and Handling

The reagents storage and mixing facilities are located in the south western sector of the beneficiation plant, between the sulphide flotation cells and the tailings and concentrate thickeners. This part of the plant is conceived as a low-traffic area, with appropriate access for the delivery of reagents by truck. The beneficiation plant uses the following reagents:

- Collector;
- Frother;

- Activator;
- pH Modifier; and
- Flocculant.

The reagents storage and handling area is equipped with dedicated sump pumps which deliver the product to collection locations in the event of spillage. Moreover, a separator wall exists to isolate this area from the main mill building, to protect personnel from hazards. In addition, the facility has all the necessary safety equipment, including fire-detection system, ventilation system, safety showers and eye-wash stations.

17.4.1.1 COLLECTOR

The collector used in the Shymanivske sulphide flotation process is expected to be delivered in liquid form to the site, in 200L drums. The collector system comprises two collector storage tanks, each holding 70m³ as effective capacity, one unloading pump serving the two tanks, and two progressive cavity type dosing pumps (one operating, one standby). The contents of the drums are unloaded into the storage tanks, and the collector distribution to the relevant points is controlled by the variable speed dosing pumps.

17.4.1.2 FROTHER

Another reagent used in the sulphide flotation process is frother. It is expected that it will be delivered in bulk containers of $1m^3$ capacity to the site, and stored separately. The frother system comprises one $2.0m^3$ storage and distribution tank, plus two progressive cavity type dosing pumps (one operating, one standby). Each frother container is placed by a forklift on a stand located above the storage tank, which is drained by gravity into the storage tank. The frother distribution to the sulphide flotation cells is controlled by the variable speed dosing pumps.

The frother storage and handling area has one sump and, in the event of spillage, it is equipped with a portable sump pump and a collection container.

17.4.1.3 ACTIVATOR

It is expected that the activator will be delivered in liquid form (aqueous solution), in bulk containers of $1m^3$ capacity, and stored separately. The activator system comprises one $45m^3$ storage and distribution tank, one transfer pump, and two progressive cavity type dosing pumps (one operating, one standby). The activator distribution to the sulphide flotation cells is controlled by the variable speed dosing pumps.

The activator storage and handling area has one sump pump, which delivers the product to a collection location in the event of spillage.

17.4.1.4 PH MODIFIER

Acidity conditioning in the sulphide flotation cells demands the use of a pH modifier. The storage and handling system of pH modifier consists of holding and mixing tanks, and transfer and dosing pumps.

The reagent storage and handling area has one sump pump which delivers the product to a collection location in the event of spillage. In addition, safety provisions in the area include safety showers and eye wash stations.

17.4.1.5 FLOCCULANT

Flocculant is used to aid the settling of material in the tailing thickener. It is expected that it will be delivered to the site in bulk bags. The flocculant is diluted with process water before being added to the thickener. The flocculant dilution and storage system consists of a fully enclosed bag splitter, a powder storage hopper, one discharge screw feeder, a blower and venturi eductor set, a rapid-wetting mixer, an agitated mixing tank, a diluted flocculant tank, and two dosing pumps. The content of the bags is pneumatically transferred to a mechanically agitated mixing tank. Primary (rapid) and secondary water dilutions are conducted to produce a solution with the required flocculant density. The mixed solution is automatically transferred to a storage tank and the flocculant solution is pumped to the tailing thickener by a progressive cavity pump. The dose is regulated by adjusting the pump speed.

The flocculant storage and handling area has a dedicated sump pump which delivers the product to a collection location in the event of spillage.

17.4.2 Water Management System

The water management system at site covers the following four areas:

- Mine pit;
- Beneficiation plant area;
- Tailing Storage Facility (TSF); and
- Waste rock pile.

The water systems at the plant are designed so that there is no liquid effluent stream flowing outside the mine site perimeter and no process water infiltrating the ground.

The water used in the beneficiation plant at the wet processing area is recycled in the process. The storm water, drainage run-off and mine dewatering are collected and used in the process. The additional water requirement for the process is drawn from the nearby Yuzhnaya aeration plant. This water needs to be treated for biological hazards prior to being used. The only water losses from the site are due to water evaporation, water trapped in the tailings, and moisture in the concentrate product shipped from the facility.

17.4.2.1 WATER SYSTEM AT THE BENEFICIATION PROCESS PLANT

The water used at the plant comes from two main ponds:

- Raw water pond: this pond is located west of the plant and east of the TSF. It has a storage volume of 131,068m^3; and

- Runoff water pond B: this pond is located east of the beneficiation plant, next to the primary crusher building. It has a storage volume of 731,020m^3.

Pond A collects water from:

- Return flow from the TSF;
- Tailings storage area stormwater run-off; and
- Make-up water from Yuzhnaya aeration plant.
- Collection Pond B gathers water from:
- Beneficiation plant area storm water run-off;
- Mine pit storm water run-off and dewatering; and
- Waste rock pile dump storm water run-off.
- The beneficiation plant's water needs are supplied by four main tanks:
- The process water storage tank;
- The potable water tank; and
- The gland and cooling water tank.

17.4.2.2 PROCESS WATER

The process water at the plant consists of a mixture of recycled and make-up water from several sources. The clarified water from the tailings and concentrate thickeners is recycled to the process water storage tank and constitutes the main component in the water balance. The total volume of recycled, clarified water from both thickeners is 29,065m^3/h before an additional 1,111 m^3/h of water is added to the process water storage tank. This water is sourced from the TSF, the collection of the run-off and precipitation, and the Yuzhnaya Aeration Plant. As stated before, the water from the Yuzhnaya Aeration Plant is biologically treated prior to its use as make-up water. The maximum allotted withdrawal from the aeration plant is 15,700m^3/d. An alternative source of make-up water to the mine site is the Karachunivske Reservoir, located 7km north of the mine site.

The process water is stored in a 11,320 m^3 tank (49m dia by 6m h). Dedicated centrifugal pumps send the process water to the different areas for ore slurrying and density adjustment. The water usage breakdown per area in the beneficiation plant is:

- Primary grinding area: 9,350 m^3/h;
- Secondary grinding area: 10,480 m^3/h;
- Tertiary grinding area: 8,167 m^3/h; and
- Finisher magnetic separation and flotation area: 2,179 m^3/h.

The total process water requirement at the plant is 30,176 m^3/h.

17.4.2.3 POTABLE WATER

Potable water is used for human consumption, eye wash and safety shower stations at the plant. The source of potable water is the Karachunivske Reservoir. A 7-km potable water pipeline is used to transport this water to the plant. A 279 m^3 tank serves as a potable water reservoir in the plant. It is estimated that the average potable water consumption at the plant will be 20 m^3/h.

17.4.2.4 GLAND AND COOLING WATER

Part of the raw water is filtered to meet the requirements for chemical additives, dilution, cooling water, gland water, and dust suppression.

Gland water serves as coolant and lubricant of the pumps shaft packing. Part of the treated (filtered) water from the treated water storage tank is pumped to the gland water tank. This is a 67 m^3 tank from which gland water is distributed to users by two single-stage centrifugal pumps (one operating and one standby). An average gland water consumption of 98 m^3/h is assumed. Cooling water is used in the chillers serving the high-pressure grinding rolls modules (HPGR's), secondary crushers, and primary, secondary and tertiary grinding mills. The cooling water system is conceived as a closed cycle, and cooling water is returned for tempering at the cooling unit. Treated water from the treated water tank is used as make-up water of the cooling system. An average cooling water consumption of 92 m^3/h among the different users is assumed.

17.4.2.5 WATER RECYCLING STRATEGY

As mentioned above, clarified water from the concentrate and tailing thickeners is recycled and overflows into the process water storage tank. Additional water is pumped into the process water storage tank from Pond A and Pond B to maintain the level in the tank.

Tailings slurry is produced at a rate of 3,082 t/h. The water fraction in the slurry is 1,079 m^3/h. It is estimated that 350 m^3/h will be recovered from the TSF. This recovered water is sent to Pond A.

17.4.3 Compressed Air

Dry compressed air is required for the following purposes:

- Plant air, for general use throughout the overall plant; and
- Concentrate filtration.

The compressed air for use in the plant is supplied via a compressed-air distribution network by three compressors (two operating and one standby). Two different qualities of air will be supplied to different consumers, plant air and instrument air. The air supply system includes the appropriate number of dryers and filters in order to supply the required quality of air. Compressed air for the specific operation of the filter presses is provided by six dedicated compressors.

17.4.4 Natural Gas

Natural gas obtained from the public distribution system is used in a boiler that produces steam to heat the building. However, provisions for natural gas serving the process have to be made, if the incorporation of the pellet plant is to be considered.

17.4.5 Fire Protection

A plant-wide pressurized fire-water protection system, especially important in the risk areas, is included in the design of the Shymanivske Iron Ore Project. The raw water pond represents the main reserve of emergency water for firefighting and contingencies. The capacity of this reservoir accounts for evaporation and seepage losses. A fire water pump house is next to the raw water pond. These pumps supply raw water to the main fire loop, which serves the fire hydrant system. This fire-protection system is in compliance with local regulations and insurance requirements, although the details will be confirmed only at the final engineering design stage.

17.4.6 Power Supply

The estimated, connected active power requirement for the Project is 152.3 MW. The operational running active power (excluding standby equipment) is 121.8 MW, considering a load factor of 80%.

17.4.7 Plant Instrumentation and Process Control

The Process Control System (PCS) for the Shymanivske Iron Ore Project comprises a main control room with four operator workstations with 50-in overhead LED displays, including software and software licences and two Engineering Workstations with dual 21-in, LED displays, including software and software licences. Due to the large footprint of the process site (approximately 3km x 4km) a modular concept is applied and transmitter signals from the field are marshalled into one of eight NEMA 4 IP 65 control panels (DCP), with suitable input/output type cards and redundant processors, which are distributed throughout the process area and connected back to servers in the control room by fibre optic cable. Servers will provide data collection, historical trending and process control. Field instrumentation will be a combination of 4-20 mA signal devices and intelligent transmitters capable of communicating digitally via a Profibus protocol to the DCPs. The control system will be easy to maintain and troubleshoot. The plant I/O will comprise approximately 350 analog, 800 Profibus and 3,600 discrete points. This system will allow a high level of confidence to the automatic operation of the plant.

18 PROJECT INFRASTRUCTURE

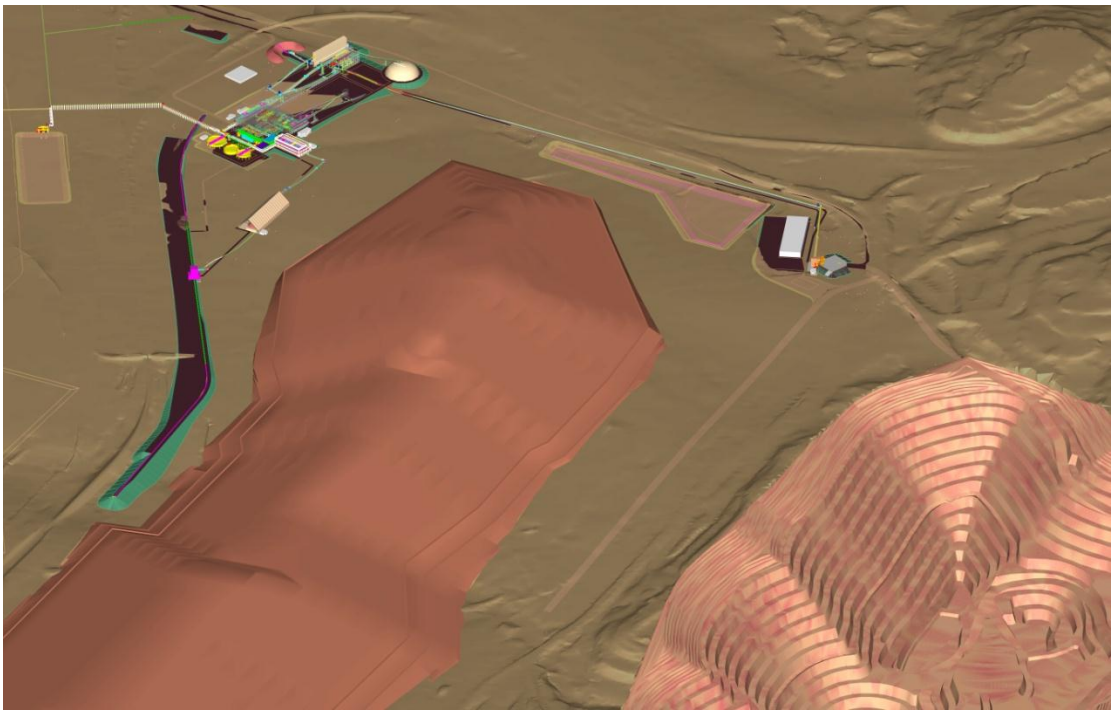
As part of this study, a site plan was developed for the Shymanivske site. Major site infrastructure consists of the following:

- Shymanivske open pit and associated waste-rock dumps;
- Haul trucks maintenance shop, mine administration building;
- Primary Crusher and transfer conveyors;
- Secondary Crushers and HPGRs building
- Dry-screening building (includes 10 dry double-deck screens);
- Cobbing building (housing 30 dry-cobbing magnetic separation pieces of equipment);
- Fine ore stock pile (includes the drawdown hoppers and take away conveyor);
- Concentrator building (includes Primary Mill Wet Screens, Primary and Secondary Mills, Verti Mills, four stages of Magnetic Separation, Flotation and Reagent area);
- Thickeners (includes tailing and concentrate thickeners and the main process water tank);
- Concentrate Filter building (includes pressure filters, and associated tanks and transfer conveyors);
- Concentrate stockpile (includes the product stockpile, reclaimer system and transfer conveyors);
- Rail loadout;
- Tailing storage facility (TSF);
- Plant control room building;
- Air compressors building (includes compressors and blowers that provide plant and instrument air);
- Concentrator warehouse and laydown area;
- Security building and truck scale;
- Administration building;
- HSE building, fire station and ambulance garage;
- Main plant sub-station switch yard;
- Process pump houses;
- Water ponds (raw water pond, stormwater collection Pond B, tailing collection ponds, waste pile collection ponds);

- Diesel fuel receiving and unloading station;
- Diesel fuel storage and vehicle fuelling system;
- Area electrical substations;
- Bridges;
- Haul and service roads;
- Rail spurs; and
- Water treatment facilities.

The Shymanivske area is serviced by existing rail and ports. Several port options were reviewed, which were subsequently narrowed down to two port options. The port of Nikolaev is the closest and therefore the most economical port of export, although there is limited handling capacity at this port. It currently has an excess of 2Mtpa it could possibly contribute to Black Iron's needs. The balance of the production will be routed to the privately owned TIS-Ruda terminal located at the Yuzhny port. Black Iron is currently negotiating an operator's agreement with the ports of Nikolaev and TIS-Ruda to define all port activities.

Figure 18.1: Overall Site 3D View



18.1 General Shymanivske Site Plot Plan

To determine the layout of the plot plan for the general Shymanivske site, the following factors were considered:

- Minimizing the haul truck travel distance for ore and waste rock;
- Use of existing bridges and service roads, such as KGOKOR Haul Road Bridge and the transportation corridor;
- Location of the approved tie-in point for rail;
- Flow of the process; and
- Existing physical constraints on site, such as ArcelorMittal's Rail, Ukrainian National Rail (UNR) and Ministry of Defense warehouses.

The selection of the site was based on minimizing the plant operating costs. Waste-rock handling is expected to be the single largest operating expense which is influenced most by truck travel distances. The layout philosophy was based on locating the waste-rock stockpile as close to the Shymanivske mine pit as possible. The best location is immediately to the west of the pit. The waste-rock stockpile area is constrained by the ArcelorMittal rail to the east and the UNR rail to the west. To the south, the Stepnoe residential area and agricultural lands limit the ultimate footprint of the waste-rock stockpile. Active military warehousing facilities to the north require a minimum clearance of 400m for any developments, and this effectively limits the land use in this area to a relatively narrow strip confined to the clearance zone and the existing rail infrastructure.

At the north-east end of the proposed waste-rock stockpile area is the KGOKOR haul road bridge. It was determined that this bridge could be upgraded to accommodate the haul truck traffic associated with the transport of ore and waste-rock. It is expected that initially the operation of the pit will include the use of this bridge because it provides a shorter haul distance to the north side of the waste-rock pile. Moving toward the southern portion of the waste-rock pile, it will be necessary to construct a new haul truck bridge to facilitate the mine's south ramp and reduce the haul distance. To further minimize the operating costs, the primary crusher needs to be installed as close to the pit as possible to minimize the ore trucking distance. Initially, it was anticipated that the best crusher location would be immediately north of the pit; however, ArcelorMittal has existing rail infrastructure in that area. It was observed that the same travel distance could be achieved by having the haul trucks cross the KGOKOR overpass to a location where there would be no conflict with the ArcelorMittal infrastructure. Therefore, a location was selected immediately west of the KGOKOR bridge and outside the military clearance zone.

An existing 150kV power line runs parallel to the west side of the existing ArcelorMittal private railway, between the Shymanivske waste dump and the open pit. Approximately 1km of this power line will have to be relocated to the north-east, clear of the KGOKOR corridor to facilitate the installation of the primary crusher, the haul truck maintenance shop, and the mine administration building.

Since the KGOKOR corridor infrastructure provides ready access to the north end of the military clearance area, it was recognized that it was also ideal to locate the Shymanivske processing plant in this location. Accordingly, the plant was located in the north-west corner, immediately south of the KGOKOR corridor and outside the military clearance zone. This also put the plant in close proximity to the Ukrainian National Rail (UNR), which will be used to ship the iron ore concentrate.

Iron ore concentrate will be transported by train from the new Shymanivske rail station to the Black Sea ports of Yuzhny (TIS-Ruda terminal) and Nikolaev. The Shymanivske rail station and rail spur are situated immediately south of the concentrator building, and will be connected to the main railway owned by the UNR.

Conveyors to transport the coarse ore from the primary crusher to the plant were generally aligned to follow the KGOKOR transportation corridor and thereby maximize the usage of the area outside the military clearance zone. As the conveyors do not cross any rail lines or roads, the potential for any operational impact upon this infrastructure has been eliminated.

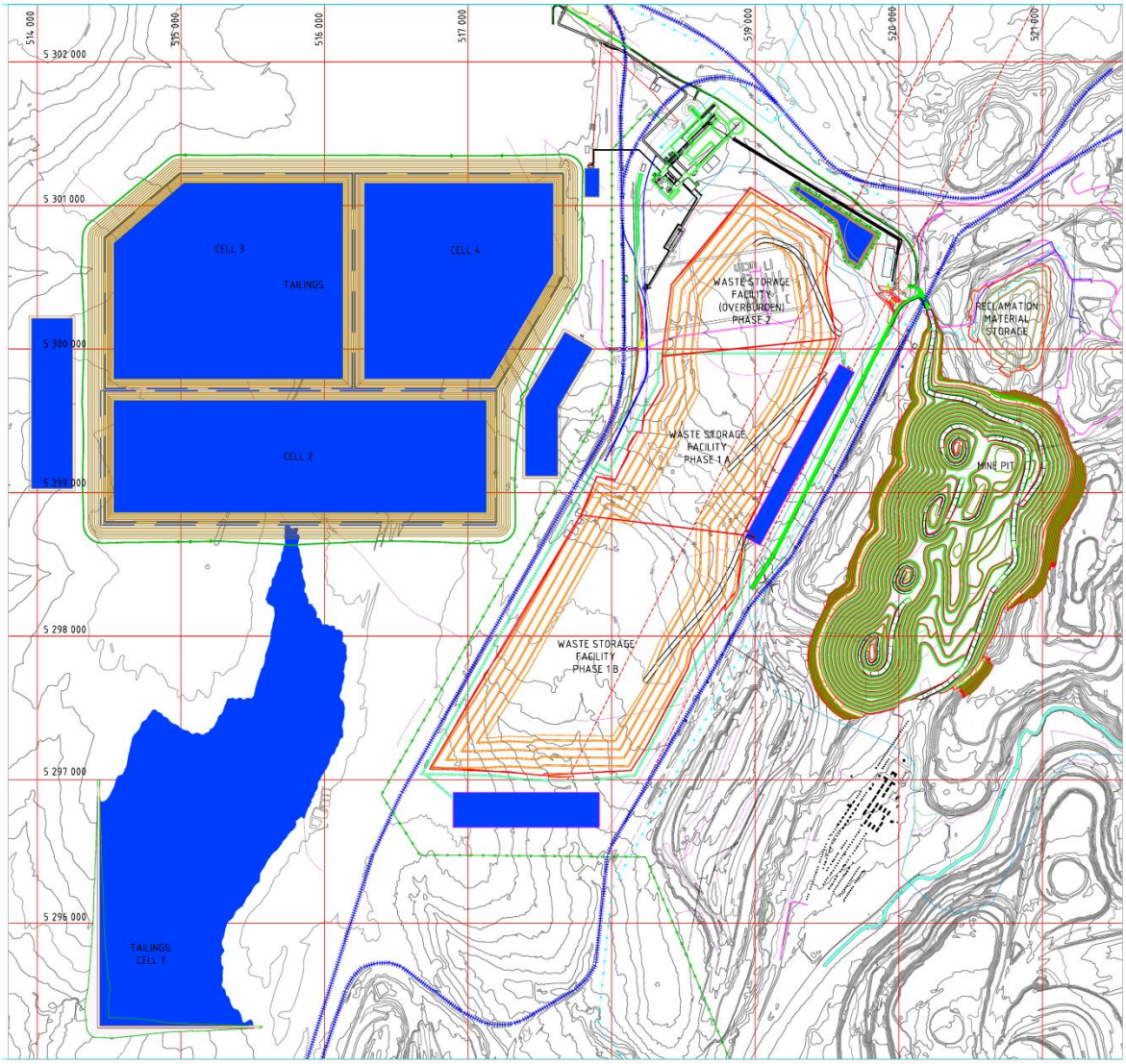
Iron ore filter cake produced in the plant is transported by a conveyor to a storage area between the plant and the railcar loading point. A travelling reclaimer and belt conveyor system are used to draw material from the stockpile and transport it to the railcar loadout.

The tailings storage facility (TSF) is located immediately across the UNR rail line, west of the concentrator building. The first cell of the TSF is located south-west of the plant site in a natural depression. The TSF is situated as close to the beneficiation plant as possible, to minimize pumping distances for the tailings and the return water lines.

In order to accommodate the Shymanivske railcar handling operations, modifications will be made to the existing UNR 6.0km bridge that allows military traffic to access the warehouse. The bridge will be extended east to cross over the added Shymanivske rail spur.

The mining garage and haul truck fuelling area have been located in the vicinity of the primary crusher building, to take advantage of the available space immediately outside the military clearance area and keep the garage and fuelling area close to the regular haul truck operations.

Figure 18.2: Plot Plan



18.2 Power

18.2.1 Power Supply

According to the local power utility consultant (UESP, UkrEnergoSetProekt), the electrical power for the Black Iron Project will be drawn from the existing 150kV Gornaya Substation owned by the local power utility Dneprovskaya ElectroEnergetisheskaya Systema, NEK Ukrenergo. The Gornaya substation is located 30km south-east of the Black Iron site.

Four options have been proposed by UESP as the source of power for the Project. Figure 18.3 shows the schematic diagram for the four options.

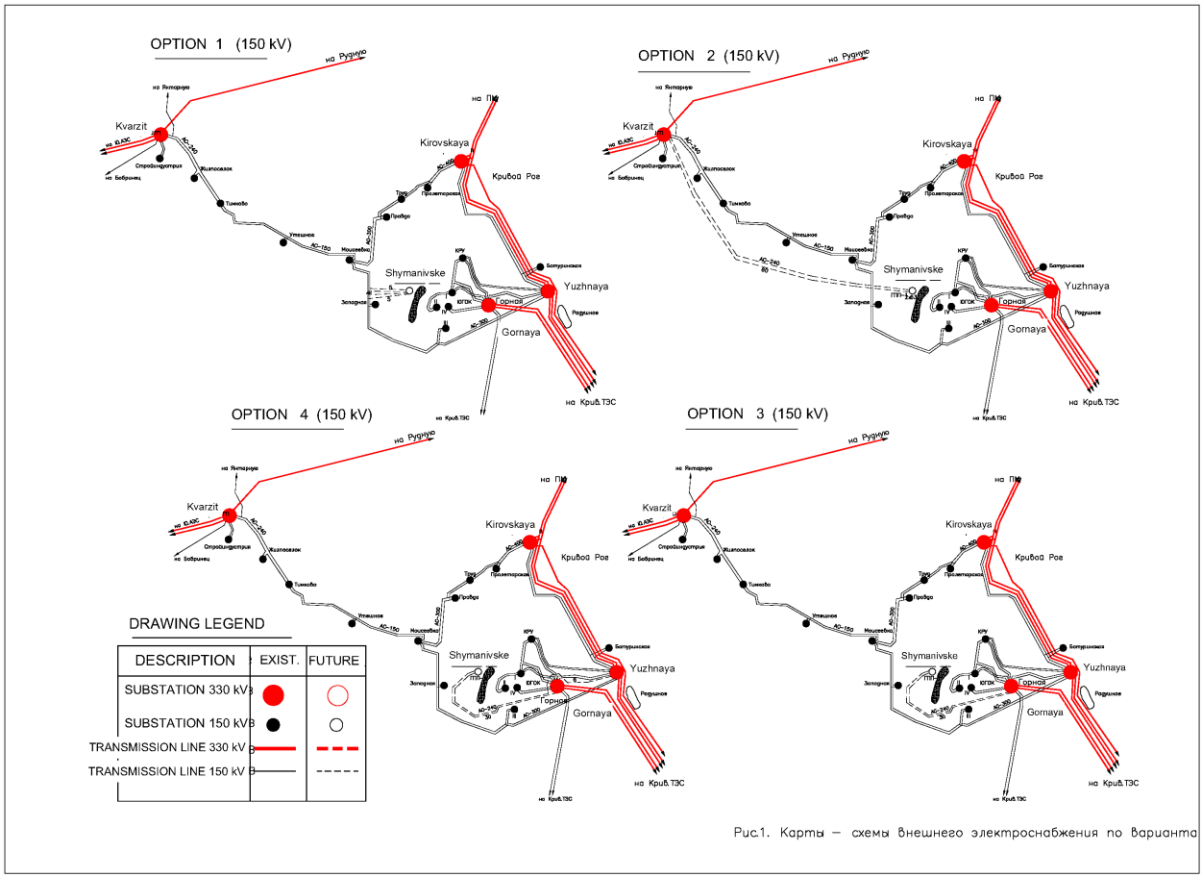
The cost estimate for the power transmission and all the upgrades / additions to the existing substations has been completed by UESP. Given the reliability, stability and strength of the electrical grid, UESP has selected option three (150kV Gornaya Substation) as the preferred option.

The power will be delivered to the Shymanivske main plant step-down sub-station via a new 30km double-circuit 150kV overhead transmission line with aluminum conductors, steel-reinforced-type AC-240mm^2.

For the purpose of the study, UESP confirmed that the local power grid has sufficient spare capacity (1,600MW in 2010 and 2,400MW by 2017) to deliver the required power to the Project. Currently the Gornaya Substation is loaded only 30% of its full capacity.

The implementation of the power supply to the Shymanivske Plant will also include improvements (upgrade of existing and installation of new electrical equipment) at Qvarzit, Timkovo, Moiseevka, Gornaya and Yuzhnaya Substations.

Figure 18.3: Power Supply Options Schematic



Three diesel generating units are included to supply emergency power (Administration Building 250kW, Concentrator 800kW, and Mine150 kW). The emergency power is not meant to be used for sustaining the operations of the plant. The purpose of the diesel generators is to provide power for the following consumers:

- Administration building power;
- Guard house;
- 30% of area lighting;
- Jacking pumps for the ball mills;
- Control room power;
- Thickener rake system (both tailing and concentrate);
- Thickeners underflow pump (50%);
- HPGR lubrication system;

- Piping heat tracing;
- Fire-detection system and dry-pipe fire-fighting system (main fire loop has diesel pump); and
- Mine administration building.

18.2.2 Power Load Calculation

The plant site-wide electrical power requirements for infrastructure, service buildings, mining, conveying, crushing, grinding, stockpiling, reclaiming, pumping and other processes were calculated on the basis of equipment sizing. The total connected active power is 152 MW (total installed power, excluding standby equipment). Considering a load factor of 80%, the total operational running power demand required from the utility is 122 MW. This power demand has been used in the Operating Cost Estimate and to develop the electrical single-line diagrams.

Table 18.1: Power Requirements

Process Area	Process Area	Plant Connected Apparent Power (without Standby Electrical Loads)	Power Factor	Plant Connected Active Power	Load Factor	Operational Running Active Power
WBS	**Description**	**kVA**	**Cosφ**	**kW**	**LF**	**kW**
1100	Mining	8,913	0.95	8,467	0.8	6,774
2100	Crushing/Screening	34,826	0.95	33,084	0.8	26,467
2200	Grinding/Separation	58,026	0.95	90,125	0.8	72,100
2300	Thickening	8,638	0.95	8,206	0.8	6,565
2400	Product Delivery	1,968	0.95	1,870	0.8	1,496
3200	Tailings	702	0.95	667	0.8	534
5500	Water Supply, Sewage & Storm	4,717	0.95	4,481	0.8	3,585
5700	Power Distribution	5710	0.95	5,425	0.8	4,340
Plant Total		**160,341**		**152,324**		**121,859**

18.2.3 Electrical Power Distribution

At the Project site, the 150kV overhead transmission line will terminate at a line bay with an air-insulated 150kV double busbar transfer system at the Shymanivske main plant step-down sub-station. Downstream from the 150 kV breakers, the voltage will be stepped down to 35kV through four 60 MVA transformers. Each transformer will be connected to the feeder bay through an overhead cable bus.

The main 35kV switchgear will consist of four buses (2x2 single buses with a tie-breaker system) and will distribute the power to all the 21 electrical sub-stations and electrical rooms via overhead trays with 35kV

cables and 35 kV and 6kV pole overhead lines. 7.5MVA and 25MVA distribution transformers will be located at the area electrical sub-stations and will step down the voltage from 35kV to 6.3kV in order to feed the 6.3kV medium voltage (MV) switchgears. 6.3kV MV switchgears will supply power to the MV motors, MV variable speed drives (VSD) and the motor control center (MCC) transformers. 1000kVA MCC transformers (6.3kV/400V) will supply power to the low-voltage (LV) MCCs. LV MCCs will supply power to the LV motors, LV VSDs and LV panels.

Process instrumentation devices and DCS-Distributed Control System Cabinets will be fed from 30kVA control transformers (400V/230V). The lighting loads will be fed from 50kVA lighting transformers (400V/230V). The piping heat tracing loads will be fed from 50kVA heat-tracing transformers (400V/230V).

Figure 18.4: Beneficiation Plant Electrical Sub-station

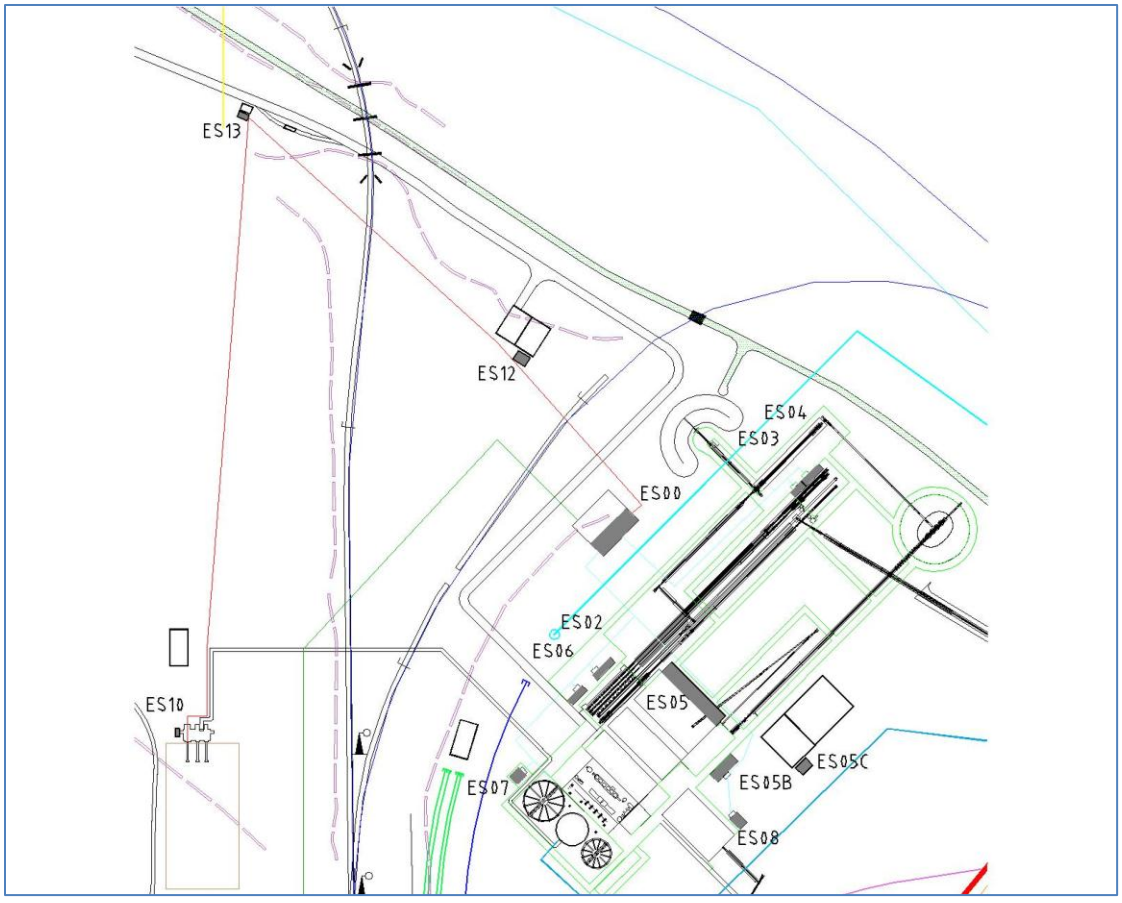
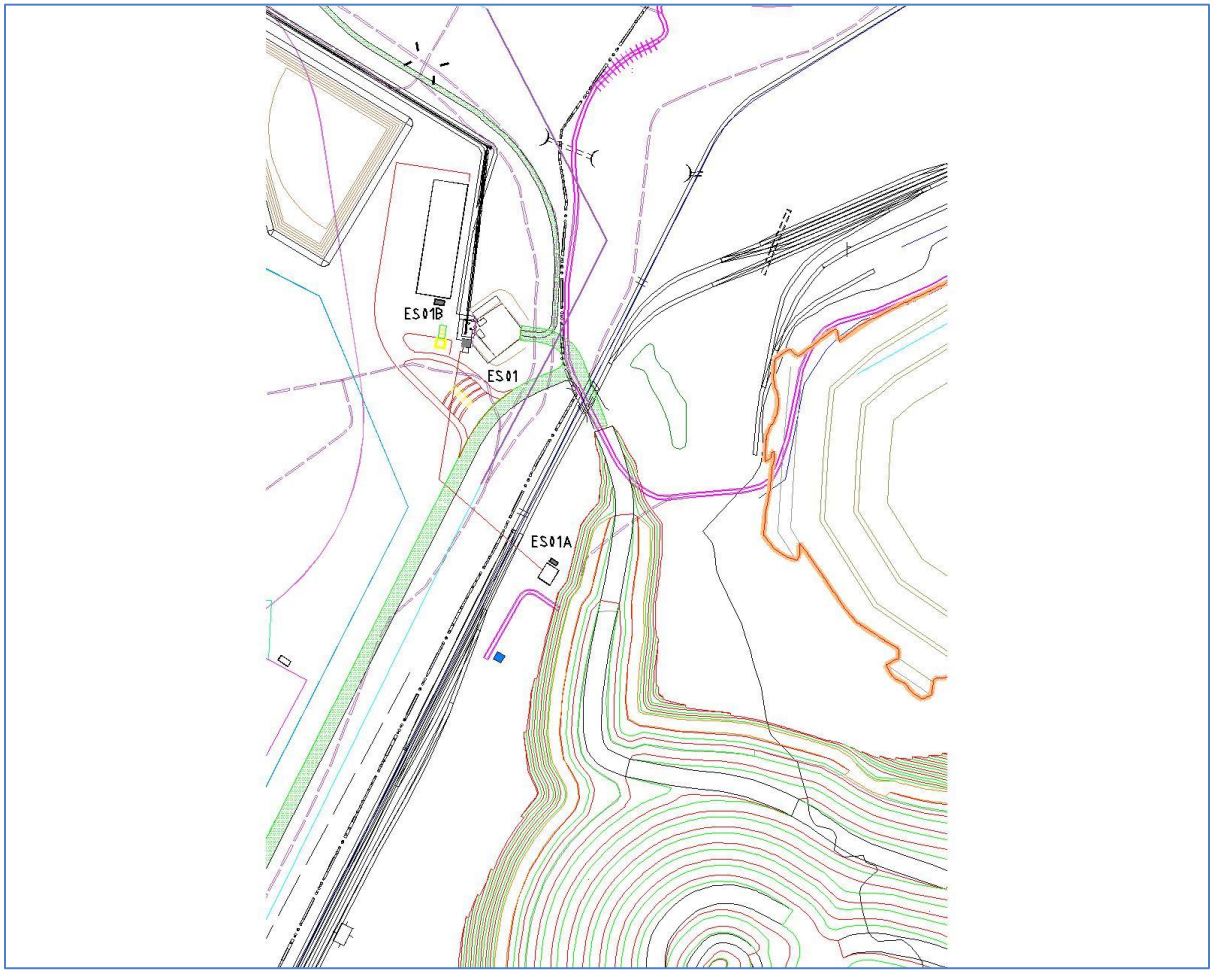


Figure 18.5: Mine Electrical Sub-stations



18.3 Tailing Storage Facility (TSF)

As part of the Feasibility Study, several options were examined for the tailings disposal requirements for the Project. The following five tailings options were studied:

1. Deposit traditional wet tailings with low-solids content in a lined pond with dykes constructed using mine waste;
2. Deposit slurry tailings with low-solids content in a lined pond constructed of coarse tailings created by cyclone operations in the field;
3. Deposit tailings slurry (up to 68% solid content) in a cellular pond constructed using mine waste;
4. Deposit thickened tailings in accelerated dewatering cells and then mine the solid waste and move it to permanent storage as compacted mine waste; and

5. Transport solid waste issued by the process plant to the permanent disposal site and store it as compacted mine waste.

   Option 3, tailings slurry deposited in a cellular pond constructed using mine waste was found to be the lowest-cost option (NPV computed was based on a discount rate of 8%) with substantial environmental benefits; hence, it was the selected option for the Project. The environmental benefits associated with this option include:

   - Reduces footprint of the disturbed area;
   - Minimal impact to groundwater because the facility provides suitable containment;
   - Construction materials are sourced from the mine operations, limiting the development of new borrow sources;
   - Relatively rapid consolidation of tailings enables progressive reclamation of the facility; and
   - Most importantly, facilitates maintaining the tailings under a water cover and thus limits generation of dust. Once the cell is full, it can then be covered with a layer of dirt and seeded with grass to avoid any future dust list off.

Subsequent to the preparation of the options analysis report (which included a limited geotechnical investigation and information on clay material available at the site) it was determined that a liner across the base of the tailings cells was not justified. A technically acceptable and cost-effective alternative to a liner was determined to be the incorporation of a clay core in the containment dykes and construction of a seepage cut-off trench through the upper silt layer in the foundation.

18.3.1 Topography and Drainage

The selected location for developing the tailings storage facility (TSF) is situated south-west of the proposed beneficiation plant. The topography of the site is essentially dome shaped, rising to a maximum elevation of 108m above sea level (ASL) in the central portion of the proposed layout, and falling to a level of 74m ASL in the west, and 90m ASL in the east and south. The ground to the north is essentially a level plateau, varying in elevation between 102m ASL and 106m ASL.

The western boundary of the TSF site is drained by three small westerly streams flowing towards a larger north-to-south flowing stream.

18.3.2 Design Objectives

The main objectives of the TSF design are:

- Ensure permanent and secure containment of all solid waste material within the engineered impoundment;
- Limit the dust generation from the TSF footprint to comply with the environmental regulatory levels;

- Maximize the recycling of return water to increase water availability for the plant operation;
- Effectively manage the water balance to keep a minimum water cap above the tailings as a means to reduce dust generation and the likelihood of excessively high-pool level above deposited tailings;
- Provide hydraulic structures capable of satisfactorily conveying the one-in-100-year design flood and the probable maximum flood, without incurring catastrophic damage;
- Minimize seepage from the TSF by rapidly establishing a low-permeability, consolidated tailings mass; and
- Achieve progressive reclamation of the facilities.

The TSF is designed to store slurry tailings produced during the mine life of 16 years. Based on a slurry flow of 1,666 m^3/ hour, the minimum storage capacity required is 213 Million cubic metres (Mm^3). This does not include freeboard and water cap requirements.

Table 18.2 summarizes the storage capacity of each cell and the total capacity of the TSF.

Table 18.2: Tailings Storage Facility – Storage Capacity

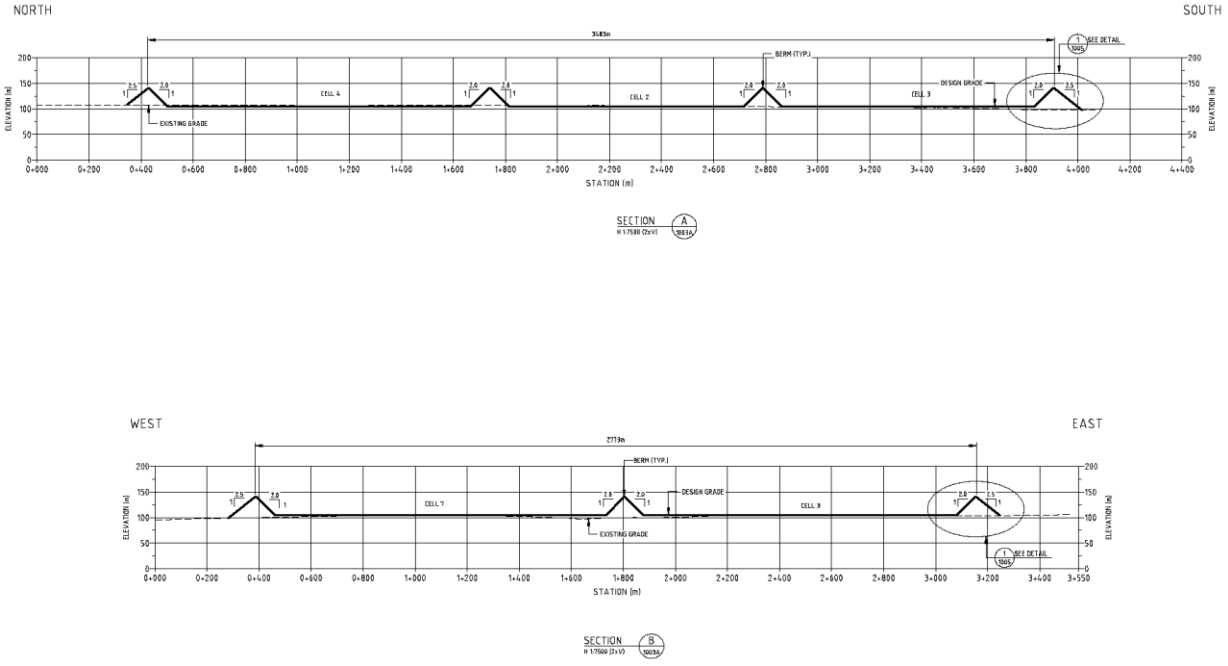
Cell	Year	Solids (Mt)	Liquid (Mt)	Solids (%w/w)	Pulp SG (t/m^3)	Slurry (wMt)	Slurry (Mm^3)
1	2	31.9	17.2	65.0	1.85	49.1	26.6
2	5	79.9	43.0	65.0	1.85	122.9	66.4
3	4	63.9	34.4	65.0	1.85	98.3	53.1
4	5	79.9	43.0	65.0	1.85	122.9	66.4
Total		**255.6**	**137.6**			**393.2**	**212.6**

18.3.3 Tailings Storage Facility Configuration

The current layout of the TSF has been based on the level of anticipated tailings production and a cellular configuration. Figure 18.2 shows the layout plan and tailings facility sections of the proposed TSF.

The first two years of tailings production (approximately 27Mm^3) will be stored in a natural depression located south of cell 2. The area features a natural drainage course within a depression, according to the available topographic data. The relief along the bottom of the depression is up to 30m and the area features natural drainage. TSF Cells 2, 3 and 4 utilize the flatter area upstream and are designed to store tailings for five, five, and four years, respectively. Figure 18.6 shows the section of tailing cells 2, 3 and 4.

Figure 18.6: TSF Sections Cells 2, 3 and 4



The dyke design features inner (upstream) profiles at a slope of 2:1 (horizontal to vertical). The outer (downstream) slopes are at 2.5:1 (horizontal to vertical) for cell 1 and 3:1 (horizontal to vertical) for cells 2 to 4, the flatter slopes being determined to ensure a minimum safety factor of 1.5 for potential failure surfaces through the foundation soils. The main body of the dykes comprises a clay core, bounded by mine waste-rock fill. Granular layers of crushed limestone and/ or dry-cobbing material from the process plant are included in the design on both sides of the clay core, to protect against the potential loss of fines from the clay into the waste-rock.

Figure 18.7 and Figure 18.8 show the dyke sections for Cell 1 and Cells 2 to 4, respectively.

Figure 18.7 TSF Cell 1 Section

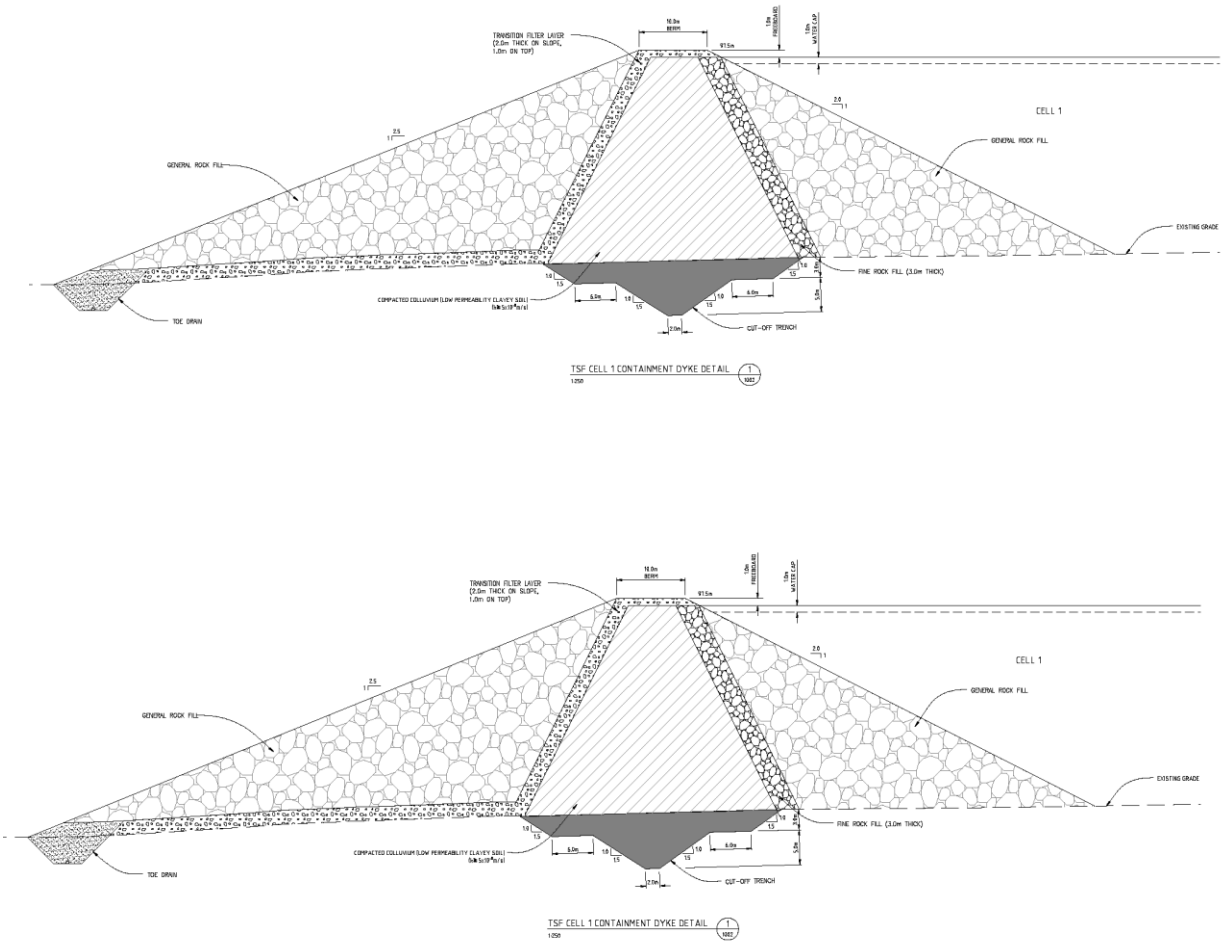
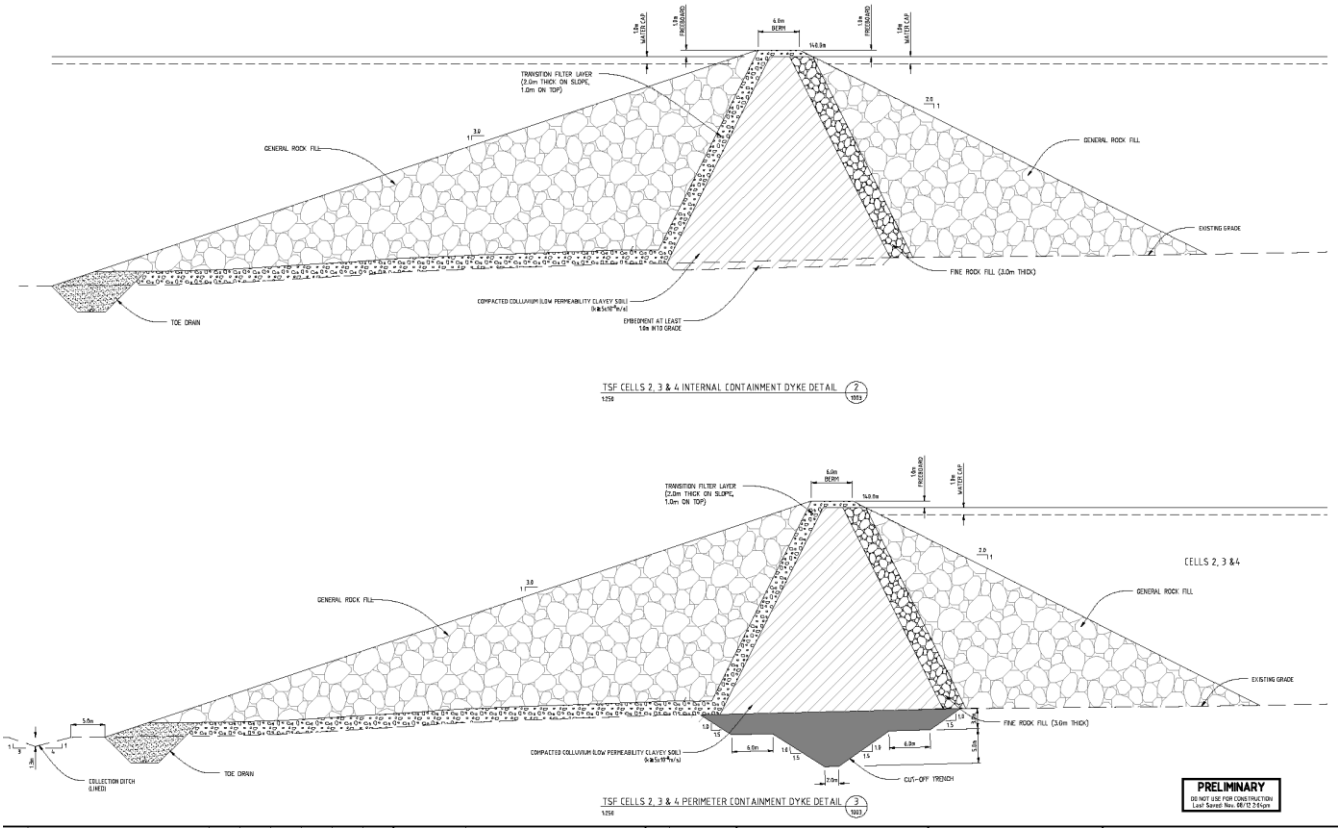


Figure 18.8: Cell 2, 3 and 4 Dyke Sections



A layer of relatively high permeability silt (loess) underlies the TSF area. The recommendation is to apply measures to control excessive seepage from occurring beneath the dykes, given the potential for excessive seepage pressures to be generated within this layer as a result of a direct hydraulic connection with the tailings in the reservoir. As a contingency to protect against the development of excessive uplift pressures, which might compromise dyke stability, a cut-off trench 8m deep has been provided in the conceptual design.

The trench side-slopes have been designed at 1.5:1 (horizontal to vertical). A 6m-wide berm is provided at 3m below ground surface to enable the backhoe to access the bottom of the trench. As the groundwater table within the TSF footprint is as high as 5m below the ground surface, pumping may be required to permit the construction of the clay cut-off trench. The design depth of the cut-off trench is preliminary at this stage and is based on the limited information of the ground conditions from the site exploration. The actual depth and the side slopes of the trench for the seepage cut-off shall be determined during construction and based on the observations of the ground and seepage conditions.

Figure 18.9 illustrates the sequencing of the storage and closure. Each cell is completely filled, capped and closed immediately after proceeding to the next cell.

Figure 18.9: TSF Storage and Collection Stages



18.3.4 Surface Water Management

The TSF surface water management facilities will comprise ponds and ditches that will collect run-off from the site. Preliminary run-off estimates from the TSF areas (cell caps, roads, berms and ditch areas) were simulated using an XPSWMM model and the Intensity Duration Frequency (IDF) data for a similar project completed by WorleyParsons in Ukraine. Since no historical data was available for the site at the time of this study, the IDF data from the similar project was used to generate the 1:100-year, 24-hour storm for sizing the run-off collection ditches and ponds.

Collection ditches along the perimeter of the TSF will convey run-off to the south, east and west ponds. To maximize the use of stormwater for recycling purposes, the current design assumes that the ponds and ditches will be clay lined to prevent infiltration losses. Also, a low perimeter berm will be built outside of the ditches to prevent run-off from unaccounted areas (areas outside of the TSF footprint) into the ponds.

In the event of the release of water to the natural environment due to rainstorms greater than the design storms, run-off from the TSF will be captured, stored, treated and tested prior to release.

The dyke design allows for 1m of freeboard to cap the water released from the consolidation of tailings. The excess water will be pumped to the raw water pond for reuse in the process plant.

Supernatant water from the operating tailings cell will be pumped continuously, using moveable floating barge pumps. An extendable floating-discharge line will run over the dyke and connect to the fixed pipe, which will run to the raw water collection pond. Over time, as the tailings disposal operation moves to the next active cell, the fixed line will be extended and booster pumps will be added as required.

18.3.5 Tailings Storage Facility Emergency Spillway

An emergency spillway is proposed for cell 1 on the south section of the dam to accommodate the flows in excess of the storm flows (1 in 100-year, 24-hour rainfall event) to avoid any over-topping of the dam. The details of the spillway system will be developed during the detail design stage.

18.4 Buildings and Services

18.4.1 Buildings

The Project consists of 42 buildings of varying construction and sizes. The major building structures will be made of steel with pre-fabricated roof and wall panels. The building foundations will consist of concrete spread footings (for light loads) and precast concrete piles. Secondary buildings will be of pre-engineered or pre-fabricated type, when applicable. The required services for each building depend on the operation requirements. Buildings with permanent staff and operators will have climate control systems (HVAC), and the electrical rooms will have HVAC systems for equipment protection. The process buildings in the wet-processing area need to have freeze protection. Fire protection, lightning protection and smoke detection have been considered for various buildings. Refer to Table 18.3 below.

Table 18.3: Building Characteristics

No	Building Description	WBS	Footprint (m^2)	Volume (m^3)	Building Material	Heating[4]	Ventilation	AC	Fire Protection System [1,2,3]
1	Primary Crusher Building & Tunnel	2100	450	7,700	Concrete & Steel	Local Only	2 change/hr	no	DSP/FH
2	Secondary Crushing Building	2100	3,200	110,900	Steel	Local Only	5.5change/hr	no	DSP/FH
3	Cobbing Building	2100	2,000	54,800	Steel	Local Only	1 change/hr	no	DSP/FH
4	Main Mill Building	2100	22,000	810,000	Steel	AHU	1 change/hr	no	DSP/FH
5	Dry-Screen Building	2100	1,700	62,000	Steel	AHU	1 change/hr	no	DSP/FH
6	Plant Control and Dry Area	2900	900	11,000	Steel	AHU	20 cfm/person	A/C	Sprinkler
7	Compressor Room	5100	900	7,700	Steel	Freeze Protection	0.5 change/hr	no	DSP/FH
8	Concentrator Filtration Building	2300	4,500	110,000	Steel	AHU	3 change/hr	no	DSP/FH
9	Product Storage Building	2400	11,500	314,000	Steel	Local Only	0.5 change/hr	no	DSP/FH
10	Concentrator Warehouse	2900	2,700	16,200	Pre-engineered	Freeze Protection	0.5 change/hr	no	Sprinkler
11	Mine Truck Shop	1300	4,000	88,000	Steel	Local Only	1 change/hr	no	DSP/FH
12	Mine Administration / Dry Area	1300	1,200	5,000	Steel	AHU	20 cfm/person	A/C	Sprinkler

No	Building Description	WBS	Footprint (m^2)	Volume (m^3)	Building Material	Heating[4]	Ventilation	AC	Fire Protection System [1,2,3]
13	Mine Warehouse and Maintenance	1300	2,200	12,000	Steel	Freeze Protection	0.5 change/hr	no	Sprinkler
14	Administration Building	5100	1,200	5,000	Steel	AHU	20 cfm/person	A/C	Sprinkler
15	Guard/Security Building	5100	150	600	Masonry	Unit Heater	20 cfm/ person	A/C	FE
16	HSE/Fire Station/Ambulance	5100	1,350	5,400	Masonry	Unit Heater	20 cfm/ person	A/C	FE
17	Rail Station Shed	5100	100	400	Masonry	Unit Heater	20 cfm/ person	A/C	FE
18	Firewater & Process Water Pump House	5500	650	4,000	Masonry	Freeze Protection	0.5 change/hr	no	FE
19	Waste Rock Pile Pump House	5500	650	4,000	Masonry	Freeze Protection	0.5 change/hr	no	FE
20	Pond B Pump House	5500	650	4,000	Masonry	Freeze Protection	0.5 change/hr	no	FE
21	Tailing Overflow Pump House	5500	650	4,000	Masonry	Freeze Protection	0.5 change/hr	no	FE
22	General Receiving Warehouse	5100	1,250	7,500	Pre-engineered	Freeze Protection	0.5 change/hr	no	Sprinkler
23	Fuel Receiving Area and Pump House	1900	800	1000	Masonry	Freeze Protection	0.5 change/hr	no	DSP/FH
24	Main Plant Sub-station	5700	600	4,300	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler

No	Building Description	WBS	Footprint (m^2)	Volume (m^3)	Building Material	Heating[4]	Ventilation	AC	Fire Protection System [1,2,3]
25	Electrical Sub-station ES01	5700	200	1,500	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
26	Electrical Sub-station ES02	5700	300	2,100	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
27	Electrical Sub-station ES03	5700	320	3200	Masonry	Freeze Protection	0.5 change/hr	A/C	Sprinkler
28	Electrical Sub-station ES04	5700	430	4300	Masonry	Freeze Protection	0.5 change/hr	A/C	Sprinkler
29	Electrical Sub-station ES04b	5700	60	300	Masonry	Freeze Protection	0.5 change/hr	A/C	Sprinkler
30	Electrical Sub-station ES05	5700	760	5300	Masonry	Freeze Protection	0.5 change/hr	A/C	Sprinkler
31	Electrical Sub-station ES05a	5700	60	300	Masonry	Freeze Protection	0.5 change/hr	A/C	Sprinkler
32	Electrical Sub-station ES05b	5700	900	6,750	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
33	Electrical Sub-station ES06	5700	353	2,700	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
34	Electrical Sub-station ES07	5700	667	5,000	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
35	Electrical Sub-station ES08	5700	242	1,800	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler

No	Building Description	WBS	Footprint (m^2)	Volume (m^3)	Building Material	Heating[4]	Ventilation	AC	Fire Protection System [1,2,3]
36	Electrical Sub-station ES09	5700	167	1,300	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
37	Electrical Sub-station ES10	5700	146	1,100	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
38	Mine Sub-station	5700	576	4,300	Steel	Freeze Protection	0.5 change/hr	A/C	Sprinkler
39	Fine Ore Storage and Tunnel	2100	7,100	253,000	Pre-engineered	Local Only	0.5 change/hr	no	DSP/FH
40	Rail Loadout Building	2400	70	2800	Concrete	Local Only	0.5 change/hr	n/a	DSP/FH
41	Diesel Generator Enclosures	5700	70	220	Masonry	Freeze Protection	0.5 change/hr	no	Sprinkler
42	Fuel Station	5400	n/a	n/a	Concrete	n/a	n/a	n/a	Fire Monitors

1: DSP= Dry Stand Pipe

2: FH= Fire Fighting Hose

3: FE: Fire Extinguisher

4. AHU: Air Handling Unit

Showers and lockers have been taken into consideration for the Plant Control, Mine Administration and HSE/Fire Station/Ambulance buildings.

The Administration building is located on the west side of the UNR and is used by general and administrative personnel. It was sized for the occupancy of 40 people and has been considered as pre-engineered type steel building. No shower or dry area has been considered for this building.

The Health, Safety and Environment (HSE) building has been included for use by the health and safety offices of the plant. First-aid activities will be performed by a permanently stationed nurse in the HSE building. Emergency response units (ambulance and fire truck) will also be located adjacent to the HSE building.

18.5 Utilities

18.5.1 Domestic Sewers

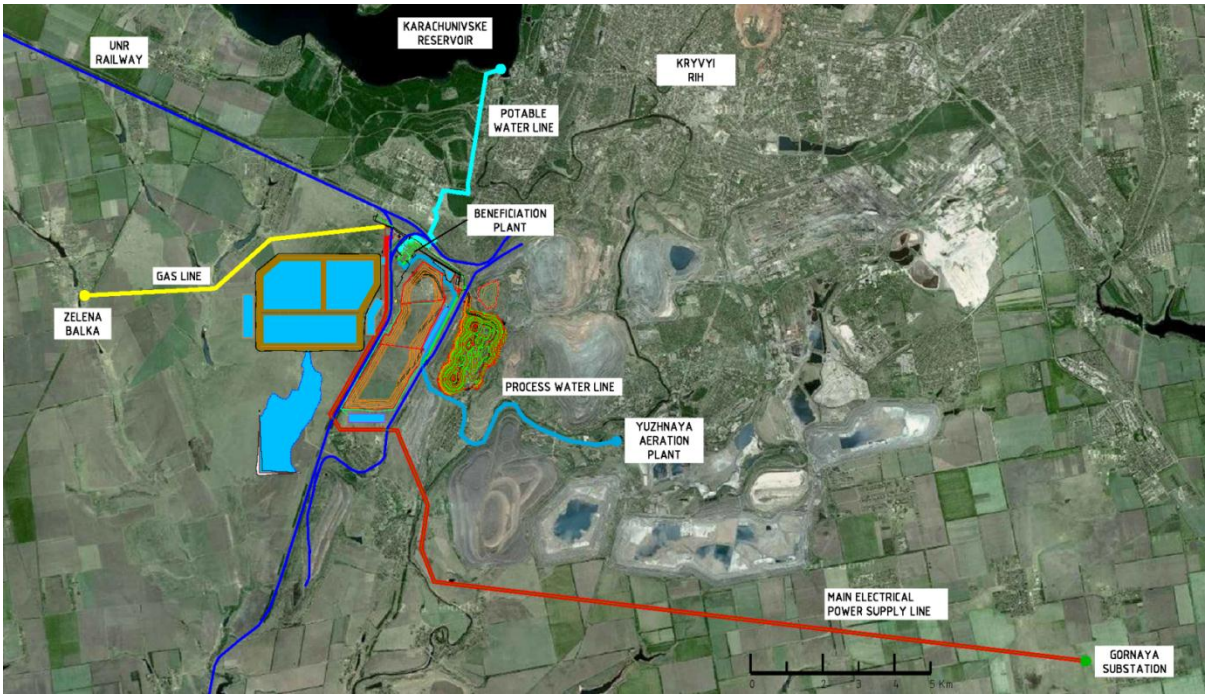
Domestic sewage for the buildings is collected and treated in the septic tanks. Three septic tanks have been considered for areas with the highest concentration of operators (administration building, main process area and mine administration building). The sewage will be collected by vacuum trucks and hauled off site for disposal and treatment.

Solid domestic waste will be collected and in outside dumpsters by contracted trucks. No disposal site is included in the plot plan.

18.5.2 Natural Gas

Natural gas will be obtained from the public distribution system through a 4” line with a design pressure of 410 KPa, at the rate of 870m^3/hr. The natural gas is used by a boiler producing steam for heating the buildings. The gas pressure will be reduced to 85KPa, which is suitable for the steam boiler, through a pressure letdown station located close to the administration building. Figure 18.10 shows the tie-in points for various utilities, including natural gas.

Figure 18.10: Utilities Tie-in points - Power, Natural Gas, Process water, Potable water



18.5.3 Compressed Air

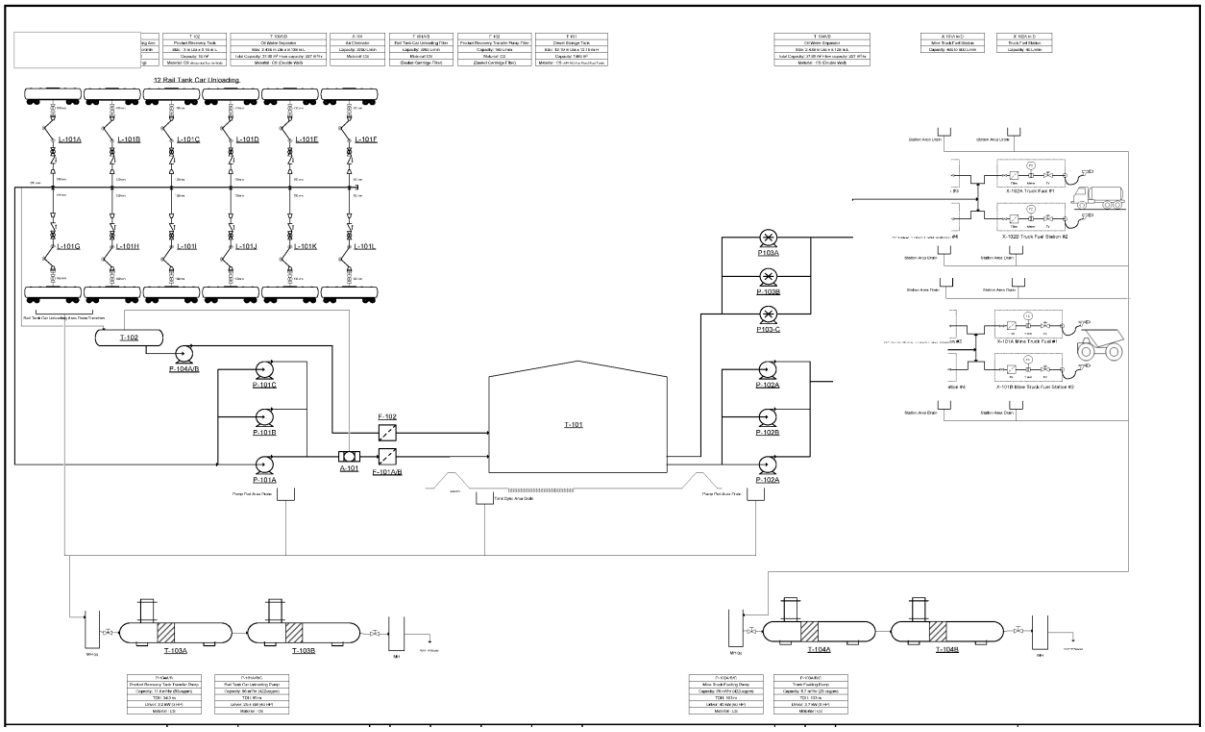
The main users of the compressed air are the filter presses. Six dedicated rotary screw compressors with a production rate of 453m^3/min, with 1000 KPa pressure will provide the required filtration air on demand. Instrument air and plant air for the rest of the beneficiation plant is supplied by three screw compressors with a total consumption of 57.6m^3/min at a pressure of 850 KPa.

18.5.4 Diesel Fuel

The main consumers of the diesel fuel are the mining fleets. The beneficiation plant uses a small volume of diesel for maintenance and ancillary equipment. No process or heating consumption is anticipated for diesel fuel. The diesel fuel consumption for the Project is estimated to be 100,000 liters per day.

The fuel is received on site by rail in tanker cars with a capacity of 107,000 liters per car. The fuel is unloaded by three unloading pumps and then stored in the main storage tank in the vicinity of the unloading station. The main storage tank will have a capacity of 1,000,000 liters, which is sufficient for 10 days of consumption. The diesel is then pumped to a day tank (100,000 liters capacity) located near the primary crusher building via 8” pipe running along the overland conveyor. Fuelling stations near the mine maintenance building will provide the diesel for the mine haul trucks and other ancillary or tanker trucks. The mine-truck fuelling is done at the fuelling station. The rest of the mine auxiliary fleet will be fuelled by a tanker truck, filled at the fuelling station.

Figure 18.11: Diesel Fuel System



18.6 Roads and Bridges

18.6.1 Roads

The roads on the Shymanivske site are divided into three categories:

- Haul roads
- Service roads
- High-traffic roads

Haul roads are used by the ore haul trucks for the primary crusher and the waste haul trucks for the waste-rock pile. They will have a gravel surface with a width of 24m and a total length of 2,730m. Dust suppression shall be applied on the road surface to minimize dust generation. Most of the haul roads will be required in later operating years to provide access to the southern part of the waste rock pile and the estimated costs associated with their construction were included in the sustaining capital.

Service roads are designed for traffic other than the haul trucks for access to various parts of the Project. Light vehicles and an ancillary fleet can use these roads. The service roads will have a gravel surface and will be designed for light traffic. The existing KGOKOR road on the north side of the plant is also considered a service road and will be used for accessing the north side of the TSF for the construction of

containment cells 2 to 4. The service roads at the Shymanivske site have been designed for a thirty-tonne payload truck. The total length of these roads is 7,200m. The KGOKOR service road is 9m wide, while the rest of the service roads are 6m wide.

High-traffic roads are located within the main processing plant area and provide access to various buildings and facilities in this area. These roads will be asphalt paved in order to minimize dust generation in the main operation area. The high-traffic roads will be 6m wide and will have a total length of 2200 m.

18.6.2 Bridges

The list of bridges at the Shymanivske site is as follows:

- KGOKOR Haul Road Bridge: This is an existing bridge with culvert section design. The bridge is located on the north side of the mine pit and provides elevated crossing over the ArcelorMittal railway. The bridge is wide enough for two-lane traffic of the haul trucks. The additional load of the heavy trucks requires reinforcement of the existing walls and a new concrete slab on top of the bridge. Utilizing this bridge for haul trucks provides the most economical solution for crossing the existing rail line and also minimizes the service interruption on the ArcelorMittal railway.
- The 6.0km Road Bridge: This existing bridge provides an elevated crossing over the UNR railway connecting the military warehouse area to the city of Kryvyi Rih. This bridge needs to be extended to the east to accommodate the additional rail spurs required by the Project.
- The 118km Road Bridge: This existing bridge is located on the north-west side of the Shymanivske site connecting it to the city of Kryvyi Rih. No modification is anticipated for this bridge.
- The UNR MOS and UNR KR Rail Road bridges: These two bridges provide access for the existing Ukrainian National Rail (UNR) on the north side of the Project site. No modification is required on these bridges.
- South Ramp Haul Road Bridge: This bridge will be required in Year Six of the mine life, and the estimated construction costs associated with it were included in sustaining capital. The purpose of the South ramp haul road bridge is to provide access for the waste-haul trucks to the southern part of the waste-rock pile when the south mine ramp is in operation. This bridge will span the existing ArcelorMittal rail and will be designed for the haul-truck loads.

18.7 Water

Water consumption in the plant consists of the following:

- Process water;
- Potable water;
- Gland and Cooling water; and
- Fire water.

The site water balance has been studied in order to determine the various sources of water and forecast the need for water from outside sources. Water systems at the plant have been designed so that there is no liquid effluent stream flowing outside the mine-site perimeter and no process-water infiltrating the ground.

For the Project area, the water supply has been divided into the following major categories:

- Surface run-off;
- Direct precipitation on water bodies;
- Withdrawals from the Yuzhnaya aeration plant;
- Recycling of clarified water from the tailings storage facility (TSF) to the plant;
- Mine pit dewatering;
- Waste-rock pile run-off collection; and
- Potable water from the Karachunivske reservoir.

Fgure 18.12 shows the overall site water balance.

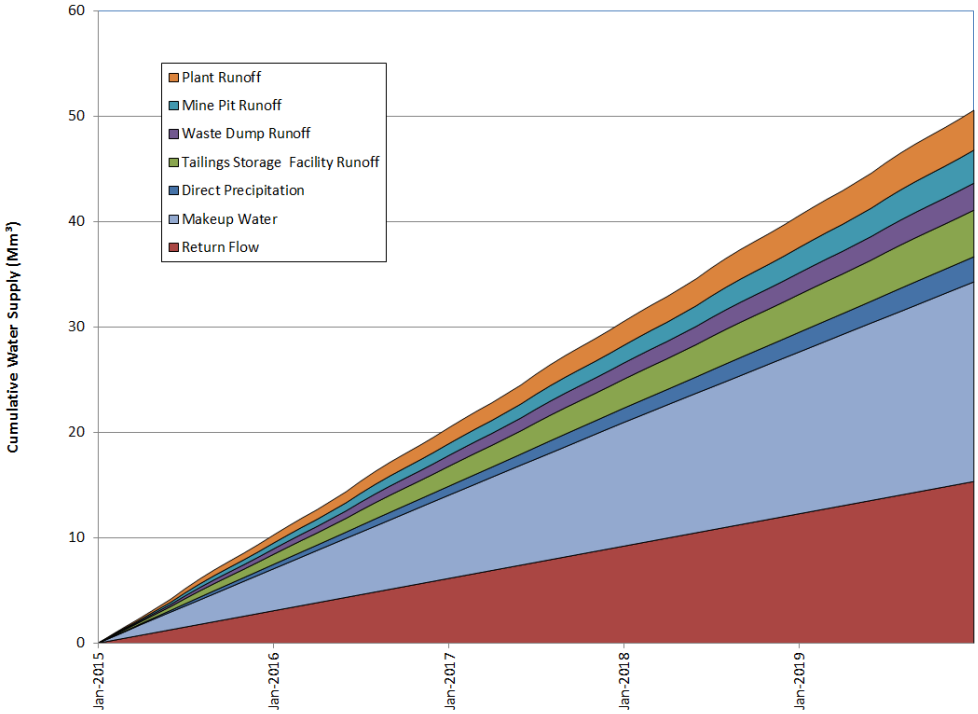
The current water-balance study covers the period from 2015 to 2019. Connate, seepage and groundwater inputs were not taken into account.

The following assumptions were made:

- Water in-flows to the TSF include direct precipitation and slurry tailings from the plant.
- Surface run-off collected in the mine pit is pumped to the run-off water storage pond “B” for plant use.
- In order to prevent the infiltration from the ponds, a compacted clay layer has been included on the walls and bottom of the ponds.
- All ponds, including the active cell in the TSF, are assumed to be wet with a permanent layer of water.

- The use of the recycled water from the TSF, water from direct precipitation and surface run-offs is maximized to reduce the demand for make-up water from the Yuzhnaya aeration plant.
- Average monthly precipitation data available to the public for the Kryvyi Rih region are assumed to be representative of the mine site. These data were converted into daily data for the modelling period, from 2015 to 2019. Net precipitation figures were obtained by reducing the precipitation data by 10%, to account for the losses due to existing vegetation or depressions in the natural grade.
- Evaporation data for the Kryvyi Rih area from 2007 to 2011 are assumed to be representative for the site.
- The results of the site-wide water balance model indicate that the water demand for the plant will be satisfied by a combination of water released from tailings; stormwater run-off (tailings, waste dump, plant areas, and mine pit); direct precipitation onto the ponds; and make-up water from treated effluent from the nearby Yuzhnaya aeration plant. The majority of the water supply is from make-up water, 30% (15.4Mm3), run-off from project areas, 34% (17.4Mm3), direct precipitation 6% (3.0Mm3), and water released from the tailings cell, 30% (15.3 Mm3). Figure 18.12 below shows the accumulated volumes of water supplied to the Project from each of these sources between 2015 and 2019.

Figure 18.12: Cumulative Water Volume Supplied to the Project



18.7.1 Process Water

Process water at the Shymanivske Project consists of recycled water and make-up water. For the purpose of this study, 50% of the water sent to the TSF is assumed to be reclaimed and recycled to the plant. The rest of the required water is provided by storm collection and make-up water from Yuzhnaya Aeration Plant. The water from the aeration plant is provided to the site free of charge. The initial water analysis shows a high level of bio-organics in the water for use in the beneficiation plant. The water will be treated in the water-treatment plant by Ultrafiltration units and associated backwash storage tank/pumps, a neutralization system, and a chemical feed system.

The water balance results show that make-up water requirements vary from month to month. Figure 18.13 presents the daily make-up volumes required from the Yuzhnaya municipal aeration plant on a monthly basis. The maximum make-up water demand occurs in March (9,092m^3 per day), and the minimum in August (8,062m^3 per day). The average annual flow is 3.08Mm^3/yr. The total withdrawal volume, over the simulation period, is approximately 15.4Mm^3. The local authorities have confirmed a project water allocation with a maximum annual withdrawal volume of 5.73Mm^3. The water-balance model results show that, on an annual basis, the water demand will be less than the allocated withdrawal rate, as shown in the following Figure 18.14. From this, it can be seen that the maximum make-up water volume of 3.29Mm^3 occurs in the first year of plant operation.

Figure 18.13: Make-up Water Monthly Average Withdrawals

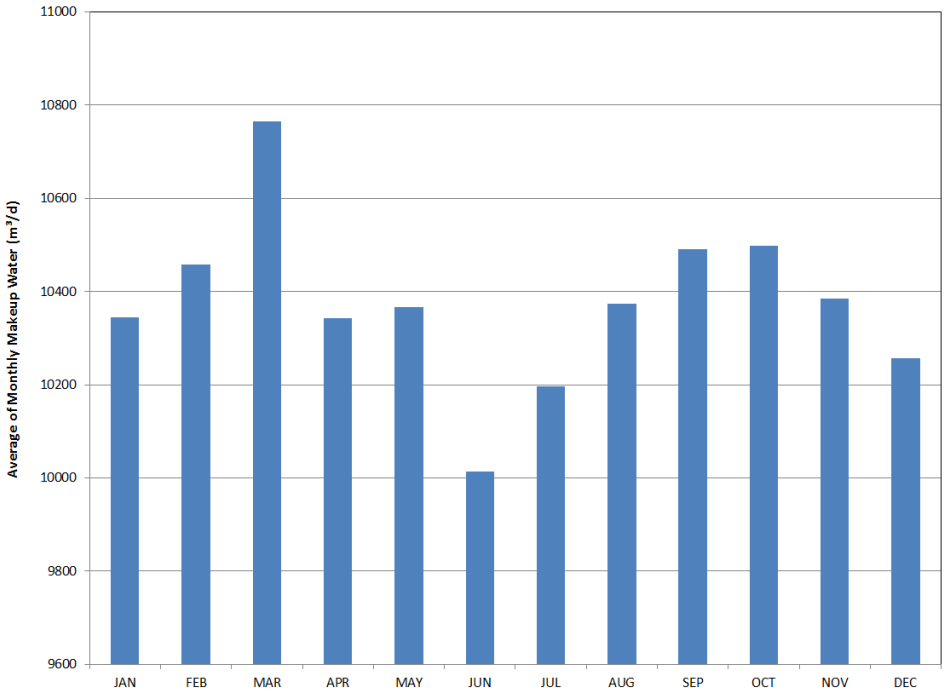
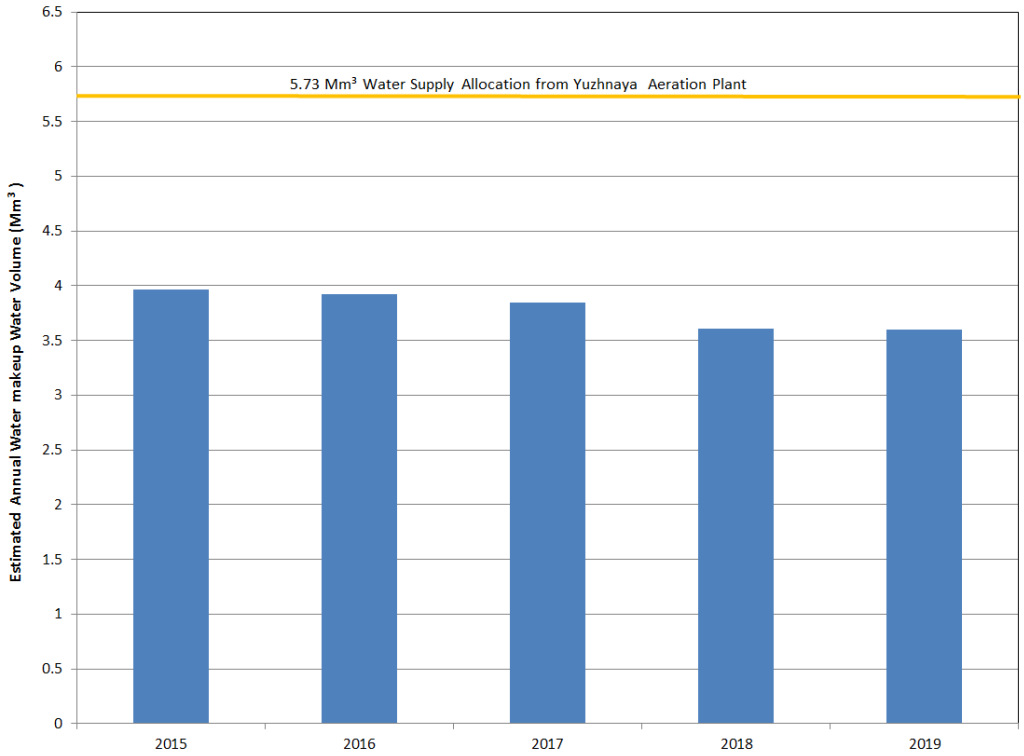


Figure 18.14: Annual Make-up Water Requirements from the Yuzhnaya Aeration Plant



The treated water will be collected in the raw water collection pond located west of the beneficiation plant next to the TSF (Cell 4). Clarified tailings water is also collected in this pond, and then the water is pumped to the process water-storage tank for use.

Mine pit, waste-rock pile, and plant run-off water will be collected in run-off water pond “B” located east of the beneficiation plant, next to the primary crusher. The collected water will be pumped through above-ground piping to the process water tank in the concentrator building for use.

Figure 18.10 shows the proposed 18” process-water pipeline from the Yuzhnaya aeration plant.

18.7.2 Potable Water

The potable water at the plant will be used for human consumption, eye wash and safety-shower stations. Potable water will be supplied through a 7 km water pipeline from the Karachunovskoe Reservoir, north of the plant.

18.7.3 Gland and Cooling Water

Raw water from the raw water pond will be filtered to remove the suspended particles and reduce the hardness, for use as gland and cooling water. The filtration will be done by two sand filters, and the filtered water will be stored in the treated water tank. This tank also feeds the sulphuric acid dilution and the dust suppression unit at the fine ore stock pile.

18.7.4 Fire Water

A plant-wide pressurized fire-water protection system is used as the main fire-fighting ring. The water is supplied by the raw water pond by dedicated fire-water pumps. These pumps (two electric and one diesel) supply raw water to the main fire-water loop at the rate of 1,817m^3/hr. This fire-protection system is in compliance with local regulations and insurance requirements. The main fire loop around the plant is 24" High Density Polyethylene (HDPE) buried line. The fire main provides the required water to the fire hydrants for fire-fighting. Fire-water monitors have been included around the fuel receiving and unloading area.

A 6" above-ground pipe provides the required fire-water for the primary crusher and mine buildings area along the overland conveyor. The fire loop in this area is also a buried 6" HDPE pipe. Fire-water monitoring has been provided for in the fuelling stations area.

18.8 Manpower

The mining operations manpower list includes all aspects of the open pit operations, including the operators and technical staff. The total number of mine operators varies from 220 to 450 people. The people for mine maintenance and technical services range from 124 to 209.

The beneficiation plant operators are estimated to include 270 people, calculated on a 24/7 operation. Total general and administration personnel are estimated to be 75

18.9 Transportation and Logistics

The Shymanivske Project site is located on the outskirts of the city of Kryvyi Rih Ukraine, a CIS country located on the Black Sea and the Sea of Azov. It is directly bordered by seven countries, including Russia. There are good motorways connecting Ukraine to its bordering neighbours and the major Western European ports, including the global hubs of Antwerp and Rotterdam. Odessa in the south is home to the largest seaports in Ukraine and is only 400 Nautical Miles (less than one day's navigation) from Istanbul, and Turkey's Black Sea Ports. Proximity to Istanbul, a trans-shipment gateway to the Mediterranean Sea and Strait of Gibraltar to the west, as well as the proximity to the Red Sea, Indian Ocean, and Arabian Sea to the south and east, make this an optimum location for globally sourced cargo to reach Ukraine, and for concentrate product to reach steel mill customers.

From a transportation perspective, Ukraine is serviced directly, or through trans-shipment, by ample carriers of all modes, and it has the supporting infrastructure to receive major project cargo from offshore as well as within the CIS and Europe.

A preliminary logistics routing study was performed by WorleyParsons in June 2012, to investigate further the current infrastructure with respect to transportation, and to identify in principal shipping envelopes and potential surface routes for the passage of major equipment between seaports, trans-shipment locations, and the jobsite. This logistics study assumes the J-I-T (Just-in-Time) delivery model, aligned with the project schedule to support construction.

Figure 18.15: Ukraine Map



18.9.1 Preliminary Logistics Strategy

The Shymanivske project involves the delivery of major equipment from various parts of the world, including Asia, North America, Europe and other CIS countries. For this project, marine, rail and truck transportation services will be utilized, individually or in combination. It is assumed that the project will require off-site laydown areas, marshalling areas and project warehousing.

It is assumed that materials and equipment will be sourced globally and delivered to the jobsite or interim location, utilizing all modes of transport. European-origin cargos will be transported primarily by a combination of truck and rail containers. Shipments from Turkey and beyond will use a combination of ocean vessel, truck and/or rail transport. Barge transportation will be used for super loads originating outside the immediate Kryvyi Rih area, for transport to the most practical location, considering the proximity to Kryvyi Rih and infrastructure obstructions, stakeholder interference and the motoring public. Costly air transport should be used only for very small shipments and for time-sensitive material, on an as-needed basis.

The Preliminary Logistics Strategy recommends “FCA INCOTERMS 2010” as the preferred delivery term for the purchase of all equipment and materials. WorleyParsons Logistics will consult the project schedule and investigate the possibility of Project Full Charter and/or Part Charter, with preferred INCOTERMS 2010 as either FCA Fabricator shop or FAS (named port/loaded).

18.9.2 Ground Transportation

In Ukraine, ground transportation is the limiting factor in determining the shipping envelope to the site. Current conditions of roads and motorways from the major ports and potential marshalling/ warehousing areas to Kryvyi Rih range from good to poor; however, they are passable. There is adequate road access to the Project site from all ports, and from continental Europe.

18.9.3 Containerized Cargo and Legal Load Trucking

Standard trucking equipment is available within Ukraine to meet the general trucking and container transportation requirements of the Project. Larger trucking companies could potentially mobilize the necessary equipment at selected ports, according to arrival schedules. With respect to flat-deck and specialized trailers, the supply is limited. From any major port in the Odessa or Nikolaev area, the transit time by truck for containerized and general cargo to the Kryvyi Rih site is less than one day.

18.9.4 Heavy Haul/Over Dimensional Transport

There is expertise in the country to execute heavy haul and over-dimensional (HH/OD) engineered transport. HH/OD transportation will be engaged at the long-lead equipment sourcing stage, which will ensure both engineered transport and equipment availability. Cabotage is in effect which does not allow for carriers based outside Ukraine to come to perform HH operations in Ukraine. However, Ukrainian carriers as required can sub-contract equipment and services to support their operations. Any sub-contractors through the project HHs would also be subject to pre-qualification by Project logistics.

Multi-axle hydraulic platform trailers are available, as well as low-bed, multi-axle transporters, and Schnabel transporters; however, self-propelled multi-axle hydraulic platform trailers (SPMT) would require mobilization from outside Ukraine. The current configuration and limitations on cargo, in particular the ball mills, would necessitate transportation by available hydraulic equipment within Ukraine. Given the Shymanivske Equipment List, the planned route/s, grades and radii do not pose major challenges.

The HH road is identified in principal as the road from Mar'yan'ske to Kryvyi Rih. It is a combination of asphalt and gravel. Transportation for the Ball Mills and other major HH/OD would occur from May to October (to align with the river navigation window at the barge off-load site), which would be safely outside any potential thaw period. In Ukraine, transportation restrictions are determined / imposed by the weather.

18.10 Marine Transportation

Ukraine is well serviced by marine carriers of all types, to its many ports in the Black Sea. There is regular weekly container service and intermittently scheduled Break-Bulk & RoRo services (inducement is viable from nearby international ports for non-containerized cargo). Berthing for Bulkers, Super Heavies, Heavy-Lift, including Post-Panamax vessels is possible at Ukraine's major Black Sea Ports. Current marine infrastructure at existing ports has the capacity to receive all the planned major equipment and materials identified for the Project.

On ocean-going barges for the sea ports, river barges for the Dnieper and Danube river traffic are available in the country or for mobilization within the CIS. Pilotage is easily accessible. Short-sea-shipping on the Danube or Dnieper river systems may be a viable option for some cargo originating in Europe and the CIS.

18.10.1 Container Service



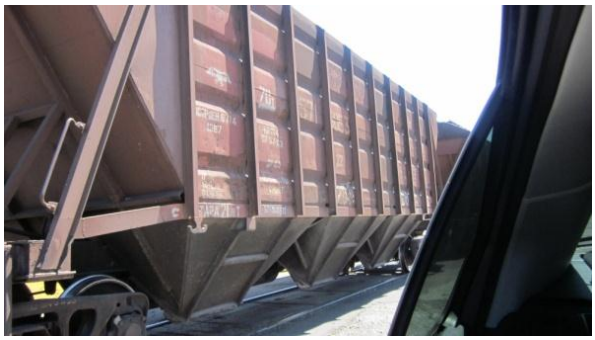
There is weekly container service, either direct or via trans-shipments, to Ukraine ports from North America, South America, Asia, Europe, the Middle East and Africa; also available are more frequent local services on the Black Sea and the feeder services from Egypt, Turkey, Russia, Romania and Bulgaria.

18.10.2 Barge Charter/Time-Charter



For barge transportation, sourcing proper equipment is a key element in the Logistics Execution Plan phase. Presently there is some availability of both ocean and river barge equipment in Ukraine. Supply of ocean and river barges and tugs is very limited globally, and the increasing number of projects increases the demand for them. Barging is the planned method for transporting Ball Mills, crushers and other OD/HH equipment. This activity will be given the foremost consideration in the Logistics Execution plan.

18.10.3 Rail



State-owned rail service is available at every major port to/from many rail ramps/spurs throughout Ukraine. While rail is the preferred mode of transportation for iron ore outbound, it is not as viable for inbound project cargo. With the exception of possible container line partnerships for inter-modal port transfer, and intra-Ukraine steel and construction material supply, rail transportation for inbound project cargo is not recommended because of size restrictions, bridge limitations, and the lack of control over schedules and transit times.

18.10.4 Shipping Envelopes

18.10.4.1 Super Load Transport: Ball Mills

The ball mills, which are the single largest pieces of equipment on the Shymanivske Project, were the primary focus during the in-country routing study to determine the current over-dimensional/HH shipping envelope and other restrictions, including the shipping window. The ultimate goal for transportation of the ball mills and other HH/OD equipment is to transport them by water to the closest practical location, and then to commence HH ground transport activities for the final leg of transport to the job site. In the study, multiple factors were considered at a high level. Some of these include:

- Port capabilities for receiving heavy lift ships;

- Potential areas for safe ship-barge transfer (noting dock structure);
- Availability of shore cranes, and port stevedoring capabilities;
- Custom clearance facilities;
- Navigation channel and berthing depths;
- Heavy-lift ship berthing and port accessibility, in combination with ship-barge transfer capability, to allow marine transportation of the mills to the closest possible viable road with access to the site;
- Seasonal marine navigation/seasonal road restrictions;
- A feasible area for barge off-load operations/ability to secure;
- Infrastructure and road access to port facilities, and at marine-ground transfer operations to the site; and
- Any access or seasonal restrictions for marine and ground transportation.

On the basis of the findings, it is estimated that the maximum single-piece configuration is L 45m x W x 6.5m x H 6.5m.

18.10.4.2 Loads Greater than Legal Loads

The current assumption is that transport configurations above the legal load with dimensions less than those listed below, can, in principal, be transported from all major Ukrainian ports listed in this study to the site location near Kryvyi Rih, once the appropriate permits and approvals have been obtained. The dimensions below include truck/trailer configuration, which is determined on the basis of equipment design.

L 20m x W 5m x H 5m /45t

Any equipment that has the potential for transport configuration to exceed the above limitations will require individual logistics assessment and concurrence.

18.10.4.3 Legal Loads

Standard Tractor/Trailer configuration L 16.5m x W 2.5m x H 4.2m

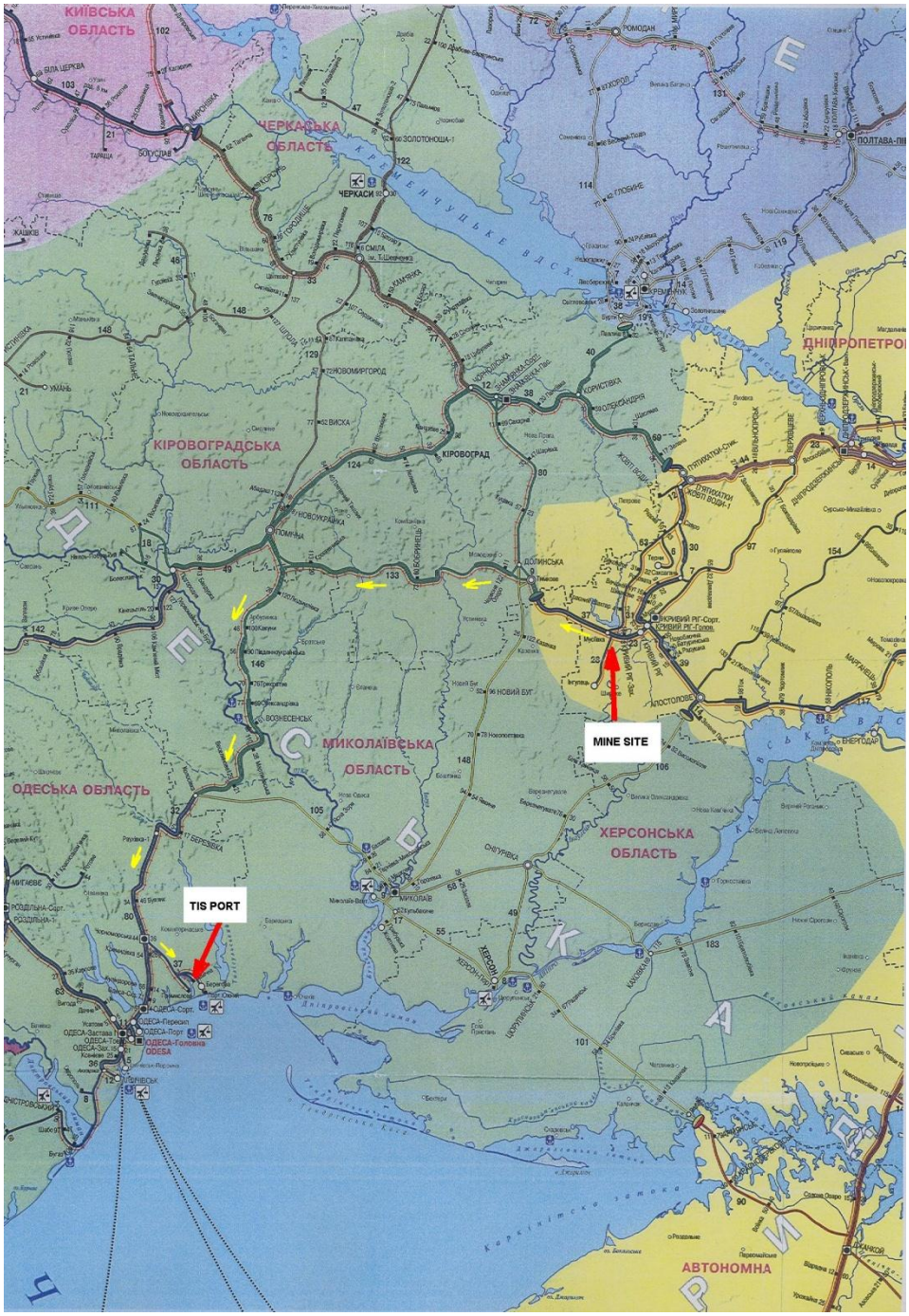
Note: Site-gate access and internal site access are to be determined in the Logistics Execution Plan phase.

18.11 Railway Transportation Study

The Black Iron Project will require the movement of 9.2Mtpa of iron ore concentrate from the Kryvyi Rih-area Moiseevka rail station to the Black Sea ports of TIS-Ruda (Yuzhny) and Nikolaev.

Railcars will be loaded and acceptance operations completed at the mine site. Then the material will be handed over to the UNR, where electric locomotives will transport the trains to the ports.

Figure 18.16: Rail Transportation Map to Port of Yuzhny



18.11.1 Routing, journey length and turnaround Time

There are a number of possible routes for trains from Shymanivske site to the TIS terminal at the port of Yuzhny. The routes vary in length from about 430km to 630km. The actual route taken by any train on any given day will depend on:

- Overall traffic demand for each route and intermediate destinations;
- Priorities of traffic;
- Availability of locomotives (electric or diesel); and
- Any route or track closures for maintenance or repair.

Ukrainian National Railways (UNR) prefers to concentrate traffic on the main electrified lines. On the potential routes that are not electrified, UNR would seek to maximize the handling of traffic in both directions to get the best value for money from the amount of fuel used, which could be up to 10L per km for a heavy freight train on a steeply graded route. For general freight traffic (batches of wagons sorted and shunted between trains at major yards en route), UNR would expect a rate of progress of about 200km per working day of 24 hours. Locomotives and crews complete round trips on regular daily cycles, which fit within their fuel range and the crews' legal working-hour limits. The UNR operational planners advised that a typical trip to or from the port of Yuzhny (nominally 500km average on any of the various routes) should normally be completed within two working days. Assuming that shunting and unloading operations at the port could be completed within one working day, a typical train-cycle time from and back to Shymanivske would be five days. Local sources advise that five days is a typical working figure used by existing freight customers and wagon suppliers for similar trips.

18.11.2 Train Sizing

It is expected that the product shipment will use the open-gondola cars owned by UNR that are typically used in Ukraine for iron ore rail service (poluwagons). Each train will consist of 55 gondola cars in accordance with the standard UNR train size. Each car will be capable of handling 69t of product, and a complete train of 55 cars will therefore move 3,795t of product. The railcar fleet will be equipped to accommodate rotary dumping in order to unload the cars at the Black Sea ports of Nikolaev and TIS-Ruda (Yuzhny).

18.11.3 Train Requirements

As discussed earlier, a typical round-trip time to the port, unloading and returning, is anticipated to be five working days. The 55-car train is the basis for the system design, as it is understood that this train length and weight meet the criteria for the most restrictive conditions for all sections of the expected travel routes. With a five-day cycle time, up to 2,200 wagons may be required to service the Black Iron operations.

18.11.4 Railspur Configuration

In order to facilitate the development of the mine-site rail system, Black Iron engaged SPKR (local railway design consulting company) to develop a rail layout and interface with the UNR, in order to secure approval to connect to the mainline. In August 2012, Black Iron received the preliminary Technical Conditions (criteria for approval) that will govern the tie-in with the UNR, which are based on the SPKR layout.

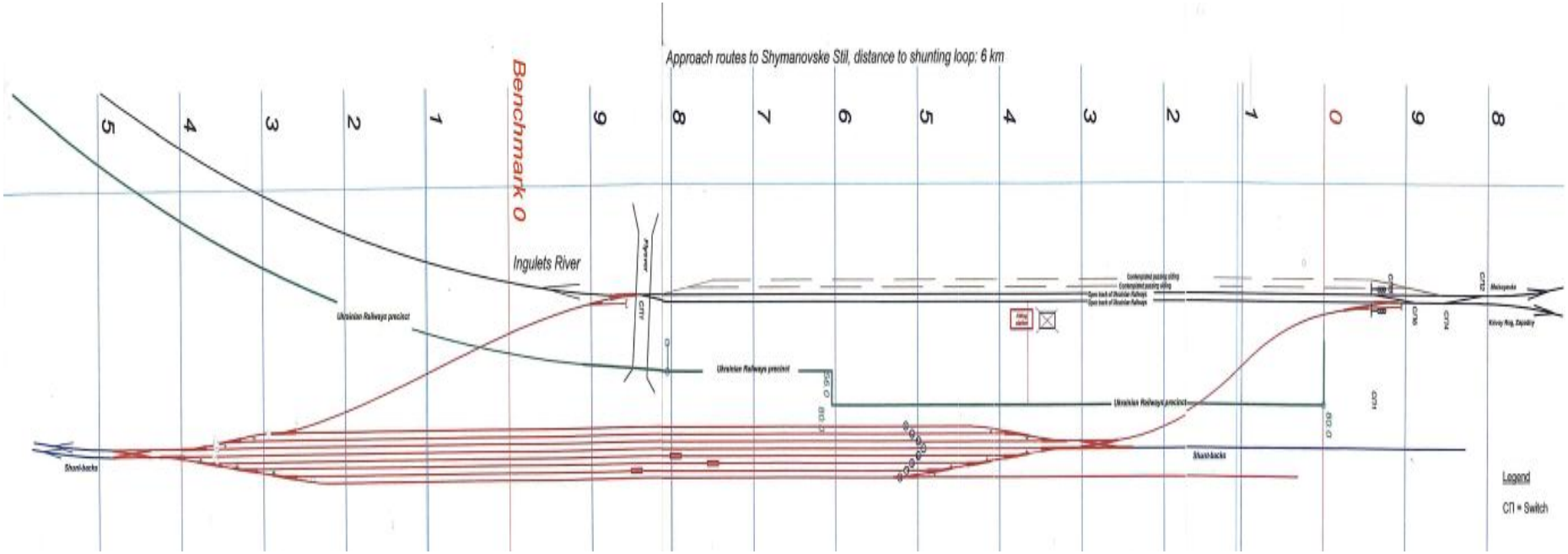
Key features of the layout will be described in the following paragraph. Two tie-ins will be installed in the vicinity of the UNR at the 6.0km mark to accommodate the Black Iron rail operations. One new turnout will be located to the north, near existing switch Number 1 and the second will be located to the south, near existing switch Number 6. Both turnouts will direct the trains to the south-east. Most of the new rail line will be installed immediately to the east of the UNR right-of-way, which is presently treed. Eight tracks will be arranged to handle the majority of the train movements. One track is extended to the north, to allow an entire empty train to pass under the filling station.

At the south end, two tracks have been provided to allow trains to off-load diesel. In addition, the switches and rail will be used to allow locomotives to move between the main tracks.

To accommodate shipping and receiving consumables and items being sent out for maintenance purposes, a dead-end track parallel to the ore-loading track has been included.

In order to facilitate the ore-loading process, diesel locomotives will be used for on-site shunting operations. To minimize the time that UNR electric locomotives will spend on-site, it is expected that there will be one main electrified track where the empty train will be delivered. The UNR locomotive will arrive from the north and drive directly into the receiving track, uncouple from the train and return to the main line via the south switch. When UNR locomotives are coupling to filled trains, they will again approach the tracks from the north, couple to the full train, and then depart through the north spur. Therefore, only the minimum required length of track will be set up to accommodate the UNR electric locomotives.

Figure 18.17: Rail Spur Configuration



Once an empty train has been delivered to the site and the UNR locomotive is clear, a diesel locomotive dedicated to shunting the trains on-site will, as required, relocate the train to adjacent tracks to accommodate the general flow of traffic. It is expected that both commercial and technical inspections of the railcars will be carried out and any defective cars will be removed from the train. Once the train has passed inspection, it will be ready for loading.

The loading process commences as the diesel locomotive pushes the train past the load-out location, at the far northern end of the rail. Then the locomotive reverses and its speed will be maintained at a constant set-point as the train returns to the south. Track scales measure the empty weight of each car as it rolls towards the load-out location. Once the locomotive is clear of the load-out chute, it will be dropped into position and the first railcar will be filled. The volumetric filling system is calibrated to control the rate at which the iron ore filter cake is discharged into the railcar. This filling sequence is directly tied to the travel speed of the train, so that the correct amount is discharged in time for the chute to stop the flow of material and allow the transition from one railcar to the next, without interrupting or altering the train speed. As the railcar continues south and clears the loading area, a second set of rail scales measures the loaded weight of each railcar. With this continuous loading process, it will take only about one minute to fill each car and the entire train will be filled in about one hour.

Loaded trains will be moved to tracks to await the arrival of the next available UNR electric locomotive. Train waybills and related documentation will be assembled and ready for transfer to UNR personnel.

18.12 Port Facility

18.12.1 Port of Yuzhny

The preferred port for the Shymanivske Project is TIS (TransInvestServis) terminal, near Yuzhny in the Odessa region. Construction of the port began in 1973, on the western shore of Adjalykskiy Liman estuary, which lies on the north-west coast of the Black Sea. Chemical products, such as ammonia, methanol, and fertilizers are transported through this port as are bulk cargoes, such as coal, ores and general cargoes. The port has developed rapidly in the last 20 years and has an on-going, well-planned development program for many years to come.

Figure 18.18: Recent Aerial photograph of the Yuzhny Port Area



All aspects are being developed in a balanced manner:

- Lengths and number of quays;
- Water depth and channel width;
- Material unloading, handling, storage and ship-loading facilities;
- Railway siding capacity for sorting, and placing for unloading;
- Capacity of connecting lines to the main line of the Ukrainian railways system (UNR); and
- Supporting services and utilities.

The port management freely provided access and information on relevant questions.

18.12.1.1 RAIL-HANDLING FACILITIES

Some relevant statistics about the rail-handling facilities:

Item	Current total	Near future plan total
Number of sorting yards	1	3
Shunting locomotives	20	Unspecified increase
Max trains per day in / out		60
Coal / mineral wagons handled per day	1,200	4,000
Number of wagon tipplers	1	2
Number of bottom discharge sheds	1	1
Number of thawing sheds for wagons	1	1
Max No of wagons place for unloading	20	20
Max No of wagons in thawing shed	8	8
Open storage capacity (all products / flexible	500,000t	900,000t

The UNR tariff boundary is located between the station at Chernomorska and the TIS rail terminal at Chimicheska station; by agreement, UNR electric locomotives haul trains in and out of Chimicheska. All commercial and technical inspections, document-handling and shunting are carried out at one location. Handovers on the main line at Chernomorska station would be difficult for the same reasons as they would be at Moiseevka.

TIS plans to enter the rail-haulage market within Ukraine's borders in a few years, to provide more control over in-coming and out-going cargoes.

Figure 18.19: Shunting Locomotives at TIS Terminals



18.12.1.2 PRODUCT STORAGE AND SHIP LOADING

The existing open storage areas can hold approximately 800,000t of ore in any combination. There are three open-storage areas equipped with stacker / reclaimer machines and serviced by front-end loaders and conveyor systems. This set-up provides great flexibility among the unloading points, storage areas and ship loaders for export and import.

Storage volumes are fully flexible by product and direction. Black Iron envisages a dockside stockpile of 500,000t. This represents 20 days of inward rail traffic and more than twice the size of the largest ship load. Ship timetabling will be critical to avoiding congestion in the storage area, which might otherwise cause in-coming trains to be held back.

Figure 18.20: Open Storage Areas at TIS Terminals with Stacker and Reclaimer Equipment



Two ship loaders can handle approximately 50,000t per day in total. Ships up to 240,000t can be accommodated in the port. Each mooring has a total length of 250m, but longer ships can use two berths. Water depth is currently 15m, and the Government recently awarded a contract to dredge the port to 21m for completion by 2015. The entry channel is single-lane, and plans are to widen it for two-way traffic.

Figure 18.21: One of the Ship Loaders at TIS Terminals



18.12.2 Port of Nikolaev

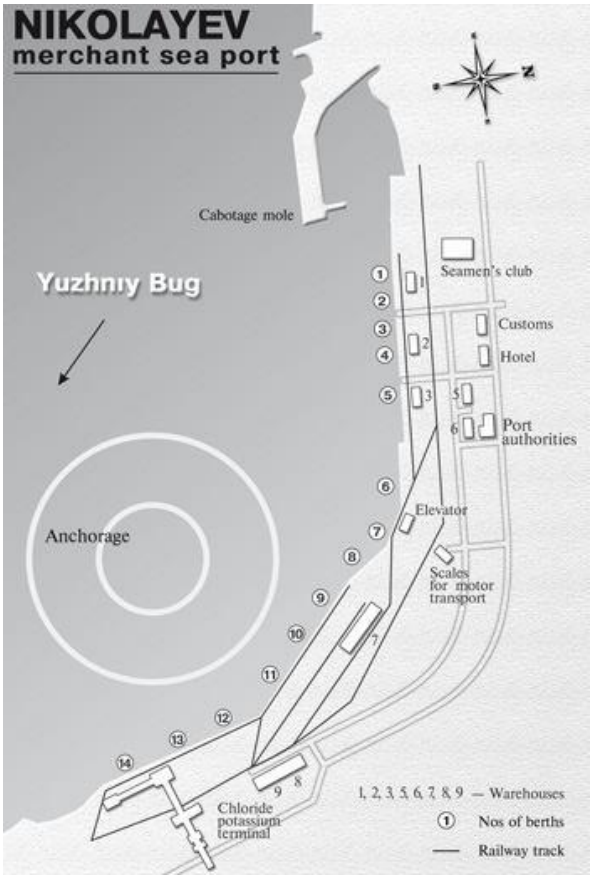
The port is located in the city of Nikolaev, on the left bank of the bend of the Yuzhnyy Bug River, 35km upstream from where the river flows into the Dneprovskiy Liman, an estuary. The port connects with the sea via the Bugsko Dneprovsko Limanskiy Channel (BDLC), passing through the Dnepro-Bugskiy Liman and Yuzhnyy Bug River. This channel starts at Berezan Island and runs 70km to the port of Nikolaev..The channel consists of 13 bends, six of which pass through the Dneprovskiy Liman, and the others through the Yuzhnyy Bug River. The channel is 100m wide and 11.2m deep. Pier No. 4 discharges cargoes from refrigerated carriers transporting items, such as meat, fish, and fruits.

Nikolaev lies nearly 115km to the east of Odessa. The port is open for navigation the whole year round. Nikolaev is neighbored by the port of Dnepro-Bugskiy and the port of the Oktyabrsk and Nikolaev rivers.

Figure 18.22: Port of Nikolaev Location map



Figure 18.23: Port of Nikolaev



The port of Nikolayev is closer to the Shymanivske Project than the port of Yuzhny (236km of rail transfer) but it has limited ship-loading capacity and shallower depth. The maximum handling capacity considered for concentrate sent to this port is 2Mtpa. Because of the shorter distance, the overall transportation cost for this port is more favourable than it is for the port of Yuzhny; however, its limited capacity and depth makes it a secondary port for the Project. For this FS, Black Iron has not obtained an official quotation from the port authorities, and the available pricing information is based on the transportation study performed by Dealex - a local logistics company. In addition, the port tariff used was benchmarked against the average rates paid for ore handling at the ports in the area. No contract has been signed between Black Iron and the Nikolaev port authorities.

19 MARKET STUDIES AND CONTRACTS

WorleyParsons understands that Black Iron Inc. is actively promoting the Project and has engaged in discussions with several clients potentially interested in high grade 68% iron ore concentrate which will be produced at the Shymanivske facility. Black Iron has also been in discussions with service suppliers for rail transportation and a preferred port facility for loading product onto ships. As of the effective date of this report, Black Iron has not entered into any material commercial agreements with any potential client or service supplier.

In November 2011, Black Iron mandated CRU Strategies, a division of CRU International Limited of the United Kingdom, to perform a market study (the “Market Study”). The objective of the study was to provide a view of developments in steel and iron ore markets that would affect the prospects of Black Iron’s proposed Shymanivske iron ore Project and product offering. It is highly likely that all production from Black Iron’s Project would be sold to export markets. Black Iron identified the following countries and regions as its main targets:

- European Union;
- Turkey;
- China;
- India;
- Middle East;
- Japan;
- Korea (South);
- Taiwan; and
- Southeast Asia.

The Market Study provided 10 years of historic data and market forecasts to the year 2036 for three main areas of interest, which include:

- Crude steel and hot metal production;
- Blast furnace capacity; and
- Demand for iron ore.

In the Market Study CRU also provided Black Iron with benchmark prices for pellet feed and pellets, and refined these specifically to Black Iron’s products, FOB Yuzhny, Ukraine.

In September 2012, Black Iron undertook a review of the iron ore concentrate forecasts made by 20 accredited financial institutions across the globe, which, in aggregate, form the “street consensus” for future concentrate, forecasted prices. These forecasts, along with other information, were used to

develop the concentrate prices for the economic analysis of this Project. The assumptions used for concentrate prices are covered in greater detail in Section 22-393 of this Report.

19.1 Crude Steel and Hot Metal Production

China is by far the largest of the target markets. According to world crude-steel production statistics, China produced 627Mt in 2010 and was expected to produce 700Mt in 2011. This represents an average growth rate of 16.6% per year since 2001. No other country or region in the target markets comes close to this performance. Growth rates in the target markets have varied but, in all cases, they lagged behind that of China. For example, in Turkey and India, the growth rates between 2001 and 2011 were about 8%, whereas in the European Union there has been almost no growth.

The most important future trend is the maturation of the Chinese market. Production should peak in 2031 at about 1.34Bt, after which production should fall in absolute terms to 1.23Bt in 2036. Although India and Southeast Asia should show faster growth than China, China will remain more important in terms of production volume.

The mix of BOF and EAF steel-making technology varies widely in the target markets. In China, about 90% of steel production is by the BOF method. Japan also depends heavily on the BOF method. In contrast, the steel production in Southeast Asia by the BOF method is less than 3%. In the European Union, South Korea, and Taiwan steel production by the BOF is in the 50%-60% range. China's high proportion of BOF steel production reinforces its dominance as a consumer of primary raw materials.

Trends in blast furnace, hot-metal production should largely mirror that of BOF steel-making. China will remain the dominant producer of hot metal but the strongest growth will be in India and Southeast Asia.

19.2 Blast Furnace Capacity

According to the CRU study, it is difficult to identify specific expansion in China, even though there must be many in the works, given the seemingly unending increase in hot-metal production. In India, the problem with identifying expansion is the reverse. Approximately 30Mtpa of capacity expansions are committed to come into production between 2012 and 2014 and there is a long list of probable and possible projects. Some known multi-million-tonne projects are not even on the list of possible projects because of uncertainties over where and when they will be built, and what sort of equipment may be required.

New blast furnaces are almost certain to be built in Southeast Asia, especially in Indonesia. It is also probable that new capacity will be built in the medium-term in Malaysia and Vietnam.

In the Market Study, CRU expects only marginal increases in capacity, in the short-term in Japan. All of the capacity increase will come from incremental expansions at existing works.

19.3 Demand for iron Ore

The share of pellets in feed mix of the target markets is expected to increase from 18% in 2011 to 21% over the period of 2016 through 2026. The pellet share will ultimately increase to 26% by 2036.

The share of sinter feed is expected to decrease from 68% to 62% during the forecasted period from 2016 to 2026 and the share of lump feed is expected to decrease from 14% to 12%. The decline in average lump rates is masked by the rapid forecasted increase in Indian steel production. The total volume of lump feed in India is expected to rise.

19.4 Iron Ore Shipping

An iron ore project's proximity to the end user of its product correlates directly with the Project's economics, specifically the margin that will be made on the product sold. Accordingly, Black Iron undertook a review of shipping distances to compare the nautical miles between the Port of Yuzhny in Ukraine, which is the port Black Iron proposes to use, and other major ports in Australia, Brazil, Canada and West Africa, where the competing projects would ship from. A summary of this review is contained in Table 19..

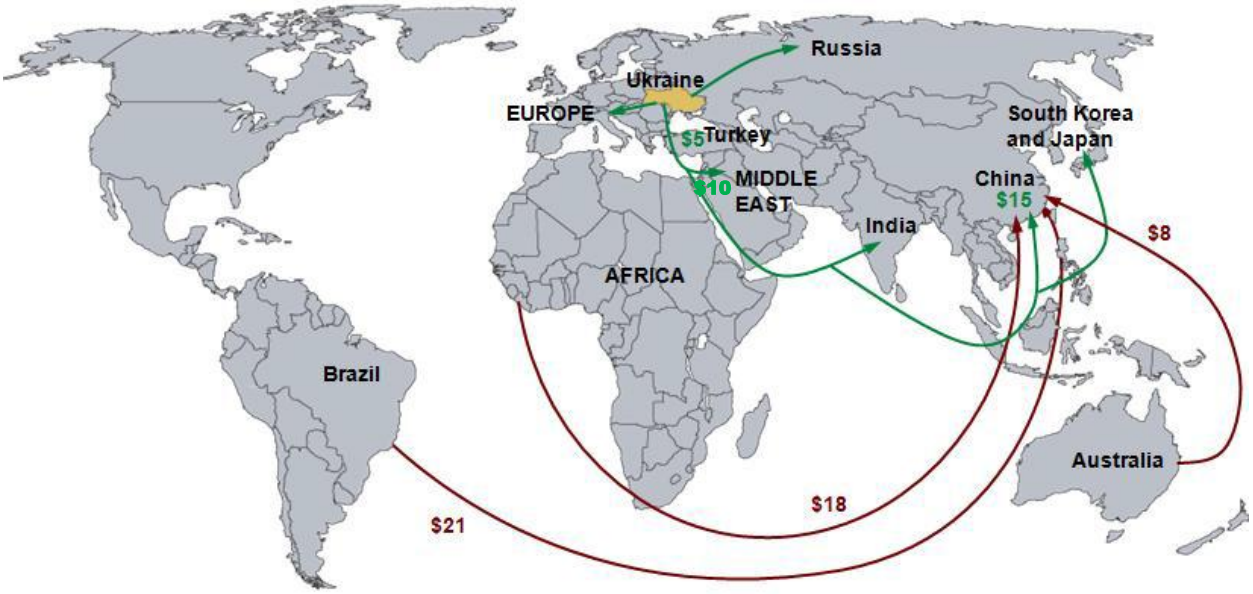
Table 19.1: Nautical Shipping Distances – Iron Ore

Port of Landing	Port of Origin: Ukraine (Yuzhny)	Australia (Dampier)	Brazil (Paranagua)	Canada (Halifax)	West Africa (Freetown)
Turkey (Ambarli)	374	7,066	6,282	4,435	3,725
Egypt (Alexandria)	1,084	6,435	6,307	4,460	3,751
UAE (Abu Dhabi)	4,085	4,846	8,320	7,512	6,803
India (Goa)	4,409	3,566	7,891	7,836	7,216
China (Quingdao)	8,572	3,471	11,274	11,011	11,070

Source: searates.com

On the basis of this review, Black Iron has prioritized its end markets to Turkey, the Middle East and India as its primary targets because of the shipping advantages. It has identified the Asian market as an additional target market because of the size of the market, its propensity to participate in the development of capital for iron ore projects, and the shipping advantage it represents relative to North and South American suppliers (as evidenced by the locations of Brazil and Canada).

Figure 19.1: Typical shipping costs for Iron ore



19.5 Conclusion

Given this preliminary assessment of the end markets available to Black Iron, and the shipping advantages that exist from the port in Ukraine—as opposed to competing projects in Australia, Brazil, Canada and West Africa—it can be concluded that the most appropriate marketing strategy for the Company is to actively explore and pursue commercial opportunities across a wide array of geographies, including Turkey, the Middle East, India, China and East Asia.

20 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

20.1 Environmental and Social Management of the Project

20.1.1 Management Resources Committed to the Project

The Project has a full-time environmental and social management team employed by Black Iron, whom are located in Kryvyi Rih and have extensive experience with the local conditions in addition to iron ore and metallurgical environmental norms. Alexander Sobko, an Accredited Ukrainian Environmental Engineer, with 22 years of experience, is in charge of these aspects of the Project. He has extensive experience in iron ore mining and metallurgy within Kryvyi Rih and is Black Iron's HSE Manager.

The environmental and social management office has commissioned the Ukrainian Design Institute Tyazhpromavtomatika (TPA) which in Russian, is called ЧАСТНОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО ТЯЖПРОМАВТОМАТИКА-to undertake environmental and social baselining and impact-assessment activities. TPA has subcontracted work-packages to individual experts.

Black Iron has commissioned WorleyParsons, to lead the environmental and social program, which includes some components of self-performed data collection and assessment.

20.1.2 Regulatory Requirements

Overview

The Ukrainian Environmental Impact Assessment, or the Otsinka Vplyvu na Navkolyshne Seredovysce (OVNS), is required by law to be approved by a State Environment Review (SER) prior to commencement of Project development activities. Legally, the OVNS can be prepared and submitted only by a suitably authorized Ukrainian design institute.

The OVNS process has some similarities to an Environment, Social and Health Impact Assessment (ESHIA), as undertaken in other countries. However the OVNS process is generally viewed as a compliance procedure, whereby the determination of the calculated emission and pollutant level that falls beyond a statutory sanitary (or buffer) zone, must be reduced to compliance limits. This determination is the basis for the regulatory approval decision.

In comparison, the international ESHIA process, as codified by the World Bank, puts more emphasis on a risk-based determination that incorporates environmental, social and health aspects in the design and the planning process from the outset of a project, with a view to creating a sustainable project with acceptable environmental, social and/or health risks. This procedure requires either eliminating in the design phase any major causes of potentially adverse impacts or providing management strategies for the impacts from the outset.

Ukraine has announced that it is set to harmonize its environmental and social laws with the European Union and that it is pursuing adoption of EU law by 2017. With this in view, Black Iron Inc. has taken the step of commissioning WorleyParsons to design an environmental and social management program for the Project, so that the facility will meet World Bank ESHIA standards once the Project's OVNS permit is ensured.

WorleyParsons has prepared a Scoping Report (Ref. WorleyParsons, 2012a), which outlines baseline studies that are required for the OVNS as well as for the delineation of the Sanitary Zone. The Scoping Report has identified additional studies and areas where enhanced depth of enquiry, or a wider geographical coverage than normal under an OVNS, would be needed to satisfy the requirements for baseline studies to meet international standards according to ESHIA guidelines.

Applicable Environmental Legislation

Mandatory regulatory requirements and standards for the Project include the following:

- Ukrainian laws and regulations;
- International environmental treaties and conventions that Ukraine is signatory to; and
- International agreements.

Voluntary codes and practices referred to in this report include;

- Guidelines and standards from the World Bank / International Finance Corporation (IFC); and
- Industry association standards (cf. industry best practice).

The hierarchy guiding the use of guidelines, national and international environmental standards and management objectives has been set out in detail in the report "*Environmental and Social Basis of Design"* (WorleyParsons, 2012b).

In summary, primacy is given to national standards, so that, whenever the Ukrainian regulatory framework is unclear on environmental and / or social matters, the Project shall follow the guidelines and standards from international sources, as well as industry best practice, whenever possible.

The "Environmental and Social Basis of Design" presents the source references for environmental performance standards for all engineering design work throughout the Project. It is, in turn, supported by more detailed specifications, including "Water Quality Design Criteria" (WorleyParsons, 2012c); "Water Management Basis of Design" (WorleyParsons, 2012d); "Design Criteria Air Quality / Dust" (WorleyParsons, 2012e); and "Design Criteria Noise / Vibration and Blasting" (WorleyParsons, 2012f).

A high-level legislation review has been undertaken (refer to the "Scoping Report" (WorleyParsons, 2012a) and a full regulatory review will be completed, as part of the OVNS.

20.1.3 Previous Work

The following documents have been used as the basis for assessing potential Project-related impacts and possible mitigation measures:

- "Shymanivske Project Feasibility Study- High-Level Scoping Report on Potential Environmental, Health and Social Aspects of the Proposed Shymanivske Iron Ore Project, Dnepropetrovsk Region, Ukraine" (WorleyParsons, 2012a);
- Report of the First Series of Sampling (TPA, 2012); and
- Stakeholder Engagement Plan (Black Iron, 2012a).

Guiding documentation includes;

- "Environmental and Social Basis of Design" (WorleyParsons, 2012b);
- "Water Quality Design Criteria" (WorleyParsons, 2012c);
- "Water Management Basis of Design" (WorleyParsons, 2012d);
- "Design Criteria Air Quality / Dust" (WorleyParsons, 2012e); and
- "Design Criteria Noise / Vibration and Blasting" (WorleyParsons, 2012f).

20.1.4 Current Status of Environmental Work

Since 2010, Black Iron has been reviewing the environmental and social baseline and context of the Project and establishing appropriate data-collection programs, impact-assessment studies, consultation programs and design criteria, so that the Project can meet the required environmental and social standards. BBA (2011) outlined the general environmental and social compliance requirements for the Project, including an overview of the regulatory process.

In April 2012, following a technical and commercial tendering process, Black Iron Inc. commissioned TPA to undertake the OVNS baseline surveys and to define the boundaries of the Sanitary Zone.

Baseline data collection commenced in June 2012, in line with a program of surveys that had been designed collabouratively between TPA and WorleyParsons.

Prior to this, WorleyParsons had undertaken desktop studies and literature reviews to develop a better understanding of existing conditions in the Project area. This information was used as the basis for the preliminary environmental aspects risk register and assessment to identify the priorities for baseline data collection, given the absence of available existing, site-specific information.

WorleyParsons conducted a number of surveys in tandem with the OVNS baseline surveys, in order to enhance the design and engineering work and develop a more comprehensive understanding of project risks and approaches to managing the risk assessment. The "Scoping Report" (WorleyParsons, 2012a) presents the findings of these surveys and outlines potential environmental and social issues and risks that need to be addressed by the Project during the design phase and during construction and operations.

TPA conducted the first round of OVNS baseline surveys during the months of June and July 2012. Given that the report became available only in August 2012, the results of the surveys were not incorporated in the "Scoping Report" issued by WorleyParsons at the beginning of August 2012. Since then, the main results have been reviewed and are presented herein.

20.2 Environmental Setting

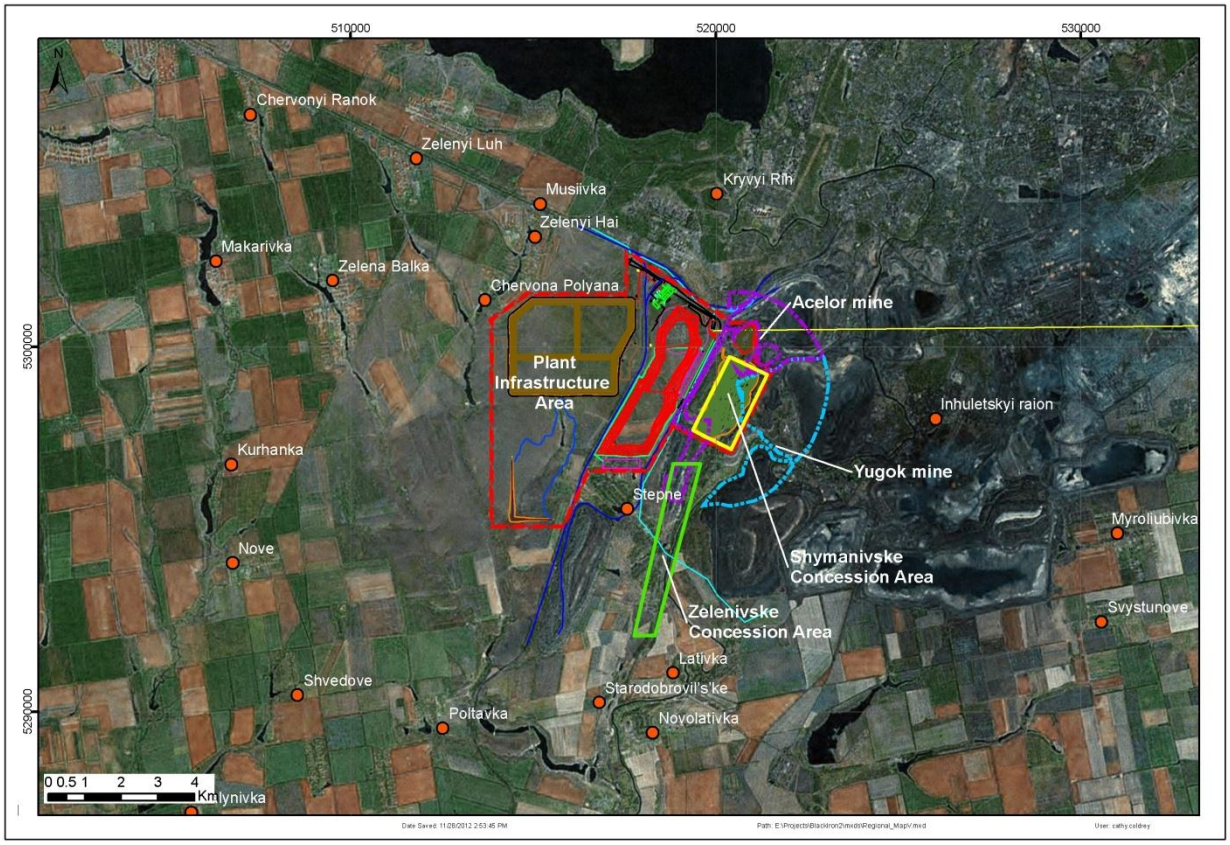
This section presents a summary of available information regarding the existing environmental and social conditions in the Project area. Specifically, it addresses air quality, ambient noise levels, soils and geology, ecology and biodiversity, and water and socio-economic issues.

Additional information about existing conditions is presented in "Shymanivske Project Feasibility Study Scoping Report" (WorleyParsons, 2012a).

The Shymanivske iron ore deposit is part of a well-established iron ore mining area with several active iron ore mining operations surrounding it. The special permit under which the Project operates covers an area of 256ha and is located 330 km south-east of Kiev, in central Ukraine.

The Shymanivske deposit is located 8km south of the city of Kryvyi Rih and approximately 6km south-east of the Karachunivske Reservoir. The site is surrounded by the villages of Rudnichne, Stepne, Chervona Polyana, Zelenyi Hai and Musiivka (Figure 20.1). Project development and operation will be in addition to the existing mining activity in the surrounding area north of the villages of Novoselivka, Lativka and Starodobrovil's'ke.

Figure 20.1: Location of the Shymanivske Deposit



The city of Kryvyi Rih is dominated by heavy industry, particularly mining and metallurgy. Directly to the east of the Shymanivske Project site lie the mines of ArcelorMittal Kryvyi Rih (also known as Kryvorizhstal) and YuGOK (the Southern Ore Mining and beneficiation plant). Land use in the wider, arable region of Kryvyi Rih is primarily agricultural.

20.2.1 Air Quality

Air pollution is a significant existing issue in Kryvyi Rih. Local air quality is adversely affected by gaseous emissions and dust generated by existing mining activities and related metallurgical processing industries.

Air-quality data from government monitoring stations (PSZ) located in the city of Kryvyi Rih provide a general overview of the conditions in the vicinity of the Project from 2008 to 2011, but the data are not considered representative of the background levels at the Project area because the monitoring points are located more than 10km from the site.

Three short-period rounds of monitoring were conducted between July and August 2012 at selected locations within the Project area by TPA and WorleyParsons to measure background levels of:

- Nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon monoxide (CO); and

- Total suspended particles (TSP) and particulate matter (PM_{10} and $PM_{2.5}$).

Results from the air-quality monitoring campaigns are described below and compared with national and international standards, as follows:

- The site-specific background concentrations of NO_2 and CO measured by TPA and WorleyParsons were below the limits set by national and international standards.
- SO_2 concentration at one of the locations tested by TPA was found to be 0.45mg/m^3, which is slightly above the limit set by the EU for a 1-hour average period (0.35mg/m^3) but is below the national standard (0.5mg/m^3).
- SO_2 concentration at four of the sampling locations measured by WorleyParsons were found to be equivalent to or slightly exceed the WB / IFC daily limit of 0.02mg/$m^{3,}$ averaging 0.025mg/$m^{3,}$ but they were below the limits set by the national legislation.
- Total dust levels measured by TPA during their monitoring campaign were in the range of 0.18 - 0.32mg/m^3, which exceeds the national limit for a 24-hour average period (0.15mg/m^3) but they are below the one-time maximum national limit (0.5mg/m^3).
- Similar results were found by WorleyParsons (0.07 – 0.4mg/m^3) during its first monitoring campaign (8-hour sampling, July 2012), although these results were obtained at different locations and are not directly comparable.
- The total dust levels measured during the second monitoring campaign by WorleyParsons (Aug 2012) were below the one-time maximum national limit, but at two of the locations, the 24-hour dust levels exceeded the national 24-hour average limit during four out of the seven sampling periods (averaging 0.19mg/m^3).

Although the roundS of sampling are somewhat limited, the results indicate that baseline air-quality conditions at the Project site are adversely affected by existing operations and activities.

20.2.2 Noise

Existing sources of noise in the Project area include the active mining operations of ArcelorMittal and YuGOK, the double-track Musiivka–Kryvyi Rih railway line, and the road network that connects Kryvyi Rih with various villages located south of the city. There is no industrial or commercial activity in the villages close to the Project site and traffic levels are light.

TPA and WorleyParsons undertook noise-monitoring surveys at various locations around the Project site during July 2012.

The results of TPA's monitoring showed that:

- The highest LA_{eq} level (52dBA) and LA_{max} level (68dBA) were found in the village of Zelyonaya Balka. Neither of these levels exceeds the national limits of 55dBA for LA_{eq} and 70dBA for LA_{max}.

- Zelyonaya Balka is the largest settlement in the vicinity of the Project and has the best- developed infrastructure and largest population. The high noise levels are thought to be attributable to higher levels of automobile traffic at this location, although this requires confirmation.

TPA did not identify any sources of continuous industrial noise at any of the monitoring locations.

In contrast, during its monitoring survey, WorleyParsons recorded a LA_{eq} of 62.8dBA at one of the monitoring locations and found that the national standard of 70dBA for LA_{max} was exceeded at five of the 10 monitoring locations.

The main noise sources observed at the monitoring sites were cars, small groups of people talking, sounds from houses and farms, naturally occurring sources (e.g., wind blowing through vegetation and birds singing) and, in some locations, trains on the Musiivka–Kryvyi Rih railway line.

It is unclear why the noise baseline at the non-industrial residential monitoring points exceeded the national standards when only low-level noise sources were apparent. Therefore, the possibility of a pervasive background industrial noise-base from the mining and metallurgical industries in the vicinity should be considered. Field procedures and selection of permanent noise-monitoring stations require validation. In brief, it is recommended that the results of the WorleyParsons monitoring survey be taken as the baseline conditions and that repeated noise measurements be taken to confirm the baseline.

20.2.3 Soils and Geology

The Shymanivske iron ore body extends in a north-northeast direction for over 100km. At Kryvyi Rih, the basement rocks are overlain by a cover of sedimentary, superficial deposits from the Cenozoic Era. The superficial cover comprises a 20-30m-thick sequence of loess silts containing clays and calcareous inclusions, weathered out from an in-situ calcareous limestone layer overlying the crystalline basement rocks.

The ore body is characterised as a Banded Iron Formation and is located in a predominantly quartzite host rock which is acutely folded and vertically orientated into a syncline with localised over-thrusting, faulting and stacking of units, constituting a layered and economically significant ore concentration.

The majority of the land in the vicinity of the Project site is covered by low, humic (high organic content) black soils, which occupy undulating plains and gentle slopes. Heavy loam soils dominate in the north of the region, whilst light loams dominate in the south.

Historically, variable thicknesses of mining waste (waste rock) have been dumped on the natural superficial deposits of the east and west flanks of the Project's primary ore body. This material has substantially settled and re-vegetated over time but, judging by its deposition as an informal mining waste, it is expected to contain sizeable void space and heterogeneity.

TPA conducted a limited surface soil survey during May and June 2012, and collected soil samples at 16 locations (not randomized or stratified) across the Project site. The results of the survey were as follows:

- There are indications of low-level industrial fugitive contamination of surface soils, including exceedances of the maximum allowable concentrations (MAC) for lead (recorded level of

36.2mg/kg vs. MAC of 32mg/kg), cadmium (recorded level of 8.2mg/kg vs. MAC of 2mg/kg) and copper (recorded level of 3.6 and 3.1mg/kg vs. MAC of 3.0mg/kg in at least one of the sampling locations). The source of heavy metals is believed to be wind-blown dust from neighbouring mine / processing sites.

- Soils are generally not saline, but are reported to contain relatively high levels of nitrates (NO_3^-) exceeding the maximum allowable concentration of 130mg/kg at 9 of the 16 locations sampled. The maximum nitrate level in the soils was 309mg/kg; the level of phosphorus was in the range of 7-31mg/kg with a MAC = 15mg/kg; and fluorides (F^-) were in the range of 0.8 – 5.6 mg/kg, except at one sampling location, where a level of 18.5mg/kg was recorded (MAC = 10mg/kg). These levels may indicate industrial contamination: fluorides belong to one of the priority pollutants of soils in the Dneopropetrovsk Region, where high levels are associated with industrial emissions from alumina and non-ferrous plants.
- No issues associated with contamination from radiation, pesticides, petrochemicals or hydrocarbons were identified, although the testing to date has not been carried out at a sufficient sampling density to rule out the possibility of contamination hot-spots being present and undetected.

An intrusive geotechnical test program comprising ten medium-depth boreholes is currently underway, which will provide more site-specific details on the sub-surface geology. Results have yet to be returned.

20.2.4 Ecology and Biodiversity

Although existing mine and neighbouring industries have affected the ecological value of the Project area and pockets of important habitats and ecosystems still remain, there are no designated protected areas in the vicinity of the site. A review of flora and fauna in and around the Project site is highlighted in the following:

- Habitat is generally characterized as disturbed vegetation cover, containing remnant examples of forest, steppe, meadow and aquatic vegetation, which is strongly influenced by intensive anthropogenic activities.
- Amphibians and reptiles are not abundant in the area, being represented by only five species. The observed amphibians are common toad (*Bufo bufo*) and lake frog (*Rana ridibunda*); the observed reptiles are sand lizard (*Lacerta agilis L.*), grass snake (*Natrix natrix L.*) and steppe viper (*Vipera renardi Christ*), which is classified as endangered in the *Red Data Book of Ukraine* (RBU).
- Birds are highly diverse in the Project area; 35 species are present, of which three are identified as rare in the RBU: long-legged buzzard (*Buteo rufinus Cretz.*), scops owl (*Otus scops L.*), and great gray shrike (*Lanius excubitor L.*). In the *Red Book of Dnepropetrovska Oblast,* two are listed as endangered: whooper swan (*Cygnus cygnus L.*) and tawny pipit (*Anthus campestris L.*).
- 17 species of mammals are present in the Project area, of which seven are registered in the RBU: bicoloured white-toothed shrew (*Crocidura leucodon*) is registered as insufficiently known; common noctule (*Nyctalus noctula*) as endangered; parti-colored bat (*Vespertilio murinus*) as

endangered; polecat (*M. iutorius*) as endangered; southern birch mouse (*Sicista subtilis*) as endangered; mole rat (*Spalax zemni*) as insufficiently known; and common hamster (*Cricetus cricetus*) as unrated.

- Three species of plants identified in the Project area are included in the *Green Data Book of Ukraine* (GBU, compiled to protect and conserve vulnerable species). The species are bunchgrass (*Stipeta capillatae*), feather grass (*Stipeta lessingianae*), and shrub (*Amygdaleta nanae*). A further eight species present in the Project area are identified in the RBU, *World Red List* (WRL) *European Red List* (ERL) and in *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES). These species are *Adonis wolgensis* (RBU), *Adonis vernalis* (RBU and CITES), *Astragalus odessanus* (RBU), *Astragalus henningii* (RBU, WRL and ERL), *Phlomis hybrida* (ERL), *Stipa capillata* (RBU), *Stipa lessingiana* (RBU), and *Linaria biebersteinii* (WRL).

20.2.5 Water

Groundwater

Information collected as part of the Scoping exercise indicates that there are likely to be two groundwater bearing units in superficial geological units within the boundaries of the Project site: a shallow upper Quaternary loess-type aquifer and a deeper aquifer unit in the Pontic and Sarmatian sand and limestone. The Sarmatian limestone is reported to be karstic at the mines located to the east of the Shymanivske deposit. Limited deeper groundwater is present in the basement bedrock, principally confined to fracture and fissure areas.

The upper Quaternary aquifer is recharged through infiltration and from leakage through storage ponds and man-made drainage ditches located on the neighbouring mine sites. The Quaternary aquifer is underlain by low permeability Miocene-Quaternary clays, which, in turn, overlie the Pontic-Sarmatian aquifer. This lower aquifer comprises up to 15m of fine-grained sand and fissured limestone, which is occasionally clayey and karstic. The aquifer overlies a low-permeability Palaeogene Kiev clay, which is present above the basement rock across the whole area.

Groundwater flows are generally towards the Inhulets River, although they are complicated locally by the presence of ravines and localized leakage from the storage ponds on neighbouring sites. Groundwater in the limestone can also discharge to the streams located within the site area.

Historically, the groundwater quality in the area has been compromised by leakage (gradual and catastrophic) from storage ponds at other mine sites. This has reportedly led to a reduction in reliance on groundwater as a source of drinking water in the surrounding villages (mainly to the south of the current mine sites), with mains water supplied instead. However, three drinking-water wells have been identified in Zelena Balka and Zelenyi Hai, located to the north and west of the tailings storage facility. Water from these locations has been sampled by TPA as part of their OVNS baseline sampling studies.

The results of the chemical tests on pre-Project baseline water sampling from the wells indicate that the water does not meet the requirements for drinking because it contains levels of suspended solids, organic

substances, salinity, sodium, cadmium, nickel, magnesium, manganese, sulphates and chlorides—all of which exceed the national standards.

Further testing includes packer tests to determine aquifer properties, and is taking place in conjunction with the geotechnical program.

Surface Water

The Shymanivske Project site is located approximately 5km to the west of the River Inhulets and 6km south of the Karachunivske Reservoir. A small unnamed tributary of the River Inhulets drains across the Project site and there are several small tributaries and ponds surrounding the site.

The River Inhulets is a tributary of the River Dnieper. The Karachunivske Reservoir impounds the River Inhulets to the west of Kryvyi Rih. The River Inhulets is predominantly supplied by rainfall-runoff, although there is some groundwater recharge (Alyokhina *et al.*, 2007). Concerns have been raised about high levels of contamination in both the Inhulets and the Dnieper basin, which provide a range of environmental services. Identified contamination sources include mining and metallurgical processing and particular concern is expressed about the capacity of these systems to take any further degradation or impact from human activity (Borysova, O. *et al.,* 2005), particularly as the Dnieper is a trans-boundary system.

TPA conducted a surface-water sampling campaign in May and June, 2012, at 17 locations in and around the Project site. Six of the sampling points were located on the River Inhulets, one at Karachunivske Reservoir and the remaining 10 on the ponds surrounding the site.

A summary of the results of the pre-Project baseline surface water monitoring for the River Inhulets and Karachunivske Reservoir is given below. Note that the MAC for fisheries ($MAC_{fishery}$) is the most stringent Ukrainian water, quality standard applicable to surface waters and it is the standard to be adhered to. The following findings summarize the surface water quality:

- The water is moderately saline, with total dissolved solids (TDS) ranging from 1,090 to 2,380mg/l, which exceeds the standard MAC for public utility use (MAC_{p-u}) of 1,000mg/l (there is no $MAC_{fishery}$ for salinity).
- Sulphates (SO_4^{2-}) range from 400 to1,500 mg/l, which is 4 to 15 times greater than the $MAC_{fishery}$ of 100 mg/l and up to three times greater than the·MAC_{p-u} of 500 mg/l.
- Chlorides (Cl^-) are generally below permissible levels, although at one sampling point on the River Inhulets just to the south of the YuGOK mine site, the chlorides were measured at 350mg/l, which is 1.5 times the·$MAC_{fishery}$.
- The concentration of calcium immediately downstream from Karachunivske Reservoir is 255mg/l ($MAC_{fishery}$ is 180mg/l).
- The concentration of magnesium exceeds the $MAC_{fishery}$ value at all sampling points. The high concentration of sulphates, calcium and magnesium in the surface waters correlates with high values of TDS.

- Concentrations of sodium vary from 126 to 280mg/l, which is up to 2.3 times that of the MACfishery.
- The values of chemical oxygen demand (COD) and biochemical oxygen demand (BOD) indicate that the surface waters are polluted by organic substances. COD ranges from 18 to 26mgO2/l, which exceeds the MAC value for utility and drinking water reservoirs (MACu-d, 15mgO2/l) but is below the respective value for amenity reservoirs (30mgO2/l). The BOD value ranges from 4.9 to 9.7mgO2/l, which exceeds the MACp-u and MACfishery (3mgO2/l).
- High levels of aluminium, manganese, copper, nickel, zinc and chromium are present at several of the sampling locations.
- Levels of arsenic, petrochemicals and phenols are found to exceed the MACfishery standards (0.1, 0.05 and 0.001mg/l respectively) at a number of sampling locations.
- Recurrent excess of the lactose-positive Bacillus coli (LPBC) is typical of the water in and downstream of Karachunivske Reservoir and in the area of the southern industrial complex of Kryvyi Rih. Although the water tested shows levels of LPBC below the standard of 5,000 per litre, it is understood that in terms of average annual values, the maximum values exceed the standards twice, returning a value of 11,000 per litre.

Pre-Project baseline testing of water samples from the ponds surrounding the Project site also indicate that the water has been impacted and, in some instances, significantly polluted (the pond in Chervonaya Polyana) with measured sulphate and chloride concentrations, showing fluctuations between 1,276 and 12,870mg/l (the standard values are 100mg/l and 300mg/l, respectively).

Environmental concerns have been raised with respect to the mines located to the north of the city, which store both effluent and produced waters from abandoned mines in their tailings dams. Between November and February every year, this water is released into the River Inhulets about 7km downstream of the city limits. The Inhulets is continuously flushed with water that is released from the Karachunivske and Makorty reservoirs, respectively, in order to improve the water quality.

20.2.6 Socio-Economic Setting

The main source of employment for Kryvyi Rih is metallurgy; in 2009, 70% of the local population was employed in the steel industry. The impact from such a high density of mining and metallurgical activity in one location is apparent and the Scientific Hygienic Centre of Ukraine states: “The city of Kryvyi Rih is considered one of the most unfavourable places to live.” (*Bankwatch*, 2012)

Currently, there are five villages in the direct vicinity of the proposed Project (Rudnichnoe, Stepne, Chervona Polyana, Zeleny Hai and Musiivka), and many more are potentially influenced by wind or groundwater or the waters of the River Inhulets. The development of the Shymanivske Project will necessitate the relocation of Rudnichnoe village, which has a population of approximately 1,200.

In addition to contamination of water sources in and around Kryvyi Rih, the city has high concentrations of pollutants in atmospheric air and soil (Pistunov and Antoniuk, 2011). It is reported to be the most polluted city in the Dnepropetrovsk region and high rates of disease have been recorded in the population. In

recent years, the number of cancer cases (tracheic, bronchial and lung), all forms of tuberculosis, strokes, cardiac infarction, iron deficiency anaemia and pregnancy pathologies have increased (Pistunov and Antoniuk, 2011). Studies have determined that population disease rates in Kryvyi Rih are highly correlated with polluting factors, in particular onco-pathology and lead.

Currently, the villages of Chervona Polyana and Zelenyi Hai are separated from the existing mine sites by over 5km of fields. With the development of the Shymanivske project, the closest infrastructure to the eastern side of Chervona Polyana and Zelenyi Hai will be tailings cells 2 and 3.

20.3 Preliminary Identification of Issues

Bordered by the mines of ArcelorMittal Kryvyi Rih and YuGOK and located on disturbed land, the Shymanivske Project is characterised as a brownfield site. Its environs show extensive geomorphological change and are characterised by relatively high levels of historic pollution.

Given that there is already a high level of degradation caused by current industrial activities in the area, the focus of an assessment of a new project such as the Shymanivske Project is to understand what will be the cumulative effect, if any, and try to determine the *significance* of it. This should lead to a determination of how *acceptable* any change in conditions from the current environmental and socio-economic conditions will be.

It is entirely plausible that the magnitude of Project-related impacts for some environmental media, such as dust concentrations, will be relatively small while the significance of the incremental increase will be great because of degraded conditions.

The key environmental and social issues associated with the Shymanivske Project are summarized below, for each of the environmental and socio-economic media previously considered. A more detailed description is provided in the “Scoping Report” (WorleyParsons, 2012a).

20.3.1 Air Quality

NOx, SOx and CO

The principal source of airborne emissions is expected to be the exhaust emissions from generators, engines, vehicles and heavy equipment. The impact of these activities on air will be quantitatively assessed as part of the OVNS. The development of an air-dispersion model to predict how air quality will evolve as a result of the routine operations of the Project is currently under development. The impact assessment will require an estimate of the Project’s contribution to existing background levels, and the results obtained will be compared with the applicable air-quality standards.

Provided that standard control measures are included in the engineering design and operation of the Project, it is not expected that the Project will cause a significant increase in the levels of these gases so that they exceed the permissible national limits.

Dust

Dust emissions will be produced during all stages of the mine lifecycle from a multitude of sources, including vegetation clearance during the construction phase; earth movements, such as the creation of new access roads, grading and levelling of the railway route and the placement of auxiliary installations (e.g., process plant in the mine and facilities at the port site); the movement of vehicles and operation of heavy equipment on unpaved roads; and bulk material and waste management, such as loading, unloading, road transportation and stockpiles.

During the operational phase dust will be generated by mining, blasting, processing and will be a consequence of wind removal from waste-dumps, stockpiles and the tailings facility.

Given the indications that background dust concentrations at certain locations around the Project site are already exceeding national limits due to dust emissions unrelated to the Project, dust-control measures for principal dust sources will be a main objective and stipulation for the Project.

In order to systematically design and focus on key dust sources and determine the most beneficial control measures, additional air-quality surveys are required during a range of climatic conditions and an air-dispersion model will need to be developed. This will enable accurate predictions of expected contributions of dust from routine operations and an accurate determination of the Project's impact on dust levels and associated air quality.

Initial analysis of predominant wind direction during the years 2000 to 2010 indicates that the wind mainly blows from the northeast to the southwest ("Scoping Report," WorleyParsons 2012a). This means that dust produced by the proposed Project, in particular activities on the mine pit, waste dumps, process plant and tailing pond, blows away from the densely populated areas in the southern end of Kryvyi Rih. Therefore, the plant site and production facilities are favourably located, so that there are no communities in the prevailing wind direction towards the south-west.

20.3.2 Noise

Principal sources of noise during the construction phase will include fabrication and construction, piling, ground preparation, machinery engines, vehicles used for transport, loading and unloading of rock and materials, and chutes and power generation if diesel generators are required for emergency purposes. During the operation phase, sources of noise will include vehicle engines, loading and unloading of rock into steel dumpers, shovelling, ripping, drilling, blasting, transport (including corridors for rail, road, and conveyor belts), crushing, grinding, and stockpiling.

Noise emissions from the Project will be controlled, so that they do not exceed the national standards of 55dBA for LA_{eq} and 70dBA for LA_{max}. Control measures shall be implemented to ensure that the noise emissions from the Project, measured at appropriate compliance points when overlain on the background levels, do not cause national standards to be exceeded.

Additional noise monitoring over a prolonged period is being carried out to establish noise emissions around the site and how they vary at different times of day, on different days of the week and under different meteorological conditions. This information will be incorporated in a model to map noise "hot

spots." Predicted noise emissions will be calculated for the construction and operations phases of the Project and these emissions will be included in the model. The model can then be used to identify the required control measures to be implemented, in order to protect key receptors from elevated noise emissions over the lifecycle of the Project.

Key receptors are the villages of Rudnichne, Stepne, Chervona Polyana, Zelenyi Hai and Musiivka.

20.3.3 Soils and Geology

The immediate footprint of the Shymanivske Project will experience a range of irreversible soil impacts associated with the land-use change. The principal soil and geology issues are:

- Outside the site boundary, there is the potential for contamination of soils from windblown dust, contaminated groundwater or surface water and/or through the disturbance and mobilization of current anthropogenic or natural soil contamination;
- There is uncertainty as to whether oxide layers in the deposit, containing pyrrhotite and pyrite, have the potential to be net acid-generating and to result in acid rock drainage;
- The loss, erosion and compaction of productive soil resource that will be required at a later stage for rehabilitation purposes;
    - Preliminary information has also highlighted the potential for hazardous ground conditions, comprising either unexploded ordnance (UXO) and/or contaminated ground that is present on the military land identified to be annexed for Project purposes. A thorough evaluation of the former military site to remove and manage these uncertainties and to limit liability is required.

A full assessment will be undertaken as part of the OVNS and control measures designed to mitigate the impacts of the Project on soils, geology, terrain and land use.

20.3.4 Ecology and Biodiversity

The following issues have been identified as having a potential impact on the current ecology and biodiversity of the area:

- Land clearance;
- Land / aquatic ecosystem burial;
- Habitat loss, fragmentation and disturbance;
- Drainage alteration;
- Exposure to contaminated run-off;
- Spread of alien invasive species;
- Reduced dispersion of seeds by fauna;
- Displacement of fauna;

- Deterioration in water quality; and
- Increased sedimentation/turbidity in freshwater ecosystems.

The extent of any impacts on the ecology and biodiversity in the area will be confirmed by the OVNS. However, preliminary data indicate that there will be no notable reduction in biodiversity in flora and fauna in the surrounding area. At the same time, the control measures will need to be implemented to ensure that the protected species listed in section 0 are not adversely impacted.

20.3.5 Water

Groundwater

The final pit depth is approximately 350m, comprising an open cut through the overburden and the excavation of footwall material.

The working open pit mine will require dry in-pit conditions, and progressive dewatering will be required through the life of the pit extension to ensure dry working faces and to avoid potential heave issues across the pit floor.

The effect of dewatering on neighbouring water-supply wells and the potential for the inadvertent inflow of off-site contaminated water into the pit will be assessed through further OVNS assessment and groundwater study work.

Information about the deeper hydrogeological regime is pending the return of the field program results in late 2012.

Surface Water

There are a number of ways in which the Shymanivske Project has the potential to impact the local hydrology and surface water.

The process plant requires approximately 1,100 m^3/h of raw water. This will be drawn from a combination of sources:

- Water released from tailings;
- Rainfall-runoff from the TSF, waste dump, plant areas and mine pit;
- Direct precipitation onto the storage ponds; and
- Make-up water.

It has been calculated that the process plant will require an average of 432m^3/h of make-up water, which will be sourced from the Yuzhnaya water treatment plant. Water from the Yuzhnaya aeration plant will require treatment prior to use. As make-up water is being sourced from the Yuzhnaya water treatment plant rather than from Karachunivske Reservoir or the River Inhulets, the levels / flows in these water bodies will not be directly affected.

The current design of the site drainage system allows all site rainfall-runoff and rainfall-runoff collected in the perimeter drains to be retained within the site and recycled for use within the process plant. There will be no net outflows from the site and hence no treatment requirements. All water will be stored in open water bodies, or stored in entrained tailings, or lost through evaporation from the water and tailings storage facilities. This will reduce the demand for make-up water and the potential for contamination of local water bodies. However, it will also mean that water bodies and / or aquifers will be impacted and lead to lower flows and storage, if they are dependent on rainfall-runoff collected in the perimeter drains or from within the Project boundary for recharge.

The site drainage is designed to handle flows up to and including a 100-year flood lasting 24 hours. There is a risk of contamination of surface water by outflows from the TSF pond, water collection ponds and site drainage system during extreme flood events, including those in excess of a 100-year event. Given the volumes of water involved in such events, it is expected that there would be significant dilution of any contaminants. There is also a risk of contamination of surface water and soils from hydrocarbons and antifreeze / glycol used during the servicing and washing of vehicles and machinery.

The OVNS will confirm the impacts of the Project on the local hydrological system and on surface-water quality and it will identify control measures to mitigate impacts.

From the preliminary scoping studies, the following hydrology issues have been identified:

- Reduced flow in the River Inhulets and other nearby watercourses, as industrial runoff is retained within the Project boundary. This will potentially have an impact on aquatic ecosystems, riparian vegetation / habitats and downstream communities.
- Increased flood risk to nearby and downstream communities as the Project alters the geomorphology of the landscape. This will potentially have an impact on aquatic ecosystems, riparian vegetation / habitats and local communities.
- Potential for contaminated water in the waste-rock dump, TSF and storage ponds to discharge to surface water and groundwater during flood events that exceed the design capabilities. This will potentially have an impact on aquatic ecosystems and human health and may pose a threat to the potable water supply.

20.3.6 Socio-economic Issues

Mining is expected to continue for 16 years at the proposed ore-extraction rate of 28.3Mtpa. The net export value of the mine product and the capital invested to establish the mine are expected to bring economic benefits to the mine area and Ukraine as a whole. Part of the economic benefit from the mine will be transferred to society in the form of wages and a more skilled workforce, disbursement for procurement of supplies, social investments and payment of revenue to the government.

The socio-economic impacts of the Project are expected to be largely beneficial. For example, it is expected that approximately 3,200 jobs and 900 jobs will be created during the construction and operation phases, respectively, as well as increased business opportunities for suppliers and contractors at the

regional and national levels, which will contribute to stimulation of the overall economy and a general increase in the skill levels of workers.

However, a major Project impact will be the requirement to resettle the village of Rudnichne.

The following impacts are associated with this resettlement:

- Potential economic and social displacement of people arising from their loss of access to land at Rudichne village and to some villages on the periphery of the site, including agricultural land;
- Potential necessity for the relocation of graves and historic sites if any are found;
- Impacts on host communities that resettled communities are moved to; and
- Long-term and severe impacts on livelihoods, food security, community infrastructure (schools and health clinics), social support networks, access routes and mental stress levels.

The resettlement of Rudichne shall be treated as an involuntary relocation process, compliant with IFC standards and safeguards (Performance Standard 5: Land Acquisition and Involuntary Resettlement, 2012). In order to deliver the Project to international standards, Black Iron will require a Resettlement Action Plan (RAP) to ensure that the resettlement associated with the required land acquisition is undertaken in a socially responsible and sustainable manner. Black Iron is aware of the fact that the Shymanivske Project will need to build a sound relationship with the host community in which it will operate, in order to establish and maintain a social licence to operate. To this end, a Stakeholder Engagement Plan has been developed and is progressively being implemented by Black Iron. A Resettlement Action Plan is to be drawn up in mid-2013, with a view to implementing a progressive resettlement process of Rudnichne that will be completed by 2015.

A socio-economic impact assessment will also address community health issues associated with dust, noise, traffic hazards and any issues arising out of the on-going brownfield ground investigations. Dust is highlighted as a particular priority requiring expert health-impact assessment procedures to mitigate risks associated with respiratory health, nuisance, discomfort, visibility and reduced quality of life, if encountered in large amounts. Finer grades of particular matter (with a diameter <PM10 and <PM2.5) are known to be significant morbidity factors, which can be exacerbated by silica content, composition and particle characteristics.

Following a full assessment of Project impacts during the OVNS, control measures will be included in Project design (infrastructure and operating regime) to ensure that significant socio-economic impacts, such as noise, are mitigated at source to guarantee that limits at sensitive receptors are adhered to.

20.4 Mine Closure

Ukraine has an emerging policy and practice with respect to progressive reclamation, and only a general reference to mine closure and reclamation is included in the Code of Ukraine on Mineral Resources, No. 132/94-VR, July, 1994. Article 24 states that a territory disturbed during the course of the Project must be reclaimed and brought to a state suitable for further public use.

Definitive reclamation requirements are subject to specific mine licence agreements and conditions, as set out in the mining permit. Nonetheless, it is prudent for an operator, in terms of risk and liability management, to establish a well-researched provision and strategy for progressive mine rehabilitation and closure throughout the mine lifecycle.

The Project has not yet developed a conceptual closure plan. However, key mine assets, such as the tailings facility and waste-rock dumps, have undergone economic and technical assessment of varying options in order to determine the optimum design case and take into account environmental factors. Alternative concepts for operating the tailings facilities took into account the impact of deferred reinstatement versus progressive rehabilitation on project costs and performance (see "Screening Study of Tailings Options," WorleyParsons, 2012). The outcome of the concept-selection process for the tailings and waste-rock strongly affects the form of financial assurance required by the Project.

A formal mine-closure plan will be developed prior to confirmation of the final project design and approvals submission (i.e., by mid-2013) and it will address issues such as bonds, percentage of annual rehabilitation and community development and livelihood diversification. All these factors are complex instruments requiring negotiation as a condition for an individual mining agreement. Financial bond assurance will be confirmed during the mine-licensing process, which will be based on the level of commitment selected to progressive rehabilitation and management. The process will be reviewed to achieve the optimum comprehensive mine-closure plan.

Guidance on international best practice for mine closure will be referred to, namely the International Council on Mining and Minerals (ICMM) Planning for Integrated Mine Closure: Toolkit (2008), as well as other reference documents, which will be required to maintain conformance with the World Bank (IFC) environmental and social performance standards. They include:

- "World Bank in Mining and Development, It's Not Over When It's Over: Mine Closure Around the World" 2002;
- "IFC EHS Guidelines on Construction and Decommissioning," 2007;
- "Mining for Closure: Policies and Guidelines for Sustainable Mining Practice and Closure of Mines," United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP), Organization for Security and Co-operation in Europe (OSCE) and the North Atlantic Treaty Organization (NATO), 2005
- The mine-closure plan will address the following procedures, (according to the guidelines of the International Institute of Environment and Development, 2002,
- The removal of infrastructure;
- The implementation of public safety measures;
- Re-contouring and revegetation (rehabilitation);
- On-going maintenance of site structures and monitoring of environmental issues;

- The operation of site facilities required to mitigate or prevent long-term environmental degradation;
- The completion of company involvement in sustainable community economic and social programmes;
- Establish time lines and costs;
- Conceptualize the expected final landform and surface rehabilitation, including removal of plant and equipment and stabilization and reclamation of dumps and impoundments;
- Provide a risk assessment to help set priorities for preparatory work;
- Present a cost-benefit analysis of different options as the plan is being prepared, reviewed, and updated;
- Present a management plan for how closure will be implemented; and
- Propose post-closure monitoring arrangements (i.e., who monitors, for how long and who pays).

It is envisaged that the cost of progressive rehabilitation to Black Iron upon mine closure will be $22,800,000USD.

20.5 Mine-Waste Rock and TSF Management

20.5.1 Waste Rock Management

The Mine-Waste Dump shall be capable of handling a total estimated bulked volume of 729 Million tonnes of waste material, comprising soil and limestone overburden and waste rock from the footwall of the pit-sides. It is recommended that a mine-waste management plan be developed in accordance with EU Directive 2006/21/EC, which would lead to reasonable prevention and planning for the physical and chemical characteristics of the mining waste from the Project. The mine-waste management plan would indicate clearly the requirements with which the waste facilities should comply in regard to location, management, control, closure and preventive and protective measures to be taken against any threat to the environment in the short- and long-term, and especially against the pollution of groundwater by leachate infiltration into the soil.

The primary means of monitoring at the Mine-Waste Dump shall be done by installing stakes or rods around the earthworks as they proceed, spaced nominally at 50m intervals laterally and transversely (i.e., perpendicular to the perimeter of the waste dump and parallel to the fall line). These installations will give a visual indication of any movements that may occur during filling operations.

In addition, six pairs of inclinometers and vibrating wire piezometers shall be installed to provide a means of measuring pore pressures and any lateral movements that may occur at the toe of the earthworks.

The monitoring program shall allow for:

- Validation of design assumptions, including the amount of strength gain;

- Measurement of the rate of pore pressure dissipation or build up; and
- Determination of the magnitude of any lateral movements, particularly adjacent to sensitive infrastructure, such as railway lines to the west and east of the site.

In addition, a series of four settlement pins shall be installed in the ground at the same locations as the inclinometres and vibrating wire piezometres. These will be offset at approximately 20m spacing and aligned perpendicularly to the Mine Waste Dump perimeter. The settlement stations will provide a means of monitoring any ground surface deformations that may occur as filling proceeds and facilitate a means of changing construction sequencing or design of any remedial measures that may be required in order to prevent a failure of the earthworks.

20.5.2 TSF Management

Limestone and waste rock shall be used in the construction of the perimeter berm, roads (including in the preparation of an aggregate surface) and containment dykes in the TSF. The use of limestone in the TSF containment dykes will aid with acid neutralization. The preliminary design for the TSF assumes the construction of a traditional slurry tailings contained by dykes comprising mine-waste rock. The TSF has been designed to:

- Provide a permanent and secure containment of all solid waste material within an engineered impoundment;
- Limit the dust generation by the TSF footprint to comply with the environmental regulatory levels;
- Maximize recycling of return water to increase water availability for the plant operation;
- Effectively manage the water balance to keep a minimum water cap above the tailings as a means to reduce dust generation and the likelihood of excessively high pool level above deposited tailings;
- Convey the 100-year design flood and the Probable Maximum Flood, without incurring catastrophic damage;
- Minimize seepage by rapidly establishing a low-permeability, consolidated tailings mass;
- Achieve progressive reclamation of the facilities; and
- Minimize dust by employing a cellular design. The cellular design reduces the shore line that is active at any given time which is the major source of dust from the tailings facility

The monitoring plan for the TSF shall address potential deformations in the foundation materials, excessive settlements in the tailings dam crest, seepage under the tailings dam and groundwater conditions during the construction and operation of each cell.

The monitoring instrumentation program for the TSF shall include the installation of piezometer, pressure gauges, a seepage flow weir and settlement monument inclinomters to provide data in order to predict trends in the behaviour of the foundation materials, groundwater, tailings dam and deposited materials.

The magnitude of tailings consolidation and subsequent settlement shall be determined and based on laboratory consolidation testing on tailings samples and field observations and monitoring during the tailings disposal.

20.6 Environmental Path Forward

20.6.1 Overall Environmental and Social Management (ESM)

The definition of the environmental and social management system to be implemented by Shymanivske Steel should be in accordance with ISO 14001:2004. An Environmental and Socio-Economic Management Plan (ESMP) for the Shymanivske Project will be required throughout the life-cycle of the project (i.e., the planning and pre-construction, construction, operation and mine-closure phases). The ESMP will have to remain a “live” system with continuous improvement targets and monitoring programs.

The ESMP shall contain plans for the management of all foreseen Project-related impacts as well as catastrophic events and emergency-response plans. It will present in detail, for each phase of the project, all the measures that will be implemented to enhance positive impacts and minimize negative ones. Further, it will present the monitoring programs required to demonstrate whether mitigation and control measures are achieving their objectives. The results of monitoring will alert Black Iron Inc. to any potential issues that may arise throughout the life of the Project, allowing the company to take appropriate corrective action(s) to ensure that the Project does not have a negative impact on the surrounding environment and local communities.

The ESMP shall contain, among other things, a number of individual Management Plans, addressing all aspects related to a particular facility, or a sensitive receptor, or an activity of the Project. This is envisaged to include separate plans for waste-rock and tailings management, an Air Quality Management Plan and a Water Management Plan. Over time, a suite of management plans will evolve to include the following recommended plans:

- An Oil and Pollutant Spill Plan;
- A Hazardous Materials Control Plan;
- An Erosion Control Plan;
- A Workplace Emergency Preparedness Plan; and
- A Traffic Safety Plan.

Each plan shall contain a monitoring program that details what is to be measured (parameters), in addition to the necessary monitoring equipment and its location, and the timing, duration and frequency of measurements.

The following sections present the details of the requirements of individual aspects of the ESMP, which will be further developed in subsequent stages of the Project.

The ESM Manual shall provide guidance to all levels of management and its sub-contractors, consultants or agents, to protect the environment and society in all phases of the Project, and upon its decommissioning.

The ESM Manual shall describe environmental and social matters and explain how to handle them in accordance with ISO 14001:2004, OHSAS 18001:1999, ISO 26000 and the national regulations in Ukraine. It will determine the commitment to a policy of prevention, reduction and elimination of undesirable environmental and social effects.

The ESM System is best viewed as an organizing framework that should be continually monitored and periodically reviewed, to provide effective direction for Black Iron Inc., and delineate the ways that ESM should respond to changing internal and external factors during the Project.

20.6.2 Dust and Air Quality

The key environmental concern is controlling and minimizing dust concentrations. Dust concentrations at certain locations around the Project site have been measured to be in excess of national limits already. Given these measurements, the Shymanivske Project will have to be designed in such a way that it does not exacerbate the problem.

An initial air-quality study considered the potential release of dust from the site because of earth-moving and mining activities associated with the construction and operation of the Project.

A Dust Emissions Study (WP, 2012g) then evaluated the emission sources to determine the potential impacts within a 100km by 100km domain, centred at the Project. Dispersion modelling was performed and an emissions inventory was established, using emission factors from several sources: the United States Environmental Protection Agency (US EPA) AP-42 emission estimation manual; the US EPA NONROAD model for unpaved road emissions; and other emission estimation manuals, such as the “Australian National Pollutant Inventory” (NPI).

The main contributor to the ambient air levels of particulate matter is the ore pit operations. Emissions from the ore pit contribute almost 60% of the predicted ambient air-particulate matter.

However, the dust work conducted to date has considered only unmitigated circumstances. Significant impacts on surrounding areas are predicted, and so an Action Plan has to be developed and implemented to reduce dust emission and improve air quality. This may best be done in consultation and cooperation with other mining companies in the area, in order to effect change collaboratively. It is essential that the dust-modelling work be continued and advanced to include impact assessments which consider scenarios under different mitigation measures.

Mitigation measures have been proposed for the project. These comprise a combination of the following:

- Engineering controls, such as installing enclosures for transfer points and sizing stations, conveyors and bins, leading to 75% reduction of dust emissions from this material handling equipment;

- Dust-suppression measures which can lead to a 40% to 80% reduction of dust emissions from granular haul roads;
- Cellular Tailings Storage Facility (TSF) to minimize the exposed surface area of the beach;
- Reduction of blast areas to produce smaller amounts of emissions and drilling and blasting conducted during low-wind conditions, where possible;
- Use of fogging systems and wind barriers to reduce emissions from waste-rock piles;
- Reduction of drop heights;
- Prevent spillage from trucks occurring and reducing the amount of silt that is present on the road, in order to reduce road emissions;
- Timing the processing with meteorological events, such as wind and rain;
- Storm-water management to prevent flooding of unpaved roads and reduce trackout;
- Sizing of trucks appropriately, to reduce the number of vehicle trips; and.
- Design of haul roads, to minimize kilometres (km) travelled.

The components of an Air Quality Management Plan for reducing Project impacts on air quality during the construction phase are outlined below.

- Machinery combustion gas emissions (NOX, SO2, CO, etc.):
- Review machinery permits and ensure appropriate maintenance;
- Minimize unnecessary journeys and adopt a policy of switching off machinery and equipment when not in use;
- Consider using machinery, equipment, vehicles and materials that are fuel-efficient; and
- Improve maintenance of transport routes.
- Controlled and uncontrolled fires (airborne emissions):
- Prohibit open fires in order to minimize air emissions, avoid accidents and minimize fire risk during the construction phase.

In addition to these measures, air quality shall be monitored through the life of the project, within the Project site and in the surrounding environs, as indicated by the environmental baseline studies. Pollutant levels shall be monitored against the baseline data and appropriate measures shall be taken at the source of emissions, if statutory limits are exceeded.

Air quality monitoring will be conducted by two possible techniques: passive and active air measurements. The monitoring plan shall state which methodology is to be adopted and it shall identify the pollutants to be monitored. In addition, TSP, PM10 and PM2.5 shall be monitored.

As mentioned above, it is important to develop a strategy to reduce dust in the proposed Project area as a whole, taking into account the dust produced by neighbouring sources. The next steps should include a cumulative-impact assessment of dust, looking at synergetic and additive effects and including a multivariate analysis.

It should be noted that for health impact assessment purposes, it would be beneficial to obtain acute and chronic air concentrations, including PM2.5 24-hour maximums and contaminant one-hour maximums.

20.6.3 Water Management

The Shymanivske Project will impact the water environment in a number of ways, namely:

- Water use for mineral processing, utilities, construction and infrastructure; Water generation through pit dewatering;
- Water retention and modification of hydrology due to large-scale development and variably porous and permeable mass material storage facilities, such as rock dumps and tailings ponds;
- Modification of hydrology through designed drainage and outflow; and
- Water storage, treatment and discharges associated with the project.

The following mitigation measures shall be implemented because significant impacts on hydrology and hydrogeology are anticipated:

- Robust surface and groundwater monitoring programmes;
- Appropriate engineering design measures to contain and capture infiltrating water escaping the waste-rock dump, TSF and storage ponds (e.g., lining with a geomembrane);
- Development of minimum required environmental flows in affected watercourses; and
- Acid-base accounting of waste-rock material to guide an assessment of optimal dump locations.
- Monitoring

A network of groundwater monitoring wells shall be installed and regularly sampled, in order to develop a sufficient baseline of data so that the existing groundwater conditions are understood, and sources and impacts can be correctly attributed.

All installed wells and test devices shall be monitored to record changes in groundwater levels and quality in the ground around the mine, waste dump, TSF and process areas.

Based on the results of the monitoring, modelling should be undertaken to assess any potential adverse changes in groundwater, streamflows and water quality in areas adjacent to the mine, waste dump, TSF and process areas. Modelling shall also be used to determine pit dewatering rates.

The parameters to be sampled in the groundwater-quality monitoring shall be according to the “Water Quality Design Criteria” report (WorleyParsons, 2012b).

The monitoring plan shall also cover streamflow and water-quality monitoring, both on-site and at key locations in the surrounding area (e.g., on downstream watercourses, ponds, etc.).

Streamflows shall be monitored at a maximum of a daily time-step throughout the life of the Project, so that seasonal variations can be identified. Low-flow conditions are of major interest as this is when the influence of the mine will be at its most significant.

The parameters to be sampled in the surface-water quality monitoring shall be according to the "Water Quality Design Criteria" report (WorleyParsons, 2012b).

20.6.4 Land Acquisition

At this stage the recommendation is that an initial, non-intrusive review, sampling and liability assessment be undertaken as soon as possible to meet the necessary Ukrainian and European contaminated-land environmental legislation and regulatory requirements.

It is recommended that Black Iron Inc. obtain sufficient information in order to be informed of risk and liability before committing to the terms of a land-acquisition transfer.

The environmental liability assessment ascertains the nature and extent of contamination (if any) in relation to pertinent regulatory standards, and with respect to media (i.e., soil, vapour, groundwater, sediments-affected, potential human or environmental receptors, and potential pathways of exposure). Contaminated site characterization services include:

- Phase I (non-intrusive) desk-based Environmental Site Assessments;
- Site Audits and Due Diligence reporting;
- Phase II (intrusive) Site Investigations;
- Risk Assessments;
- Groundwater Assessment;
- Remediation Design and Implementation; and
- Environmental Monitoring Programs.

20.6.5 Further Environmental Activities

The following environmental and socio-economic activities are planned for the Project:

- Completion of the OVNS assessment work;
- Establishment of a dedicated, automated weather station on-site and installation of permanent flow-gauging and water-quality monitoring points on the River Inhulets, along with the development of an environmental database to manage results;
- Submission of an official Declaration of Intent;
- Calculation of the extent of a Sanitary Zone for the Project;

- Design and undertaking of a specific cumulative effects impact assessment associated with dust and air quality. The assessment must systematically review the planning principles and goals for the Project; dust and emission sources; spatial and temporal boundaries; direct, indirect and potential multivariate effects; confirmed baseline conditions; environmental factors, such as weather conditions or seasonal effects (thermal inversions, etc.); incremental stress assessment; pathways; receptors and thresholds:
- Development of a specific, support document based on the outcomes of the cumulative effects impact assessment that clarifies the incremental impact associated with the Project, as compared with the existing baseline conditions. This document will be designed to highlight for authorities the relative impact of the Project and to provide a clearer basis for analyzing alternatives and setting goals for compliance, monitoring and management.
- An economic analysis may be required to clarify the impact and opportunities associated with cumulative dust impacts and modernization, in order to achieve best-practice mine operations. If this is the case, a risk-based methodology aligned with international best practices will be required.
- Establishment of a forum for working with existing operators to address and plan for the amelioration of existing conditions.
- Submission of OVNS to Ukrderzhbudexpertisa for validation and SER.
- Positive SER conclusion.
- Provision of support to Stakeholder Engagement Plan implementation (including confirmation of establishment of grievance mechanism and community office).
- Drafting and presentation of RAP (Resettelment Action Plan) for consultation with authorities.
- RAP implementation support.
- Harmonization review of ESHIA requirements to bring the proposed project in line with EU regulations applicable to Ukraine, as of 2017 (2013–2014).
- Development and publication of ESHIA for the prospective investment community (2013–2014).
- Support to ESM System development, including the drafting of ESMP and contractor specifications.
- Development of a Mine Waste Management Plan.
- Provision of support for the acquisition of required permits, including the permits for emission of pollutants into the atmosphere by stationary sources; operations with wastes; the beginning of dangerous activities and/or the start of usage of dangerous/unsafe machinery; and storage and removal of wastes.
- Preparation and submission of the first Annual Mine Environmental and Social Monitoring Report.

21 CAPITAL AND OPERATING COSTS

This section outlines the capital and operating costs for the Shymanivske Iron Ore Project with an averaged annual production capacity of 9.2.Mtpa of iron ore concentrate produced on a dry basis. The capital and operating cost estimates related to the mine were prepared by P&E. The estimates for the concentrator and the plant site infrastructure were developed by WorleyParsons.

21.1 Mine Capital and Sustaining Capital Cost

The projected mine capital and sustaining capital costs are shown in Table 21.1

The mine equipment purchase and leasing costs incurred in Year -1 and Year +1 are treated as capital costs. On-going equipment leasing interest costs are included in the annual mine operating costs.

The sustaining capital costs include equipment purchase costs and lease principal costs incurred in Years 2 to 16, and any salvage value from the sale of used haul trucks at the end of the Project life.

Table 21.1: Projected Mine Capital and Sustaining Capital Costs

Item	Projected mine capital and sustaining capital costs ($US M)																	
	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Mine development costs	61.3																	61.3
Mine Equipment Costs[A]	62.5																	62.5
Mine equipment sustaining capital costs[B, C]		66.8	30.0	28.5	28.8	33.2	13.1	0.5	10.4	14.3	50.1	77.7	0.7	10.9	3.9	23.7	(28.9)	364.4

a) The mine equipment capital costs include the cost of lease downpayments and outright purchasing of equipment. Costs also include items such as spare shovel buckets, the electrical power distribution system for the electric shovels, mine mechanical and electrical maintenance vehicles, pick-up trucks, crew bus, initial employee training, the initial payment for a haul truck training simulator, technical services equipment, an automated dispatch system and pit radio system costs.

b) The Project infrastructure capital cost includes the costs of the mine electrical distribution system for the mine dewatering system as well as the cost of the mine dewatering pumps and piping and the cost of the fuel reservoir and the mine equipment re-fuelling station.

c) The mine equipment sustaining capital costs include the following: scheduled equipment lease principal payments; other equipment purchases; the balance of the haul truck training simulator

cost; the cost of a pit slope monitoring system; haul truck salvage values; and miscellaneous costs in Year 16.

d) Not included in Table 21.1 are the Projected mine equipment lease interest costs, the shovel electrical power distribution and control system equipment, material costs and scheduled shovel refurbishing costs to be incurred in Years 2 to 16. They are treated as mine operating costs and amount to $22.8 million over the mine life.

21.1.1 Major Mine Production Equipment

The mine equipment capital costs were estimated on the projected equipment requirements, quotes received from suppliers in Ukraine and elsewhere, and other cost information obtained from the P&E equipment-cost database. The mine equipment requirements were estimated to include the following: mine development and production schedule; pit design; haul road layout and destinations; working hours per shift; projected cycle times and productivity; equipment availability and utilization; anticipated workplace and ambient conditions; and practicality and safety. The proposed key mine production equipment models are summarized in Table 21.2. The mine equipment to be leased in Years -1 and +1 is listed in Table 21.4.

Table 21.2: Proposed Vendor Models of Major Mine Production Equipment

Item	Proposed Model*	Description	Quote
Production blasthole drill	Caterpillar MD6420	This diesel-powered rotary drill will have a 16 m mast. It can single pass drill 16.46 m and up to 311 mm (12 ¼ inch) in diameter.	Caterpillar No. GS-8453-131
Hydraulic face shovel	Caterpillar 6060 FSE	This is an electric-powered hydraulic face shovel. It is expected that the mine will typically use 23, 28 and 31 m^3 buckets for ore, waste rock and overburden respectively.	Zeppenlin Offer No. 6090 KHVM31835
Haul truck	Caterpillar 793F	To be equipped with a nominal 226 t capacity steel body.	Zeppelin Offer No. 793F KHVM31778
Bulldozer	Caterpillar D10T	Equipped with a single rack ripper.	Zeppelin Offer No. D10T KHVM3174
Wheel dozer	Caterpillar 844H	Equipped with a 16 m^3 semi-U blade.	Zeppelin Offer No. 844H KHVM3173

Item	Proposed Model*	Description	Quote
Wheel loader	Caterpillar 994F	18 m^3 high lift configuration.	Zeppelin Offer No. 994F KHVM3181
Grader	Caterpillar 16M	Equipped with ripper.	Zeppelin Offer No. 16M KHVM31807

* It is expected that at the detailed design stage one will compare quotes from Caterpillar and other established mine equipment suppliers before finalizing the mine production equipment models.

The number of mobile equipment units that is expected to be added to the mine equipment fleet in each year is shown in Table 21.3 below.

- It is assumed that major pieces of mobile equipment that come into service in Years -1, and +1 will be leased-to-own, although on-going acquisitions will also be made.
- The mine will have three face shovels in Year -1, and five face shovels in Year +1. Five new replacement shovels are to be added to the fleet, starting in Year 10. One of the original five shovels is scheduled to be refurbished in Year 11 and then used intermittently in years 11 to 15. The mine could start to salvage parts from the other original shovels, starting in year 11.
- The haul truck fleet will be progressively expanded, as shown in Table 21.3. It is expected that the six haul trucks added to the fleet in Year 15 will be sold for salvage value in Year 16, and that 18 used haul trucks (each having less than 50,000 hours) will be sold at the end of the mine life in Year 16. Options such as advancing some material movement, use of contractors and/or rental haul trucks should be evaluated as a potential way to reduce costs to accommodate the brief two year peak need for six additional haul trucks starting in year 15.
- The replacement schedule for the ancillary equipment varies, depending on equipment duty and application. For example, the original bulldozers are scheduled to be replaced in Year 8 and the heavy-duty tow truck will be used over the life of the mine.

Table 21.3: Number of Mobile Equipment Units Entering Service in Each Year

Item	Year																	LOM Total
	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Pre-stripping drill	1																	1
Production blasthole drill	2	2				1								1				6
Pre-shear / drainage hole drill		1																1
Hydraulic face shovels	3	2									1	4						10
Haul trucks	14	14								2	8	6		2	1	6		53
Operations support equipment:																		
Bulldozer	7	3							8									18
Wheel dozer		1									1							2
Wheel loader	1									1								2
Grader	2	1										2						5
Water truck	1	1										1						3
Fuel/lube truck	1									1								2
Portable lighting unit	2	2								1								5
Heavy-duty field service trucks	2	1									3							6
Light-duty field service trucks	2	1									3							6
Tow truck	1																	1
Boom truck	1										1							2
Mobile crane	1																	1
Tractor and heavy duty trailer	1																	1
Flat bed truck with jib crane	1										1							2
Tire manipulator	1																	1
Elevated work platform	1																	1
Pick-up trucks	9	2			6	6			6	6			6	6				47
Crew bus	1					1					1							3

21.1.2 Mine Equipment Leasing:

The major pieces of equipment that will enter into service under lease terms in Years -1 and Year 1 are shown in Table 21.4 It is assumed that the support mine equipment entering into service in Years -1 to 16 will be purchased.

Table 21.4: Mine Equipment Leased in Years -1 and +1

Year lease commences*	Equipment Leased	Proposed Equipment Model
-1	1 overburden drill	Atlas Copco PV275 drill
	2 production drills	Caterpillar MD6420 rotary drill
	3 face shovels	Caterpillar 6060 FSE electric hydraulic face shovel
	14 haul trucks	Caterpillar 793F
	2 graders	Caterpillar 16M
	1 water truck	
	7 bulldozers	Caterpillar D10T
	1 wheel loader	Caterpillar 994F
+1	2 production drills	Caterpillar MD6420 rotary drill
	1 pre-shear drill	
	2 face shovels	Caterpillar 6060 FSE electric hydraulic face shovel
	14 haul trucks	Caterpillar 793F
	1 grader	Caterpillar 16M
	1 water truck	
	3 bulldozers	Caterpillar D10T
	1 wheel dozer	Caterpillar 844H

* Projected lease-to-own costs are based on preliminary lease parameters provided by equipment suppliers including indicative terms received from Cat Financial (proposal valid to January 1, 2013). Cost estimates are based on projected 60 to 72 month leasing terms (except for the water trucks which are assumed to be leased-to-own over 84 months).

21.2 Mine Operating Costs

The mine operating costs were developed from first principles, taking into account the mine production schedule; projected effective working hours and projected equipment performances with hot changes. Also taken into consideration were the availability of lunch-time replacement operators; anticipated field and operating conditions; supplier-provided data and cost information; and other information, including relevant information in the P&E cost database; and other operating, regulatory and safety aspects. The operating-cost basis assumes that Black Iron will develop and operate the mine, using its own labour and equipment. Explosives, blasting agents and blasting accessories would be provided by a local explosives supplier.

The mine-operating costs include projected mine supervision, equipment operator and maintenance and technical services labour costs; the costs of drilling, blasting, loading and haulage consumables (i.e., fuel, electrical power, lubricants, maintenance and repair parts and consumables, tires, ground engagement tools, undercarriage, and related non-labour costs, such as maintenance equipment operating costs); grade control assays; ROM pad clean-up and operational stockpile reclaim; and associated, direct-mining costs. The mine dewatering system and operating system costs were estimated separately, and are included in the Project infrastructure operating cost.

The Projected operating costs are shown in Table 21.5.

Table 21.5: Projected Annual Mine Operating Costs

Item	Projected mine operating costs USD (Millions)																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
Labour		4.9	4.6	4.5	4.1	4.1	4.2	4.6	4.1	4.8	5.5	6.3	5.7	6.3	6.5	6.9	3.3	81.0
G&A labour		1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.9	21.7
Electrical Power		3.3	2.9	2.9	2.9	2.9	2.7	2.7	2.7	3.1	3.7	3.7	3.9	3.9	4.2	4.2	2.1	52.9
Consumables		56.4	53.6	51.6	53.4	54.1	53.3	57.2	57.0	66.8	10.9	76.6	76.1	84.1	93.0	95.3	38.3	1,038.6
Maintenance		7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.9	118.4
Utilities		34.3	29.2	30.6	25.7	26.1	26.7	31.8	29.2	35.3	45.5	54.5	48.7	55.9	54.2	63.2	22.0	613.9
G&A		1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.2	26.8
Subtotal direct costs		109.6	101.1	100.3	96.8	97.8	97.5	106.9	103.7	120.6	136.2	151.6	145.0	160.8	168.5	180.1	75.9	2,953.2
Other*			4.6	4.2	3.4	2.6	1.2	0.1	0.1	0.1	0.2	5.4	0.1	0.1	0.1	0.1		22.8
Total		109.6	105.7	104.5	100.2	100.4	98.7	107.0	103.8	120.7	136.4	157.0	145.1	160.9	168.6	180.2	75.9	1,976.0

These costs include the equipment-lease interest costs; shovel electrical power distribution and control system equipment; and material costs and scheduled shovel refurbishing costs incurred in Years 2 to 16.

Selected parameters used in estimating the operating costs are shown in Table 21.6.

Table 21.6: Examples of Parameters used in Mine-operating Cost Estimating

Item	Basis
Labour costs	Labour costs are based on the results of a local labour cost survey. The mine would operate on a 2x 12-hour shift per day basis, with a total of 4 rotating crews. Labour costs are based on a currency conversion rate of 9 UAH: 1 USD. Sample labour costs are: Mine Superintendent: $23,625/person-year Mine supervisor: $14,430/person-year Shovel operator: $14,430/person-year Haul truck driver: $13,118/person-year Driller: $11,806/person-year Senior Mining Engineer: $20,988/person-year
Consumables	Powder factor in overburden: 0.132kg/t. It is assumed that 12% of the overburden, which comprises of historic mine waste-rock and soil horizons underlain by limestone, will need to be drilled and blasted. Powder factor in ore: 0.347kg/t. Powder factor in waste-rock: 0.345kg/t. Projected emulsion blend densities: 1.15g/cc in overburden, 1.20g/cc in ore, 1.14g/cc in waste rock. Projected 2012 Q4 diesel fuel cost of $0.905/L was escalated by 1%/ a to $0.9325/L in Year 2015 (Year 1) and held constant beyond that date. Projected 2012 Q4 electrical power cost of $0.0750/kWh was escalated by 1%/ato $0.0773/kWh in Year 2015 (Year 1) and held constant beyond that date.

21.3 Overall Capital Expenditure (CAPEX)

21.3.1 Summary

The base case capital costs for the Shymanivske Iron Ore Project have been estimated in USD for Q4, 2012, and include no allowances for escalation, exchange rate fluctuations or project risks. The estimate is based on an Engineering Procurement and Construction Management (EPCM) implementation approach which is based on the Project contracting strategy outlined in Section 24.

The mine capital costs are as described in section 21.1 above. Major site infrastructure included in capital costs consists of the following:

- Shymanivske open pit and associated waste-rock dumps;
- Primary Crusher and transfer conveyors;
- Secondary crushers and HPGR's building
- Dry screening building (includes 10 dry double deck screens);
- Cobbing building (housing 30 dry cobbing magnetic separation equipment);
- Fine ore stock pile (includes the drawdown hoppers and take away conveyor);
- Concentrator building (includes Primary Mill Wet Screens, Primary and Secondary Mills, Verti Mills, four stages of Magnetic Separation, Flotation and Reagent area);
- Thickeners (includes tailing and concentrate thickeners as well as the main process water tank);
- Concentrate Filter building (includes pressure filters and associated tanks and transfer conveyors);
- Concentrate stock pile (includes the product stock pile, reclaimer system and transfer conveyors);
- Rail load out;
- Tailing storage facility Cell 1;
- Plant control room building;
- Air compressors building (includes compressors and blowers that provide plant and instrument air);
- Concentrator warehouse and laydown area;
- Security building and tuck scale;
- Administration building;
- HSE building, fire station and ambulance garage;
- Main plant substation switchroom;
- Process pump houses
- Water ponds (as required for start up otherwise included in sustaining capital);
- Diesel fuel receiving and unloading station;
- Diesel fuel storage and vehicle fuelling system;

- Area electrical substations;
- KGOKOR bridge reinforcement;
- Haul and service roads;
- Rail spurs;
- Water treatment facilities;

The Shymanivske area is serviced by existing rail and ports.

The Cost Estimate is prepared by WorleyParsons to produce a Capital Cost Estimate with a predicted accuracy of +/- 15% (Class 3 “Define” Phase Estimate).

The total P50 estimated cost of the overall project is USD 1094.03 million. This amount is based on a 50/50 probability of over-run / under-run and excludes market forces and currency hedging.

This total has been compiled as shown in Table 21.7

Table 21.7: Estimate Total Installed Costs (EPCM basis):

Category	Item	Million, USD
EPCM items	WBS 1000 – Mining	140.76
	WBS 2000 – Beneficiation Plant	514.60
	WBS 3000 – Tailings and Waste	27.12
	WBS 4000 – Environmental	1.16
	WBS 5000 - Infrastructure	123.40
	WBS 6000 – UDI Management	6.62
	WBS 7000 – Project In-directs	135.09
	Subtotal 1 base cost :	**948.75**
	WBS 8000 – Owner’s Costs	45.82
	Subtotal 2 base cost :	**994.57**
	WBS 9100 - Contingency	99.46
	TOTAL Project Cost	**1094.03**

Table 1 Notes:

1. The contingency amount was calculated to be 6.5% by analysis. Design allowance of 3.5% was added to provide a total of 10% to the subtotal base cost.
2. Market forces and currency hedging are currently excluded from the CAPEX cost estimate.
3. A more detailed estimate by commodity is included in the appendix.

21.3.2 Contingency Estimate

A Monte Carlo risk analysis was produced and used to set the contingency allowance for the Project. The contingency amount was calculated to be 6.5% by analysis. A design allowance of 3.5% was added to provide a total of 10% to the subtotal base cost.

21.3.3 Basis of Estimate

The capital cost estimate includes all the direct and indirect costs and appropriate project estimating contingencies for all the facilities required to bring the Project into production, as defined by a feasibility-level engineering study.

A 3D model was developed and material take-offs for piping, steel, and mechanical equipment and bulks were generated from the 3D model. Table 12.8Table 21.8 defines the level of development of key documents for the Feasibility Study used to develop the estimate:

Table 21.8: Key Documents Level of Development:

Item	Feasibility
Site-based Investigations	
Geographical location	Defined
Topographical survey	Completed
Geotechnical survey	Completed
Hydrological survey	Preliminary Completed
Power Survey	Preliminary Completed
Project Team site visit	Completed
Process Design	
Bench-scale test work	Completed
Pilot Plant test work	Not Required
PFDs	Issued for Design
P&IDs	Issued for Hazop
Equipment List	Issued
Mass Balance	Issued
Equipment datasheets	Issued for most equipment
Line List	Preliminary
Valve List	Issued
Facilities Design	
Site Plan	Defined
Overall Plant Layout	Frozen
Mechanical GAs	Frozen
Structural GAs	Modelled

Item	Feasibility
Piping GAs	Modelled (6” and above)
Electrical SLDs	Issued
Capital Cost Estimate	
Mechanical Equipment (major)	Firm quote x 3
Mechanical Equipment (balance)	Budget
Civil Supports	Take-off
Structural Steel	Take-off
Piping	Take-off
Civil supply rates	Budget quote
Steel supply rates	Budget quote
Earthworks	Take-off
Electrical Equipment	Take-off
C&I Equipment	Take-off
Buildings	Take-off
Mine Equipment	Firm quote
Tailings Facility Design	Issued

21.3.4 Procurement

Firm and budget prices were obtained for most packages, as listed below, and shown in Table 21.9

Table 21.9: List of Equipment & Materials (Firm/Budget Price/Estimation)

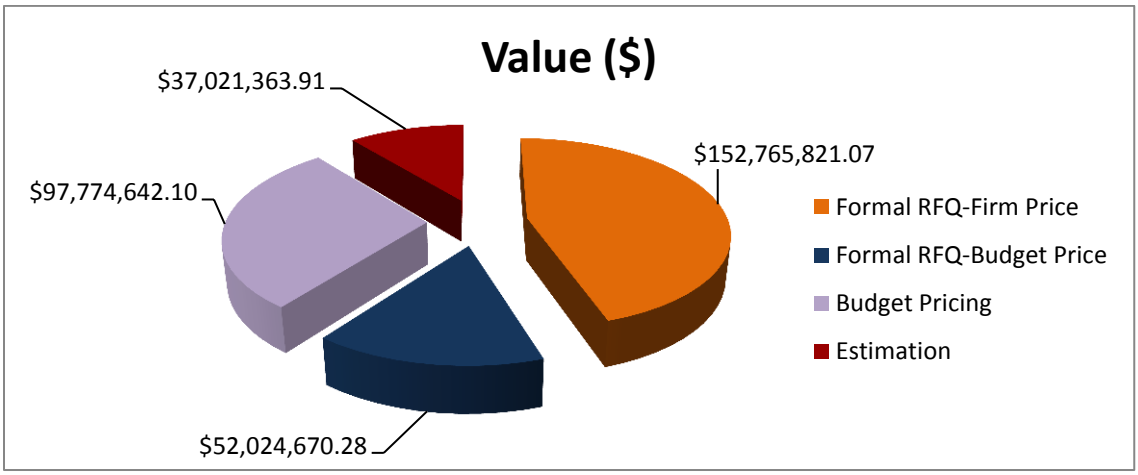
Item	Plan Req#	Description	Comment
Electrical			
1	207040-00076-RFQ-2001	Main Transformers	Formal RFQ-Budget Price
2	207040-00076-RFQ-2002	Distribution Transformers	Formal RFQ-Budget Price
3	207040-00076-RFQ-2003	Medium Voltage Switchgear	Budget Price
4	207040-00076-RFQ-2004	Low Voltage Switchgear and MCC	Budget Price
5	207040-00076-RFQ-2005	MV & LV VFD (Variable Frequency Drive)	Budget Price
6	207040-00076-RFQ-2006	LV, MV Cables	Ukrainian Supplier Price List
Instrumentation			
7	207040-00076-RFQ-3002	DCS	Budget Price

Item	Plan Req#	Description	Comment
8	207040-00076-RFQ-3003	Control Valves and Regulators	Budget Price
9	207040-00076-RFQ-3004	Plant Communication System (i.e. radio communication)	Estimation
10	207040-00076-RFQ-3005	Instrument Cables	Ukrainian Supplier Price List
11	207040-00076-RFQ-3006	Plant Security Services	Budget Price
12	207040-00076-RFQ-3007	Pressure Drop Station for NG	Estimation
Civil, Structure, Architectural			
13	207040-00076-RFQ-4001	Supply and Fabricate Structural Steel	Quoted Price and Ukrainian Supplier Price List
Safety and Security Equipment			
14	207040-00076-RFQ-6001	Medical Equipment	Estimation
Pipe, Fittings and Valves			
15	207040-00076-RFQ-7001	Valve (Manual)	Budget Price
16	207040-00076-RFQ-7002	Steel Pipe and Fittings	Ukrainian Supplier Price list
Mechanical Equipment			
17	207040-00076-RFQ-8001	Hydrocyclones	Formal RFQ-Budget Price
18	207040-00076-RFQ-8002	Belt Conveyors (Design and Supply)	Budget Price
19	207040-00076-RFQ-8003	Gyratory Crusher	Formal RFQ-Firm Price
20	207040-00076-RFQ-8004	Ball Mills	Formal RFQ-Firm Price
21	207040-00076-RFQ-8005	Screens(Banana and Wet)	Formal RFQ-Budget Price
22	207040-00076-RFQ-8006	Thickeners and Flocculants System	Formal RFQ-Firm Price
23	207040-00076-RFQ-8008	Magnetic Separators (Rougher & Cleaner and Cobbing) & Vibrating Feeders	Formal RFQ-Firm Price
24	207040-00076-RFQ-8009	Pressure Filters	Formal RFQ-Budget Price
25	207040-00076-RFQ-8010	HPGR (High Pressure Grinding Rollers)	Formal RFQ-Firm Price
26	207040-00076-RFQ-8011	Belt Feeders	Budget Price
27	207040-00076-RFQ-8012	Cone Crusher (Secondary Crusher)	Formal RFQ-Budget Price
28	207040-00076-RFQ-8013	Emergency Diesel Generators	Ukraine Budget and Estimation
29	207040-00076-RFQ-8014	Tower Mills	Formal RFQ- Firm Price
30	207040-00076-RFQ-8015	Concentrate Stacker/Reclaim	Formal RFQ-Budget Price
31	207040-00076-RFQ-8016	Rail Load Out Package	Formal RFQ-Budget Price

Item	Plan Req#	Description	Comment
32	207040-00076-RFQ-8017	Flotation Cells	Formal RFQ-Budget Price and Firm price
33	207040-00076-RFQ-8020	Supply and Fabricate Plate Work	Ukrainian Supplier Price List and Budget Quote
34	207040-00076-RFQ-8021	Apron Feeders	Formal RFQ-Firm Price
35	207040-00076-RFQ-8022	Hoists and Cranes (Overhead Travelling Cranes)	Budget Price
36	207040-00076-RFQ-8023	Agitators	Budget Price
37	207040-00076-RFQ-8024	Pump Slurry	Budget Price
38	207040-00076-RFQ-8025	Pumps Sump	Budget Price
39	207040-00076-RFQ-8026	Air Compressors	Budget Price
40	207040-00076-RFQ-8027	Raw Water Filtration Plant	Estimation
41	207040-00076-RFQ-8028	Sampling System	Budget Price
42	207040-00076-RFQ-8029	Dust Collection	Budget Price
43	207040-00076-RFQ-8030	Fire Protection System	Estimation
44	207040-00076-RFQ-8031	Ancillary Fleet	Estimation
45	207040-00076-RFQ-8032	Mobile Cranes	Estimation
46	207040-00076-RFQ-8033	Water Pump	Budget Price
47	207040-00076-RFQ-8034	Rock Breakers	Budget Price
48	207040-00076-RFQ-8036	Ball Mill Charger	Budget Price
49	207040-00076-RFQ-8037	WTP (Water Treatment Plant)	Estimation
50	207040-00076-RFQ-8038	STP (Sewage Treatment Plant)	Estimation
51	207040-00076-RFQ-8039	Mill Liner Handler	Budget Price
52	207040-00076-RFQ-8041	Knife Gates(Slide Gates)	Budget Price
53	207040-00076-RFQ-8042	Safety Shower and Eyewash	Estimation
54	207040-00076-RFQ-8043	Vibrating Discharge Hopper	Budget Price
55	207040-00076-RFQ-8044	Coarse Tails Stacker	Budget Price
56	207040-00076-RFQ-8045	Sculpture Flotation Conditioning Tank and Concentrate Storage Tanks	Estimation
57	207040-00076-RFQ-8046	Reagent System	Estimation
58	207040-00076-RFQ-8047	Distributors	Budget Price
59	207040-00076-RFQ-8048	Cooling Water System	Estimation

Item	Plan Req#	Description	Comment
Miscellaneous			
60	207040-00076-RFQ-9001	Light Vehicles (4wds)	Estimation
61	207040-00076-RFQ-9002	Lab Equipment	Estimation
62	207040-00076-RFQ-9003	Information Management Business System	Estimation
63	207040-00076-RFQ-9004	HVAC	Estimation
64	207040-00076-RFQ-9005	Fuel Supply & Small Skid Mounted	Estimation
65	207040-00076-RFQ-9006	Scales (Truck Scales)	Estimation
66	207040-00076-RFQ-9007	Emergency Response Unit	Estimation
67	207040-00076-RFQ-9008	Camp Operations and Catering Services	Estimation
Subcontracts			
68	207040-00076-RFQ-1101	Supply and install Concrete Work	Ukrainian Constructor Budget Price
69	207040-00076-RFQ-1102	Installation Packages (Mech., St., El., I&C)	Estimate from MTO
70	207040-00076-RFQ-1103	Civil and Earth Work	Ukrainian Constructor Budget Price
71	207040-00076-RFQ-1104	Substations Buildings	Estimate from MTO
72	207040-00076-RFQ-1105	Auxiliary Buildings (Mine, Office, HSE, Guard House)	Estimate from MTO

Figure 21.1: Firm/Budget Price/Estimation



21.3.5 Assumptions of Base Cost Estimate

The following assumptions were made in preparing the Capital Cost Estimate:

- Statutory Permits are in place prior to construction.
- Trade Practices Agreements are met prior to construction.
- Engineering, Procurement and Construction Manangement (EPCM), are completed in accordance with the EPCM schedule in section 24.
- Site access is granted, as per the timeline shown in the EPCM Construction Schedule.
- Land Acquisition and Right-of-Way have been established for construction.
- The weather conditions are not of extreme proportions that may disrupt the continuance of safe work. A nominal allowance for inclement weather is made in the labour productivity assessment.
- Project delivery will not be constrained because of concurrent projects.
- The construction workforce will be sourced by local, surrounding communities and no construction camp is allowed for.
- Costs associated with vendor representatives have been allowed for.
- Land acquisition costs are part of the Owner's costs.
- Suitable fabrication shops are available locally (from logistics data compiled by the logistics study in Ukraine).
- Special cranes and special freight services as required for heavy / difficult lifts or oversized goods for transport have also been estimated from information made available in the procurement logistics Ukraine trip.
- Capital spares and commissioning spares are included in CAPEX. Operational spares are included in OPEX.
- Pre-commissioning check-outs prior to mechanical completion are included.
- Labour productivities take into account:
    1 Greenfield site conditions;
    2 Adequate skilled labour in the region;
    3 Site location of the Kryvyi Rih iron-ore basin;
    4 Safety considerations; and
    5 Availability of laydown areas and real estate for construction requirements.

21.3.6 Exclusions from Base Cost Estimate

The following items were excluded from the Capital Cost Estimate:

- Government Sales Tax or Value Added Tax on imported goods;
- Tariffs/duties;
- Any variation to the scope from that described in the feasibility study report;
- Deferred capital costs (addressed with sustaining capital);
- Changes to industrial relations laws;
- Finance and interest charges for project duration;
- Salvage value for equipment and the refuse of material demolished during construction;
- Any environmental requirement not identified in this estimate;
- Military land reclamation;
- Abnormal weather conditions;
- Soil remediation for any *in situ* hazardous contaminants;
- Extended periods of industrial unrest;
- The cost of delays associated with obtaining statutory approvals (e.g., building or development approval);
- Sunk costs (e.g., cost of this study and previous ones etc.);
- Market forces related to the imbalance of supply and demand economics beyond the expected annual rate of inflation of prime commodities, such as steel, copper and pipe;
- The effect of related concurrent projects on the availability of construction labour and materials;
- Fuel price variation;
- Foreign Exchange; and
- Acts of God.

Foreign currencies are expressed in USD, based on foreign exchange rates shown below:

Table 21.10: Exchange Rates

United States Dollar	Other Currency	
1.0 USD =	1.026	CAD (Canadian Dollars)
1.0 USD =	8.050	UHA (Ukrainian Hryvna)
1.0 USD =	0.638	GBP (British Pound)
1.0 USD =	0.797	EUR (Euro)
1.0 USD =	3.466	PLN (Polish Zloty)
1.0 USD =	32.07	RUB (Russian Ruble)
1.0 USD =	6.344	CNY (Chinese Yuan Renminbi)

No allowance has been made for variation in the rate of exchange between the estimate date and the placement of order. It is assumed that foreign exchange variation and the cost of hedging will be classed as the Owner's cost.

21.3.7 Manual Labour Rates

Labour rates were derived from obtaining local Ukraine salary rates and developing a All-in Crew rate as follows.

The **"craft wage rate template"** worksheet was developed for craft trade rates (considering a craft mix of foremen, experienced journeymen and apprentice helpers), showing base pay, employer fringe benefits and government burdens per hour per trade (e.g., iron workers, pipefitters, etc.). The individual craft labour rates were then averaged to form a combined overall rate for each particular trade.

The **"crew wage rate template"** worksheet was developed for discipline crew rates and considers a mix of different craftspeople in each crew. A crew may have 10 to 30 craftspeople working together to install a particular commodity (steel, concrete, piping, etc.). The individual craft wage rates for each worker are averaged to show a combined overall crew rate that includes base pay, employer fringe benefits and government burdens per hour. There is a crew number associated with each work crew.

The **"crew work cycle template"** worksheet was developed for the work shift differential incentives added to the crew rates. The template assumes 42 hours per week paid at straight time, and eight hours paid at double time for the sixth day (Saturday).

The **"All-in crew rate template"** worksheet was developed for indirect costs (including contractors' indirects and equipment rentals) added to the previous sub-total for each construction crew to form the all-inclusive or "all-in" rate. The indirects are summarized into major categories and expressed as a percentage of the previous built-up sub-total crew rate.

The typical average crew rates used for the estimate are in Table 21.11:

Table 21.11: Crew Rates

Crew	ID	Base + fringes rate per DFL hour USD	Eqpt rental rate per DFL hour USD	Indirects rate per DFL hour USD	"All-in" rate per DFL hour USD
Architectural Heavy	A1	4.86	5.40	6.77	17.03
Architectural Light	A2	4.54	2.73	5.75	13.02
Concrete	B	4.72	5.93	6.50	17.15
Site Development	C1	5.14	14.93	8.16	28.23
Piling , railway	C2	4.30	11.21	6.74	22.25
Earthworks	C3	4.68	18.50	8.16	31.34
Electrical	E	5.47	5.75	7.28	18.50
Scaffolding	F	4.63	2.79	5.74	13.16
Coating (painting)	G	4.58	2.76	5.69	13.03
Insulation	I	4.63	3.85	6.01	14.49
Mech Eqpt	M1	5.17	20.71	9.36	35.24
Mech Platework	M2	4.87	10.75	7.51	23.13
Piping	P	5.26	11.34	8.05	24.65
Project Common Services	R	4.95	4.97	6.48	16.40
Structural Steel	S1	5.11	15.35	8.49	28.95
Misc Steel , siding panels	S2	5.11	9.00	8.49	22.60
Instrumentation	X	5.19	4.69	6.80	16.68

21.3.8 Contractors' Distributables

Contractors' distributables are shown with the indirect build-ups mentioned above in labour rates.

These rates cover construction equipment and expenses to support and deploy installation labour.

Cost components covered by these rates include:

- Mobilization and demobilization;
- Temporary site facilities and utilities;
- Maintenance of temporary facilities and equipment;

- Contractors' construction equipment;
- Small tools and consumables;
- Manual indirects;
- Site office operation;
- Staff and supervision;
- Home office and costs; and
- Contractors' fees and overhead.

Note that contractor distributable percentage excludes costs for large cranes (greater than 150 MT). Large cranes are estimated separately.

21.3.9 Common Distributables

The common distributables are also included in the indirects referred to in the labour crew rate above. These are assessed on a Project-wide basis.

These distributables include, but are not limited to, the following:

- Construction facilities (roads, walks, parking areas, trailers, temporary buildings, temporary utilities, general purpose scaffolding, cribbing and dunnage);
- Construction supervision support and final clean-up, craft training and testing, on-site services (e.g. cleaning), operation and maintenance of construction facilities, surveying and pre-operational testing support;
- Construction equipment, tools and supplies (construction equipment, tools, maintenance of equipment and tools, fuels and lubricants, consumable supplies and safety supplies);
- Material transportation from warehouse to job site; and
- Project expenses (licenses and permits).

21.3.10 Productivity

Productivity factors were applied to direct field labour hours in order to compensate for labour productivity loss on the job site. Factors that can contribute to good field productivity include fast and efficient access to the work area, an experienced work force, effective site work force planning/scheduling, and experienced supervision (general foremen and line foremen). These factors are necessary to adequately transform construction drawing details and specifications into effective construction-shift objectives, counteract weather conditions, efficiently deliver material and equipment to work areas, and effectively utilize and maintain construction equipment and power tools in sufficient quantities.

The current productivity losses being considered in the CAPEX for this feasibility study are as follows:

Table 21.12: Productivity Factor (PF)

Commodity Code	Commodity	PF
A	Site Development – Civil	**1.8**
B	Earthworks	**1.8**
C	Concrete	**2.0**
D	Structural Steel	**2.27**
F	Facilities / Buildings	**2.19**
G	Specialties, Rail, Bridges, Scaffolding	**2.10**
L	Lagging, Insulation & Refractory	**2.13**
M	Mechanical Equipment	**2.23**
N	Tanks, Bins, Platework	**2.27**
P	Piping	**2.23**
Q	Pipelines	**2.23**
U	Electrical Equipment	**2.23**
V	Instruments	**2.23**
W	Electrical Bulks	**2.23**
X	Instrumentation Bulks	**2.23**
Y	Painting	**2.13**

21.3.11 EPCM Services

21.3.11.1 General

The Engineering, Procurement and Construction Management (EPCM) services are estimated by WorleyParsons and based on the Execution Project schedule and the deliverables necessary to complete the Project.

Projected costs for EPCM have been separated between home office costs and field office costs and include the provision of services for:

- Project Management;
- Discipline Engineering;
- Administration;
- Document Control;
- Cost Control;
- Cost Estimating;

- Planning and Scheduling;
- Procurement and Logistics;
- Inspection and Expediting;
- Secondary consultants for mine and Ukraine Design Institute (UDIs);
- Environmental engineering and UDI environmental studies;
- Field Engineering;
- Construction Management;
- Commissioning Support;
- Business travel and accommodation; and
- Other EPCM employee costs, such as training / mobilization / demobilization, etc.

The estimate also includes, as part of the owner's cost:

- Office expenses, including rental;
- Site vehicles for CM staff;
- Stationery, printing and photocopying; and
- Communications (telephone, fax, couriers, postage).

21.3.11.2 FREIGHT

A logistics study was completed by a WorleyParsons logistics specialist in order to review options for access to ports, rail and roads. Budget prices for freight costs were obtained for major pieces of equipment. The freight for the remainder of materials was factored on the basis of recent surveys and the costs of similar projects.

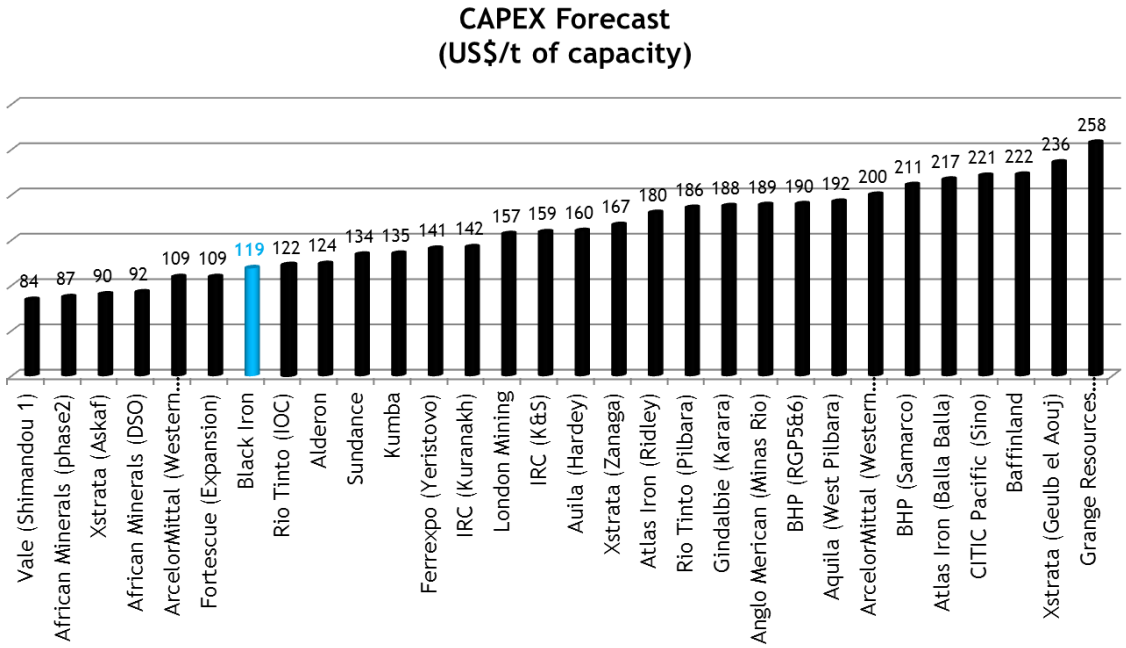
21.3.12 Pre-commissioning, Commissioning Handover and Closeout Costs

Provision has been made in the EPCM estimate for pre-operational testing and pre-commissioning punch lists to mechanical completion. This includes construction crews, a commissioning manager, field commissioning engineers, field planners and post-handover personnel. Provision has also been included for commission and start-up assistance.

It is assumed that formal commissioning, start-up and handover, including planning, procedures, training and execution, will be borne by Black Iron as an operational activity carried out by the Owner's operations staff. These costs are not included in the engineering-procurement-construction-management (EPCM) estimate, but are included in Owner's costs.

Benchmarking studies below compare the cumulative cost estimate for this project in Ukraine against other recent developments in Africa, Australia and South America.

Figure 21.2: Benchmark Cost Estimates (Based on Renaissance Capital September 2011 Estimates with updated BKI number)



21.3.13 Operating Costs

The operating cost has been developed according to typical industry standards and norms for an operation of this nature. The costs depicted in this document consist of all the operating cost elements needed to produce a concentrate product suitable for sale and export.

Operating costs are built up from a well-defined basis of estimate and are defined for each of the following areas:

- Mining Operations (by P&E Mining Consultants Inc.);
- Crushing and Screening;
- Grinding, Concentration and Tailings Handling;
- Infrastructure;
- Rail Transportation and Port; and
- General and Administrative.

21.3.14 Plant Design Parameters

21.3.14.1 Plant Capacity

The Project design is based on the nominal throughput of 27.9 million tonnes per annum (Mtpa), which produces 9.1Mtpa iron ore concentrate. Table 21.13 summarizes the design and average life-of-mine capacity:

Table 21.13: Plant Capacity

Design Condition	Mine Throughput (Mtpa)	Concentrate Production (Mtpa)
Nominal	27.9	9.1
Design	30.7	10
Average (Life of Mine Post Ramp-up year)	28.3	9.2

21.3.15 Life-of-Mine

The life of the mine is 16 years, according to the final production schedule prepared by P&E Mining Consultants Inc. (P&E). The production schedule has been prepared to keep a constant feed rate to the plant (post ramp-up year) and maintain the average magnetite percentage close to 19.4%, calculated on the basis of the beneficiation plant requirement.

On the basis of the average characteristics of Run-of-Mine (ROM) ore feed to the plant, it is estimated that the average mass yield is 32.7%. The annual concentrate production has been established on this basis.

Table 21.14: ROM and Concentrate Production Schedule

Year	Period	Diluted Ore Milled (tonne)	Diluted Fe_{mag} Milled (%)	Yield (%)	Concentrate Production (tonne)
Year 1	Q 1	4,457,000	16.89	29.0	1,291,066
	Q 2	6,200,000	20.20	33.9	2,100,858
	Q 3	7,085,000	19.21	32.4	2,296,270
	Q 4	7,085,000	19.32	32.6	2,308,032
Years 2-16	Y 2	27,860,000	19.52	32.9	9,159,839
	Y 3	28,340,000	19.07	32.2	9,125,785
	Y 4	28,340,000	19.55	32.9	9,331,905
	Y 5	28,340,000	19.05	32.2	9,119,397

Year	Period	Diluted Ore Milled (tonne)	Diluted Fe_{mag} Milled (%)	Yield (%)	Concentrate Production (tonne)
	Y 6	28,340,000	18.63	31.6	8,942,057
	Y 7	28,340,000	19.82	33.3	9,444,520
	Y 8	28,340,000	19.14	32.3	9,156,806
	Y 9	28,340,000	19.33	32.6	9,239,038
	Y 10	28,340,000	19.93	33.5	9,491,900
	Y 11	28,340,000	19.18	32.4	9,176,127
	Y 12	28,340,000	19.56	32.9	9,334,269
	Y 13	28,340,000	19.41	32.7	9,271,633
	Y 14	28,340,000	19.48	32.8	9,301,125
	Y 15	28,340,000	18.96	32.0	9,081,682
	Y 16	26,608,191	20.22	33.9	9,026,828

21.3.16 Project Schedule

Concentrate production from the Project is scheduled to start in January 2016. This is the start of the first year of the in-mine production schedule. A ramp-up period of six months has been considered as the time in which the mine will reach the nominal production capacity.

21.3.17 OPEX Accuracy

The expected order of accuracy is in the range of +/-15%, as required by this estimate class, and it is deemed appropriate for a Feasibility Study.

21.3.18 OPEX Elements

The OPEX has been formed by 10 elements, as defined below:

1. Labour;
2. General and Administration labour;
3. Power;
4. Consumables;
5. Maintenance;
6. Utilities;

7. Environment;
8. General and Administration (G&A);
9. Diesel fuel;
10. Transportation (Rail & Port); and
11. Sustaining Capital.

Element 1: Labour

The labour element in this document refers to the operation labour. This portion of labour is considered to be involved in the day-to-day operation of the plant and is mainly located in the mine or plant site. All the vehicle operators, maintenance crew, drivers, plant operators and technicians are included in this category. This category of labour includes mainly shift work, which is present 24/7 in the plant during operation.

Element 2: G&A Labour

This portion of labour consists of plant management and general administration staff. Plant management, health & safety, finance, corporate administration, procurement & logistics, and human resources staff form this group. This category includes mostly day work and does not occur in multiple shifts.

Element 3: Power

The power element covers the electrical power consumption of the entire operation, including the process plant, the mine and tailings area. This element captures all the power usage generated by the power grid, and not the emergency power generated by diesel generators.

Element 4: Consumables

The consumable category covers all the wear parts and consumable material in the Beneficiation and tailings area. Mining consumables are not included in this element and are part of the mining OPEX (which is done by P&E). The consumables include liners for equipment such as crushers and mills, grinding media; screen decks; and other relevant items, such as HPGR tyre stud-lined, flotation reagents and flocculant.

Maintenance items, such as lubrication, preventive maintenance, and emergency maintenance items, are excluded from this element.

Element 5: Maintenance

Element 5 is calculated on the basis of the percentage of the installed equipment cost and is intended to cover the cost of all maintenance items required for the beneficiation plant. Mining equipment maintenance is not part of this element and it is presented in the mine OPEX.

The maintenance cost covers regular maintenance of equipment, spare parts and replacement costs, lubrication, planned shut-downs and emergency repairs.

Element 6: Utilities

Utilities consist of the following items needed for operation of the entire plant:

- Natural gas;
- Process make-up water;
- Potable water;
- Tailing monitoring survey;
- Roads dust suppression;
- Sanitary sewer collection and disposal; and
- Solid waste disposal.

Element 7: Environmental

This element contains the annual cost of environmental assessments and monitoring, including air, water, waste, noise, sedimentation and ecology.

Element 8: General Administration

This element covers the administration cost required for running the operation. The labour portion of the cost has been covered in Element 2 above; and this element covers the consumables, training sessions, legal fees, consultants and other administrative costs.

Element 9: Diesel Fuel

The main consumer of diesel fuel is the mining fleet. The beneficiation plant has a very small consumption of fuel for the ancillary vehicles. Diesel fuel is received via tanker trains and stored in tanks for use in the fuelling system. Both mine trucks and other vehicle fuelling stations are located close to the mine.

Element 10: Transportation

Transportation includes the concentrate transportation cost from plant to ship. This cost involves rail transportation, rail car unloading, stacking at port, storage, reclamation and ship loading.

21.3.18.1 SUSTAINING CAPITAL

Sustaining capital, captures the cost of future activities, in order to keep the plant in production at the nominal production rate. Table 21.15 includes sustaining capital items in the financial model.

Table 21.15: Sustaining Capital Items in the Financial Model

Sustaining Capital Item	Value (USD)	Expenditure Time Frame
Mine Fleet	$ 364,414,802	Through life of mine
Mine Administration Building, Mine Truck Shop and Mine Warehouse	$ 10,563,137	Year 1
Mine closure cost	$ 3,000,000	Year 16
Replacing and Maintaining Processing Equipment	$45,686,695	Annually starting from year 5
Mine South Ramp Bridge	$ 15,000,000	Year 6
Additional Haul Truck Road	$ 1,382,492	Year 5
Beneficiation Plant De-bottlenecking	$ 4,000,000	Half in year 1 and half in year 2
Construction of Tailing Cell 2	$ 95,320,760	30% year 2, 50% year 4 and 20% year 6
Construction of Tailing Cell 3	$ 58,226,186	Year 7
Construction of Tailing Cell 4	$ 41,816,208	Year 11
Expanding Tailing Water Collection Ponds	$ 17,561,695	40% on year 2 and 60% on year 8
Tailing Ponds Trenching	$ 734,059	Year 2, 3 and 5
Tailing and Waste-rock Reclamation Cost	$ 19,800,00	Year 3, year 7, year 11 and year 16
Expanding Waste Rock Pile Collection Ponds and Trenching	$ 22,061,795	Year 1, year 2, and year 4
Water Collection Pond B	$ 1,365,729	Year 2
Beneficiation Plant Light Vehicle and Ancillary Fleet Replacement	$ 2,400,000	Year 6, year 7, year 11 and year 12
Construction of Access Road to North of Tailing	$ 764,024	Year 2
Working Capital	$ 4,000,000	Year 1
Total	**$689,297,582**	

No deferred capital for expansion of the plant has been considered in this study.

21.3.18.2 EXCLUSIONS

The following items are excluded from the scope of OPEX:

- Sustaining capital;
- Royalty payments;
- Corporate tax;
- Value Added Tax (VAT);
- Marketing and sales;
- Currency exchange rate during life-of-mine;
- Escalation and inflation cost during life-of-mine; and
- Contingency.

21.3.18.3 BASIS OF PRICES

Table 21.16 summarizes the unit rates for the items used in the OPEX calculation and the source of the price. These prices are based on the as-received currency. All quotations in Ukrainian Hryvnia (UAH) will be subject to the exchange rate. Port tariffs have been quoted in US dollars (USD).

Table 21.16: Unit Rate Prices

Item	Unit	Price (UAH)	Price (USD)	Source
General Consumables				
Electric Power	MWh	675.00		National Committee of Energy Cost
Diesel Fuel	l	8.114		Local diesel fuel suppliers
Natural Gas	m^3	4.7		Natural gas authority – Kryvyi Rih
Potable Water	m^3	4.7		Local potable water providers
Make-up Water	m^3	-		Treated water from Yuzhnaya Aeration Plant is used as process make-up water. There is no cost for the water.
Beneficiation Plant				

Item	Unit	Price (UAH)	Price (USD)	Source
Consumables				
Grinding Media (50-60mm)	tonne	7820		PAO HARP (grinding media supplier)
Grinding Media (20-25mm)	tonne	8350		PAO HARP (grinding media supplier)
Grinding Media (10-15mm)	tonne	12,930		PAO HARP (grinding media supplier)
Collector: PAX (Potassium Amyl Xantahte)	tonne	14,700		ETC Kiev (PAX supplier)
Sulphuric acid 98%	tonne	1,200		KhimFarmInvest LLC, Kiev
Frother: MIBC	tonne	20,000		ETC Kiev (PAX supplier)
Depressant: Starch (Dextrin)	tonne	10,500		Fortuna Ingredient – Kremenchug (Starch supplier)
Flocculent (for thickeners)	tonne	50,000		Akva Holding Dnepropetrovsk (flocculent distributor)
Activator (NaSH)	tonne	6,750		KhimFarmInvest LLC, Kiev
Screen panel - Steel	m^2	450		MashStroyIndustriya LLC, Lugansk
Screen panel - Polyurethane	m^2	4400		MashStroyIndustriya LLC, Lugansk
Transportation				
Rail Transportation to Port of Nikolaev	Rail Car	2,555		Based on the letter from Alliance Trans Rail.
Rail Transportation to Port of Yuzhniy	Rail Car	4,760		Based on the letter from Alliance Trans Rail.
Port of Yuzhniy Tariff	tonne		$6.65	Based on letter from TIS-Vugilla LLP.
Port of Nikolaev Tariff	tonne		$5.40	Based on report from Dealex.

21.3.18.4 COST CATEGORIES

Operating cost has been divided into two categories: Fixed costs and variable costs. Table 21.17 tabulates the cost categories for various work breakdown structures.

Table 21.17: Fixed and Variable Costs

WBS / Area		Variable Cost	Fixed Cost
1000	**Mine**	Labour Drilling and Blasting Loading and Hauling Other vehicles Diesel Fuel Road and Dumps Power Maintenance supplies	G&A Labour Utilities
2000	**Beneficiation Plant**	Power Consumables Maintenance supplies	Labour G&A Labour Utilities
3000	**Tailings & Waste**	Power Maintenance Supplies	Labour G&A Labour Utilities
4000	**Environmental**		Environmental Cost Labour G&A Labour Utilities
5000	**Infrastrucutre**	Power Diesle Fuel Process Water Rail Transportation Port Cost Maintenance Supplies	Labour G&A Labour Utilities
9000	**Black Iron PMT**	Consumables Freight	Labour G&A Labour Utilities General Admin

To calculate the annual OPEX throughout the life of the mine, the variable cost items have been prorated for each year of plant throughput or concentrate production, as compared to the plant nominal throughput or production rate.

21.3.18.5 CALCULATION APPROACH

The estimated operating costs presented in this study were based on a number of approaches, as follows.

21.3.18.5.1 LABOUR

Labour needed for the operation and G&A have been based on the industry standard for similar operations, considering general practice in Ukraine. Some of the labour needed for the operation has been increased on the recommendation of a local consultant.

Twenty-four hours a day, 365 days a year have been considered as the basis of labour costs. Standard working hours of 42 hours per week have been considered as per local codes. This translates to one week of work at 12 hours per day and one week off. The equivalent of four shifts per day has been considered in the manpower calculation.

A 15% addition to the cost of each employee has been considered to cover the sick days and vacations.

Gross labour rates and salaries have been provided by a local consultant and based on local rates, including the tax and social dues.

21.3.18.5.2 POWER

Power consumption is based on a well-defined load list. Motor sizes are listed according to the vendor recommendations in most cases, particularly for the larger loads. The calculation is based on the total installed power, excluding the standby equipment. For Ball Mills and VertiMills, actual grinding power draw has been calculated using the Bond formula for mill power calculation. For other equipment, load factor has been applied to the installed power and based on the design factors.

21.3.18.5.3 CONSUMABLES

Consumable consumptions are based on a combination of testwork, vendor recommendations and in-house database information. Grinding media consumption for ball mills has been calculated by using the Abrasion Index (Ai). The Ai value has been obtained through the testwork on the ore.

For the vertical mills, the consumption rate of grinding media has been borrowed from the operations on similar magnetite ore.

Wear parts consumption for major items of equipment, such as crushers, HPGRs, Ball Mills and VertiMills is based on the quotations from vendors and based on their experience with similar operations.

Flotation reagent type and consumptions are based on testwork data. Flocculant consumption is based on the in-house data and the acceptable industrial rate for the ore type in the Project.

Consumptions of office consumables and PPE are based on industry norms per employee.

21.3.18.5.4 MAINTENANCE

Equipment maintenance has been applied as a factor to the installed cost of the equipment. A factor of 220% of equipment-supply cost has been used to calculate the installed cost. The following factors have been used to calculate the annual cost of maintenance:

Severe service equipment: 4%

Medium-severity service: 3%

Low-severity service: 1.5%

Buildings maintenance: 1%

21.3.18.5.5 UTILITIES

Diesel fuel for the plant ancillary fleet has been calculated and based on the engine horsepower of each machine, pro-rated on its utilization and working hours.

Natural gas usage has been calculated and based on the heating requirements for the buildings. HVAC calculation has been performed to define the demand.

Dust suppression has been based on the recommendation from pavement design to reduce the dust during plant operation, in order to mitigate the environmental risk on the Project.

21.3.18.5.6 ENVIRONMENTAL

Annual allowance for environmental monitoring and assessment has been considered for the operation cost estimate. These values are based on industry standards and modified to match local practices.

21.3.18.5.7 GENERAL AND ADMINISTERATION

This cost has been entirely based on the in-house data and confirmed with Black Iron to satisfy local project needs.

21.3.18.5.8 SUSTAINING CAPITAL

Tailing dykes construction is based on the quantities provided by tailing design, and the unit rates of each material are based on the Capital Expenditure (CAPEX) calculation.

Bridge construction cost is an allowance based on today’s cost of a similar bridge.

21.3.18.6 EXCHANGE RATE AND ESCALATION

The currency of the operating cost estimate is the US dollar (USD). The unit rates for cost items of OPEX, which have been received from local sources, are reported in Ukrainian Hryvnia (UAH).

In order to convert the UAH value to USD, financial reports from banks have been used to determine the exchange rate for the estimate. Since the OPEX will be effective at the beginning of the operation (January 2016), the forecast exchange rate for that time has been considered in the UAH conversion. Table 21.18 shows the key economic factors forecasts for Ukraine, which are based on Rainffeisen Bank's AVAL report.

Table 21.18: Ukraine Key Economic Factors Actual & Forecast

Item	2008	2009	2010	2011	2012F	2013F
GDP (UAH bn)	948.1	913.3	1082.6	1316.6	1516.9	1736.9
GDP (% yoy)	2.3	-14.8	4.1	5.2	2.5	4.0
CPI (avg, % yoy)	25.2	15.9	9.4	8.0	2.5	7.5
USD/UAH (avg)	5.26	8.02	7.95	7.97	8.20	8.90
USD/UAH (avg, % yoy)		52.5	-0.9	0.3	2.9	8.5

Judging from this report (and other similar reports), it is expected that the USD/UAH will be 1:9 in 2013 (from the current value of 1:8.1). This change will affect the cost of items that are supplied from in-country sources. Weakening of the currency will increase the cost of items and result in inflation.

In order to consider the effect of changes in currency value and inflation, a 1% total real USD increase in the price of elements has been considered to bring today's value up to the forecasted cost at the beginning of 2016. No escalation has been applied after plant start-up during the life of the mine.

The exchange rate has been kept at the 2013 conservative, forecasted value of $1USD:9UAH.

21.4 OPEX Charts

The charts below present the OPEX for the following cases. All of the unit costs are based on average annual production throughout the life-of-the-mine.

- Mine Operation: Table 21.19 the Mine OPEX includes all the operating cost items relevant to the mining activities. The battery limit is to the dump pocket of the primary crusher for ore and the waste-rock pile for waste material. All the haulage, blasting, surface preparation maintenance of mining fleet is included in this table.
- Beneficiation Plant: Table 21.20 includes all the cost items relevant to processing the ore from the primary crusher to the rail load-out. The shipping of the concentrate is excluded from this cost.

- Mine and Beneficiation Plant – FOB Ukraine Port: (Table 21.21) presents the FOB cost per ton of concentrate. This includes total mine beneficiation plant, rail transportation and port charges to load the final concentrate product onto a customer's vessel. The rail transportation and port charges are based on the average annual costs for a combination of two export ports being Nikolaev and TIS Yuzhniy.

Table 21.19: Mine Annual Opex - By Elements

	Cost Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Total (USD)	$/Ton
1	Labour	$ 4,933,995	$ 4,692,892	$ 4,528,920	$ 4,126,468	$ 4,150,342	$ 4,218,423	$ 4,631,238	$ 4,199,927	$ 4,826,168	$ 5,523,769	$ 6,338,379	$ 5,737,588	$ 6,341,790	$ 6,506,286	$ 6,968,030	$ 3,308,261	$ 81,032,478	$0.55
2	G&A labour	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,389,692	$ 1,301,192	$ 926,726	$ 21,683,611	$0.15
3	Electrical power	$ 3,350,515	$ 2,987,418	$ 2,960,471	$ 2,995,770	$ 2,966,789	$ 2,768,920	$ 2,789,827	$ 2,773,714	$ 3,184,520	$ 3,784,267	$ 3,716,792	$ 3,934,404	$ 3,957,629	$ 4,285,994	$ 4,247,828	$ 2,134,429	$ 52,839,287	$0.36
4	Consumables	$ 56,447,402	$ 53,678,093	$ 51,697,382	$ 53,457,910	$ 54,176,687	$ 53,352,289	$ 57,231,619	$ 57,064,468	$ 66,835,087	$ 70,922,841	$ 76,606,324	$ 76,179,187	$ 84,126,300	$ 93,086,708	$ 95,321,857	$ 38,359,730	$ 1,038,543,885	$7.10
5	Maintenance	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,362,146	$ 7,945,313	$ 118,377,507	$0.81
6	Utilities	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0.00
7	Environmental	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0.00
8	G&A and Fleet Lease	$ 1,704,580	$ 6,377,796	$ 5,912,608	$ 5,142,943	$ 4,344,435	$ 2,996,862	$ 1,838,903	$ 1,824,580	$ 1,824,580	$ 1,964,580	$ 7,202,080	$ 1,824,580	$ 1,824,580	$ 1,824,580	$ 1,824,580	$ 1,244,210	$ 49,676,480	$0.34
9	Diesel Fuel	$ 34,480,284	$ 29,293,883	$ 30,686,461	$ 25,775,287	$ 26,101,538	$ 26,733,188	$ 31,887,035	$ 29,285,841	$ 35,366,372	$ 45,574,651	$ 54,510,908	$ 48,791,350	$ 55,966,213	$ 54,246,804	$ 63,249,259	$ 22,000,171	$ 613,949,244	$4.20
	Total	$ 109,668,616	$ 105,781,919	$ 104,537,681	$ 100,250,217	$ 100,491,629	$ 98,821,520	$ 107,130,461	$ 103,900,369	$ 120,788,566	$ 136,521,946	$ 157,126,322	$ 145,218,947	$ 160,968,351	$ 168,702,212	$ 180,274,894	$ 75,918,841	$ 1,976,102,491	$13.51

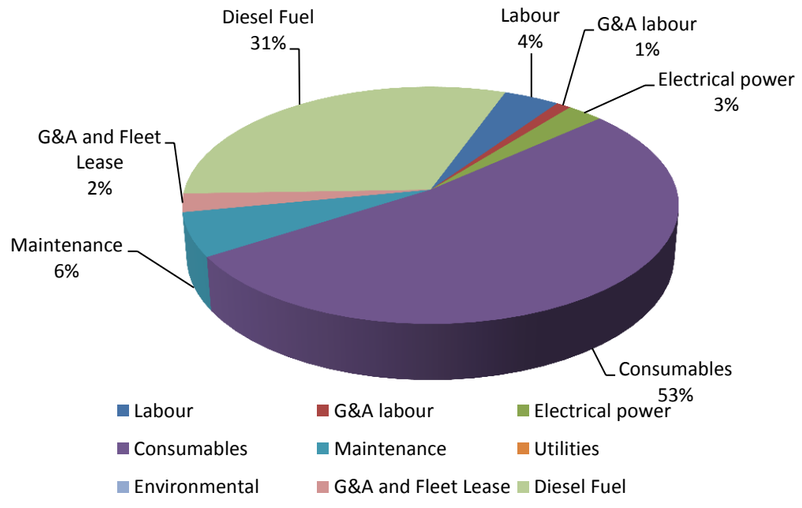
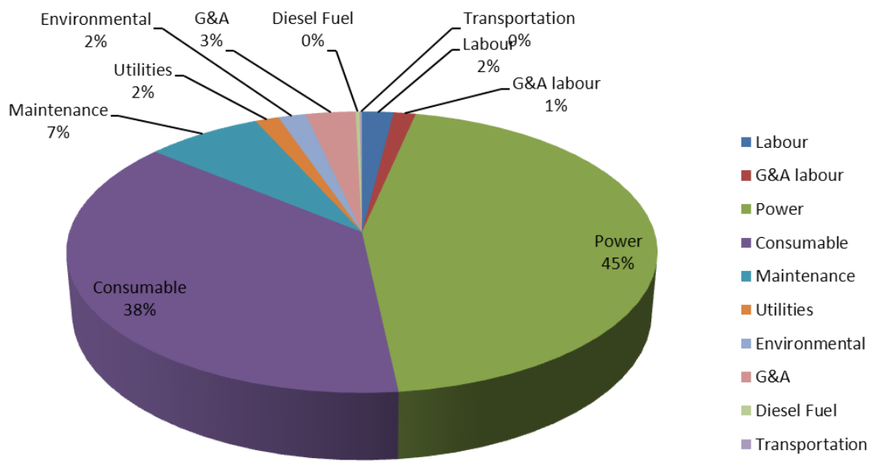


Table 21.20: Beneficiation Plant Opex

	Beneficiation Plant	Tailings & Waste	Environmental	Infrastructure	Sales and G&A	Total
	2000	3000	4000	5000	9000	
Cost Item	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton
1 Labour	$0.27	$0.02		$0.02		$0.32
2 G&A labour					$0.22	$0.22
3 Power	$6.75	$0.04		$0.47		$7.26
4 Consumable	$6.08			$0.01		$6.09
5 Maintenance	$1.15			$0.03		$1.18
6 Utilities		$0.02		$0.22		$0.24
7 Environmental			$0.28			$0.28
8 G&A					$0.50	$0.50
9 Diesel Fuel	$0.04					$0.04
10 Transportation					$0.02	$0.02
Total	$14.30	$0.09	$0.28	$0.75	$0.75	$16.17



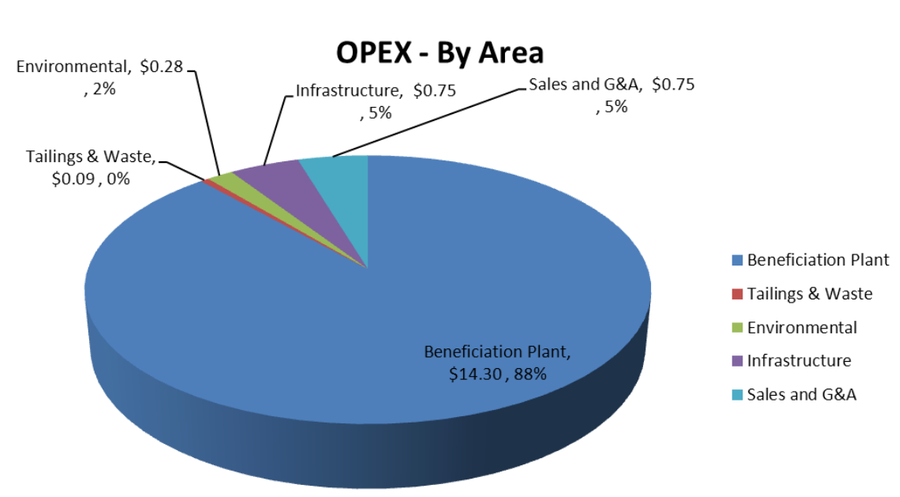
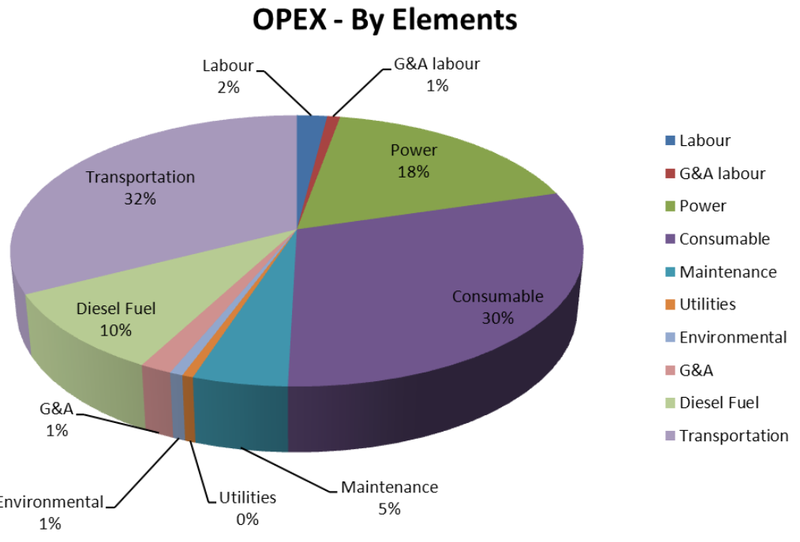
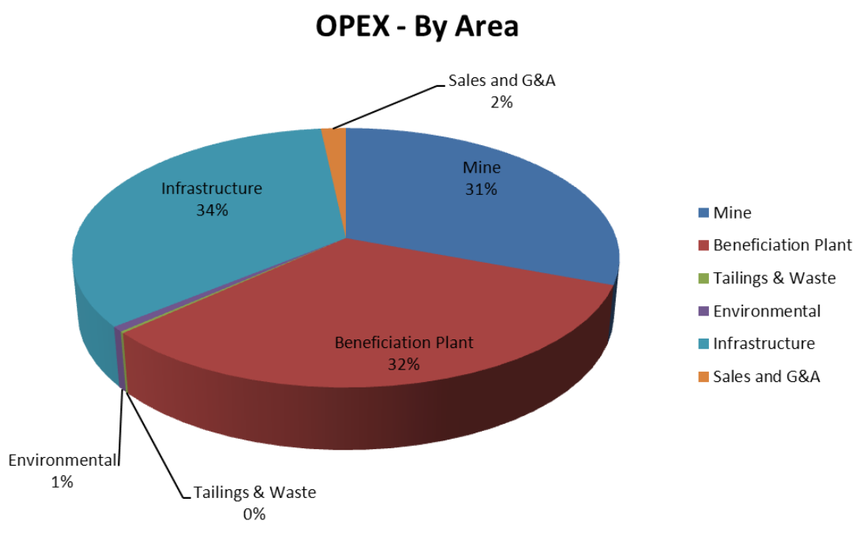


Table 21.21: OPEX – Mine and Beneficiation Plant – FOB Ukraine Port

	Mine 1000	Beneficiation Plant 2000	Tailings & Waste 3000	Environmental 4000	Infrastructure 5000	Sales and G&A 9000	Total
Cost Item	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton	$/Ton
1 Labour	$0.55	$0.27	$0.02		$0.02		$0.87
2 G&A labour	$0.15					$0.22	$0.37
3 Power	$0.36	$6.74	$0.04		$0.47		$7.73
4 Consumable	$7.10	$6.08			$0.01		$13.20
5 Maintenance	$0.81	$1.15			$0.03		$2.03
6 Utilities	$0.00		$0.02		$0.22		$0.24
7 Environmental	$0.00			$0.28			$0.28
8 G&A	$0.34					$0.50	$0.69
9 Diesel Fuel	$4.20	$0.04					$4.24
10 Transportation					$14.29	$0.02	$14.31
Total	$13.51	$14.30	$0.09	$0.28	$15.04	$0.75	$43.97





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22 ECONOMIC ANALYSIS

The economic evaluation of the Shymanivske Iron Ore Project was performed using the discounted cash flow model. The Capital and Operating Cost Estimates based on the mine plan developed in this Study to produce 9.2Mt of iron ore concentrate annually were used as input to the model. The Internal Rate of Return (IRR) on total investment was calculated on the basis of 100% equity financing. The Net Present Value (NPV), based on a discounting rate between 0% and 10% resulting from the net cash flow generated by the Project, was also calculated. The payback period is also indicated as a financial measure. A sensitivity analysis was also performed and presented. The following assumptions were made for the financial analysis:

- Construction starting in October 2013;
- Plant start-up and commissioning in Q4 of 2015;
- Plant ramp-up from January to June 2015;
- Life of the mine, 16 years;
- FOB sale price of $125/t of iron ore concentrate is used for the first year of production; $117 for the second year of production; and $115/t of concentrate for production years 3 to 16, calculated on the basis of a final product grade of 68.0% Fe. This price was based on the following:
    - Long-term CFR concentrate benchmark price of $95/t forecasted as the consensus estimate of 20 different global investment bank analysts on the basis of 62% concentrate;
    - Iron content adjustment of $5/t for each 1% Fe (i.e., $30/t adjustment to account for the 68% iron product Shymanivske will produce);
    - Shipping cost of $10/ton for product being shipped from Ukraine to the Middle East;
    - Forecasted trends in shipping rates; and
    - Black Irons “Sales Price Market Study”.

Note:

- Royalty payments of $0.40 per ton of ore mined have been accounted for in the discounted cash flow model.

Working capital of $4,000,000 has been added to the total capital requirement to cover the interest payments for the first three months of operation.

Further key modelling assumptions include:

- All of the product is sold in the same year of production;

- An exchange rate of 8.1 UAH per USD has been used for the CAPEX (up to Jan. 2016) and 9.0 UAH per USD for the OPEX and Sustaining Capital (year 2016 and beyond).
- The financial analysis is carried out on a pre-tax basis but does include royalties payable to Ukraine's government.

Table 22.1 presents the undiscounted cash flow projection for the Project. WorleyParsons assumed that the initial capital cost disbursement takes place over a 2-year period prior to production start-up. Production starts in Year 1 being January 2016 with a six month ramp up.

A discount rate is applied to the cash flow to arrive at an NPV and payback period. The NPV calculation was done at 0%, 6%, 8% and 10%. The Base Case NPV was assumed at a discount rate of 8%.

Table 22.1: Financial Analysis Results for Iron Ore Concentrate Sales

IRR (pre-tax)	**45.9%**	
Discount Rate	Pre-Tax NPV USD (Millions)	Payback (Years)
0%	$ 8392	1.9
6%	$ 4328	2.1
8%	$ 3524	2.2
10%	$ 2887	2.3

The Project is forecasted to provide an IRR of 45.9% (before tax but post royalty) and an NPV of $3,524 million, using an 8% discount rate. The payback period is 2.2 years after the start of production.

22.1 Sensitivity Analysis

A sensitivity analysis was done on parameters that are deemed to have the biggest impact on the Project financial performance. The following sensitivity analysis was performed and the results are presented in Table 22.2, Table 22.3 and Figure 22.1.

- Base Case initial CAPEX estimate +/- 15%;
- Base Case Commodity Selling Price +/- 15%; and
- Base Case OPEX estimate +/- 15%.

As is indicated, the NPV at an 8% discount rate is the most sensitive to the commodity selling price, followed by operating costs and initial capital cost.

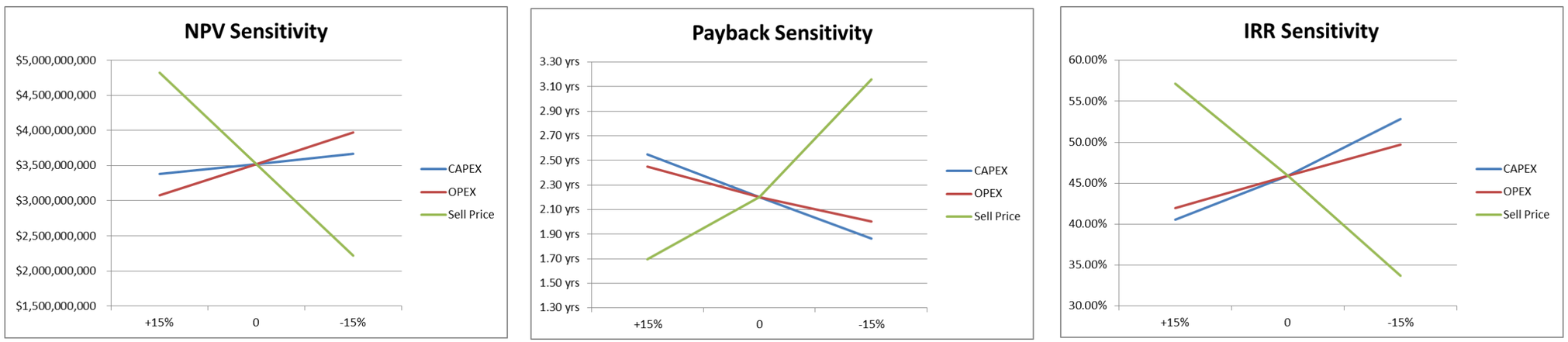
Table 22.2: Sensitivity Analysis Table for Iron Ore Concentrate Sales

	Base Case		Initial CAPEX				OPEX				Selling Price			
			+15%		-15%		+15%		-15%		+15%		-15%	
IRR	**45.90%**		40.56%		52.84%		41.98%		49.72%		57.16%		33.74%	
	NPV	**Payback**	**NPV**	**Payback**	**NPV**	**Payback**	**NPV**	**Payback**	**NPV**	**Payback**	**NPV**	**Payback**	**NPV**	**Payback**
0%	$ 8,391,542,459	1.90 yrs	$ 8,227,437,722	2.17 yrs	$ 8,555,647,196	1.63 yrs	$ 7,429,001,346	2.09 yrs	$ 9,354,083,572	1.74 yrs	$ 11,145,900,903	1.49 yrs	$ 5,637,184,015	2.63 yrs
6%	$ 4,328,480,496	2.12 yrs	$ 4,179,319,237	2.45 yrs	$ 4,477,641,754	1.80 yrs	$ 3,794,651,383	2.35 yrs	$ 4,862,309,608	1.93 yrs	$ 5,874,278,732	1.64 yrs	$ 2,782,682,260	3.00 yrs
8%	$ 3,524,192,425	2.20 yrs	$ 3,379,506,318	2.55 yrs	$ 3,668,878,531	1.86 yrs	$ 3,075,754,079	2.45 yrs	$ 3,972,630,770	2.00 yrs	$ 4,827,572,343	1.70 yrs	$ 2,220,812,506	3.16 yrs
10%	$ 2,886,533,827	2.29 yrs	$ 2,746,098,985	2.66 yrs	$ 3,026,968,670	1.93 yrs	$ 2,506,055,547	2.55 yrs	$ 3,267,012,108	2.08 yrs	$ 3,996,318,775	1.75 yrs	$ 1,776,748,880	3.34 yrs

Table 22.3: Table for 8% Discount Rate

	CAPEX			OPEX			Sell Price		
Change	**NPV**	**Payback**	**IRR**	**NPV**	**Payback**	**IRR**	**NPV**	**Payback**	**IRR**
+15%	$ 3,379,506,318	2.55 yrs	40.56%	$ 3,075,754,079	2.45 yrs	41.98%	$ 4,827,572,343	1.70 yrs	57.16%
0	$ 3,524,192,425	2.20 yrs	45.90%	$ 3,524,192,425	2.20 yrs	45.90%	$ 3,524,192,425	2.20 yrs	45.90%
-15%	$ 3,668,878,531	1.86 yrs	52.84%	$ 3,972,630,770	2.00 yrs	49.72%	$ 2,220,812,506	3.16 yrs	33.74%

Figure 22.1: Sensitivity Analysis Graph for Iron Ore Concentrate Sales



22.2 Currency Sensitivity Analysis

For the purpose of the FS, an exchange rate of 8.1 UAH per USD has been used for the CAPEX (up to January, 2016) and 9.0 UAH per USD for the OPEX and Sustaining Capital (2016 and beyond). Variations in the exchange rates from year 2016 onward impact the financial analysis as follows.

Table 22.4: Impact of Ukraine Hryvna Exposure – Currency Sensitivity for Iron Ore Concentrate

Exchange Rate as of year 2016 onward	(UAH/USD)			
	8:1	**9:1**	**10:1**	**11:1**
NPV @ 8% discount USD (millions)	3,334	3,524	3,677	3,800
Total Estimated Capital Cost (Concentrate)	1,094	1,094	1,094	1,094
Estimated Operating Cost ($/t Concentrate)	46.73	43.97	41.75	39.96
Average Annual Cash Flow USD (millions)	568	593	613	629

22.3 Risk Management

The following overview provides details of the Risk Management Process that took place during the Shymanivske Project Feasibility Study, in order to identify risks which may be encountered during the Project Execution Phase. A copy of the Risk register is included in the appendix.

Purpose

The purpose of this section is to outline the threats and opportunities that were identified during the Risk Management Workshops.

In general, the risk management process helps ensure that a project is designed, constructed, commissioned, operated and maintained with an acceptable level of risk in relation to its financial viability, to the environment, to the community and to the health and safety of personnel and plant integrity.

Risk management involves identification, assessment and management of threats and opportunities that may impact any of the objectives of the Project, including those relating to:

- Health & Safety;
- Security;
- Natural Environment;
- Assets;
- Schedule /Production;

- Project Return;
- Community / Government; and
- Reputation.

22.3.1 Context

The Risk Management Workshops completed during the Feasibility Study of the Shymanivske Project addressed the risks associated with the various future Project activities, including:

- Engineering and studies;
- Permitting;
- Procurement;
- Construction; and
- Commissioning.

22.3.2 Objectives

The risk management objectives for the Shymanivske Project Feasibility Study are as follows:

- Ensure that effective risk management principles and processes are employed to enhance decision-making and assist in reducing risk to people, the environment and assets; and
- Ensure that a risk management process is applied to identify, prioritize, appropriately prevent, minimize, mitigate, communicate and manage risks throughout the various stages of the Project.

22.3.3 Process

The essential tasks of the risk management process are:

- Establishment of the context for the risks being considered;
- Evaluation of tolerability and identification of potential risk reduction measures; and
- Selection, implementation and monitoring of appropriate control and reduction measures, and risk action plans.

Risks identified through this process will be controlled by adopting effective risk control strategies, appropriate to the level and nature of the risk, with the aim being to reduce or mitigate the risk to the Project.

22.3.3.1 EVALUATE RISKS

Once risks have been analyzed, they are assigned a severity ranking, which determines their overall priority on the project. Risks should be treated in order of priority. The Table below summarizes risk, priority and the associated action required.

Risk Severity Rating	Priority (1 is highest)	Action Required
Extreme (Red)	1	Immediate attention
High (Purple)	2	Immediate attention
Moderate (Yellow)	3	Action as soon as practicable
Low (Green)	4	Low priority

22.3.3.2 TREAT RISKS

a) General

Risk treatment should be appropriate to the nature and severity of the risk. At a minimum, risk-treatment action plans must be developed for extreme and high risks. However, action plans for moderate and low risks should also be undertaken if the level of effort to reduce the risk does not disproportionately outweigh the level of risk itself.

All risks are assigned to a responsible person (the Risk Owner). Any risk-treatment actions will be assigned to a Risk Actioner, who may or may not be the Risk Owner, along with an expected completion date.

The output of this process is referred to as the Risk Register.

22.3.4 Identified Risks

The following list will discuss some of the risks identified during the Risk Management Workshop as extreme or high, after mitigation. A complete set of risks identified during the workshop can be seen in the Final Risk Workshop Report included in the appendix.

22.3.4.1 HIGH EXISTING PARTICULATE

a) Description

- A high level of existing particulate in the area exceeds environmental regulation limits and prevents the approval of an environmental permit, which delays the Project.

b) Existing Controls

- Dust mitigation strategy is developed early in the execution phase; and
- Extensive base line studies are developed to produce a proper air dispersion model.

c) Mitigation

- Approach local regulators and surrounding mines to develop mitigation strategies.

22.3.4.2 KRYVYI RIH CITY LAND ACQUISITION DELAY

a) Description

- Delay in acquisition of the Kryvyi Rih city land (at the planned Shymanivske open pit) causes a schedule delay.

b) Existing Controls

- Black Iron undertakes negotiations with Kryvyi Rih city council and adjacent mines;
- Develop a land acquisition schedule; and
- Black Iron's Vice President of Government Relations engages in early discussions with local mines and city (town) councils.

c) Mitigation

- No further action over and above existing controls is taken.

22.3.4.3 POOR SAFETY CULTURE

a) Description

- Poor safety culture causes injuries and fatality during construction.

b) Existing Controls

- Ensure that training manuals and safety managers are present on site at all times;
- Implement a Human Resources policy;
- Test for alcohol every day;
- Develop a proper safety management plan;
- Enforce the safety rules and procedures; and
- Provide incentives for good work performed.

c) Mitigation

- Ensure extensive safety training;
- Put expatriates in key safety positions; and
- Enforce "no exceptions" policy, from the beginning of the project.

22.3.4.4 RELOCATION OF RUDNICHNOE VILLAGE

a) Description

- Delay in relocating the Rudnichnoe village residents results in construction delay.

b) Existing Controls

- Develop a relocation strategy and execute the relocation plan as soon as possible.

c) Mitigation

- Hire experienced consultants to manage the relocation.

22.3.4.5 CASH FLOW

a) Description

- The lack of funding and cash flow for the purchase of equipment during the first year of construction results in a schedule delay.

b) Existing Controls

- Start the financing process as early as possible.

c) Mitigation

- Increase the level of effort and identify alternative investing options. Renegotiate payment terms.

22.3.4.6 MINISTRY OF DEFENCE LAND ACQUISITION

a) Description

- Delay in acquisition of the Ministry of Defence land causes a delay in schedule.

b) Existing Controls

- Black Iron negotiations with Ministry of Defence;
- Black Iron raise issue to senior Ukraine Government officials;
- Land acquisition schedule; and
- A float in the main schedule allows for potential delays.

c) Mitigation

- Consider alternative layouts and facility locations.

22.3.4.7 UNEXPLODED ORDNANCE ON MILITARY LAND

a) Description

- Early site investigation and work pose the risk of finding unexploded ordnance resulting in fatality.

b) Existing Controls

- Assurance from the military in terms of unexploded ordinance;
- Independent verification (geological); and
- Access to designated areas only.

c) Mitigation

- Two independent surveys of the military land

22.3.4.8 ORDNANCE IN MILITARY WAREHOUSE

a) Description

- Extreme proximity of the beneficiation plant to the military warehouses might result in an explosion, resulting in fatality/ property damage.

b) Existing Controls

- Military has confirmed that the buffer zone of 400m for any occupied facility is sufficient.

c) Mitigation

- Erect a fence on the 400m zone with permanent security.
- Add height to military safety berms around the warehouses.

22.3.4.9 POLITICAL INSTABILITY AND LEGAL CHANGES

a) Description

- Licencing and permitting agreements change and cause additional cost and scheduling delay.

b) Existing Controls

- Black Iron's Vice President of Government Relations is proactive in identifying potential changes.

c) Mitigation

- Increase level of effort on licencing and permitting related tasks;
- Submit early PROEKT;
- Communicate regularly with licencing and permitting authorities;

22.3.4.10 UNEXPECTED GEOLOGY CONDITIONS AT THE MINE

a) Description

- Unknown structural geology condition causes a reduction in the pit slope angle.

b) Existing Controls

- Conduct Geotechnical investigation program in the mine area; and
- Conservative pit slope design parameters, were used for the FS design.

c) Mitigation

- No further action over and above existing controls.

22.3.4.11 Low Iron Ore Concentrate Price

a) Description

- Low iron ore concentrate price makes funding more difficult.

b) Existing Controls

- A realistic, if not even slightly conservative, concentrate price was used for the FS economic modelling.

c) Mitigation

- No further action over and above existing controls

22.3.4.12 YuGOK Garage Relocation Delay

a) Description

- Delay in relocation of the YuGOK garage causes schedule delay.

b) Existing Controls

- BKI negotiations with YuGOK and Kryvyi Rih city council expedites the relocation.

c) Mitigation

- No further action over and above existing controls

22.3.4.13 Gas and Fuel Prices

a) Description

- Increase in gas and fuel costs leads to additional CAPEX and OPEX.

b) Existing Controls

- Consider equipment powered by electricity.

c) Mitigation

- Sign long-term future contracts for gas and fuel.

22.3.4.14 TECHNICAL CONDITIONS CHANGE

a) Description

- Technical conditions for power, rail, water, gas, and road network may differ from the currently assumed agreements, necessitating engineering rework and causing schedule delays and additional CAPEX.

b) Existing Controls

- Proactive discussions with all utilities and city council.

c) Mitigation

- No further action is required over and above existing controls

23 ADJACENT PROPERTIES

The Shymanivske, Kryvyi Rih, iron ore deposit is part of the major regional iron ore formation of KrivBass, represented by linear north-south trending metamorphosed sedimentary rocks hosting a siliceous-banded iron formation (BIF) over a length of 300km.

The Shymanivske deposit is located at the central part of the iron ore district, situated in a valley surrounded by operating mines. Presently, there are five operating mines and iron ore beneficiation plants in the area:

- ArcelorMittal mine and beneficiation plant is located 1km north-east of the Property. It has been in production since 1959 and the current plant capacities are as follows. Ore mining: 24.2Mtpa from two active open pits; concentrate output: 9.9Mtpa, with Fe content of 65.4%.
- YuGOK (southern mining and beneficiation plant) is located 1km east of the Property. It has been in production since 1955 and the current plant capacities are as follows. Concentrate output 9.0Mtpa with Fe content of 65%.
- InGOK (Inhulets mining and beneficiation plant) is located 12km south of the Property. This is the largest iron ore concentrate producing plant in Ukraine and it has been in operation since 1965. The current plant capacity is 15.0Mtpa of iron ore concentrate. The plant produces two types of concentrate: high grade 67.5% Fe content (6.8Mtpa) and low grade 63.7% Fe content (8.2Mtpa).
- CGOK (central mining and beneficiation plant) is located 15km north of the Property. The current plant capacities are as follows: iron ore concentrate output 6.0Mtpa with Fe content of 65% and 68.2%; Pellets: output 2.2Mtpa with Fe content of 63.9%.
- SevGOK (Northern mining and beneficiation plant) is located 32km north of the Property. The current plant capacities are as follows: Iron ore concentrate output 14.2Mtpa with Fe content of 66%; Pellets: output 11.8Mtpa with Fe content of 63.5%.

The above information is available to the public and is not necessarily indicative of the quality or quantity of the mineralization on the Shymanivske property.

24 OTHER RELEVANT DATA AND INFORMATION

24.1 Contracting Strategy

24.1.1 Summary

The Shymanivske iron ore project is a schedule driven project and incorporates a wide range of components, ranging from work in the Mine to the Port.

The diversity of the work, the varying scale of the work and the risks associated with each component lead to different contracting strategies for the various components of the Project. They represent one possible approach to executing the work based on information obtained, site visits, contractor investigations and WorleyParsons experience in the Former Soviet Union (FSU) but other approaches may be equally suitable as well.

- The contracting strategy has been chosen and based on:
- Primary emphasis on meeting the overall schedule;
- Consideration for contract type and location;
- Likely scope of work definition and potential risks;
- Competitive tension expected in the relevant contracting markets; and
- Management and cultural sensitivity towards Ukrainian Design Institutes (UDIs).

For the implementation phase of the Project it is recommended Black Iron implement an Engineering, Procurement and Construction Management (EPCM) contracting strategy. In this role WorleyParsons as the EPCM contractor will carry out detailed engineering and provide a full procurement function on behalf of Black Iron and provide construction management and environmental management services. WorleyParsons will also provide overall management for the Project, with the recognition that Black Iron (BKI) has limited manpower resources and will count on the Project Management Services of the EPCM Contractor to provide those services.

The number and the variety of the contracts will require a significant EPCM project management team to ensure that the work is adequately supervised and coordinated.

WorleyParsons as the EPCM Contractor shall work in conjunction with the relevant Ukrainian Design Institutes (UDIs). This premise works on two levels: the UDIs have local expertise, site-specific knowledge and usually provide a technical capability as consulting engineers. Secondly, UDIs have a regulatory authority function in Ukraine and they represent the only real channel for obtaining local validation of engineering design as well as controlling the permitting procedure and ultimate approval for project permits.

The Detailed engineering phase will be managed initially from the WorleyParsons Toronto office, incorporating the services of specialist consultants, contractors and UDIs. As the capability of the WorleyParsons contractor's engineering and construction team in Ukraine develops sufficiently, the centre of gravity for construction management will shift to Ukraine and to WorleyParsons Kazakhstan and/or China office for the completion of detailed engineering. This is expected to occur at the basic engineering stage or between the 40% and 80% completion stage of detailed design, depending on the work package and the capability of the UDI. Infrastructure work packages will occur at the earliest or at approximately 40% completion and will require little or no 3D modelling. Infrastructure work consists of administration buildings, Utility Buildings and Firewater protection systems, and work is anticipated to be done in Ukraine to take advantage of the local knowledge and lower labour rates.

The Beneficiation Plant detailed design is planned to be completed in the WorleyParsons China office, where they have complete 3D capability and experience in Iron Ore projects with the types and quality expected by Black Iron. The WP China office has lower charge out rates and has experience in the EPCM material management process and 3D modelling, which is key to executing a schedule driven project.

WorleyParsons will act as procurement agent for and on behalf of Black Iron. As the EPCM contractor, WorleyParsons will manage the procurement, delivery and turnover to the Construction contractors of the equipment and materials identified in the contract documents.

WorleyParsons is also planning on re-establishing its office and LLC corporate registration in Ukraine to facilitate the work done in Ukraine. A WorleyParsons team will be put in place for UDI Management, Infrastructure Engineering, Procurement (for Ukraine activities) and Construction Manangement. WorleyParsons intends to utilize Ukraine construction contractors to the maximum extent practical. WorleyParsons will manage all construction activities.

The schedule date for the plant start-up is January 2016, based on a start of detailed engineering April 1, 2013. The peak engineering and construction workforce based on this schedule is 350 and 3500 persons, respectively.

24.1.2 Plan Objectives

The objectives of this contracting plan are to:

- Specify the contracting plan and the strategy of the Project execution.
- Identify the major contracts required for the Project and develop the strategy for each contract package.
- Provide guidance to other parts of the Project, including scheduling, cost estimating, and risk assessment.
- Examine various contracting strategies to identify those that could be most appropriate for achieving the goals of the Shymanivske iron ore Project.

The contracting strategy is developed to ensure the success of the Project objective - production of 9.2 MTpa of iron ore concentrate, within the schedule and budget.

24.1.3 Key Approach to Project UDI Management

WorleyParsons shall work in conjunction with the relevant Ukrainian Design Institutes (UDIs).

This premise works on two levels: the UDIs have local expertise, site-specific knowledge and usually provide a technical capability as consulting engineers. Secondly, UDIs have a regulatory authority function in Ukraine and they represent the only real channel for obtaining local validation of engineering design as well as controlling the permitting procedure and ultimate approval for project permits.

24.1.4 Labour Relations and the Labour Code in Ukraine

24.1.4.1 EMPLOYER / EMPLOYEE RELATIONS

Employment conditions in Ukraine are generally governed by the Labour Code, which was enacted when Ukraine was still part of the Soviet Union. The Code still contains many socialist concepts, including a strong sense of the employee's right to work, and many protections for employees.

Although employers can enter into individual labour contracts with employees, the terms of those agreements may not be worse than conditions guaranteed under the Labour Code. Contracting out of the provisions of the Labour Code is not permitted. However, the Code itself is not that strongly enforced. When issues do arise, they tend to be pursued directly with the courts, rather than through a relevant administrative agency. If employers are aware of and respect the statutory rights of employees, labour should not cause any significant issues for employers in Ukraine.

24.1.4.2 UNIONS

Unions have a visible place in the labour market. There is a specific law for Trade Unions. They are easy to establish and the law grants certain benefits to the unions. The largest trade union confederation in Ukraine, the Federation of Trade Unions of Ukraine (FPU), claims to unite more than 10 million trade union members.

The Labour Code recognizes collective agreements, and employers must accept collective agreements, if demanded by employees.

If a collective agreement is established, it will be binding for all employees, even those who are not members of a trade union. The trade union will also monitor the employer's compliance with the agreement.

Approval of the trade union is generally not required before overtime may be worked. There are unions, but the unions are not actively engaged and strikes and other union activities are not expected to be an issue.

24.1.5 Project Drivers

It is assumed that the Project drivers are:

- Safe execution;
- Utilization of local resources;
- Schedule;
- Cost: economical solution;
- High quality design and construction;
- Protection of the environment; and
- Manpower requirements – local and international, skill levels available.

24.1.6 Estimated Construction Material Quantities

The Project has an estimated total capital cost of $US 1.1 billion with estimated material quantities as follows:

Steel	15,300 tonnes (350 MPa grade)
Concrete	50,000 m^3
Piles	3,800
Pipe	103,000 m (size up to 48”)
Mass Excavation	1.8 million m^3
Field labour	5.5 million hours with a peak of 3200 persons

Figure 24.1: 3D Model of Plant

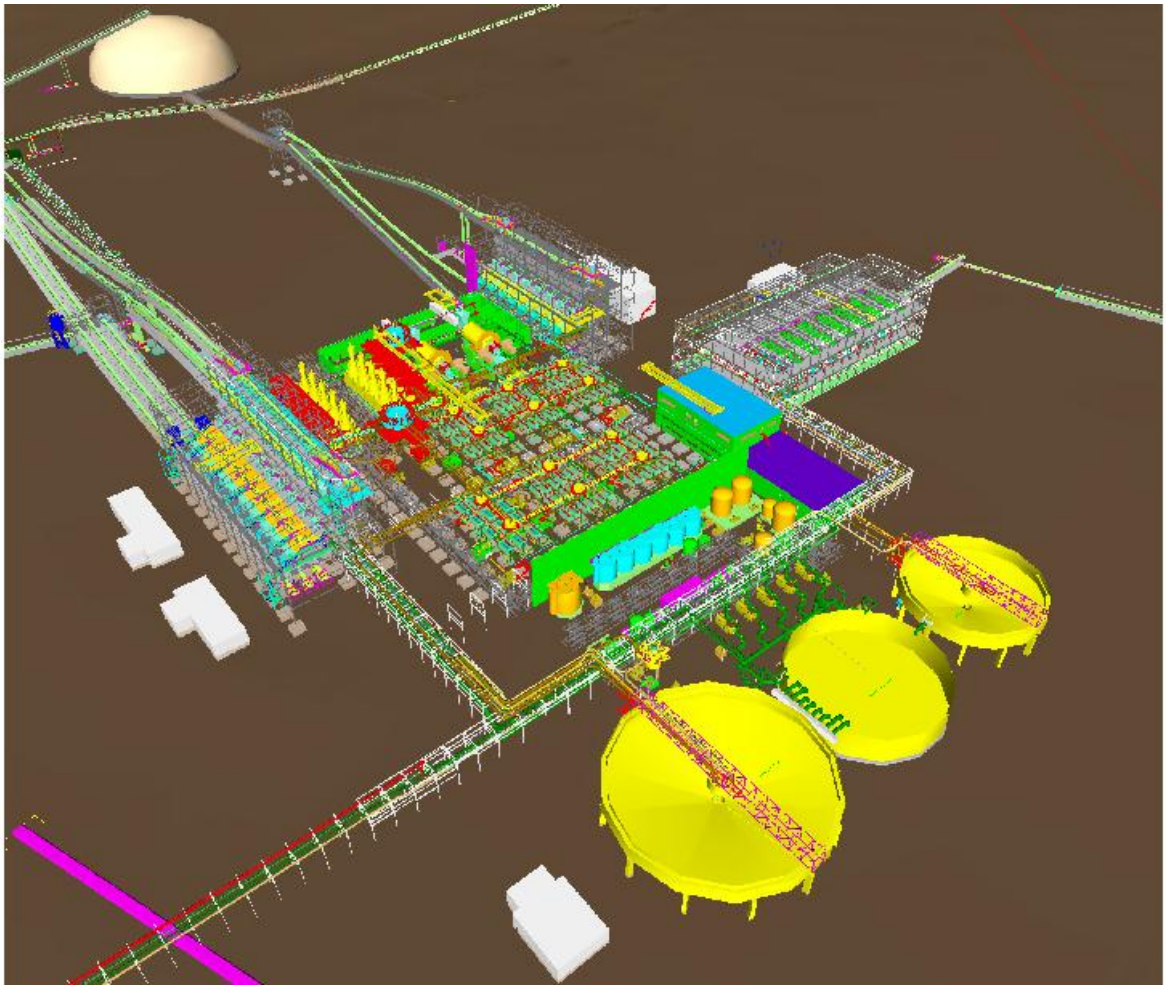
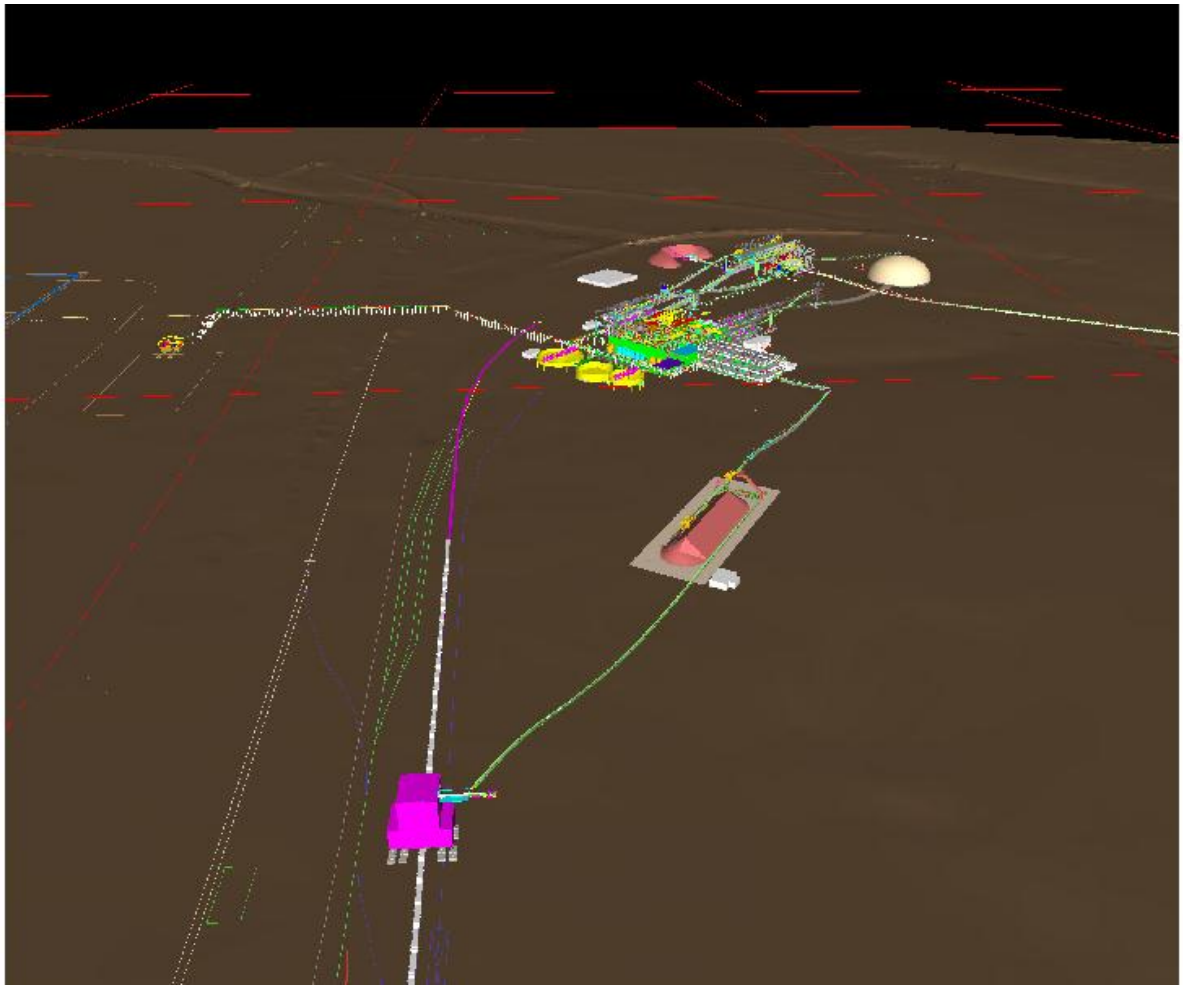


Figure 24.2: 3D Model of Site



24.1.7 Location Factors

There are a number of factors that are specific to project execution in Ukraine that must be taken into account. These factors are:

- Weather: winter conditions with temperatures as low as -30 degrees C can make construction conditions difficult. Civil works during winter months, particularly in January and February, should be avoided or paid for with a premium. Buildings, where possible, shall be scheduled for closure by winter.
- UDIs: Ukrainian Design Institutes (UDIs) have a regulatory authority function in Ukraine and they represent the only real channel for obtaining local validation of engineering design as well as controlling the procedure and ultimate approval for project permits.

- Community affairs issues include:
  - Dust; and
  - Local village needs with respect to being relocated.

24.1.8 UDI Survey and Classification Process

WorleyParsons and Black Iron have carried out extensive research on all aspects of UDI capability. The result of this research indicates that UDI's could be classified as follows:

- Narrow engineering disciplines focus with limited scope capability;
- Specialist engineering institutes which formally has government license to act on behalf of the government bodies, such as: environmental, power distribution, nuclear power, etc.;
- Institutes with license and expertise in several engineering disciplines; and
- Institutes with very wide engineering discipline capability, able to manage design process and engage several design subcontractors with specialist expertise.

During the research it was also identified that the institutes' design preferences are based on proven technology sourced within the CIS region, predominantly considered outdated by Developed World Standards. There are also indicators of notable resistance to change and/or improvement.

The Institute's market is a close (almost a cartel type) market, with all institutes sharing market information and project design scope amongst themselves.

24.1.8.1 UDI's Identified Suitable for the Project Design Execution

Four UDIs have been identified as the Institutes capable of acting as the Managing Institutes for the whole or a part of the Project scope:

- **Yuzhgiproruda** (former Ukgiproruda [UGR]) hereafter **YGR** – specializing in mining and mine development. The institute is multidisciplinary and has experience in design management, engaging a number of design subcontractors.
- **Mehanobr-Chermet** hereafter **MCM** – specializing in metallurgical process and process equipment design. This institute has particular experience in ore processing design and technology. The institute is multidisciplinary and has experience in design management, engaging a number of design subcontractors.
- **KOLO** – specializing in metallurgical process design. This institute is privately owned with very limited development and modern methods of design. By number of employees (40 to 60), it is the smallest institute in the region, experienced in design management engaging a number of design subcontractors.
- **KBP** – specializing in mining and mine development. KBP is multidisciplinary and has experience in design management, engaging a number of subcontractors. KBP has indicated

they will work with KGCM of Kazakhstan for the process design portion. KBP is state owned and one of the largest UDI's with 600 employees.

Discussion with all four UDIs was conducted during the feasibility phase. KOLO was contracted by BKI to work with WorleyParsons in reviewing and approving the current design, including PFDs, BOD and Design Criteria, ensuring the design meets the codes and regulations for Ukraine.

24.1.8.1.1 UDI OPTIONS FOR CONTRACTING STRATEGY

There are two main areas that will require UDI involvement in the Black Iron project. One is adaptation of WorleyParsons Feasibility Study into Ukrainian Proekt and its subsequent approval. The second is the certification of the Detailed Engineering stage of the Project.

24.1.8.1.2 PROEKT ADAPTATION AND APPROVAL

Approved Proekt is required by Ukrainian law as a prerequisite for Construction Permit application. Proekt can only be executed by an organization licensed to perform engineering work in Ukraine. It will be essentially a process of converting WP engineering deliverables into prescribed Proekt format deliverables without any re-design unless required by Ukrainian law which should be minimal given the close interaction with various UDI's including MCM and Kolo during development of this Feasibility Study. However, there will be some development of areas not covered by the WP's Feasibility Study.

24.1.8.1.3 DETAILED ENGINEERING

There are no requirements to have the detailed engineering drawings approved by the government. It is a requirement, however, that these should be certified by a licensed engineering organization.

It is envisaged that all detailed engineering deliverables generated outside Ukraine will already be compliant with Ukrainian technical standards. Therefore a UDI will not be required to adapt those deliverables, but simply to review and certify them as meeting the local requirements.

In addition to detailed engineering deliverables generated by WorleyParsons there will be a number of areas that will be developed in Ukraine. The examples of such areas are: fire-fighting system and civil defence. These deliverables are unique to Ukraine and shall be developed by an organization intimately familiar with the Ukrainian standards, practices and requirements. The most logical choice will be to engage the same design institute to develop these areas as the one involved in Proekt development.

24.1.9 Construction Prequalification site visit

A trip to Ukraine was conducted the week of Sept 10, 2012 by the WorleyParsons and Black Iron Project Managers and the WorleyParsons Construction Manager, for the purpose of meeting and evaluating several construction companies and steel fabricators. Two Ukrainian General Contracting companies familiar with iron ore work were visited as well as a Turkish General Contracting company that is currently working in Ukraine but supplies much of its labour from outside Ukraine, and in particular, Turkey.

Key learning's from the visit were:

- Local contractors are capable of handling portions of the work but not the entire project. The work will need to be split among several contractors. The work is typically done through General Contractors with established teams of sub-contractors to execute the complete scope.
- The constructors visited in Kryvyi Rih and Kharkov are familiar with Iron Ore-type projects, as the main project work done in the area is for the five operating mines in the region. Although a greenfield project of the magnitude of the Black Iron project has not been constructed in recent years, the constructors are continuously working with the existing mine operations to facilitate upgrades and repairs.
- The town of Kryvyi Rih is sufficiently close to the site and of sufficient size to preclude the need of a construction camp. Bussing of workers from the town to the site and arranging accommodation for outside workers is planned, and needs to be firmed up in advance of the construction start.
- There are several steel fabricators capable of producing the steel with the quality required for the Project. Steel prices in Ukraine are low and the steel fabrication facilities have excess capacity. Typical production for a steel fabricator is 2,000t per month. (Project requirement is approximately 15,000t).
- Detailing of steel for construction is done by the fabricators using Tekla, which is also the software used in North America and is compatible with STAADPRO, software used by WorleyParsons for steel design. The fabricators can work with English or Russian drawings and produce shop drawings in both Russian and English.
- The steel fabricators typically also get involved with the erection of the steel, which is recommended because it will add a considerable work force available to the site, and assist with material transfer and sequencing of erection at site. One fabrication shop visited had a steel erection work force of 500 people complete with their own equipment.
- Typical productivity factors for workers in the region may be high considering the expertise the workers have with respect to Iron Ore plants. There is an opportunity to favorably impact the labour productivity with proper material management and the sequencing of construction work packages.
- There are several mechanical and pipe fabricators in the region. There is an opportunity to improve labour productivity and move labour hours from the site, by employing local fabricators for pipe, steel, chutes and other prefabricated and modular construction items.

24.1.10 EPCM Contractor's Scope of Work

WorleyParsons strategy as the EPCM contractor is based on the following philosophies:

- Meeting the Project schedule is more important than having absolute control of the cost within reason; and
- Contracts should be limited to the areas of expertise of each of the contract parties.

24.1.10.1 Overall Project Management

The EPCM contractor will provide program management services for the Project. Services provided will include:

- Engineering management
- Procurement management
- Construction management
- Logistics management
- Contracts administration
- Interface management
- Ukraine approvals
- Health and safety
- Quality management
- Environmental management
- Project controls and overall reporting
- Development and maintenance of project budgets
- Project planning and scheduling
- Document and data management
- Development and maintenance of an overall work breakdown structure
- Facilities management
- Material management
- ICT and communication management
- Preparation and issuance of monthly reports, cash flow projections and other reports, as may be agreed

- Risk assessment and risk management planning
- Securing necessary regulatory approvals
- Community and industrial relations
- Coordination of all related activities with the project owner (Black Iron and its Ukrainian subsidiary Shymanivske Steel LLC)

24.1.10.2 DESCRIPTION OF SCOPE OF WORK

The following sections give a summary of the EPCM role and how WorleyParsons as the EPCM contractor will perform these roles.

24.1.10.2.1 ENGINEERING

For the successful execution of engineering for the Shymanivske project, WorleyParsons will develop the engineering plan and the detailed engineering packages to engage Ukrainian Design Institutes (UDI's) for adaptation of the design and to get Ukrainian approvals. The Technical Assignments (TA's) will be structured to support construction contracts, which will be coordinated with the procurement process in a timely manner. Among the first TAs to be prepared will be those needed to allow UDI's to develop the TEO's (technical and economic substantiations) and OVNS required for Ukraine Expertiza approval of Black Iron's mining and facility development plans.

WorleyParsons will have limited (coordination only), engineering responsibilities for inside battery limits (ISBL) of mining operations. Mine design is currently the responsibility of P&E, which is contracted directly to Black Iron and likely to continue for the detailed design phase of the Project.

The Detailed engineering phase will be managed initially from the WorleyParsons Toronto offices, incorporating the services of specialist consultants, contractors and UDIs. As the capability of the gravity for engineering and construction management will shift to Ukraine and WP China for the completion of detailed engineering. This is expected to occur at the basic engineering stage or between the 40% and 80% completion stage of detailed design, depending on the work package and the capability of the UDI. Infrastructure work packages will occur at the earliest or at approximately 40% completion and will require little or no 3D modelling. Infrastructure work consists of administration buildings, Utility Buildings and Firewater protection systems, and work is anticipated to be done in Ukraine to take advantage of local knowledge and lower labour rates.

The Beneficiation Plant is planned to be completed in the WP China office, where they have complete 3D capability and experience in Iron Ore projects with the types and quality expected by BKI. The Kazakhstan and China HVE offices have lower charge out rates and utilize the WorleyParsons material management process, which is a key to executing a schedule driven project.

During the implementation phase, engineering execution will be oriented toward timely production of detailed design documentation, to support construction of the Shymanivske project and will include:

- Management of Technical Assignments and involvements of UDIs supported by specialist consultants;
- Management of safety in design;
- Ukraine regulatory approvals to ensure compliance with Ukraine codes and standards;
- Constructability, safety and operability reviews;
- Engineering support during commissioning; and
- As-built data management.

24.1.10.2.2 PROCUREMENT MANAGEMENT

WorleyParsons will act as procurement agent for and on behalf of Black Iron.

The Procurement team will initially be based at the offices in Toronto, with the assistance of procurement teams in Ukraine and China. The procurement team lead will shift to Ukraine as the design advances to approximately 50% complete as it is expected that many of the bulk and certain equipment items will be sourced from Ukraine.

WorleyParsons will manage the procurement, delivery and turnover to the construction contractors of the equipment and materials identified in the contract documents.

24.1.10.2.3 LOGISTICS MANAGEMENT

It is recommended that a traffic and logistics services company be appointed to be integrated into the Project team to provide all traffic, freight forwarding and logistics services to the Shymanivske Iron Ore Project. The service provider should be in place and available to provide support early in the Basic Engineering phase.

The traffic and logistics service company would be responsible for the preparation of a detailed route survey, to participate in Design and Vendor discussion phases to develop freight strategies and to achieve the following:

- Minimize out-of-gauge shipments;
- Prepare freight plans for each PO ensuring economical and safe transportation within schedule limits;
- Provide preshipment marine engineering services;
- Be responsible for the preparation and management of all customs; shipping and importation documentation;
- Handle shipping from vendor’s facility to site, including site receiving support; and
- Manage and track all shipment components down to line item detail.

WorleyParsons would hold a formal tender; it is proposed that the tender strategy be based on a freight cost plus basis. Tenders will be selected on the previous experiences of both WorleyParsons and Black Iron, and will be approved by the client prior to issue.

The selected Tenders will be required to demonstrate:

- Worldwide capability / experience, including experience in Ukraine and/or other CIS countries and possession of necessary licenses to work in Ukraine;
- Availability of a freight tracking / management systems, capable of interfacing with the WorleyParsons Material Management system;
- Proposed working methodology and pricing structure; and
- Established Quality and Health & Safety Management systems, preferably adhering to international standards.

24.1.10.2.4 CONTRACT MANAGEMENT

In this role, WorleyParsons will provide a comprehensive Contract Management service for all contracts associated with the Project. It is envisaged that this role will include the following activities for which WorleyParsons will provide dedicated Contract Management personnel, experienced in the provision of these services:

- Pre-qualification of suitable national and international contractors, consultants, vendors and suppliers to ensure a minimum of three bids for each contract and / or purchase order;
- Preparation of Invitation to Tender (ITT) documentation, issuance of ITT documentation, responding to ITT clarifications and coordinating responses. These will be done in English and when necessary in Russian Language;
- Commercial and technical bid evaluation and clarification duties;
- Negotiate with the preferred contractor and prepare a recommendation to award by Black Iron or Shymanivske Steel;
- Provide contract management and administration services for all contracts;
- Quality assurance;
- Safety leadership and management; and
- Review and approve invoices.

WorleyParsons will utilize its proven project management systems and processes, which include the WorleyParsons Enterprise Management System (EMS) and the WorleyParsons Project Management Procedures (WPMP).

24.1.10.2.5 INTERFACE MANAGEMENT

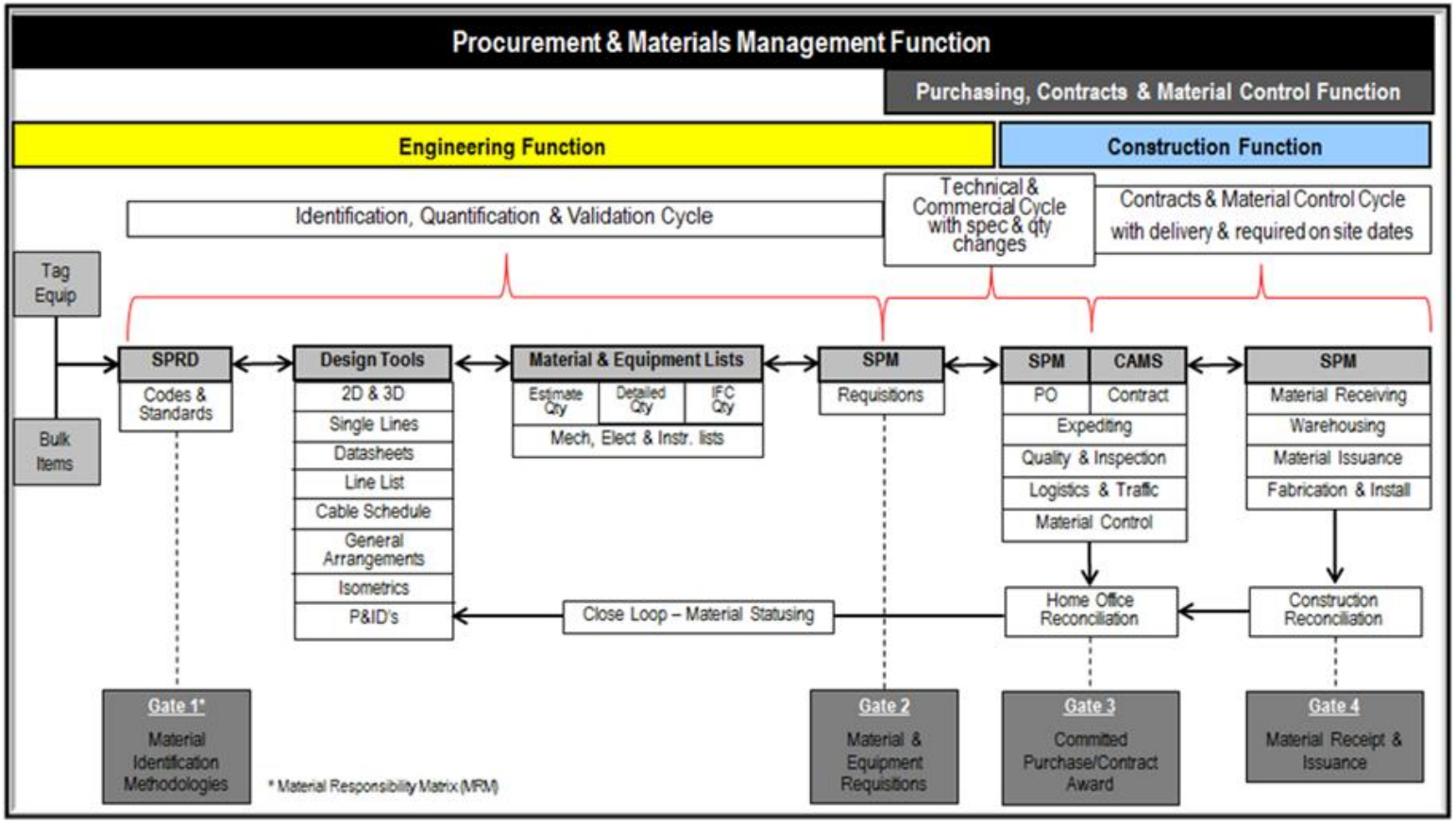
Interface Management is the responsibility of all parties and will be managed by the WorleyParsons Interface Manager. Interface points will be identified in the contract tender documents and each Construction contractor will be required to have on staff an interface coordinator. A weekly interface management meeting will be held to coordinate work among all involved contractors and client organizations.

24.1.10.2.6 MATERIALS MANAGEMENT

The material management strategy for the Project will embrace the “cradle to grave” philosophy. The procurement professionals assigned to the Project will manage, monitor and measure the equipment, materials and services required for the Project. As the chart below represents, there is significant collabouration with Procurement and Engineering in the early stages of the Project during the identification, quantification and validation cycle; this is the interface between gates 1 and 2 when the requisitions (supply and services) are to be issued. Then the major technical and commercial activities commence between gates 2 and 3, when the purchase orders and contracts are to be issued. Having a good understanding and control of the materials, equipment and services required for the Black Iron project, the procurement professionals are able to expedite, inspect and deliver the right material in the right place at the right time. The interface between gates 3 and 4 is the hand over from home office to construction site.

WorleyParsons shall be responsible for receipt, security and storage of materials at site. A warehouse and fenced laydown area will be established and managed by WorleyParsons for all tagged and free issue materials.

Figure 24.3: Procurement & Materials Management Function



24.1.10.2.7 UKRAINE APPROVALS

WorleyParsons with the assistance of the UDI will ensure that all Ukraine regulatory requirements are complied with, as they relate to this project. A matrix document will be developed and used by the Project to ensure all design, procurement, construction and construction support activities are in compliance with local and national laws and regulations. The assigned regulatory Affairs Coordinator will provide guidance and secure all local and national approval stamps and documents.

EPCM contractor's Regulatory Affairs coordinator will interface with UDIs, which will develop the detailed design packages, to ensure that all permits and approvals are secured prior to construction work commencing.

The permitting and regulatory process for project approval was developed with the UDIs and a copy is included in the Appendix. The regulatory process has also been worked into the level 2 EPCM schedule.

24.1.10.2.8 HEALTH AND SAFETY

The Health & Safety Plan is managed by WorleyParsons. Each contractor will be required to have an approved HSE manager and an approved HSE plan prior to beginning work at the site. All site personnel will be required to participate in an HSE orientation and training program prior to receiving site access. HSE initiatives will be coordinated across all construction contractors, and site-wide awareness campaigns will be led by WorleyParsons HSE manager with the full support of the WorleyParsons project director. HSE programs will be based on Ukrainian law as a minimum. Weekly HSE steering committee meetings will be held at site and will include the HSE managers from all contractors.

24.1.10.2.9 QUALITY MANAGEMENT

The WorleyParsons' Quality Manager will approve each construction contractor's quality manager and quality plan. WorleyParsons will have quality assurance staff at site and will inspect field installations for compliance to the contractors quality plan. If required, non conformance reports (NCRs) will be issued for unacceptable work and must be cleared before payment will be approved for the work in question.

24.1.10.2.10 COMMISSIONING AND OPERATIONS START-UP

The overall plant commissioning program includes the completion of installation and the pre-commissioning by installation contractors and suppliers under supervision of the general contractor reporting to the EPCM contractor. It is envisaged that the approach to commissioning would be as follows:

- The internal acceptance tests, no-load tests, performance tests and acceptance tests would be carried out on each section of the plant, in accordance with the parameters set in the design criteria and applicable standards.
- The installation contractor(s) would undertake pre-commissioning and cold commissioning on a progressive area-by-area basis, under the direction of the General contractor.

- The EPCM contractor and specialist commissioning personnel would perform the ore commissioning.

As part of the equipment purchasing philosophy, commissioning and spares for two years will be reviewed and recommendations made for the holding of the spares within the stores warehouse inventory. All materials will be identified against a stock record system, in order to ensure that stock re-order levels are reviewed on a continuous basis during the commissioning process.

All reagents for the commissioning of the facilities will be purchased as the first fill of reagents. The first fill of reagents will make the necessary allowances for the filling of the reagents storage vessels, process tanks, vessels and associated piping to allow commissioning to proceed unhindered. During commissioning, it will be necessary to prepare some of the reagents and additional deliveries may be required for this task.

Training of operations personnel will commence prior to this phase and may involve on-site training in similar plants.

24.1.10.2.11 WAY FORWARD

The strategy defined in this Report is preliminary, and it is defined for the purpose of the Feasibilty estimate.

The strategy should also be tested against the market by conducting a constructor survey and pre-qualification exercise early in the EPCM phase. This exercise shall define the payment models adopted, in order to attract the desired level of competition.

The contracting strategy should be continually reviewed and updated, depending on changes to the internal or external Project environment.

24.1.11 Schedule

A Level 2 EPCM Schedule was developed and is included in the Appendix C. In order to optimize the design, procurement and construction methods, WorleyParsons will develop a construction sequencing strategy with the goal of minimizing field hours, optimizing labour density, and reducing construction peaks, indirect costs and safety risks.

24.1.11.1 MILESTONES

1.	Bridging Phase	Start	01-Jan-13
2.	Development of Proekt	Start	01-Mar-12
3.	EPCM Project Award	Start	01-Apr-13
4.	Kick-off Meeting	Finish	12-Apr-13
5.	Detailed Engineering Start	Finish	12-Apr-13
6.	Procurement Start	Start	12-Apr-13
7.	Project Initiation & Set-up Complete	Finish	28-Jun-13
8.	Construction Start	Start	5-Nov-13
9.	Detailed Engineering 90% Complete	Finish	01-Jul-14
10.	Procurement Complete	Finish	21-Nov-14
11.	Beneficiation Plant Building Closed-in	Finish	03-Dec-14
12.	HV Power Available	Finish	09-Jul-15
13.	Construction Complete	Finish	04-Nov-15
14.	Mechanical Completion	Finish	07-Oct-15
15.	Cold Commissioning Complete	Finish	26-Nov-15
16.	Project Close-out	Finish	02-Dec-15
17.	Hot Commissioning & Start-up	Finish	28-Dec-15

24.1.12 Manhour Forecasts

The manhours for engineering and procurement have been developed and the planned workshare among Canadian, Ukrainian and HVE manhours are shown in Figure 24.4

Figure 24.4: Engineering Labour

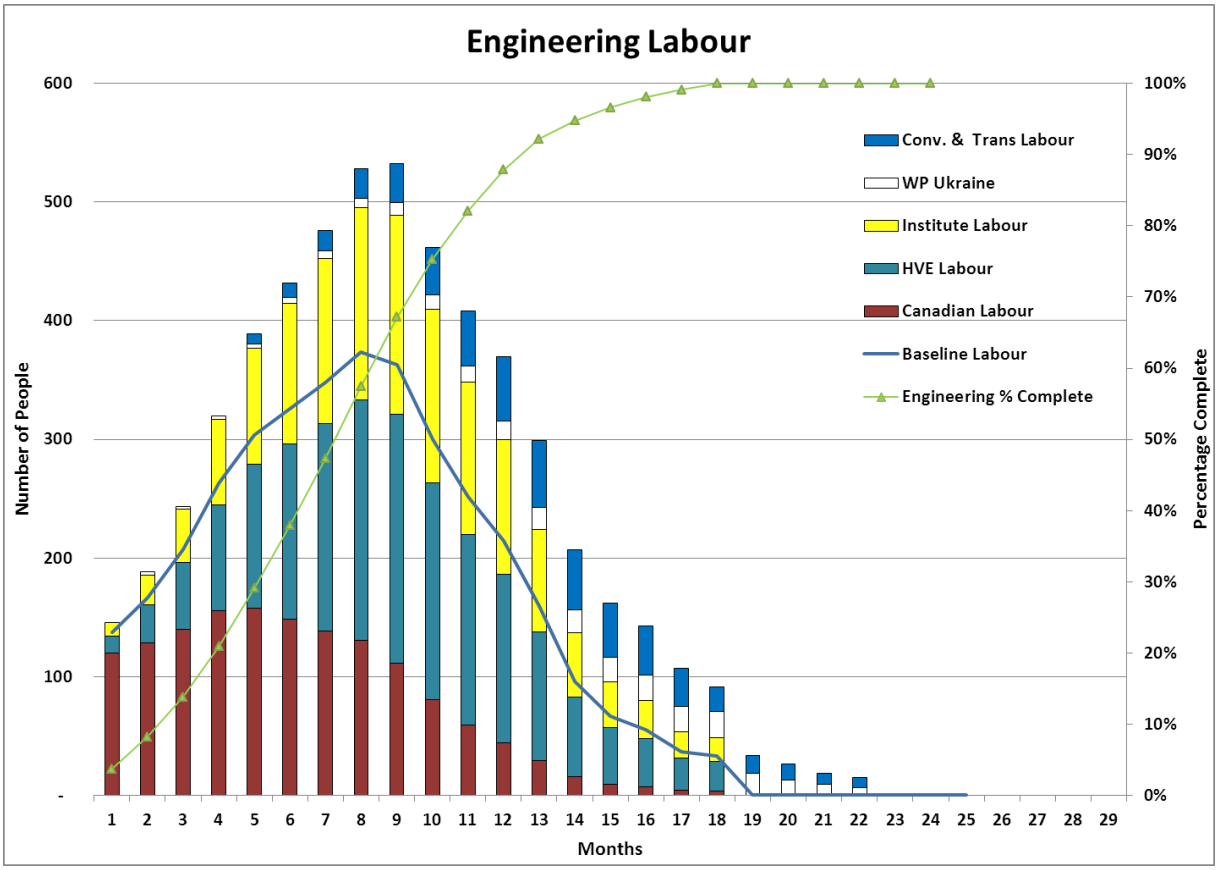
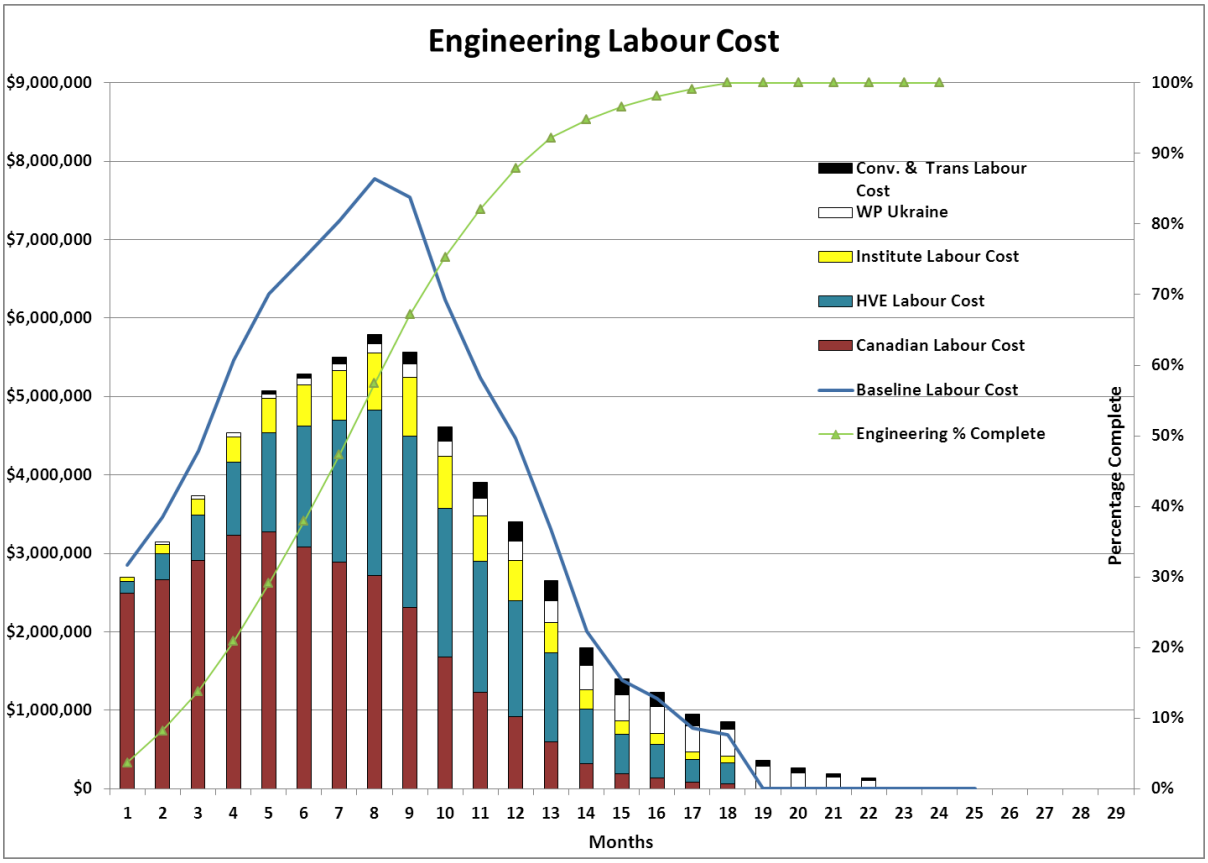
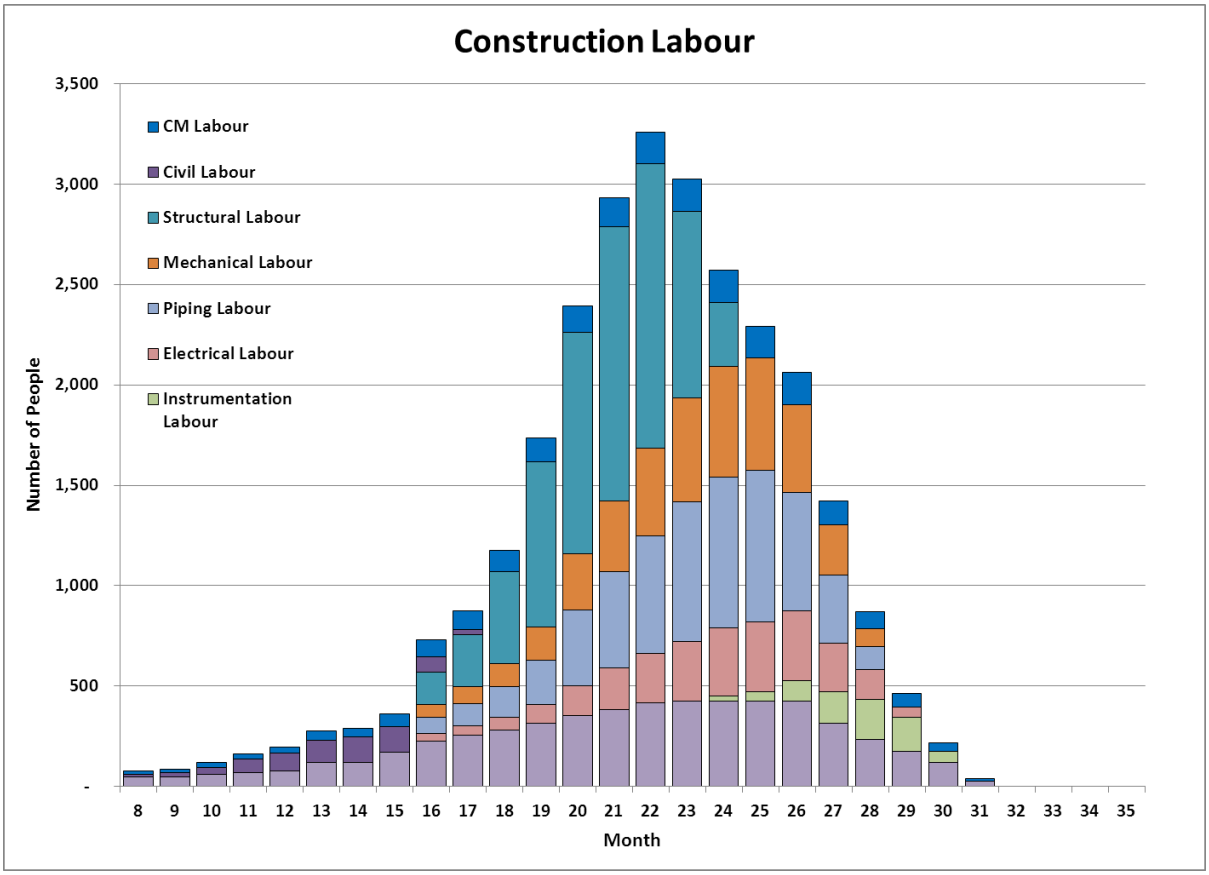


Figure 24.5: Engineering Labour Cost



The manhours for construction management are based on the organization chart, the EPCM schedule and the field labour hours from the estimate.

Figure 24.6: Construction Labour



24.1.13 Construction Contracting Strategy

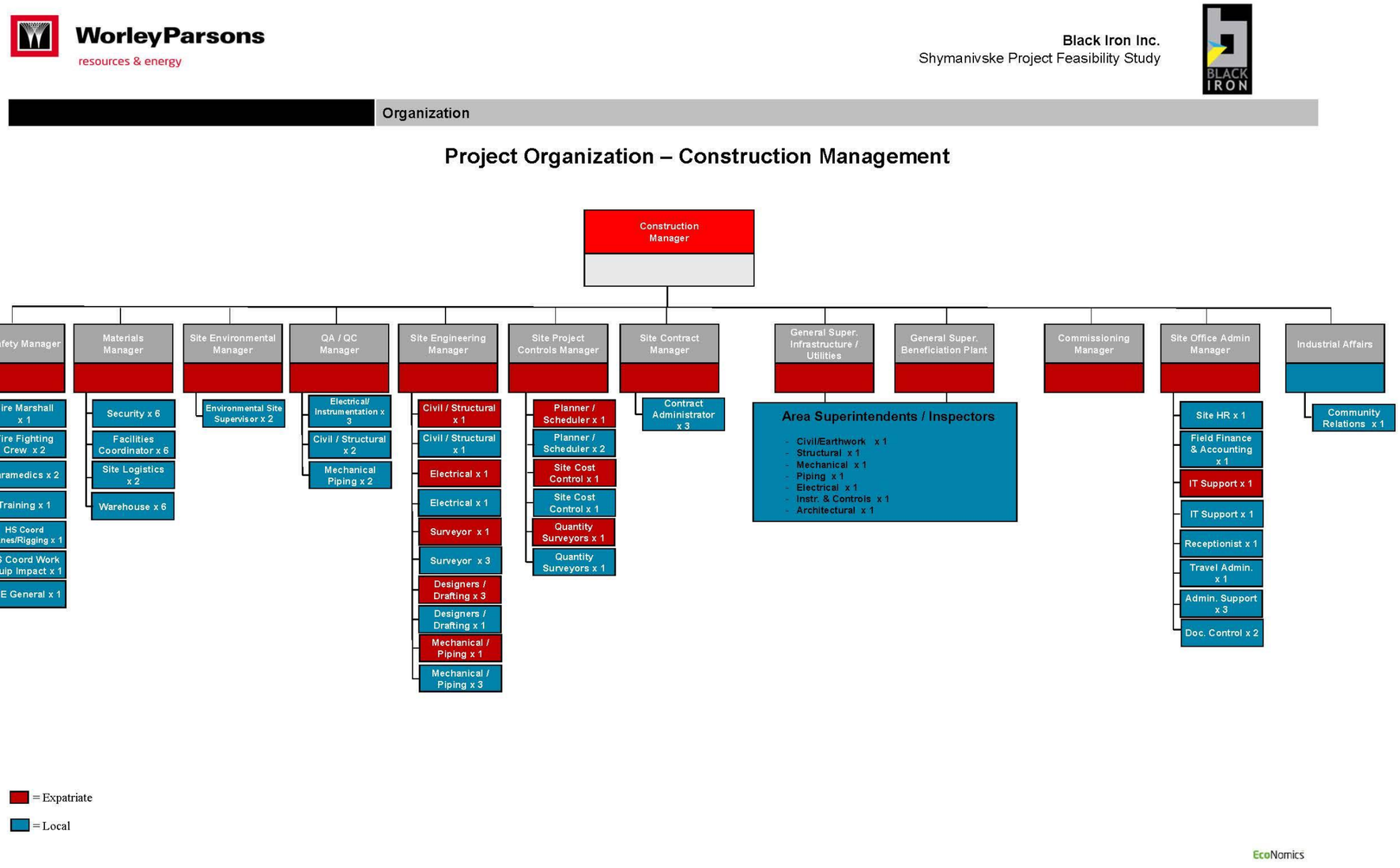
WorleyParsons is committed to executing the Project in a cost effective manner that provides the best opportunity for achieving mine operations within the agreed timeframe for the Project, while utilizing the most cost effective technology and achieving a high level of safety.

The contracting plans for the Project have been developed with these important goals in mind.

24.1.13.1 Organizational Structure

A copy of the Construction Management Team org chart is included in the Figure below. The Construction Management Team (CMT) may be adjusted, once the contracting strategy is confirmed. Our experience has been that, even though we delegate to contractors, they sometimes struggle to set up adequate project controls that can be integrated into the Project schedule and cost reporting system. WorleyParsons approach is to remain flexible and constantly review the makeup of the CMT, based on the ability of the Contractors.

Figure 24.7: Construction Organization Chart



24.1.13.2 CONSTRUCTION MANAGEMENT

WorleyParsons as the EPCM contractor will manage all construction activities and intends to utilize Ukrainian construction contractors to the maximum extent practical. WorleyParsons had an office and Limited Liability Company (LLC) in Ukraine in 2007 and 2008 to manage the engineering and construction of the Ferrexpo project. WorleyParsons will re-establish an office and LLC in Ukraine to execute the Black Iron Project. The main roles of the office in Ukraine will be:

- UDI Management;
- Infrastructure engineering in support of the UDI;
- Procurement including expediting and logistics management of Ukraine suppliers;
- Construction management team; and
- Provide legal structure and support to WP expatriate employees in Ukraine.

24.1.13.3 WORK SPLIT

The Project will have several major construction contracts involving process facilities, material handling and power distribution. Additionally, there will be other site-wide contracts for infrastructure and support, including logistics and communications.

Contract packages have been selected to incorporate as much related work as appropriate, under similar contracting types. The contract types that may be used for the Project include Lump Sum, Unit Rates and Cost Reimbursable. Variations may include Target Price and various types of incentive programs to help achieve the desired Project goals.

The contracting strategy is structured with a vision to use national contractors to the maximum extent, considering package size and contractor capability. Non-Ukrainian but licensed to work in Ukraine contractors will be used as necessary, if there is no suitable local contractor.

Two options are being considered for the construction contracts and will need to be finalized during the contractor pre-qualification process.

- Option 1: Vertical single asset (e.g., Beneficiation Plant construction contracts)
- Option 2: Horizontal plant wide (e.g., Civil, structural, Mechanical, Electrical and Instrumentation)

Under option 1 the Beneficiation Plant, Secondary Screening and Crushing, Filter and Primary Crusher Facility have been identified as the four plant areas for which separate bid packages could be developed to include all construction activities including civil, structural, mechanical, piping, electrical and automation.

Based on constructor's surveys to date, there is no single vertically integrated Ukrainian contractor that can handle the entire Project scope. Bids will also be issued to construction contractors who work in the region just outside Ukraine, such as Turkey, Poland and Russia and that are familiar with working in Ukraine.

The construction contractors will also be responsible for the supply of bulk materials; however, pre-qualified suppliers will be identified to ensure consistent quality and to obtain quantity discounts.

Preferred supplier agreements will be set up for steel, cable and pipe (including fittings). The facility contractors will be asked to use these suppliers unless they can demonstrate schedule and cost benefits for using other suppliers. The preferred supplier will be established prior to contractor bid issue, to reserve shop space, pre-qualify quality and establish bulk discount rates.

24.1.13.4 CONTRACTING PLAN

A preliminary contracting plan has been developed to best achieve the goals of the Project. The plan is based upon WorleyParsons experience in construction management, and the current state of the contracting environment. The strategy is summarized in the Table shown below and is further discussed in detail in the sub-sections which follow. The company's recommendation is to combine Contract packages to select general contractors for significant areas of the plant which can be decided after the constructors survey is done early in the next phase or during the bidding phase.

The Project will be broadly split into the facility groupings. Contract packages will be developed and based on logical interface points, geographical locations and similarity of work. Construction contractors will be pre-qualified for each contract package. The required award date of each contract is based on the construction start date contained in the Project schedule.

WorleyParsons has responsibility for the development of construction and construction support contract packages. Construction contractors will be required to deliver a Project execution plan outlining methodology, site organization, HSE, quality, progress reporting, schedule, construction equipment requirements, and materials management.

Detailed Design will be the responsibility of WorleyParsons and drawing control between the WorleyParsons site team and construction contractors will be in accordance with the Materials Management Plan and the Document & Data Management Procedure.

Construction field engineering will be the responsibility of WorleyParsons. All field design clarifications will be coordinated by field construction engineers working in the construction site team. The field construction engineer will prepare sketches and / or Request For Information (RFIs) and will coordinate with the engineering design team to resolve any site design problems. All site-generated sketches and RFIs will be numbered and logged and sent to document control for distribution. Distribution will normally be to the detailed design engineering department, contracts, procurement, Project controls and any other department that has responsibility to document or act on field design changes.

The site Project teams will be organized to interface with the construction contractors' organizations and will cover project management, field engineering, project controls, contracts administration, materials and warehousing and construction coordination. Alignment between WorleyParsons and construction contractor teams will start with the kick-off meeting and will continue through contract close-out.

The construction contractors will be required to develop method statements, work packs, test packs, an execution schedule based on project milestones, staffing plans, and mobilization plans. The construction contractor's mobilization plan will indicate the on-site build-up of staff, facilities and equipment.

Contractor coordination will be the responsibility of WorleyParsons. Coordination will be by daily interface of WorleyParsons staff with the construction contractor staff. Weekly coordination meetings will be based on the construction contractors approved schedule. Issues impacting the contractor or program schedule will be identified and solutions agreed upon. The weekly coordination meeting will address Health & Safety, quality, risk and any issue the construction contractor believes is impacting his progress. WorleyParsons will prepare the weekly coordination minutes of meeting and distribute them in accordance with the contract document distribution matrix.

Construction contractors will be required to prepare a monthly progress report for submission to WorleyParsons. The monthly report will be the construction contractor's statement on the status of his contract and will contain information on the following: HSE, an overview of progress, construction equipment mobilised to site, manpower status, outstanding RFIs, the status of Non Conformance Reports (NCRs), material and fabrication reports, quality performance and progress pictures.

The construction contractors' approved schedules will be the documents used to measure progress and control material and equipment deliveries furnished by WorleyParsons. The contractors' schedules will also be used to perform risk analysis and to develop recovery plans. The Contractors' manpower plan will be used during schedule and progress performance analysis.

WorleyParsons will issue field instructions to the construction contractors when additional requirements are identified. The construction contractors will perform work based on the field instructions and price the changes based on the schedule of rates included in the construction contracts.

WorleyParsons will administer the change management requirements included in the construction contractor's contract. Contract changes will be reviewed for impact on cost, schedule, materials and equipment deliveries, manpower requirements, construction equipment requirements, additional engineering and third party involvement.

WorleyParsons will keep a risk register for the total Project and will conduct risk management meetings on a monthly basis. The monthly meeting should include senior members of the WorleyParsons management team and the Owner's project management team.

WorleyParsons will manage the procurement, delivery and turnover to the construction contractors of the equipment and materials identified in the contract documents. The construction contractors will be responsible for this free-issue equipment and materials and will be accountable for preservation requirements, warehousing, and handling prior to installation. Material shortages and equipment delivery slippages will be reported to the WorleyParsons materials manager for resolution.

Construction contract close-out activities and requirements will be identified in the Construction contracts. Construction contract close-out will be managed by the WorleyParsons contracts manager and the construction contractors' designated manager.

Contract Package	Contract Type
Civil	Lump Sum & Unit Rates
Structural	Supply and Install; Lump Sum & Unit Rates
Mechanical	Lump Sum & Unit Rates
Electrical	Lump Sum & Unit Rates
Automation	Lump Sum & Unit Rates
HV Power Supply	Turnkey
Power Distribution Substations & Switchyards	Lump Sum & Unit Rates
Rail	Lump Sum & Unit Rates
Site Prep, Roads & Infrastructure	Lump Sum & Unit Rates
Communications	Lump Sum & Unit Rates
Design Institutes	Unit Rates Reimbursable
Customs and Brokerage	Lump Sum & Unit Rates
Logistics and Heavy haul	Lump sum & Unit Rates Reimbursable
Pilot Test	Lump Sum & Unit Rates
Third party inspections	Unit Rates
Steel fab supply	Preferred Supplier Agreements
Pipe	Preferred Supplier Agreements
Cable	Preferred Supplier Agreements
Modularization and Off-site Fabrication	Lump Sum and Unit Rates

25 INTERPRETATION AND CONCLUSIONS

25.1 Mineral Resource Estimates

Mineralization on the Property comprises meta-taconite, which is folded and faulted and quite structurally complex in some areas. The Shymanivske Deposit consists of four mineralized units, three of which (SX1F, SX2F and SX4F) are Magnetite-Quartzite and are considered in the Mineral Resource estimate. The fourth unit is an Oxide Zone (SX5F), consisting of Magnetite-Martite-Quartzite that is currently treated as waste due to the inability to recover the iron from the oxidized minerals using the planned process route. Black Iron has indicated that they have no plans to bring this material into the Mineral Resource estimate in the near future.

The present Mineral Resource estimate was completed by using all historical drilling and information from Black Iron's Twin Drillhole and definition-drilling programs. The results for all non-oxidized horizons are summarized in the Table below.

Table 25.1: Mineral Resource Estimate for the Shymanivske Iron Ore Deposit (Cutoff Grade of 10% Fe_{mag})

Category	Tonnes (Million)	Fe_{tot} %	Fe_{mag} %
Measured	355.1	32.0	19.5
Indicated	290.7	31.1	17.9
Total M&I	**645.8**	**31.6**	**18.8**
Inferred	188.3	30.1	18.4

In WGM's opinion, the Fe_{tot} grades in the Mineral Resource estimate should not be relied upon as a basis for evaluating the deposit. Given the considerable Fe-silicate component of the iron mineralization, WGM is of the opinion that these assays and averages do not represent a truly meaningful measure of the deposit, and that only the Fe_{mag} should be used to economically assess this deposit. However the Fe_{tot} assays are included in this study for comparison purposes with previous Shymanivske mineral resource estimates and with similar global iron deposits.

25.2 Mining Methods

The Shymanivske Project will be developed as a large-scale, open pit operation. The final dimension at surface will have a north-south length of 2,500m and east-west width of 1,250m with an approximate depth of 350m.

The scale of production will require peak mining rates of up to 250,000tpd, or 87Mtpa, in order to meet the iron ore processing rate of 28.34Mtpa.

For production-scheduling purposes, and in order to distribute the waste quantities over the life of the project, a phased-pit approach has been implemented. The pit has been sub-divided into four phases, and mining may occur in multiple phases at the same time, so that mining is taking place in the deeper parts of one phase while stripping is taking place in the upper parts of the next phase.

The production schedule for a 16-year mine life requires the mining of 28.34 Mt of iron ore per year. Waste-stripping quantities will vary from year to year, depending on the area being mined.

The mining operation will consist of the following activities:

- Topsoil recovery and stockpiling:
- Overburden stripping by bulldozer ripping and pushing, using the mining fleet with light blasting of some materials;
- Drilling and blasting of waste-rock and ore, using 250mm-diameter blast holes and mining on 15m benches;
- Ore grade control;
- Loading and hauling of ore and waste, using 23 m^3 hydraulic shovels and 226t capacity off-highway trucks. Over the life of the operation, the shovel fleet will range from five to six units and the truck fleet will range from 28 to 53 trucks;
- Open pit dewatering from in-pit water collection sumps; and
- Mine services will be provided by a fleet of dozers, graders, water trucks, and maintenance vehicles.

Over the 16-year life of the project, two designated waste-storage facilities (WSF) will be required. RMS-1 is a reclamation material stockpile (RMS) located north of the pit, which will contain 1.5 million m^3 of topsoil from the open pit. For overburden and waste rock, WSF-1 and WSF-2 are located to the west of the open pit mine and will contain approximately 265 million m^3. The footprint is approximately 467ha and will be built to a height of approximately 100m. Some of the waste from the mining operation will be used to build the tailings containment cells.

The mine support facilities will include a truck shop and office complex with a personnel change house, technical and supervisory offices, and warehouse facilities.

The mining operation manpower list includes all aspects involved with the open pit operation, including:

- Senior mine and maintenance supervision;
- Office technical staff, engineering, geology, surveying, etc;
- Clerical, maintenance planning, training;
- Mine operations crews;
- Mine support crews; and
- Mine maintenance crews.

The total mine workforce will vary over time as production rates increase or decrease, and it will range from 500 to 650 people over the life of the mine.

25.3 Metallurgy and Ore Processing

Metallurgical testwork achieved the desired quality of concentrate and showed that, by using the designed process and flowsheet, it is possible to economically recover the magnetite from Shymanivske ore.

In order to reach concentrate with the desired specification, the ore shall be processed through crushing, stage grinding, low-intensity magnetic separation and sulphide flotation.

During the FS the metallurgical recovery process was optimized by considering several process options. The HPGR flowsheet option had a lower operating cost compared with the other options. The resulting project NPV for this case represented the best case going forward and the FS study was completed on this basis. The outcome of this study has been confirmed by the results of the testwork that showed Shymanivske ore to be a hard and competent ore which is more suitable for HPGR crushing than SAG milling. In addition, the testwork indicated the magnetite liberates at the final grind size of P80 32µm. Accordingly, the process circuit was designed to minimize the energy consumption. As a best practice, this includes dry cobbing, followed by stage grinding with closed loop gangue rejection and Vertical Mills to minimize the energy consumption rate.

As a result of the process optimization, the plant capacity increased by 26% and the operating cost was reduced by 16%. The FS describes an operation producing 9.2Mtpa of high-grade 68% iron ore concentrate.

25.4 Infrastructure

The Shymanivske area is serviced by existing rail and ports. Several options were reviewed for the export of concentrate, which were subsequently narrowed down to two port options. The port of Nikolaev is the closest and therefore the most economical port of export; however, it has a limited capacity in excess of 2Mtpa. The balance of the production will be routed to the privately-owned TIS-Ruda terminal located at the Yuzhny Port. Black Iron still needs to negotiate an operator’s agreement with the ports of Nikolaev and TIS-Ruda to define all port activities.

The required utilities such as power, process water and natural gas are available in the vicinity of the Project. The local Power Utility Consultant (UESP, UkrEnergoSetProekt) confirmed that the local power grid has sufficient spare capacity (1,600MW in 2010 and 2,400MW by 2017) to deliver the required power to the Project. Currently the Gornaya Substation is loaded to only 30% of its full capacity. Overhead lines, and modifications and additions to the existing substations are required, and have been considered as part of the total Project capital cost. The rail transportation system is available on site. A tie-in point is already approved for the Project to connect to the national rail grid.

25.5 Environmental Permitting and Land Acquisition

25.5.1 Regulatory Requirements

Environmental protection activities in Ukraine are regulated by the Law of Ukraine On Environmental Protection (1991), and the state authority responsible for environmental protection, which is the Ministry of Ecology and Natural Resources of Ukraine (MENR, formerly Ministry of Environmental Protection, MoEP). The following Ukrainian legislation is particularly relevant to the environmental and social issues associated with the Shymanivske Iron Ore Project:

- Law On Protecting the Natural Environment, No. 1264-XII of 25.06.1991;
- Law On Ecological Expertise, No. 45/95-VR of 09.02.1995;
- Ambient Air Protection Law of Ukraine, No. 2707-XII of 16.10.1992;
- Law On Land Protection, No. 962-IV of 19.06.1992; and
- Law On Flora, No. 591-XIV, -9.04.1999.

25.5.1.1 OVNS and Permitting Procedures

All new development projects that have a potential for significant adverse impacts on the environment and / or on society are assessed by the State Environment Review or SER (see Figure 25.1). This involves submission of project technical design documentation, including a report called Otsinka Vplyvu na Navkolyshne Seredovysce (OVNS). The OVNS Report is reviewed by the Ukrainian State Construction Expertiza (Ukrderzshbudexpertiza) and checked for its completeness and adequacy prior to submission to the SER.

Environmental permits can only be applied for after Project approval is granted by the SER. The legal and organizational framework of the Ukrainian permitting system is set by the Law of Ukraine on the Permitting System in Ukrainian Economy (VVR, 2005). This Law also regulates the activity of the administrative bodies responsible for issuing the permits.

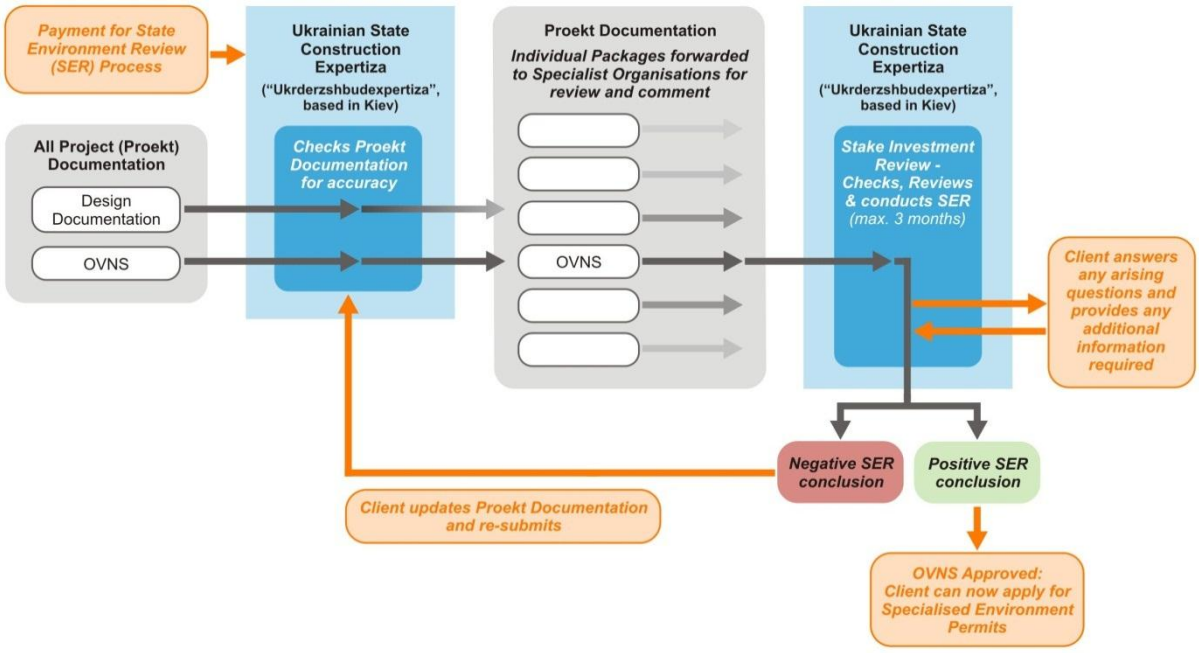
The complete list of required permits and permitting documents is set by the Law of Ukraine on the List of Permitting Documents for Economic Activity (VVR, 2011). There are 153 permitting documents prescribed by this Law. A list of permits that Black Iron Inc. will need to obtain is presented in the "Scoping Report" (WorleyParsons, 2012a).

Permitting will be required for project activities that involve:

- Emissions to the atmosphere;
- Water use (discharge and withdrawal); and
- Waste generation, collection, transfer, handling and disposal.

Once approval of the OVNS has been declared by the SER and permits have been issued, compliance with the discharge limits detailed in the permits must be validated by a program of monitoring, assessing and reporting.

Figure 25.1: The Ukrainian State Construction Expertiza Process



Upon expiration of permit validity, the Project sponsor must re-apply for the permits with revised discharge figures, as identified through monitoring and assessment.

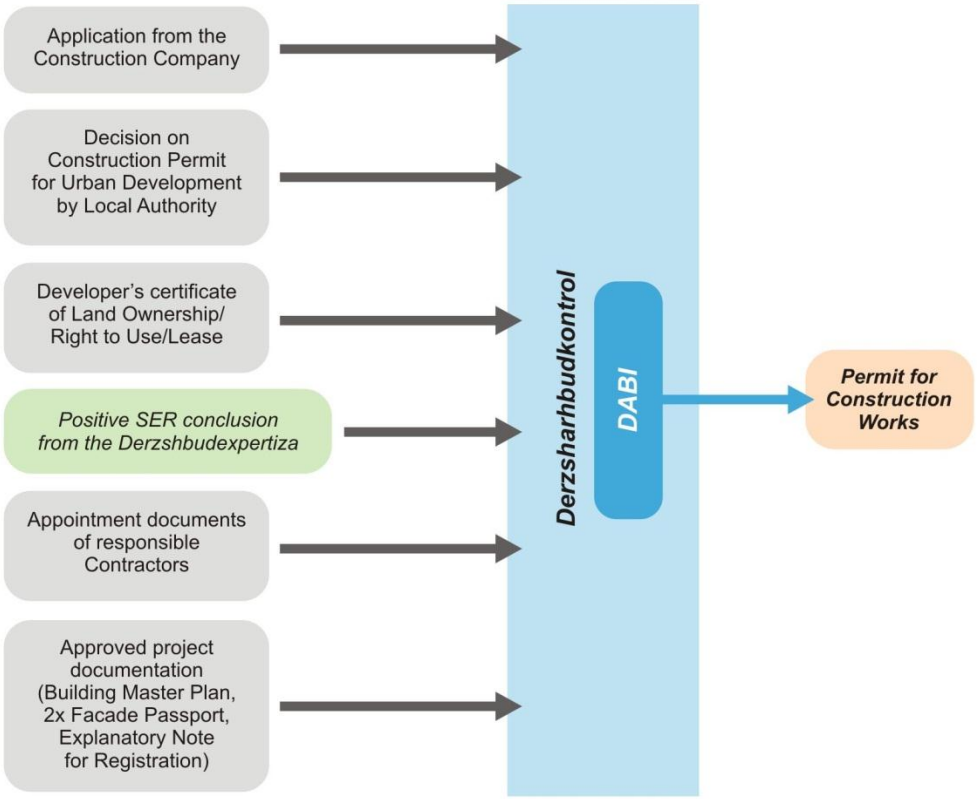
Sufficient time should be allowed to ensure that all the relevant permits can be obtained without causing delays to the Project schedule.

The “Scoping Report” (WorleyParsons, 2012a) presents detailed information about the most important permits that are likely to be required, including the timing for obtaining and using the permits, the issuing authorities and the cost for permit acquisition.

25.5.2 Construction Permitting Process

The construction permitting process is shown on Figure 25.2 below. It involves submission of the complete Project technical design documentation, referred to as *proekt* documentation (transliterated from the Russian проект for project) that includes the full OVNS report and payment by BlackIron Inc. for the SER process to the State Construction Expertiza. The Central Services of "Ukrderzshbudexpertiza"/"UkrInvestExpertiza" are located on the Lesi Ukrainki Blvd., 26, in Kiev.

Figure 25.2: Construction Permit Approval Process



25.5.3 EU Harmonization

With respect to potential changes or modifications to legislation, the MENR has developed a draft National Environmental Policy. This draft Policy sets out a timetable for alignment with EU regulations on the environment, as follows:

- 2008 – 2012: Development of robust national environmental policies;
- 2012 – 2017: Transition to European environmental standards; and
- 2017 – 2020: Implementation of European environmental standards.

It is expected that in the immediate term, from 2012 to 2017, increasingly stringent regulations governing emissions and waste management will be developed. Furthermore, an overhaul of the entire environmental evaluation and assessment process may also be pursued. The environmental program that has been established for the Project has been designed to be pro-active with regard to the imminent legislative changes that are anticipated.

International environmental conventions that Ukraine is a signatory to, and which may have relevance to the Shymanivske Iron Ore Project, are listed in the "Scoping Report."

25.6 Land Acquisition and Exploration

Land directly adjacent on the West side of the Shymanivske ore body owned by Ukraine's Government is being sought by Black Iron for the iron-ore processing and infrastructure facilities. This land is currently being used by Ukraine's Ministry of Defense and historically has been used for a range of activities.

It is therefore brownfield land with a potential of there being sub-surface contaminated hazards. This represents an unknown but potentially significant project risk to Black Iron because of the following:

- Inheritance of liability by Black Iron for sub-surface contamination and costs of future remediation if any;
- Schedule risk (delays, inherent costs) to the Project, arising from uncertainty about safety and management of ground-disturbing activities; and
- Environmental and community impacts from disturbance of contaminated land.

Although the military land issues could represent a significant material risk to the Project with respect to cost, schedule, and a range of other constraints, it is a manageable risk.

25.7 Status of Environmental Work

As stated above, under Ukrainian law the Project requires the Ukrainian Environmental Impact Assessment, or OVNS, which must be approved by the State Environment Review (SER) prior to commencement of Project development activities. Legally, the OVNS can be prepared and submitted only by a suitably authorized Ukrainian Design Institute (UDI).

The Project is set to be developed in conformance with Ukrainian standards. However, with the implementation of European regulations in 2017, and given the existing environmental issues in Kryvyi Rih as outlined above, it is strongly recommended that an internationally compliant program of Environmental, Social and Health Impact Assessment (ESHIA) be undertaken to include the cumulative impacts and to enable the project to meet European operating standards.

The OVNS process has been initiated by Black Iron Inc., and work has commenced to align the OVNS studies with international requirements for the ESHIA.

Since 2011, Black Iron Inc. has been reviewing the environmental, social baseline and context of the Project, and establishing appropriate data collection programs, impact assessment studies, consultation

programs and design criteria, so that the Project can meet the required environmental and social standards. In early 2012, WorleyParsons undertook a series of desktop studies and literature reviews to develop a better understanding of the existing conditions in the Project area. There was found to be an absence of available existing site-specific information for the Project area, so the information obtained during the desktop studies was used to inform a preliminary environmental aspects risk register and assessment, which would identify the priorities for baseline data collection. In April, 2012, following a technical and commercial tendering process, Black Iron commissioned TPA to undertake the OVNS baseline surveys and to define the boundaries of the sanitary zone.

TPA commenced the first round of OVNS baseline surveys during the months of June and July 2012, in line with a program of surveys that were designed collaboratively between TPA and WorleyParsons. WorleyParsons conducted a number of surveys in tandem with the OVNS baseline surveys, in order to enhance the design and engineering work for the Project and to further develop a comprehensive understanding of Project risks and approaches to managing the risk assessment. The findings of the WorleyParsons surveys are presented in a "Scoping Report," (WorleyParsons, 2012a) which outlines potential environmental and social issues and risks that need to be addressed by the Project during the design, construction and operations phases. The data from TPA's surveys were not available before the "Scoping Report" was issued, so they are included for the first time in this FS.

The baseline surveys for the OVNS have been completed as of December 2012. Further baseline data collection is recommended to continue for a period of time to ensure that seasonal variations in the conditions are captured and appropriately considered in the OVNS and ESHIA studies. This will ensure management plans are suitably representative of the range of site conditions.

25.7.1 Potential Environmental Issues

Three major issues associated with the Project have been identified relating to air quality, resettlement and land acquisition. In addition, there are several other minor issues associated with the Project, including groundwater contamination, alteration of the hydrological regime, noise, socio-economic factors and health.

25.7.1.1 Air Quality

Air pollution is a significant, existing issue in Kryvyi Rih. Local air quality is adversely affected by gaseous emissions and dust generated by existing mining activities and the related metallurgical processing industry. In particular, dust concentrations at certain locations around the Project site were found to exceed national limits based on air quality sampling. The principal source of airborne emissions is expected to be the exhaust emissions from generators, engines, vehicles and heavy equipment. Given the indications that background dust concentrations at certain locations around the Project site already exceed national limits caused by dust emissions unrelated to the Project, dust-control measures for principal dust sources will be a main objective and stipulation for the project. The plant site and production facilities are favourably located to ensure that no communities are located in the prevailing wind direction towards the south-west.

25.7.1.2 RESETTLEMENT

There are currently five villages situated in the immediate vicinity of the proposed Project (Rudnichnoe, Stepne, Chervona Polyana, Zeleny Hai and Musiivka). These villages and many more could be potentially influenced by wind and groundwater, or the waters of the River Inhulets. The development of the Project will necessitate the relocation of Rudnichnoe village, which has a population of approximately 1,200. Black Iron is aware that the Project will need to build a sound relationship with the host community in which it will operate in order to establish and maintain a social licence to operate. To this end, a Stakeholder Engagement Plan (SEP) has been developed and is progressively being implemented by Black Iron. A Resettlement Action Plan (RAP) will be drawn up in mid-2013, with a view to implementing the progressive resettlement of the population of Rudnichnoe in a socially responsible and sustainable manner by 2015.

25.7.1.3 LAND ACQUISITION

The military land that is being acquired by Black Iron for the iron ore processing and infrastructure facilities is an active military site that has been used historically for a range of activities. It is, therefore, brownfield land with the potential of having sub-surface hazards that may be contaminated. A full assessment of the military land will be undertaken as part of the OVNS and ESHIA, in order to identify areas of contaminated land and the remediation measures that will be required prior to the commencement of Project activities.

25.7.1.4 OTHER MINOR ISSUES - WATER

Historically, the groundwater quality in the Project area has been compromised by leakage (gradual and catastrophic) from storage ponds containing effluent and water produced at other mine sites. Pre-Project baseline testing of water samples from the ponds surrounding the Project site also indicated that the water has been impacted and, in some instances, significantly polluted (e.g., the pond in Chervonaya Polyana). Further testing, including packer tests to determine aquifer properties, is currently being undertaken in conjunction with the geotechnical program.

In addition to contaminating the groundwater in the project area, between April and August every year, water from the storage ponds at mine sites to the north of the city is flushed into the River Saksagan, a tributary of the River Inhulets. In order to mitigate contamination of the rivers Saksagan and Inhulets, they are, in turn, flushed with water from the Dzerzhinskoe and Karachunivske reservoirs, respectively. Water quality testing of the River Inhulets during April and August will be undertaken as part of the OVNS and ESHIA studies, in order to establish the baseline levels of contaminants in the river during this period. The OVNS will also confirm the impacts of the Project on the local hydrological system, and it will identify control measures to mitigate impacts.

The deepest part of the pit reaches the elevation of -290m ASL, which is below the assumed level of the water table. Dewatering of the pit will, therefore, be required. The effect of this dewatering on neighbouring water-supply wells and the potential for the inadvertent inflow of off-site contaminated water into the pit will be assessed through further OVNS assessment and groundwater study work.

25.7.1.5 GEOTECHNICAL

Historically, variable thicknesses of mining waste (i.e., waste rock) have been dumped on the natural, superficial deposits of the east and west flanks of the Project's primary ore body. This material has substantially settled and re-vegetated over time but, judging by its deposition as an informal mining waste, it is expected to contain sizeable void space and heterogeneity. An intrusive geotechnical test program comprising 10 medium-depth boreholes is currently underway, which will provide more site-specific details on the sub-surface geology. The immediate footprint of the Project will experience a range of irreversible soil impacts associated with the land-use change, and a full assessment will be undertaken as part of the OVNS, including control measures designed to mitigate the impacts of the Project on the soils, geology, terrain and use of the land.

It is recommended that a Waste Management Plan be developed in accordance with EU Directive 2006/21/EC, in order to enable reasonable prevention and planning for the physical and chemical characteristics of the mining waste from the Project.

25.7.1.6 NOISE

Existing sources of noise in the Project area include the active mining operations of ArcelorMittal and YuGOK, the double-track Musiikva–Kryvyi Rih railway line, and the road network that connects Kryvyi Rih with various villages located south of the city. There is no industrial or commercial activity in the villages close to the Project site, and traffic levels are light. During the baseline surveys, the noise levels at the non-industrial residential monitoring points were found to exceed the national standards, even though only low-level noise sources were apparent. It is possible that there is pervasive background industrial noise from the mining and metallurgical industries in the vicinity. Repeated noise measurements are required as part of the OVNS to confirm the baseline results. Key receptors where monitoring will be undertaken are the villages of Rudnichnoe, Stepne, Chervona Polyana, Zelenyi Hai and Musiivka. Following a full assessment of Project impacts during the OVNS, control measures will be included in the Project design (e.g., infrastructure and operating regime) to ensure that significant socio-economic impacts, such as noise, are mitigated at source to guarantee that limits at sensitive receptors are adhered to.

25.7.1.7 ECOLOGY AND BIODIVERSITY

A preliminary review of ecology and biodiversity in the Project area identified that, although existing mine and neighbouring industries have affected the ecological value of the Project area, pockets of important habitats and ecosystems still remain. However, there are no designated protected areas in the vicinity of the site. A more detailed study of the area will be undertaken as part of the OVNS to confirm the extent of any impacts of the Project on the ecology and biodiversity in the area. However, considering the extensive mining already underway in neighbouring areas, the overall impact on the diversity of local species, particularly of larger mammals, is expected to be insignificant. Control measures will need to be implemented to ensure that protected species are not adversely impacted.

25.7.1.8 SOCIO-ECONOMIC

The socio-economic impacts of the Project are expected to be largely beneficial. For example, it is expected that during the construction and operation phases, 3,200 jobs and 1000 jobs will be created, respectively. There will also be increased business opportunities for suppliers and contractors at the regional and national levels, which will contribute to stimulation of the overall economy, accompanied by a general increase in the skill levels of workers.

However, the Project will have some negative socio-economic implications in the Kryvyi Rih area, including the resettlement of the village of Rudichnoe, as discussed above. Community health implications are also a consideration, with issues associated with dust, noise, traffic hazards and the on-going brownfield ground investigations. Dust is highlighted as a particular priority requiring an expert health impact assessment to identify measures to mitigate risks associated with respiratory health, nuisance, discomfort, visibility and reduced quality of life, if dust levels are significant.

26 RECOMMENDATIONS

26.1 Mineral Resource Estimates

Most of the previous drilling, including the Twin Drillhole program, was vertical or sub-vertical. During the subsequent definition-drilling program, WGM proposed flatter angles to give more information about the location and orientation of faulted blocks and the existence of several projected faults within the deposit from south to north. This program partially achieved its goals in delineating some structural elements within the deposit. However, in the steeply dipping areas close to the west and east limbs of the main anticline structure, some proposed holes were cancelled because of the position of collars on old waste dumps that belong to the neighbouring mines. Completion of the remainder of these holes either as originally planned or from in-pit once production has commenced, would give more structural information. This would aid in understanding the controls and boundaries of the Oxide Zone and the magnetite-bearing quartzite, thereby improving the quality of the Mineral Resource estimate and helping to achieve better mine planning and scheduling at the boundaries of the Oxide Zone. WGM recommends that, for any future work, the Saksagan stratigraphic member codes be applied more circumspectly.

26.2 Mineral Processing and Metallurgical Testwork

All of the completed testwork, including the testwork during the FS, has been done at the bench scale level. Pilot scale testwork is recommended to substantiate the bench scale test work that was done during the FS with specific focus on the impact of dry cobbing, HPGR crushing and the energy saving and magnetite recovery associated with placing the magnetite separators in close circuit with the ball mills.

As part of the pilot test program a dry cobbing test is recommended to determine if drums plugging and scaling have an impact on the efficiency of the cobbing separation. This pilot scale test of the cobbing separation needs to be completed by the start of detailed engineering of the crushing and screening section of the plant.

The current process design includes a 10% rejection rate at the dry-cobbing step. Testwork indicates that a rate as high as 15% may be achievable, which would reduce the overall power requirements. It is recommended to test the dry cobbing at the vendor facility to see if the early rejection of tailings can be increased to the benefit of the Project. This is recommended prior to the purchase of process equipment.

It is recommended that the HPGR test be conducted at the vendor’s facilities to evaluate the parameters needed for final sizing of HPGRs prior to placing the purchase order for the Vertical Mills.

26.3 Project Infrastructure

Contracts should be negotiated for the following services prior to start of construction:

- Rail;
- Port;
- Electrical power; and
- The supply of water, natural gas and sewage disposal.

26.4 Land Acquisition

Issues related to land rights that need to be resolved prior to the start of construction include:

- Commence the Shymanivske mining pit land allotment process to obtain surface rights. Although this land is owned by the city of Kryvyi Rih, there are two neighboring mines that have leases covering a portion of the concession pit land to which Black Iron was granted subsurface rights.
- Finalize ongoing discussions with state authorities regarding the acquisition of adjacent land currently used by the Ministry of Defense for the location of the process plant, tailings and waste-rock storage.

26.5 Geotechnical

- Geotechnical and hydrogeological investigations are required in the pit area to confirm the assumed pit slope angles and dewatering requirements for the mine. These investigations must be completed as soon as access to the land is made available.
- A comprehensive geotechnical program needs to be performed for the building foundations in the plant area to supplement drilling done as part of this feasibility study. The program must be completed prior to the start of detailed engineering.
- A comprehensive hydrogeological and hydrological investigation must be preformed as part of the environmental assessment to supplement drilling done as part of this feasibility study.

26.6 Bridging Phase

In order to meet the overall project construction schedule, the following activities need to be completed in advance of the detailed engineering phase.

- Finalize a contract with a Ukrainian Design Institute (UDI) to develop the permit documents, (TEO and Proekt), as required by the Ukrainian government;
- Work with an UDI to obtain GASK approval;

- Develop Mining Allotment documents and obtain GGTN approval; and
- Conduct environmental activities as listed in Section 26.7 below.

26.7 Environmental

The following Environmental activities that were started in the feasibility study phase must be continued:

- Recommence the Environmental OVNS process immediately in the bridging phase;
- In the event that the project desires to secure funding from an Equator Principle financial institute, then it is recommended that the IFC Performance Standard ESHIA process initiated in the FS phase be continued in parallel with the OVNS process;
- The OVNS and ESHIA shall specify environmental and social management plans required for the early works, construction and operational phases of the project. Given the project time-frame (EPCM initiation in April 2013), it is recommended that these plans are started as early as possible during the bridging phase (end 2012 / early 2013); and
- Ukraine is aligning with European Union (EU) environmental regulations by 2017, and therefore, will need to comply with EU Directives for impact assessment amongst other pieces of legislation. In order to meet this time-frame, it is recommended that the ESHIA process be continued and conducted in parallel with the OVNS process.

26.8 Main Conclusion

This feasibility study phase of the project was done to sufficient detail to refine the economics to a ±15% level of accuracy and outline the issues facing the project going forward. The Project economics are sufficently robust to warrant moving to the next phase of bridging engineering and the subsequent Detailed Engineering phase in April 2013. The estimated cost for the entire EPCM phase up to, and including, startup is USD $1,094 million.

Black Iron needs to obtain the necessary surface rights to conduct mining activities on the Shymanivske Project. However, surface rights are not required to conduct the ongoing exploration and engineering activities. The next major permitting step for Black Iron is to obtain a Mining Allotment, which entails government approval of the optimized pit shell and the environmental impact studies. It is important for the viability of this project that outstanding land issues be resolved.

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Quotations from the equipment vendors

Appendix A Shymanivske Permit and Terms

Державна служба геології та надр України

СПЕЦІАЛЬНИЙ ДОЗВІЛ

на користування надрами

4537

4537

Дата видачі

від 13 грудня 2007 року

Підстава надання:

Наказ від 25.10.2011 № 138

(дата прийняття та номер наказу Держгеонадр, протоколу Міжвідомчої комісії з організації укладення та виконання угод про розподіл продукції або протоколу аукціонного комітету та договору купівлі-продажу)

Вид користування надрами відповідно до статті 14 Кодексу України про надра, статті 13 Закону України «Про нафту і газ» та пункту 5 Порядку надання спеціальних дозволів на користування надрами

видобування

Мета користування надрами:

видобування залізистих кварцитів

Відомості про ділянку надр (геологічну територію відповідно до державного балансу запасів корисних копалин України), що надається у користування:

назва родовища

Шиманівське родовище

Географічні координати:	Т.1	Т.2	Т.3	Т.4
ПШ	47°49'57"	47°51'02"	47°50'46"	47°49'40"
СхД	33°15'32"	33°16'21"	33°17'10"	33°16'22"

місцезнаходження:

Дніпропетровська область, Інгулецький район

(область, район, населений пункт)

прив'язка на місцевості відповідно до адміністративно-територіального устрою України:

південно-західна околиця м. Кривий Ріг

(напрямок, відстань від найближчого населеного пункту, залізничної станції, природоохоронних об'єктів)

площа

2,56 км^2

(зазначається в одиницях виміру)

Обмеження щодо глибини використання (за рай потреби)

Вид корисної копалини відповідно до переліків корисних копалин загальнодержавного та місцевого значення, затверджених постановою Кабінету Міністрів України від 12 грудня 1994 р. № 827

залізисті кварцити

Загальний обсяг запасів (ресурсів) на час надання спеціального дозволу на користування надрами (основні, супутні)

залізисті кварцити:

кат. В+С$_1$ - 254033 (В - 20075; С$_1$ - 233958) тис. т, С$_2$ - 8830 тис. т

скельні породи для виробництва будівельного щебеню:

кат. В+С$_1$ - 235335,9 (В - 7566,3; С$_1$ - 227769,6 тис. м^3), С$_2$ - 2704,7 тис. м^3

(одиниця виміру, категорія, обсяг)

Геологія

Держзнак. ПК «Україна». Зам. 1-3316. 2011 р. III кв.

Ступінь освоєння надр: **розробляється з 1962 року**

(розробляється, не розробляється)

Відомості про затвердження (апробацію) запасів корисної копалини (зазначається у разі видобування): **ДКЗ СРСР, протокол від 17.11.1989 № 10741**

(дата складення, номер протоколу, найменування органу)

Джерело фінансування робіт, які планує виконати надрокористувач під час користування надрами: -

(державні або недержавні кошти)

Особливі умови:

1. Виконання умов Державного управління екоресурсів у Дніпропетровській області (екологічна картка від 21.10.2004 № 106).
2. Щорічний радіаційний контроль за породами в кар'єрі та продукцією з них на відповідність вимогам НРБУ-97.
3. Своєчасна і в повному обсязі сплата обов`язкових платежів до Державного бюджету згідно з чинним законодавством.
4. Щорічна звітність перед ДНВП "Геоінформ України" згідно з формою 5-гр.
5. Обов'язковий моніторинг та наукове супроводження виконання особливих умов передбачених дозволом та угодою про умови користування надрами відповідно до абзацу третього пункту 26 Порядку надання спеціальних дозволів на користування надрами, затвердженого Постановою Кабінету Міністрів України від 30.05.2011 року № 615.

Відомості про власника: **ТОВАРИСТВО З ОБМЕЖЕНОЮ ВІДПОВІДАЛЬНІСТЮ «ШИМАНІВСЬКЕ СТІЛ»**
КОД 35201059
53700, ДНІПРОПЕТРОВСЬКА ОБЛ., ШИРОКІВСЬКИЙ РАЙОН, СЕЛИЩЕ МІСЬКОГО ТИПУ ШИРОКЕ, ВУЛИЦЯ НАДІЇ, БУДИНОК 1

(найменування юридичної особи, код згідно з ЄДРПОУ або прізвище, ім'я, по батькові фізичної особи – підприємця, ідентифікаційний номер, місцезнаходження)

Відомості про погодження надання спеціального дозволу на користування надрами: **Державне управління екоресурсів у Дніпропетровській області – від 21.10.2004 № 106**
Держнаглядохоронпраці України – від 01.11.2004 № 5.3-12/7126

(найменування органу, який виходив подання дозволу, дата прийняття та номер документа про погодження)

Строк дії спеціального дозволу на користування надрами (кількість років): **до 1 (першого) листопада 2024 (дві тисячі двадцять четвертого) року**

(цифрами та словами)

Угода про умови користування ділянкою надр є невід'ємною частиною спеціального дозволу на користування надрами і визначає умови користування ділянкою надр: від 21.11.2011 №4534

(дата складення та номер угоди про умови користування надрами)

Особа, уповноважена підписати спеціальний дозвіл на користування надрами:

Начальник Управління з надання надр у користування та ліцензування господарської діяльності (посада)

О.В. Сушко (ініціали та прізвище)

ДЕРЖАВНА СЛУЖБА ГЕОЛОГІЇ ТА НАДР УКРАЇНИ Ідентифікаційний код 37430031 (підпис)

МП А№000279

Appendix B Risk Register

Risk Register and Action Plan

Column Key:

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	Drop down list, select one item from list
	Enter text in this column

Number	Rank	Risk Description (Event and Consequence OR Cause)	Existing Controls	Risk Severity Before Treatment					Risk Treatment Plan	Ability to Influence	Action Plan Type	Risk Severity After Treatment					Responsible Person
					Consequence		Likelihood	Risk Level Before Treatment					Consequence		Likelihood	Risk Level After Treatment	
37	0	Increasing the M&I resource through additional geological drilling.	3 000 m of drilling in spring in 2013	Opp	Opportunity	Opp	Opportunity	*Opportunity*				Opp	Opportunity	Opp	Opportunity	*Opportunity*	
55	0	Utilizing the area south of tailings for initial stages of operation reduces the Capital cost.		Opp	Opportunity	Opp	Opportunity	*Opportunity*				Opp	Opportunity	Opp	Opportunity	*Opportunity*	
7	1	High level of existing particulate in area exceeds environmental regulation prevents the approval of envronmental permit which delays the project	Dust mitigation strategy developed early. Extensive base line studies to produce a proper air model.	5	Catastrophic	D	Unlikely	*Extreme*	Approach local regulators and surrounding mines to develop mitigation strategies	Low / None	Reduce likelihood	5	Catastrophic	D	Unlikely	*Extreme*	George Mover
11	2	Poor safety culture causes injuries and fatality during construction.	Training manuals and Safety managers on site. HR policy used. Alcohol testing everyday. Proper safety management plan. Enforcing the safety rules and procedures. Incentives for good work performed.	5	Catastrophic	D	Unlikely	*Extreme*	Extensive safety training. Expatriates for key safety positions. No exceptions policies from the beginning of the project.	Moderate	Reduce likelihood	5	Catastrophic	E	Rare	*High*	Construction Manager
33	3	Delay in relocating of R village results in construction delay	Develop a relocation strategy and execute the relocation plan as soon as possible	5	Catastrophic	D	Unlikely	*Extreme*	Hire experienced consultants to manage the relocation	Moderate	Reduce likelihood and consequence	4	Major	D	Unlikely	*High*	Igor Butchatskiy
77	4	Lack of funding and cash flow for purchase of equipment during first year construction results in schedule delay.	Allow float in schedule. Start financing process as early as possible	5	Catastrophic	D	Unlikely	*Extreme*	Increase level of effort. Identify alternative investing options. Renegotiate payment terms.	Moderate	Reduce likelihood and consequence	4	Major	D	Unlikely	*High*	Matt Simpson
28	5	Delay in acquisition of Military land - delay in schedule.	BKI negotiation with Ministry of defence, Land acquisition schedule, allowing float in the main schedule for potential delays.	4	Major	C	Moderate	*Extreme*	Consider alternate layouts and facility locations	Moderate	Reduce likelihood	4	Major	D	Unlikely	*High*	Igor Butchatskiy
29	6	Delay in acquisition of city land caused schedule delay	BKI negotiation with KR city council, Land acquisition schedule, allowing float in the main schedule for potential delays. VP community relations discussions with local mines and councils	4	Major	C	Moderate	*Extreme*		Low / None	Accept	4	Major	C	Moderate	*Extreme*	Igor Butchatskiy
35	7	Delay in obtaing Ministry of Agriculture land.	BKI negotiation with Ministry of agriculture, Land acquisition schedule, allowing float in the main schedule for potential delays.	4	Major	C	Moderate	*Extreme*	Consider alternate layouts and facility locations	High	Reduce likelihood and consequence	3	Moderate	D	Unlikely	*Moderate*	Igor Butchatskiy
1	8	Begining site investigation and work poses the risk of finding unexploded ordinance which results in fatality.	Assurance from the Military and independent verification (geological). Only designated areas accessed.	5	Catastrophic	E	Rare	*High*	Two independent surveys of military land	High	Reduce likelihood	5	Catastrophic	E	Rare	*High*	Igor Butchatskiy
3	9	Extreme proximity of the Processing plant to military warehouse might result in an explosion because of moving material - resulting in fatality/ property damage.	Military has confirmed that the Buffer zone of 400 m for any occupied facility is sufficient.	5	Catastrophic	E	Rare	*High*	Erect fence on 400m zone with permanent security. Add height to military berms	Moderate	Reduce likelihood and consequence	4	Major	E	Rare	*High*	Igor Butchatskiy
23	10	Political instability causes license and permitting agreements change and results in additional cost and schedule	VP government relations, proactive in identifing potential changes.	5	Catastrophic	E	Rare	*High*	Increased level of effort. Add float in the schedule. Submit early PROEKT	Moderate	Reduce likelihood and consequence	4	Major	E	Rare	*High*	Igor Butchatskiy
4	11	Opposition from the communities to the project causes delay in schedule/ cancellation.	Stakeholder engagement plan includes all communities. Resettlement plan, active engagement from the community including public hearings.	4	Major	D	Unlikely	*High*	Local sponsorships of charities. Change layout to reposition tailings . PR consultant to execute stakeholder plan. Landscape to beautify site. Mine and Tailings and Waste Pile Reclamation Plan. Modify design to allow early reclamation	Moderate	Reduce likelihood and consequence	3	Moderate	D	Unlikely	*Moderate*	Igor Butchatskiy
5	12	Late decision to start with ESHIA may delay to construction date.	Planned in the schedule.	4	Major	D	Unlikely	*High*	Allow float in schedule. Mix of investors and plan cash flow accordingly	High	Reduce likelihood and consequence	3	Moderate	D	Unlikely	*Moderate*	Stefan G
19	13	Difficulty in enforcing the contract causes schedule delays.	Contracting strategy. Allow float in the schedule.	4	Major	D	Unlikely	*High*	More than one contractor, plan for flexibility in contracting	Moderate	Reduce likelihood and consequence	3	Moderate	D	Unlikely	*Moderate*	Rob Spiering
26	14	Difficulty in finding a capable and reliable UDI cause schedule and cost.	Schedule accounts for difficulty in finding UDIs. Splitting scope to different UDIs, limited scope	4	Major	D	Unlikely	*High*	WorleyParsons opens local office to execute from Ukraine. Provide design supervision to Ukraine. EPMC Stragegy	High	Reduce likelihood and consequence	3	Moderate	D	Unlikely	*Moderate*	Rob Spiering
45	15	Difficulty of Recuperation of VAT causes cost increase.	Employ a local corporate tax accountant/lawyer	4	Major	D	Unlikely	*High*	Develop early tax strategy	Moderate	Reduce consequence	3	Moderate	D	Unlikely	*Moderate*	Igor Butchatskiy

Risk Register and Action Plan

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					Consequence		Likelihood	Risk Level Before Treatment					Consequence		Likelihood	Risk Level After Treatment	
53	16	Unknown structural geology condition causes the reduction in pit slope angle.	Geotechnical investication programme in the mine area early in the design process. Conservative parameters were used for the design	4	Major	D	Unlikely	*High*		Low / None	Accept	4	Major	D	Unlikely	*High*	Fred Claridge
78	17	Low iron ore price makes funding more difficult.	Determine realistic concentrate price for economic modelling	4	Major	D	Unlikely	*High*		Low / None	Accept	4	Major	D	Unlikely	*High*	Aaron Wolfe
17	18	Innability to obtain qualified operation staff creates operational interruptions issues.	Recruitment and training planning.	4	Major	E	Rare	*High*	Provisions for Expats	High	Reduce likelihood and consequence	3	Moderate	E	Rare	*Moderate*	George Mover
20	19	Inability of local General contractors to perform causes increased schedule delay and cost.	Structured contract with penalties. Prequalification of contractors.	4	Major	E	Rare	*High*	Consider international contractor. Allow float in schedule . Scope split between more than one contractor	Moderate	Reduce likelihood and consequence	3	Moderate	E	Rare	*Moderate*	Construction Manager
68	20	Concentrate does not meet customer pelletizing spec. resulting in reduce marketabillity.	Pelletizing test during pilot testing. Modify process to meet requirements	4	Major	E	Rare	*High*	Evaluate concentrate requirements and determine sensitivity of our concentrate against the requirements	Moderate	Reduce consequence	3	Moderate	E	Rare	*Moderate*	Masoud G
72	21	Late stage bankrupcy of a vendor, contractor causes additional delays.	Careful vendor selection	4	Major	E	Rare	*High*	Float in schedule allow change of vendors	Moderate	Reduce likelihood and consequence	3	Moderate	E	Rare	*Moderate*	Rob Spiering
18	22	Changing Legal frame in Ukraine affects the permitting process and schedule delays.	Regular communication with various ministries, VP government relations. Allow float in the schedule permitting process.	3	Moderate	C	Moderate	*High*		Low / None	Accept	3	Moderate	C	Moderate	*High*	Igor Butchatskiy
30	23	Delay in relocation YuGOK- garage causes schedule delay	BKI negotiation with YuGOK and KR city council to expedite the relocation	3	Moderate	C	Moderate	*High*		Low / None	Accept	3	Moderate	C	Moderate	*High*	Igor Butchatskiy
31	24	Delay in relocation AM railway and storage pond.	BKI negotiation with AM to facilitate the relocation of AM facilities	3	Moderate	C	Moderate	*High*	Revise mine plan to allow for a later relocation of AM railway	Low / None	Reduce consequence	2	Minor	C	Moderate	*Moderate*	
43	25	Market situation delays suppliers delivery.	Early equipment PO's for major equipment to secure manufacturing space	3	Moderate	C	Moderate	*High*	Float in schedule. Consider delivery times in selection process.	Moderate	Reduce likelihood and consequence	2	Minor	D	Unlikely	*Low*	
56	26	Increased in gas & fuel cost causes additional cost.	Consider electric powered equipment	3	Moderate	C	Moderate	*High*	Sign a long term future contracts	Moderate	Reduce consequence	3	Moderate	C	Moderate	*High*	George Mover
76	27	Technical condition for power, rail, water, gas and road network may differ from the currently assumed agreements, resulting in engineering rework, schedule delays and additional CAPEX.	Constant discussions with utilities and city council. Get the PROEKT approval early	3	Moderate	C	Moderate	*High*		Low / None	Accept	3	Moderate	C	Moderate	*High*	George Mover
50	28	Interface between WP and UDIs results in rework and schedule delay, construction issues.	Ukrainian office. Interpreters and translators. Engaging UDI early in design and constant communication including bringing UDI staff to WP offices	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
2	29	Discovering the hazardous material results in additional cost and schedules delays.	Contamination assessment and Environmental liability. Assurance from the Military and independent verification.	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
25	30	Collusion between vendors, suppliers and contractors causes additional cost.	Vendor prequalification and contracting strategy.	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
27	31	Not well defined permitting process in Ukraine causes schedule delay.	Diagrams process and verify with ministries	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
32	32	Difficulty in obtaining permission to construct South ramp under pass or over pass.	Initiate discussion with AM and rail owners early in the process. Design the construction with least amount of interruption to existing operations	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
36	33	difference between the block model and the output of the mine results in additional blending which causes increased OPEX cost.	Blending, grade control and stock piling.	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
38	34	Currency fluctuation increases CAPEX	Hedge Currencies based on cash flow	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
40	35	inability of Ukrainian bulk suppliers to support construction quality increases cost and schedule delay.	Have agility in the design. Survey the availability of bulk materials before proceeding with final design.	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	

Risk Register and Action Plan

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					Consequence		Likelihood	Risk Level Before Treatment					Consequence		Likelihood	Risk Level After Treatment	
41	36	Language barrier with Ukrainian suppliers causes schedule delay and cost.	Interpreters and translators. Local Ukrainian office and UDI's	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
42	37	Lack of response of suppliers delays project.	Expedite through Ukrainian office	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
44	38	Difficulty to import equipment and material causes delays in schedule.	Employ local custom broker	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
47	39	Difficulty in procuring specific steel sections causes increased cost and schedule delay.	Used available steel sections through surveying local fabrication shops	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
49	40	Difficulty in obtaining heavy construction equipment (cranes) delays project.	Construction plan and scheduling for heavy lifts	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
51	41	WP knowledge of Code and Standards in Ukraine results in rework.	UDI's review design for compliance with local codes and standards. Translate local codes at the beginning of project.	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
54	42	Uncertainty of the thickness of the soil layer under the waste dumps results in foundation instability.	Geotechnical investigation programme in the waste dump area is in progress to confirm the subsurface condition	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
58	43	Planned construction productivity factor not in line with the estimated on results in schedule delay.	Float in the schedule and solid construction management team	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
59	44	Labour related Interruption causes delay.	Good construction management. Labour relations strategy. Prequalification of contractors	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
60	45	Ore hardness assumed from test work is lower than the site reduces through put and therefore OPEX is higher.	Validate the impact of grindability on current flow sheet	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
61	46	The test work is not representative of the ore composition which reduces the throughput.	Additional drilling and testing and refining the block model	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
64	47	Nonconformity between the current bench scale test results and vendor results impacts throughput.	Design factor has been applied for equipment sizing. Obtained firm prices from vendors with current bench scale testing	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
65	48	Vendor test results for HPGR, filtration, settling and rheology differ from bench scale results impacts throughput.	Pilot plant and vendor testing before final selection of equipment. Further bench scale testing	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
73	49	Vertimill supplier being sole source can results in schedule delay and additional cost.	Early PO and schedule float	3	Moderate	D	Unlikely	*Moderate*				3	Moderate	D	Unlikely	*Moderate*	
6	50	Impact to the ground water table from mining activities may cause addition cost of project and operational delay.	Early Hydrogeological drilling program and characterization and modelling.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
8	51	Proximity of our pit to the railway causes subsidence to the railway, addition cost to the project.	Verifying the strength of the subsurface and design accordingly. Setback from the rail.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
9	52	Modification to the bridges (KGOKOR, KM 6 bridge) causes disruption to railway service/ additional cost.	Detailed Plan for a stage modification to the bridges to minimize the interruption. Coordination with the railway owners. (AM & UNR).	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
12	53	Significant reduction the water flow into the Ingulets river causes less water downstream and affects the irrigation, and resulting in opposition to the project.	Layout and dewatering strategy.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
13	54	Identification of the rare species causes opposition of project and additional cost.	Baseline studies.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
14	55	Chemicals used in the floatation process causes delay or additional cost.	Engineering design. Containment in tailings.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	

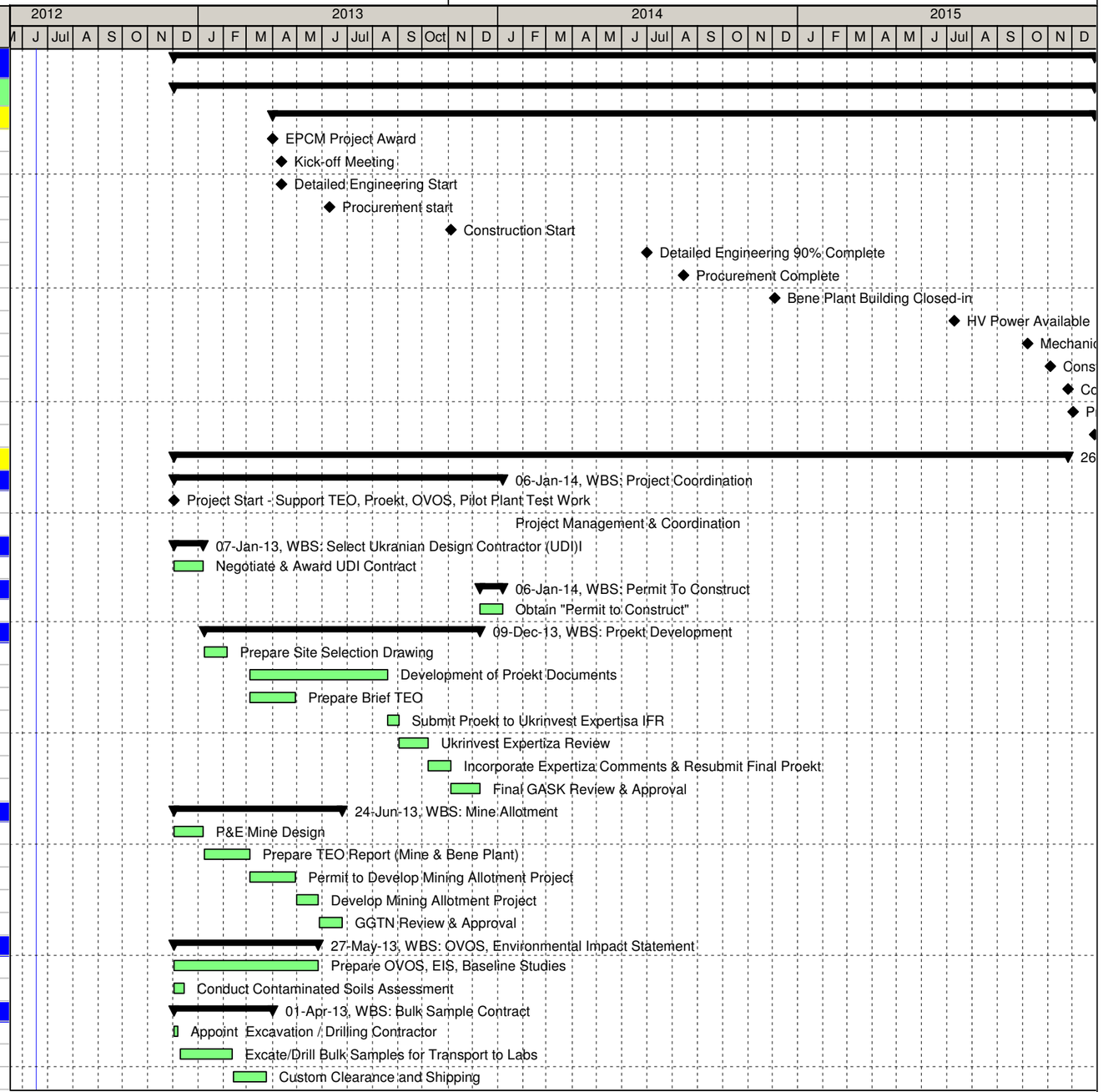
Risk Register and Action Plan

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					Consequence		Likelihood	Risk Level Before Treatment					Consequence		Likelihood	Risk Level After Treatment	
15	56	Identification of monument of archaeological significance may cause delay.	Archaeological plan, consultant, archaeological investigation underway. Rare find procedure.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
16	57	Contamination of ground water (waste dump and tailings) causes additional financial costs.	Mine and tailings waste management Control. International best practices. Carbonates for co-disposal management. Slope of erosion management.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
21	58	Difficulty to deliver oversized equipment to the site causes increased cost.	Develop logistic strategy.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
22	59	Loss or damage of equipment during shipment causes increased cost and schedule delay	Insurance for contingencies.	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
34	60	Delay in obtaining approvals to connect to local utilities.	Issue the technical conditons to local utilities, and try to accomodate the requirements in design	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
62	61	Scalability of bench scale results in worse recoverability reducing throughput.	Pilot plant testing and vendor testing	3	Moderate	E	Rare	*Moderate*				3	Moderate	E	Rare	*Moderate*	
24	62	Competition from surrounding mines causes difficulties in obtaining resources, staff or material -additional operational cost.	Initiate discussions with the surrounding mines. Develop recruitment strategies to draw from surrounding towns.	2	Minor	C	Moderate	*Moderate*				2	Minor	C	Moderate	*Moderate*	
46	63	Geotechnical drilling results in increased cost in construction.	Used all available data. Conservative design assumptions	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
10	64	Flash flood during construction causes damage; cost and schedule impact.	Drainage Control plan, design temporary runoff control.	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
39	65	Innability of Ukrainian bulk suppliers to support construction capacity increases schedule delay and cost.	Contracting strategy. Prequalification, Survey of local bulk suppliers. Using more than one bulk suppliern	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
48	66	Quality of bolts and welding consumables add cost.	Quality control during construction	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
52	67	Delay in obtaining Visa for technical reps delays projects.	Relocation specialist and initiate the process early	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
57	68	Dust and fly rock from pit blasting impact rail operations.	Controlled basting design to minimize fly rock. Maintain safe distance from the rail	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
63	69	Effect of using magnetic separators in close circuit with grinding circuit has not been tested. The risk that the assumed grindibility parameters differ from the actual operation impacting the throughput.	Pilot plant will confirm the recovery parameters	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
66	70	Lack of environmental, tailings and material handeling testing will impact process design.	Testing performed before detailed design. Used bench mark results from previous projects	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
74	71	Low quality electrical supply (frequency and voltage) results in low equipment performance.	Utility and main consultant to grid has confirmed the strength of the supply. Power coming from two sources. Get test results from utility supplies in the area	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
79	72	the theft during construction result in increased CAPEX.	Proper security and lighting during contruction	2	Minor	D	Unlikely	*Low*				2	Minor	D	Unlikely	*Low*	
71	73	GOST approved vendors for electrical equipment can lead to higher CAPEX.	Ensure GOST approval during procurement process	2	Minor	E	Rare	*Low*				2	Minor	E	Rare	*Low*	
67	74	Shipping 32 microne concentrate with 9% moisture in rail cars has potential risk for delay in loading and unloading.	Convervative rail turn around time. Thaw shed at port. Sufficient storage capacity at port.	1	Insignificant	D	Unlikely	*Low*				1	Insignificant	D	Unlikely	*Low*	
69	75	Technology transfer rules prevent expected equipment arriving.	Plan for techniciallocical trade issues	1	Insignificant	D	Unlikely	*Low*				1	Insignificant	D	Unlikely	*Low*	
70	76	delay government approval of HPGR delays project.	UDI's are familiar with HPGR's and did not expect any problems	1	Insignificant	E	Rare	*Low*				1	Insignificant	E	Rare	*Low*	
75	77	Lack of familiarity with new technology results in difficulties to obtain qualified staff.	Training and vendor supervision	1	Insignificant	E	Rare	*Low*				1	Insignificant	E	Rare	*Low*	

Appendix C EPCM Schedule

Activity ID	Activity Name	Start	Finish
Total		03-Dec-12	28-Dec-15
Project: BLACK IRON PROJECT - EPCM		03-Dec-12	28-Dec-15
WBS: PROJECT MILESTONES		01-Apr-13	28-Dec-15
MM10000	EPCM Project Award	01-Apr-13*	
MM10010	Kick-off Meeting		12-Apr-13
MM10030	Detailed Engineering Start		12-Apr-13
MM10040	Procurement start	10-Jun-13	
MM10080	Construction Start	05-Nov-13	
MM10035	Detailed Engineering 90% Complete		01-Jul-14
MM10050	Procurement Complete		14-Aug-14
MM10070	Bene Plant Building Closed-in		03-Dec-14
MM10060	HV Power Available		09-Jul-15
MM10090	Mechanical Completion		07-Oct-15
MM100120	Construction Complete		04-Nov-15
MM10140	Cold Commissioning Complete		26-Nov-15
MM10130	Project Close-out		02-Dec-15
MM10150	Hot Commissioning & Start up Complete		28-Dec-15
WBS: BRIDGING PHASE		03-Dec-12	26-Nov-15
WBS: Project Coordination		03-Dec-12	06-Jan-14
PM10000	Project Start - Support TEO, Proekt, OVOS, Pilot Plant Test ...	03-Dec-12*	
PM10010	Project Management & Coordination	03-Dec-12	06-Jan-14
WBS: Select Ukranian Design Contractor (UDI)I		03-Dec-12	07-Jan-13
PM10050	Negotiate & Award UDI Contract	03-Dec-12	07-Jan-13
WBS: Permit To Construct		10-Dec-13	06-Jan-14
PM20100	Obtain "Permit to Construct"	10-Dec-13	06-Jan-14
WBS: Proekt Development		08-Jan-13	09-Dec-13
PM30000	Prepare Site Selection Drawing	08-Jan-13	04-Feb-13
PM30010	Development of Proekt Documents	05-Mar-13	19-Aug-13
PM30060	Prepare Brief TEO	05-Mar-13	29-Apr-13
PM30020	Submit Proekt to Ukrinvest Expertisa IFR	20-Aug-13	02-Sep-13
PM30030	Ukrinvest Expertiza Review	03-Sep-13	07-Oct-13
PM30040	Incorporate Expertiza Comments & Resubmit Final Proekt	08-Oct-13	04-Nov-13
PM30050	Final GASK Review & Approval	05-Nov-13	09-Dec-13
WBS: Mine Allotment		03-Dec-12	24-Jun-13
PM40000	P&E Mine Design	03-Dec-12*	07-Jan-13
PM40010	Prepare TEO Report (Mine & Bene Plant)	08-Jan-13	04-Mar-13
PM40020	Permit to Develop Mining Allotment Project	05-Mar-13	29-Apr-13
PM40030	Develop Mining Allotment Project	30-Apr-13	27-May-13
PM40040	GGTN Review & Approval	28-May-13	24-Jun-13
WBS: OVOS, Environmental Impact Statement		03-Dec-12	27-May-13
PM50000	Prepare OVOS, EIS, Baseline Studies	03-Dec-12	27-May-13
PM50010	Conduct Contaminated Soils Assessment	03-Dec-12	14-Dec-12
WBS: Bulk Sample Contract		03-Dec-12	01-Apr-13
BS10000	Appoint Excavation / Drilling Contractor	03-Dec-12	07-Dec-12
BS10010	Excate/Drill Bulk Samples for Transport to Labs	10-Dec-12	11-Feb-13
BS10020	Custom Clearance and Shipping	12-Feb-13	25-Mar-13



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

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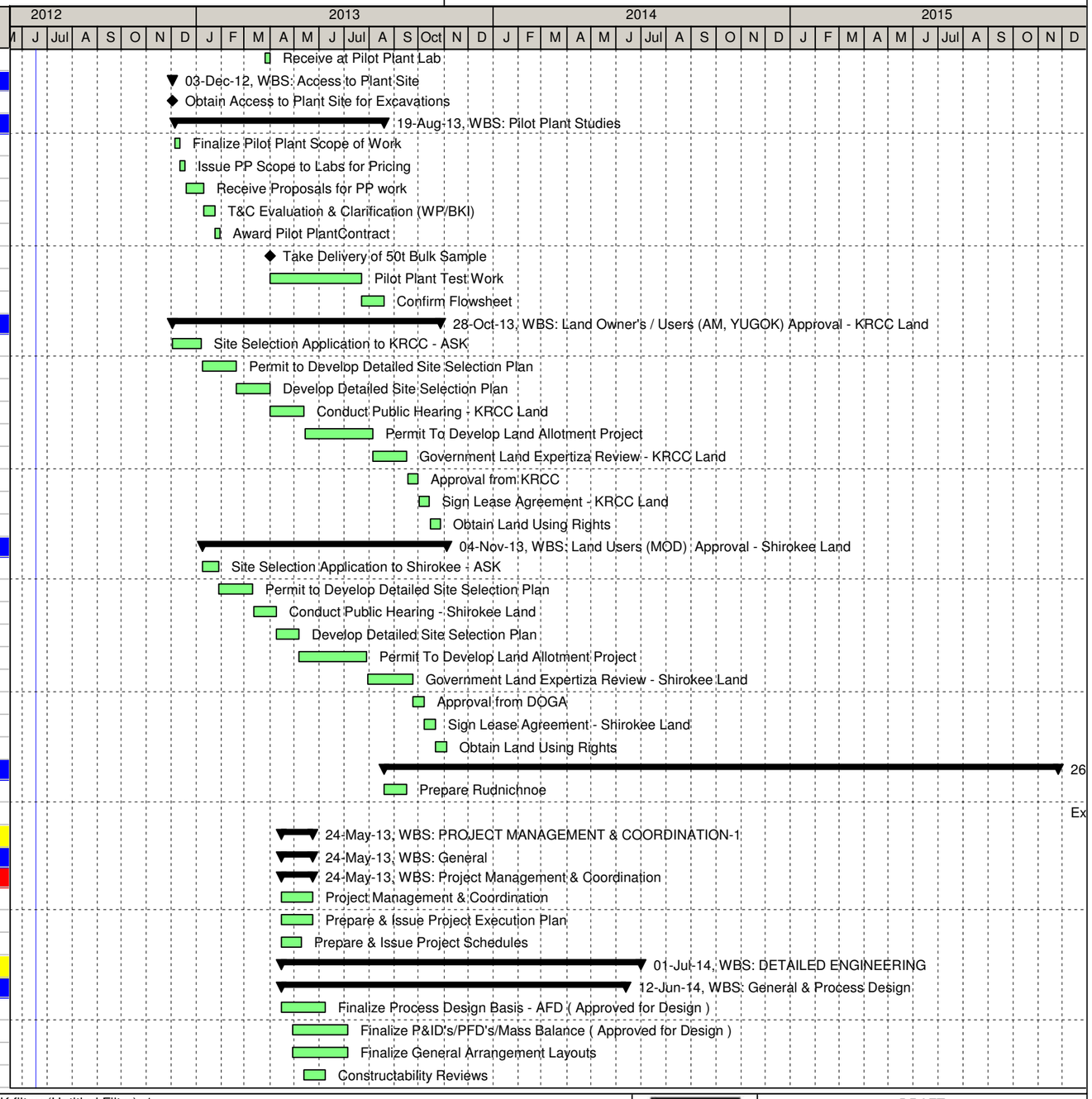
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Shymanivske Project EPCM Schedule

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Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
BS10030	Receive at Pilot Plant Lab	26-Mar-13	01-Apr-13
WBS: Access to Plant Site		03-Dec-12	03-Dec-12
PM50500	Obtain Access to Plant Site for Excavations		03-Dec-12*
WBS: Pilot Plant Studies		05-Dec-12	19-Aug-13
PM60100	Finalize Pilot Plant Scope of Work	05-Dec-12	11-Dec-12
PM60110	Issue PP Scope to Labs for Pricing	12-Dec-12	18-Dec-12
PM60120	Receive Proposals for PP work	19-Dec-12	09-Jan-13
PM60130	T&C Evaluation & Clarification (WP/BKI)	10-Jan-13	23-Jan-13
PM60140	Award Pilot PlantContract	24-Jan-13	30-Jan-13
PM60200	Take Delivery of 50t Bulk Sample		01-Apr-13
PM60210	Pilot Plant Test Work	02-Apr-13	22-Jul-13
PM60220	Confirm Flowsheet	23-Jul-13	19-Aug-13
WBS: Land Owner's / Users (AM, YUGOK) Approval - KRCC Land		03-Dec-12	28-Oct-13
PM80000	Site Selection Application to KRCC - ASK	03-Dec-12	07-Jan-13
PM80010	Permit to Develop Detailed Site Selection Plan	08-Jan-13	18-Feb-13
PM80020	Develop Detailed Site Selection Plan	19-Feb-13	01-Apr-13
PM80030	Conduct Public Hearing - KRCC Land	02-Apr-13	13-May-13
PM80040	Permit To Develop Land Allotment Project	14-May-13	05-Aug-13
PM80060	Government Land Expertiza Review - KRCC Land	06-Aug-13	16-Sep-13
PM80070	Approval from KRCC	17-Sep-13	30-Sep-13
PM80080	Sign Lease Agreement - KRCC Land	01-Oct-13	14-Oct-13
PM80090	Obtain Land Using Rights	15-Oct-13	28-Oct-13
WBS: Land Users (MOD) Approval - Shirokee Land		08-Jan-13	04-Nov-13
PM80100	Site Selection Application to Shirokee - ASK	08-Jan-13	28-Jan-13
PM80110	Permit to Develop Detailed Site Selection Plan	29-Jan-13	11-Mar-13
PM80130	Conduct Public Hearing - Shirokee Land	12-Mar-13	08-Apr-13
PM80120	Develop Detailed Site Selection Plan	09-Apr-13	06-May-13
PM80140	Permit To Develop Land Allotment Project	07-May-13	29-Jul-13
PM80160	Government Land Expertiza Review - Shirokee Land	30-Jul-13	23-Sep-13
PM80170	Approval from DOGA	24-Sep-13	07-Oct-13
PM80180	Sign Lease Agreement - Shirokee Land	08-Oct-13	21-Oct-13
PM80190	Obtain Land Using Rights	22-Oct-13	04-Nov-13
WBS: Rudnichnoe Resettlement Plan		20-Aug-13	26-Nov-15
PM90100	Prepare Rudnichnoe	20-Aug-13	16-Sep-13
PM90110	Execute the Resettlement of Rudnichnoe	17-Sep-13	26-Nov-15
WBS: PROJECT MANAGEMENT & COORDINATION-1		15-Apr-13	24-May-13
WBS: General		15-Apr-13	24-May-13
WBS: Project Management & Coordination		15-Apr-13	24-May-13
GE10030	Project Management & Coordination	15-Apr-13	24-May-13
GE10040	Prepare & Issue Project Execution Plan	15-Apr-13	24-May-13
GE10050	Prepare & Issue Project Schedules	15-Apr-13	10-May-13
WBS: DETAILED ENGINEERING		15-Apr-13	01-Jul-14
WBS: General & Process Design		15-Apr-13	12-Jun-14
DE10000	Finalize Process Design Basis - AFD (Approved for Design)	15-Apr-13	07-Jun-13
DE10010	Finalize P&ID's/PFD's/Mass Balance (Approved for Design)	29-Apr-13	05-Jul-13
DE10050	Finalize General Arrangement Layouts	29-Apr-13	05-Jul-13
DE10040	Constructability Reviews	13-May-13	07-Jun-13



Actual Work
Remaining Work
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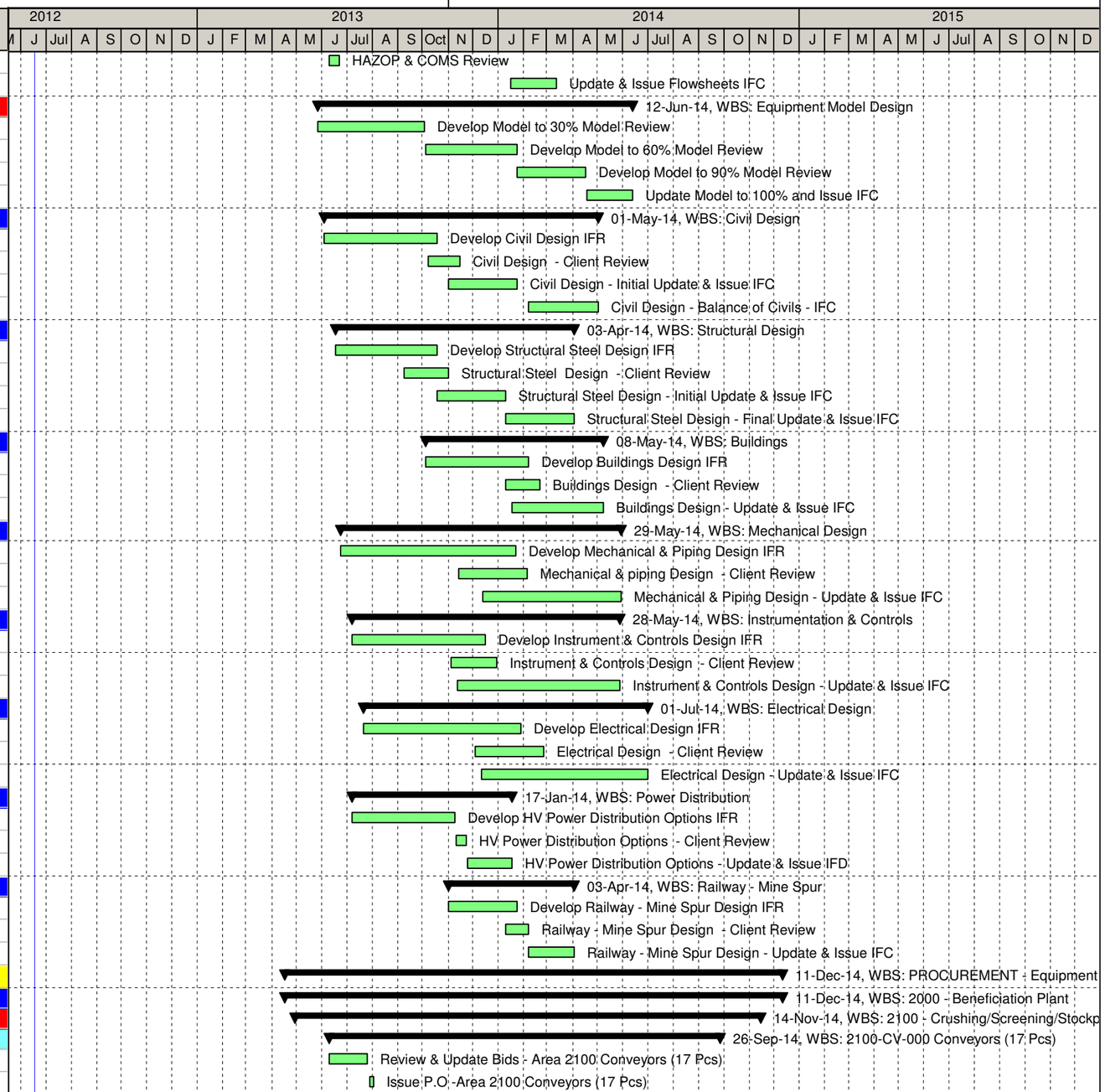
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Shymanivske Project EPCM Schedule

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Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
DE10030	HAZOP & COMS Review	10-Jun-13	21-Jun-13
DE10020	Update & Issue Flowsheets IFC	16-Jan-14	12-Mar-14
WBS: Equipment Model Design		27-May-13	12-Jun-14
DE10200	Develop Model to 30% Model Review	27-May-13	03-Oct-13
DE10210	Develop Model to 60% Model Review	04-Oct-13	23-Jan-14
DE10220	Develop Model to 90% Model Review	24-Jan-14	17-Apr-14
DE10230	Update Model to 100% and Issue IFC	18-Apr-14	12-Jun-14
WBS: Civil Design		03-Jun-13	01-May-14
DE20000	Develop Civil Design IFR	03-Jun-13	18-Oct-13
DE20010	Civil Design - Client Review	07-Oct-13	15-Nov-13
DE20020	Civil Design - Initial Update & Issue IFC	01-Nov-13	23-Jan-14
DE20030	Civil Design - Balance of Civils - IFC	07-Feb-14	01-May-14
WBS: Structural Design		17-Jun-13	03-Apr-14
DE30000	Develop Structural Steel Design IFR	17-Jun-13	18-Oct-13
DE30010	Structural Steel Design - Client Review	09-Sep-13	01-Nov-13
DE30020	Structural Steel Design - Initial Update & Issue IFC	18-Oct-13	09-Jan-14
DE30030	Structural Steel Design - Final Update & Issue IFC	10-Jan-14	03-Apr-14
WBS: Buildings		04-Oct-13	08-May-14
DE40000	Develop Buildings Design IFR	04-Oct-13	06-Feb-14
DE40010	Buildings Design - Client Review	10-Jan-14	20-Feb-14
DE40020	Buildings Design - Update & Issue IFC	17-Jan-14	08-May-14
WBS: Mechanical Design		24-Jun-13	29-May-14
DE50000	Develop Mechanical & Piping Design IFR	24-Jun-13	21-Jan-14
DE50010	Mechanical & piping Design - Client Review	13-Nov-13	04-Feb-14
DE50020	Mechanical & Piping Design - Update & Issue IFC	13-Dec-13	29-May-14
WBS: Instrumentation & Controls		08-Jul-13	28-May-14
DE60000	Develop Instrument & Controls Design IFR	08-Jul-13	16-Dec-13
DE60010	Instrument & Controls Design - Client Review	05-Nov-13	30-Dec-13
DE60020	Instrument & Controls Design - Update & Issue IFC	12-Nov-13	28-May-14
WBS: Electrical Design		22-Jul-13	01-Jul-14
DE70000	Develop Electrical Design IFR	22-Jul-13	28-Jan-14
DE70010	Electrical Design - Client Review	04-Dec-13	25-Feb-14
DE70020	Electrical Design - Update & Issue IFC	11-Dec-13	01-Jul-14
WBS: Power Distribution		08-Jul-13	17-Jan-14
DE80000	Develop HV Power Distribution Options IFR	08-Jul-13	08-Nov-13
DE80010	HV Power Distribution Options - Client Review	11-Nov-13	22-Nov-13
DE80020	HV Power Distribution Options - Update & Issue IFD	25-Nov-13	17-Jan-14
WBS: Railway - Mine Spur		01-Nov-13	03-Apr-14
DE90000	Develop Railway - Mine Spur Design IFR	01-Nov-13	23-Jan-14
DE90010	Railway - Mine Spur Design - Client Review	10-Jan-14	06-Feb-14
DE90020	Railway - Mine Spur Design - Update & Issue IFC	07-Feb-14	03-Apr-14
WBS: PROCUREMENT - Equipment & Materials		17-Apr-13	11-Dec-14
WBS: 2000 - Beneficiation Plant		17-Apr-13	11-Dec-14
WBS: 2100 - Crushing/Screening/Stockpiling (544 Pcs)		29-Apr-13	14-Nov-14
WBS: 2100-CV-000 Conveyors (17 Pcs)		10-Jun-13	26-Sep-14
PR21000	Review & Update Bids - Area 2100 Conveyors (17 Pcs)	10-Jun-13	26-Jul-13
PR21010	Issue P.O -Area 2100 Conveyors (17 Pcs)	29-Jul-13	02-Aug-13



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

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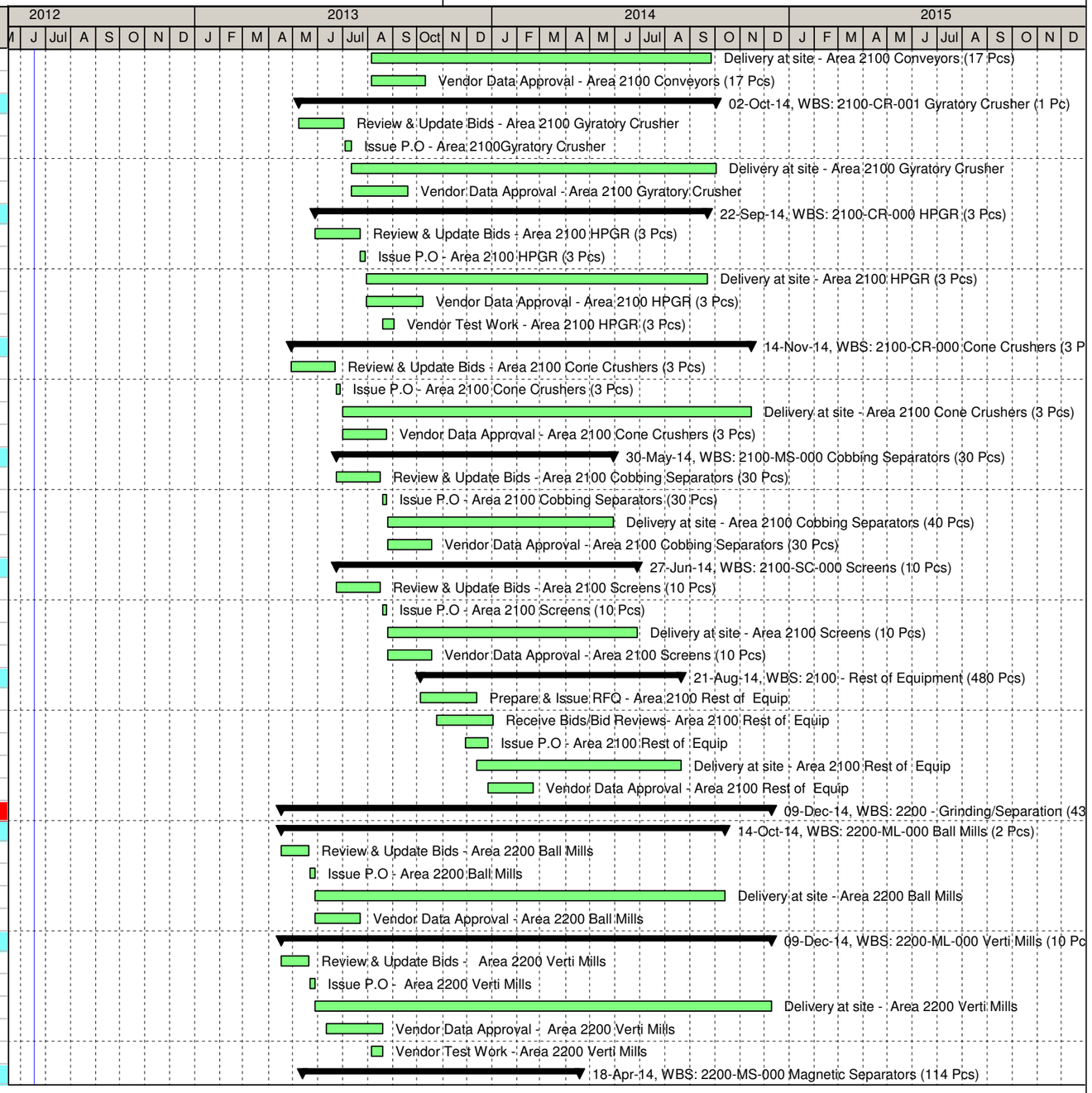
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Shymanivske Project EPCM Schedule

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Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
PR21030	Delivery at site - Area 2100 Conveyors (17 Pcs)	05-Aug-13	26-Sep-14
PR21020	Vendor Data Approval - Area 2100 Conveyors (17 Pcs)	05-Aug-13	11-Oct-13
WBS: 2100-CR-001 Gyratory Crusher (1 Pc)		09-May-13	02-Oct-14
PR21040	Review & Update Bids - Area 2100 Gyratory Crusher	09-May-13	03-Jul-13
PR21050	Issue P.O - Area 2100Gyratory Crusher	04-Jul-13	11-Jul-13
PR21070	Delivery at site - Area 2100 Gyratory Crusher	12-Jul-13	02-Oct-14
PR21060	Vendor Data Approval - Area 2100 Gyratory Crusher	12-Jul-13	19-Sep-13
WBS: 2100-CR-000 HPGR (3 Pcs)		28-May-13	22-Sep-14
PR21080	Review & Update Bids - Area 2100 HPGR (3 Pcs)	28-May-13	22-Jul-13
PR21090	Issue P.O - Area 2100 HPGR (3 Pcs)	23-Jul-13	29-Jul-13
PR21110	Delivery at site - Area 2100 HPGR (3 Pcs)	30-Jul-13	22-Sep-14
PR21100	Vendor Data Approval - Area 2100 HPGR (3 Pcs)	30-Jul-13	07-Oct-13
PR21260	Vendor Test Work - Area 2100 HPGR (3 Pcs)	20-Aug-13	02-Sep-13
WBS: 2100-CR-000 Cone Crushers (3 Pcs)		29-Apr-13	14-Nov-14
PR21120	Review & Update Bids - Area 2100 Cone Crushers (3 Pcs)	29-Apr-13	21-Jun-13
PR21130	Issue P.O - Area 2100 Cone Crushers (3 Pcs)	24-Jun-13	28-Jun-13
PR21150	Delivery at site - Area 2100 Cone Crushers (3 Pcs)	01-Jul-13	14-Nov-14
PR21140	Vendor Data Approval - Area 2100 Cone Crushers (3 Pcs)	01-Jul-13	23-Aug-13
WBS: 2100-MS-000 Cobbing Separators (30 Pcs)		24-Jun-13	30-May-14
PR21160	Review & Update Bids - Area 2100 Cobbing Separators (30 ...	24-Jun-13	16-Aug-13
PR21170	Issue P.O - Area 2100 Cobbing Separators (30 Pcs)	19-Aug-13	23-Aug-13
PR21190	Delivery at site - Area 2100 Cobbing Separators (40 Pcs)	26-Aug-13	30-May-14
PR21180	Vendor Data Approval - Area 2100 Cobbing Separators (30 ...	26-Aug-13	18-Oct-13
WBS: 2100-SC-000 Screens (10 Pcs)		24-Jun-13	27-Jun-14
PR21200	Review & Update Bids - Area 2100 Screens (10 Pcs)	24-Jun-13	16-Aug-13
PR21210	Issue P.O - Area 2100 Screens (10 Pcs)	19-Aug-13	23-Aug-13
PR21230	Delivery at site - Area 2100 Screens (10 Pcs)	26-Aug-13	27-Jun-14
PR21220	Vendor Data Approval - Area 2100 Screens (10 Pcs)	26-Aug-13	18-Oct-13
WBS: 2100 - Rest of Equipment (480 Pcs)		04-Oct-13	21-Aug-14
PR21240	Prepare & Issue RFQ - Area 2100 Rest of Equip	04-Oct-13	12-Dec-13
PR21250	Receive Bids/Bid Reviews- Area 2100 Rest of Equip	25-Oct-13	02-Jan-14
PR21270	Issue P.O - Area 2100 Rest of Equip	29-Nov-13	26-Dec-13
PR21290	Delivery at site - Area 2100 Rest of Equip	13-Dec-13	21-Aug-14
PR21280	Vendor Data Approval - Area 2100 Rest of Equip	27-Dec-13	20-Feb-14
WBS: 2200 - Grinding/Separation (438 Pcs)		17-Apr-13	09-Dec-14
WBS: 2200-ML-000 Ball Mills (2 Pcs)		17-Apr-13	14-Oct-14
PR22050	Review & Update Bids - Area 2200 Ball Mills	17-Apr-13	21-May-13
PR22060	Issue P.O - Area 2200 Ball Mills	22-May-13	28-May-13
PR22080	Delivery at site - Area 2200 Ball Mills	29-May-13	14-Oct-14
PR22070	Vendor Data Approval - Area 2200 Ball Mills	29-May-13	23-Jul-13
WBS: 2200-ML-000 Verti Mills (10 Pcs		17-Apr-13	09-Dec-14
PR22090	Review & Update Bids - Area 2200 Verti Mills	17-Apr-13	21-May-13
PR22100	Issue P.O - Area 2200 Verti Mills	22-May-13	28-May-13
PR22120	Delivery at site - Area 2200 Verti Mills	29-May-13	09-Dec-14
PR22110	Vendor Data Approval - Area 2200 Verti Mills	11-Jun-13	19-Aug-13
PR22130	Vendor Test Work - Area 2200 Verti Mills	06-Aug-13	19-Aug-13
WBS: 2200-MS-000 Magnetic Separators (114 Pcs)		13-May-13	18-Apr-14



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

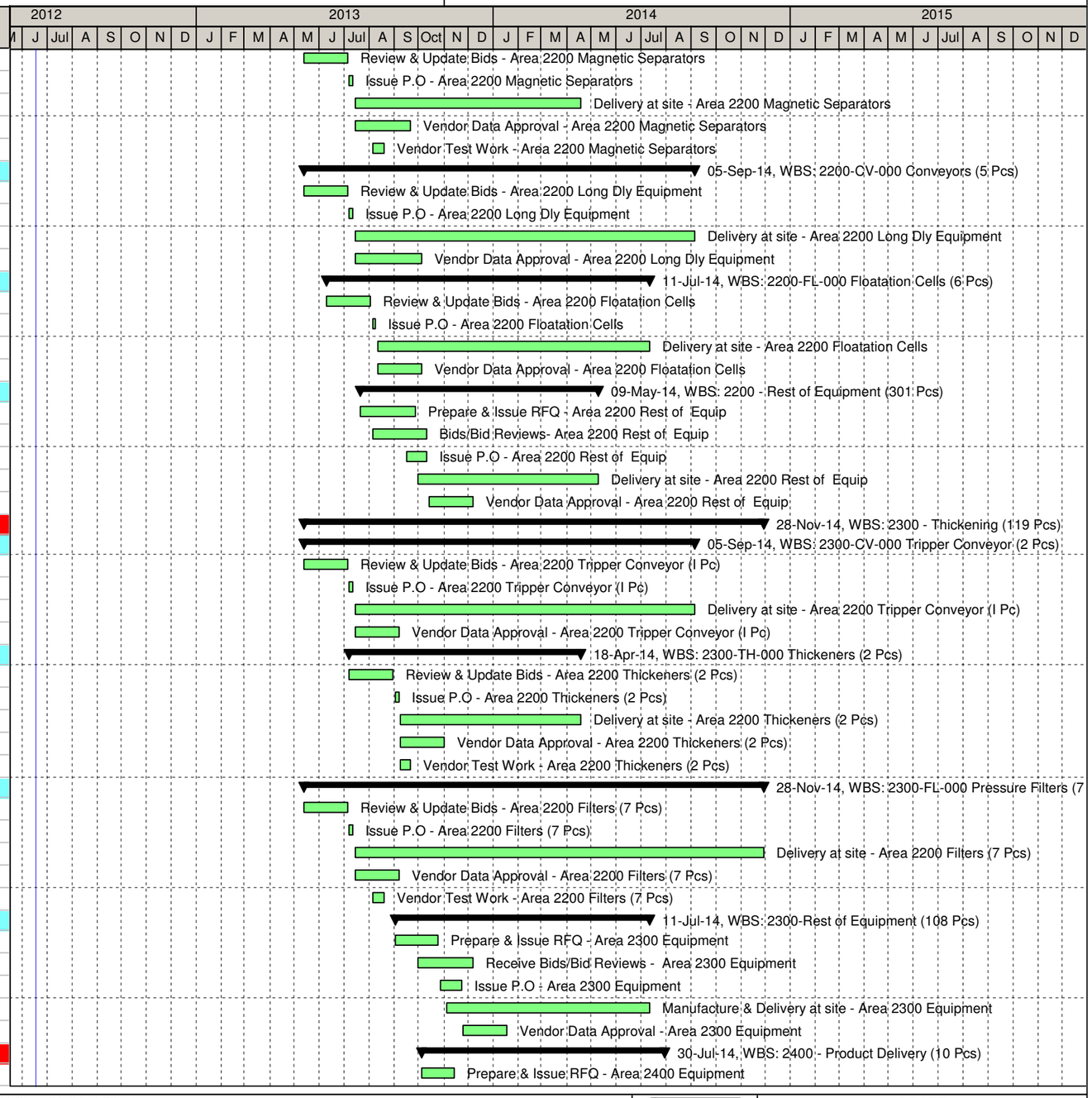
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Shymanivske Project EPCM Schedule

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Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
PR22140	Review & Update Bids - Area 2200 Magnetic Separators	13-May-13	05-Jul-13
PR22150	Issue P.O - Area 2200 Magnetic Separators	08-Jul-13	12-Jul-13
PR22170	Delivery at site - Area 2200 Magnetic Separators	15-Jul-13	18-Apr-14
PR22160	Vendor Data Approval - Area 2200 Magnetic Separators	15-Jul-13	20-Sep-13
PR22310	Vendor Test Work - Area 2200 Magnetic Separators	06-Aug-13	19-Aug-13
WBS: 2200-CV-000 Conveyors (5 Pcs)		13-May-13	05-Sep-14
PR22180	Review & Update Bids - Area 2200 Long Dly Equipment	13-May-13	05-Jul-13
PR22190	Issue P.O - Area 2200 Long Dly Equipment	08-Jul-13	12-Jul-13
PR22210	Delivery at site - Area 2200 Long Dly Equipment	15-Jul-13	05-Sep-14
PR22200	Vendor Data Approval - Area 2200 Long Dly Equipment	15-Jul-13	04-Oct-13
WBS: 2200-FL-000 Floatation Cells (6 Pcs)		10-Jun-13	11-Jul-14
PR22220	Review & Update Bids - Area 2200 Floatation Cells	10-Jun-13	02-Aug-13
PR22230	Issue P.O - Area 2200 Floatation Cells	05-Aug-13	09-Aug-13
PR22250	Delivery at site - Area 2200 Floatation Cells	12-Aug-13	11-Jul-14
PR22240	Vendor Data Approval - Area 2200 Floatation Cells	12-Aug-13	04-Oct-13
WBS: 2200 - Rest of Equipment (301 Pcs)		22-Jul-13	09-May-14
PR22260	Prepare & Issue RFQ - Area 2200 Rest of Equip	22-Jul-13	27-Sep-13
PR22280	Bids/Bid Reviews- Area 2200 Rest of Equip	05-Aug-13	11-Oct-13
PR22270	Issue P.O - Area 2200 Rest of Equip	16-Sep-13	11-Oct-13
PR22300	Delivery at site - Area 2200 Rest of Equip	30-Sep-13	09-May-14
PR22290	Vendor Data Approval - Area 2200 Rest of Equip	14-Oct-13	06-Dec-13
WBS: 2300 - Thickening (119 Pcs)		13-May-13	28-Nov-14
WBS: 2300-CV-000 Tripper Conveyor (2 Pcs)		13-May-13	05-Sep-14
PR23010	Review & Update Bids - Area 2200 Tripper Conveyor (I Pc)	13-May-13	05-Jul-13
PR23020	Issue P.O - Area 2200 Tripper Conveyor (I Pc)	08-Jul-13	12-Jul-13
PR23040	Delivery at site - Area 2200 Tripper Conveyor (I Pc)	15-Jul-13	05-Sep-14
PR23030	Vendor Data Approval - Area 2200 Tripper Conveyor (I Pc)	15-Jul-13	06-Sep-13
WBS: 2300-TH-000 Thickeners (2 Pcs)		08-Jul-13	18-Apr-14
PR23050	Review & Update Bids - Area 2200 Thickeners (2 Pcs)	08-Jul-13	30-Aug-13
PR23060	Issue P.O - Area 2200 Thickeners (2 Pcs)	02-Sep-13	06-Sep-13
PR23080	Delivery at site - Area 2200 Thickeners (2 Pcs)	09-Sep-13	18-Apr-14
PR23070	Vendor Data Approval - Area 2200 Thickeners (2 Pcs)	09-Sep-13	01-Nov-13
PR23170	Vendor Test Work - Area 2200 Thickeners (2 Pcs)	09-Sep-13	20-Sep-13
WBS: 2300-FL-000 Pressure Filters (7 Pcs)		13-May-13	28-Nov-14
PR23090	Review & Update Bids - Area 2200 Filters (7 Pcs)	13-May-13	05-Jul-13
PR23100	Issue P.O - Area 2200 Filters (7 Pcs)	08-Jul-13	12-Jul-13
PR23120	Delivery at site - Area 2200 Filters (7 Pcs)	15-Jul-13	28-Nov-14
PR23110	Vendor Data Approval - Area 2200 Filters (7 Pcs)	15-Jul-13	06-Sep-13
PR23190	Vendor Test Work - Area 2200 Filters (7 Pcs)	06-Aug-13	19-Aug-13
WBS: 2300-Rest of Equipment (108 Pcs)		02-Sep-13	11-Jul-14
PR23130	Prepare & Issue RFQ - Area 2300 Equipment	02-Sep-13	25-Oct-13
PR23150	Receive Bids/Bid Reviews - Area 2300 Equipment	30-Sep-13	06-Dec-13
PR23140	Issue P.O - Area 2300 Equipment	28-Oct-13	22-Nov-13
PR23180	Manufacture & Delivery at site - Area 2300 Equipment	04-Nov-13	11-Jul-14
PR23160	Vendor Data Approval - Area 2300 Equipment	25-Nov-13	17-Jan-14
WBS: 2400 - Product Delivery (10 Pcs)		04-Oct-13	30-Jul-14
PR24650	Prepare & Issue RFQ - Area 2400 Equipment	04-Oct-13	14-Nov-13



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

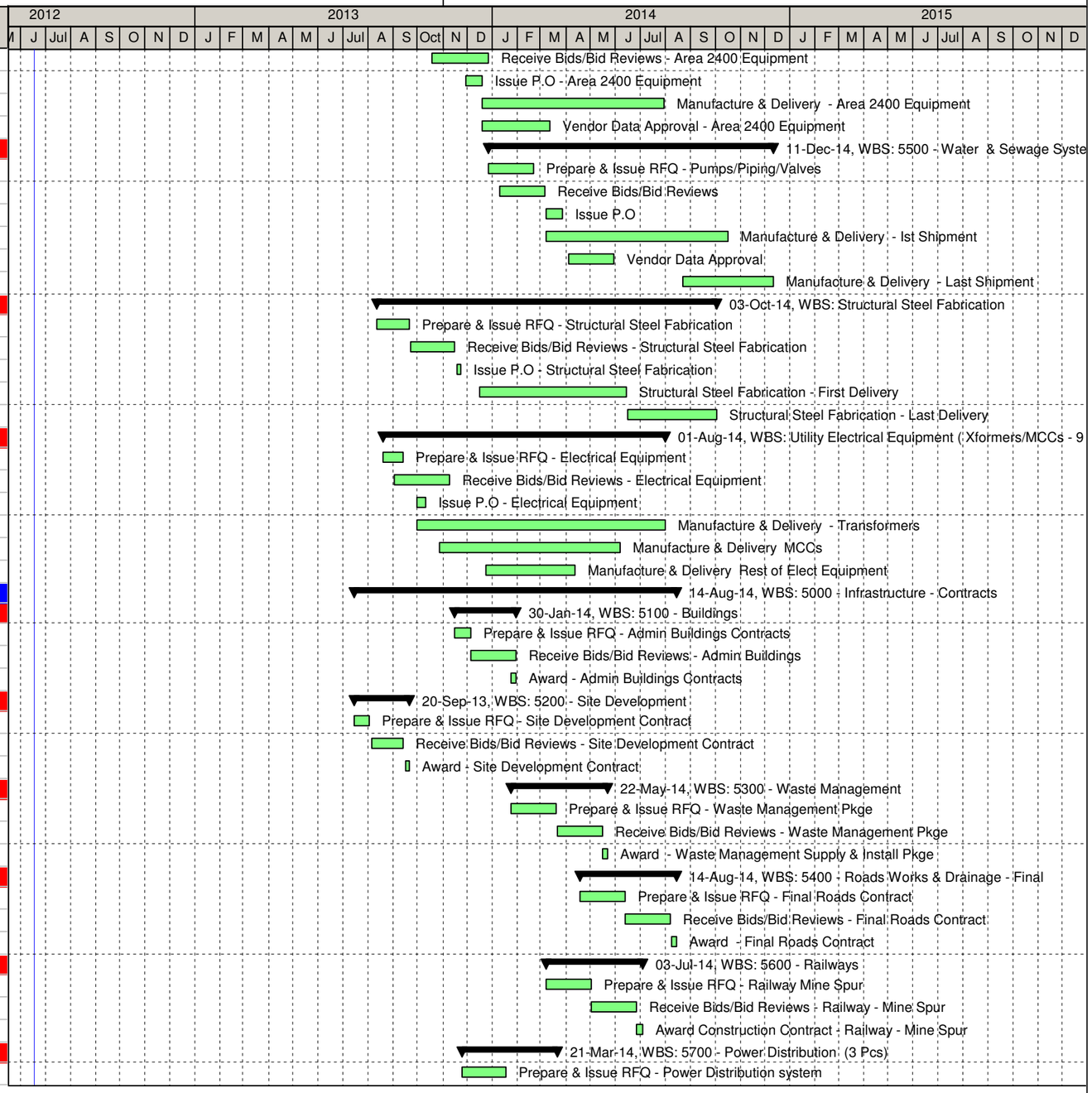
WorleyParsons

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Shymanivske Project EPCM Schedule

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Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
PR24660	Receive Bids/Bid Reviews - Area 2400 Equipment	18-Oct-13	26-Dec-13
PR24670	Issue P.O - Area 2400 Equipment	29-Nov-13	18-Dec-13
PR24690	Manufacture & Delivery - Area 2400 Equipment	19-Dec-13	30-Jul-14
PR24680	Vendor Data Approval - Area 2400 Equipment	19-Dec-13	12-Mar-14
WBS: 5500 - Water & Sewage System (96 Pcs)		27-Dec-13	11-Dec-14
PR55010	Prepare & Issue RFQ - Pumps/Piping/Valves	27-Dec-13	20-Feb-14
PR55020	Receive Bids/Bid Reviews	10-Jan-14	06-Mar-14
PR55030	Issue P.O	07-Mar-14	27-Mar-14
PR55050	Manufacture & Delivery - Ist Shipment	07-Mar-14	16-Oct-14
PR55040	Vendor Data Approval	04-Apr-14	29-May-14
PR55060	Manufacture & Delivery - Last Shipment	22-Aug-14	11-Dec-14
WBS: Structural Steel Fabrication		12-Aug-13	03-Oct-14
PR30000	Prepare & Issue RFQ - Structural Steel Fabrication	12-Aug-13	20-Sep-13
PR30010	Receive Bids/Bid Reviews - Structural Steel Fabrication	23-Sep-13	15-Nov-13
PR30020	Issue P.O - Structural Steel Fabrication	18-Nov-13	22-Nov-13
PR30030	Structural Steel Fabrication - First Delivery	16-Dec-13	13-Jun-14
PR30040	Structural Steel Fabrication - Last Delivery	16-Jun-14	03-Oct-14
WBS: Utility Electrical Equipment (Xformers/MCCs - 9 Pcs)		19-Aug-13	01-Aug-14
PR40000	Prepare & Issue RFQ - Electrical Equipment	19-Aug-13	13-Sep-13
PR40010	Receive Bids/Bid Reviews - Electrical Equipment	02-Sep-13	08-Nov-13
PR40020	Issue P.O - Electrical Equipment	30-Sep-13	11-Oct-13
PR40030	Manufacture & Delivery - Transformers	30-Sep-13	01-Aug-14
PR40040	Manufacture & Delivery MCCs	28-Oct-13	06-Jun-14
PR40050	Manufacture & Delivery Rest of Elect Equipment	23-Dec-13	11-Apr-14
WBS: 5000 - Infrastructure - Contracts		15-Jul-13	14-Aug-14
WBS: 5100 - Buildings		15-Nov-13	30-Jan-14
PR51000	Prepare & Issue RFQ - Admin Buildings Contracts	15-Nov-13	05-Dec-13
PR51010	Receive Bids/Bid Reviews - Admin Buildings	06-Dec-13	30-Jan-14
PR51020	Award - Admin Buildings Contracts	24-Jan-14	30-Jan-14
WBS: 5200 - Site Development		15-Jul-13	20-Sep-13
PR52000	Prepare & Issue RFQ - Site Development Contract	15-Jul-13	02-Aug-13
PR52010	Receive Bids/Bid Reviews - Site Development Contract	05-Aug-13	13-Sep-13
PR52020	Award - Site Development Contract	16-Sep-13	20-Sep-13
WBS: 5300 - Waste Management		24-Jan-14	22-May-14
PR53350	Prepare & Issue RFQ - Waste Management Pkge	24-Jan-14	20-Mar-14
PR53360	Receive Bids/Bid Reviews - Waste Management Pkge	21-Mar-14	15-May-14
PR53370	Award - Waste Management Supply & Install Pkge	16-May-14	22-May-14
WBS: 5400 - Roads Works & Drainage - Final		18-Apr-14	14-Aug-14
PR53000	Prepare & Issue RFQ - Final Roads Contract	18-Apr-14	12-Jun-14
PR53010	Receive Bids/Bid Reviews - Final Roads Contract	13-Jun-14	07-Aug-14
PR53020	Award - Final Roads Contract	08-Aug-14	14-Aug-14
WBS: 5600 - Railways		07-Mar-14	03-Jul-14
PR56000	Prepare & Issue RFQ - Railway Mine Spur	07-Mar-14	01-May-14
PR56010	Receive Bids/Bid Reviews - Railway - Mine Spur	02-May-14	26-Jun-14
PR56020	Award Construction Contract - Railway - Mine Spur	27-Jun-14	03-Jul-14
WBS: 5700 - Power Distribution (3 Pcs)		25-Nov-13	21-Mar-14
PR57420	Prepare & Issue RFQ - Power Distribution system	25-Nov-13	17-Jan-14



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

WorleyParsons

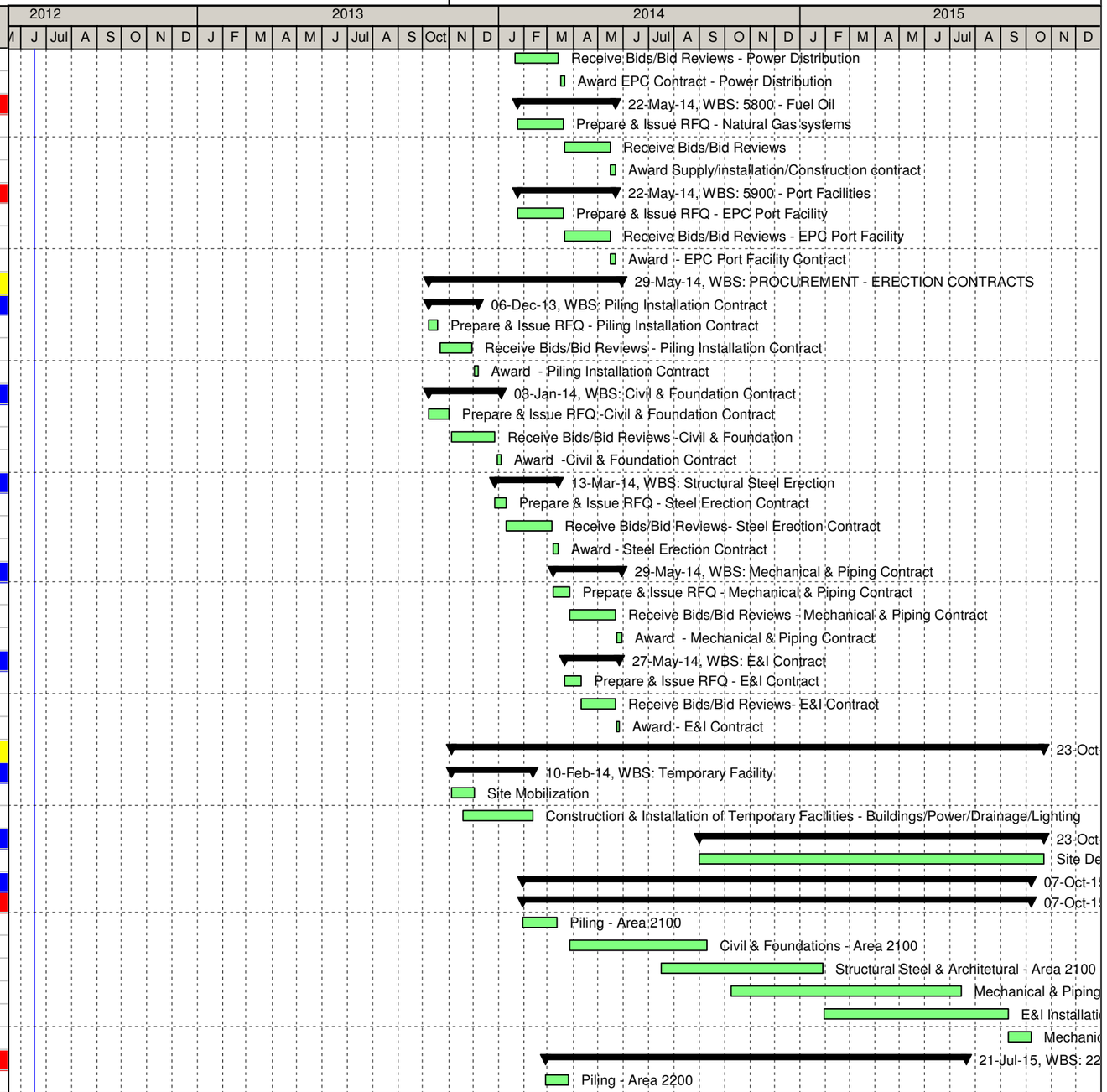
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Shymanivske Project EPCM Schedule

DRAFT

Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
PR57430	Receive Bids/Bid Reviews - Power Distribution	20-Jan-14	14-Mar-14
PR57440	Award EPC Contract - Power Distribution	17-Mar-14	21-Mar-14
WBS: 5800 - Fuel Oil		24-Jan-14	22-May-14
PR58390	Prepare & Issue RFQ - Natural Gas systems	24-Jan-14	20-Mar-14
PR58400	Receive Bids/Bid Reviews	21-Mar-14	15-May-14
PR58410	Award Supply/installation/Construction contract	16-May-14	22-May-14
WBS: 5900 - Port Facilities		24-Jan-14	22-May-14
PR59000	Prepare & Issue RFQ - EPC Port Facility	24-Jan-14	20-Mar-14
PR59010	Receive Bids/Bid Reviews - EPC Port Facility	21-Mar-14	15-May-14
PR59020	Award - EPC Port Facility Contract	16-May-14	22-May-14
WBS: PROCUREMENT - ERECTION CONTRACTS		07-Oct-13	29-May-14
WBS: Piling Installation Contract		07-Oct-13	06-Dec-13
PR59060	Prepare & Issue RFQ - Piling Installation Contract	07-Oct-13	18-Oct-13
PR59070	Receive Bids/Bid Reviews - Piling Installation Contract	21-Oct-13	29-Nov-13
PR59080	Award - Piling Installation Contract	02-Dec-13	06-Dec-13
WBS: Civil & Foundation Contract		07-Oct-13	03-Jan-14
PR59090	Prepare & Issue RFQ -Civil & Foundation Contract	07-Oct-13	01-Nov-13
PR59100	Receive Bids/Bid Reviews -Civil & Foundation	04-Nov-13	27-Dec-13
PR59110	Award -Civil & Foundation Contract	30-Dec-13	03-Jan-14
WBS: Structural Steel Erection		27-Dec-13	13-Mar-14
PR59120	Prepare & Issue RFQ - Steel Erection Contract	27-Dec-13	09-Jan-14
PR59130	Receive Bids/Bid Reviews- Steel Erection Contract	10-Jan-14	06-Mar-14
PR59140	Award - Steel Erection Contract	07-Mar-14	13-Mar-14
WBS: Mechanical & Piping Contract		07-Mar-14	29-May-14
PR59150	Prepare & Issue RFQ - Mechanical & Piping Contract	07-Mar-14	27-Mar-14
PR59160	Receive Bids/Bid Reviews - Mechanical & Piping Contract	28-Mar-14	22-May-14
PR59170	Award - Mechanical & Piping Contract	23-May-14	29-May-14
WBS: E&I Contract		21-Mar-14	27-May-14
PR59180	Prepare & Issue RFQ - E&I Contract	21-Mar-14	10-Apr-14
PR59190	Receive Bids/Bid Reviews- E&I Contract	11-Apr-14	22-May-14
PR59200	Award - E&I Contract	23-May-14	27-May-14
WBS: CONSTRUCTION		05-Nov-13	23-Oct-15
WBS: Temporary Facility		05-Nov-13	10-Feb-14
CM00000	Site Mobilization	05-Nov-13	02-Dec-13
CM00010	Construction & Installation of Temporary Facilities - Buildings...	19-Nov-13	10-Feb-14
WBS: 1000 - Mine		01-Sep-14	23-Oct-15
CM10000	Site Development - Stripping	01-Sep-14*	23-Oct-15
WBS: 2000 - Beneficiation Plant		30-Jan-14	07-Oct-15
WBS: 2100 - Crushing/Screening/Stockpiling		30-Jan-14	07-Oct-15
CM21010	Piling - Area 2100	30-Jan-14	12-Mar-14
CM21020	Civil & Foundations - Area 2100	27-Mar-14	10-Sep-14
CM21030	Structural Steel & Architetural - Area 2100	17-Jul-14	28-Jan-15
CM21040	Mechanical & Piping Installation - Area 2100	09-Oct-14	15-Jul-15
CM21060	E&I Installation - Area 2100	29-Jan-15	09-Sep-15
CM21070	Mechanical Completion - Area 2100	10-Sep-15	07-Oct-15
WBS: 2200 - Grinding/Separation		27-Feb-14	21-Jul-15
CM22010	Piling - Area 2200	27-Feb-14	26-Mar-14



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

WorleyParsons

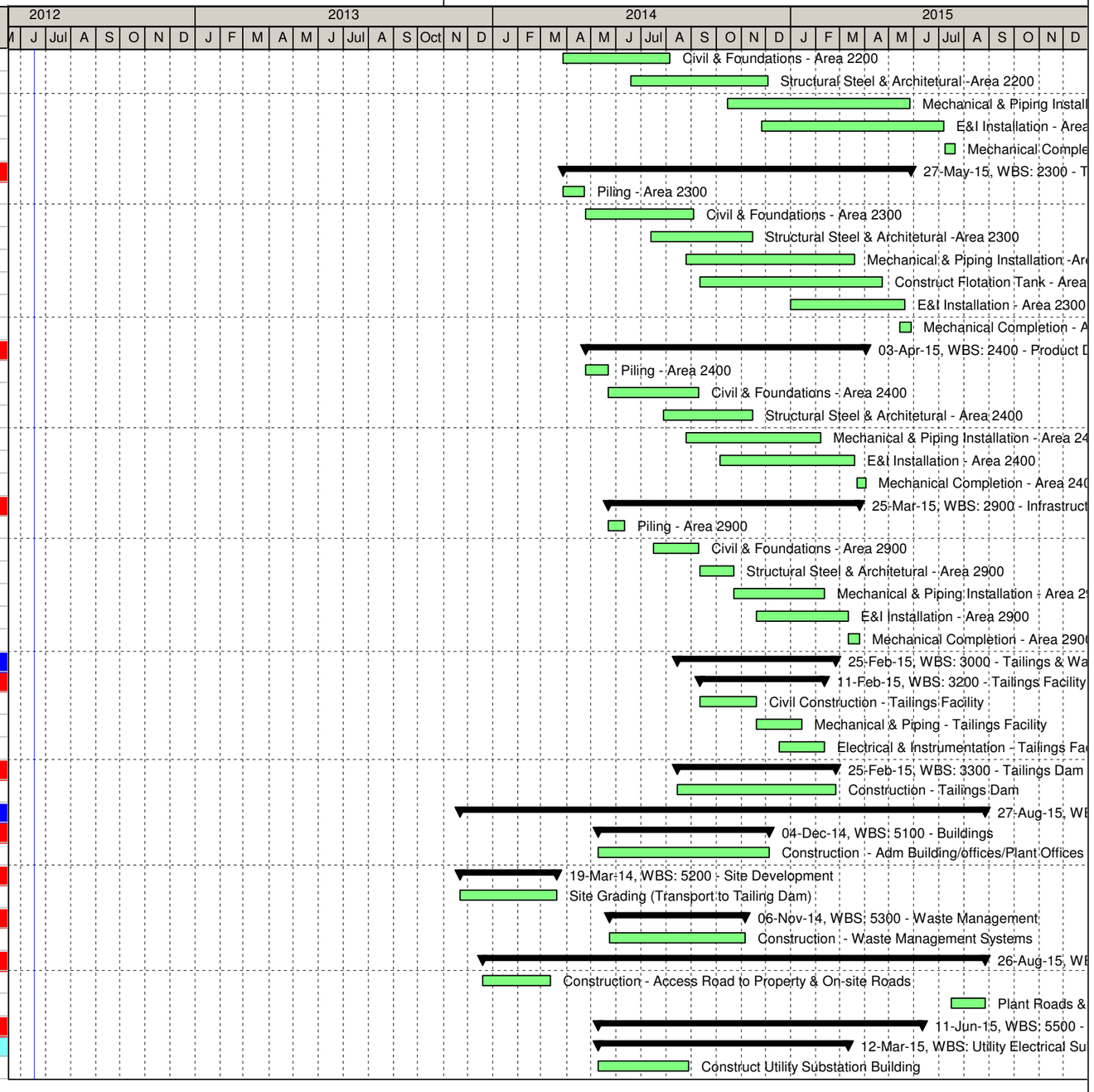
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Shymanivske Project EPCM Schedule

DRAFT

Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
CM22020	Civil & Foundations - Area 2200	27-Mar-14	05-Aug-14
CM22040	Structural Steel & Architetural -Area 2200	19-Jun-14	03-Dec-14
CM22050	Mechanical & Piping Installation -Area 2200	15-Oct-14	26-May-15
CM22060	E&I Installation - Area 2200	26-Nov-14	07-Jul-15
CM22070	Mechanical Completion - Area 2200	08-Jul-15	21-Jul-15
WBS: 2300 - Thickening		27-Mar-14	27-May-15
CM23010	Piling - Area 2300	27-Mar-14	23-Apr-14
CM23020	Civil & Foundations - Area 2300	24-Apr-14	03-Sep-14
CM23030	Structural Steel & Architetural -Area 2300	14-Jul-14	14-Nov-14
CM23050	Mechanical & Piping Installation -Area 2300	25-Aug-14	20-Mar-15
CM23040	Construct Flotation Tank - Area 2300	11-Sep-14	22-Apr-15
CM23060	E&I Installation - Area 2300	01-Jan-15	20-May-15
CM23070	Mechanical Completion - Area 2300	14-May-15	27-May-15
WBS: 2400 - Product Delivery		24-Apr-14	03-Apr-15
CM24010	Piling - Area 2400	24-Apr-14	21-May-14
CM24020	Civil & Foundations - Area 2400	22-May-14	10-Sep-14
CM24030	Structural Steel & Architetural - Area 2400	28-Jul-14	14-Nov-14
CM24040	Mechanical & Piping Installation - Area 2400	25-Aug-14	06-Feb-15
CM24050	E&I Installation - Area 2400	06-Oct-14	20-Mar-15
CM24060	Mechanical Completion - Area 2400	23-Mar-15	03-Apr-15
WBS: 2900 - Infrastructure		22-May-14	25-Mar-15
CM29010	Piling - Area 2900	22-May-14	11-Jun-14
CM29020	Civil & Foundations - Area 2900	17-Jul-14	10-Sep-14
CM29030	Structural Steel & Architetural - Area 2900	11-Sep-14	22-Oct-14
CM29040	Mechanical & Piping Installation - Area 2900	23-Oct-14	11-Feb-15
CM29050	E&I Installation - Area 2900	20-Nov-14	11-Mar-15
CM29060	Mechanical Completion - Area 2900	12-Mar-15	25-Mar-15
WBS: 3000 - Tailings & Waste		14-Aug-14	25-Feb-15
WBS: 3200 - Tailings Facility		11-Sep-14	11-Feb-15
CM33000	Civil Construction - Tailings Facility	11-Sep-14	19-Nov-14
CM33010	Mechanical & Piping - Tailings Facility	20-Nov-14	14-Jan-15
CM33020	Electrical & Instrumentation - Tailings Facility	18-Dec-14	11-Feb-15
WBS: 3300 - Tailings Dam		14-Aug-14	25-Feb-15
CM39070	Construction - Tailings Dam	14-Aug-14	25-Feb-15
WBS: 5000 - Infrastructure		21-Nov-13	27-Aug-15
WBS: 5100 - Buildings		09-May-14	04-Dec-14
CM51000	Construction - Adm Building/offices/Plant Offices	09-May-14	04-Dec-14
WBS: 5200 - Site Development		21-Nov-13	19-Mar-14
CM52000	Site Grading (Transport to Tailing Dam)	21-Nov-13	19-Mar-14
WBS: 5300 - Waste Management		23-May-14	06-Nov-14
CM53080	Construction - Waste Management Systems	23-May-14	06-Nov-14
WBS: 5400 - Roads Works		19-Dec-13	26-Aug-15
CM54000	Construction - Access Road to Property & On-site Roads	19-Dec-13	12-Mar-14
CM54010	Plant Roads & Drainage - Final Surfacing	16-Jul-15	26-Aug-15
WBS: 5500 - Water Supply & Sewage System (105 Pcs)		09-May-14	11-Jun-15
WBS: Utility Electrical Substation (9 Pcs)		09-May-14	12-Mar-15
CM55100	Construct Utility Substation Building	09-May-14	28-Aug-14



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

WorleyParsons

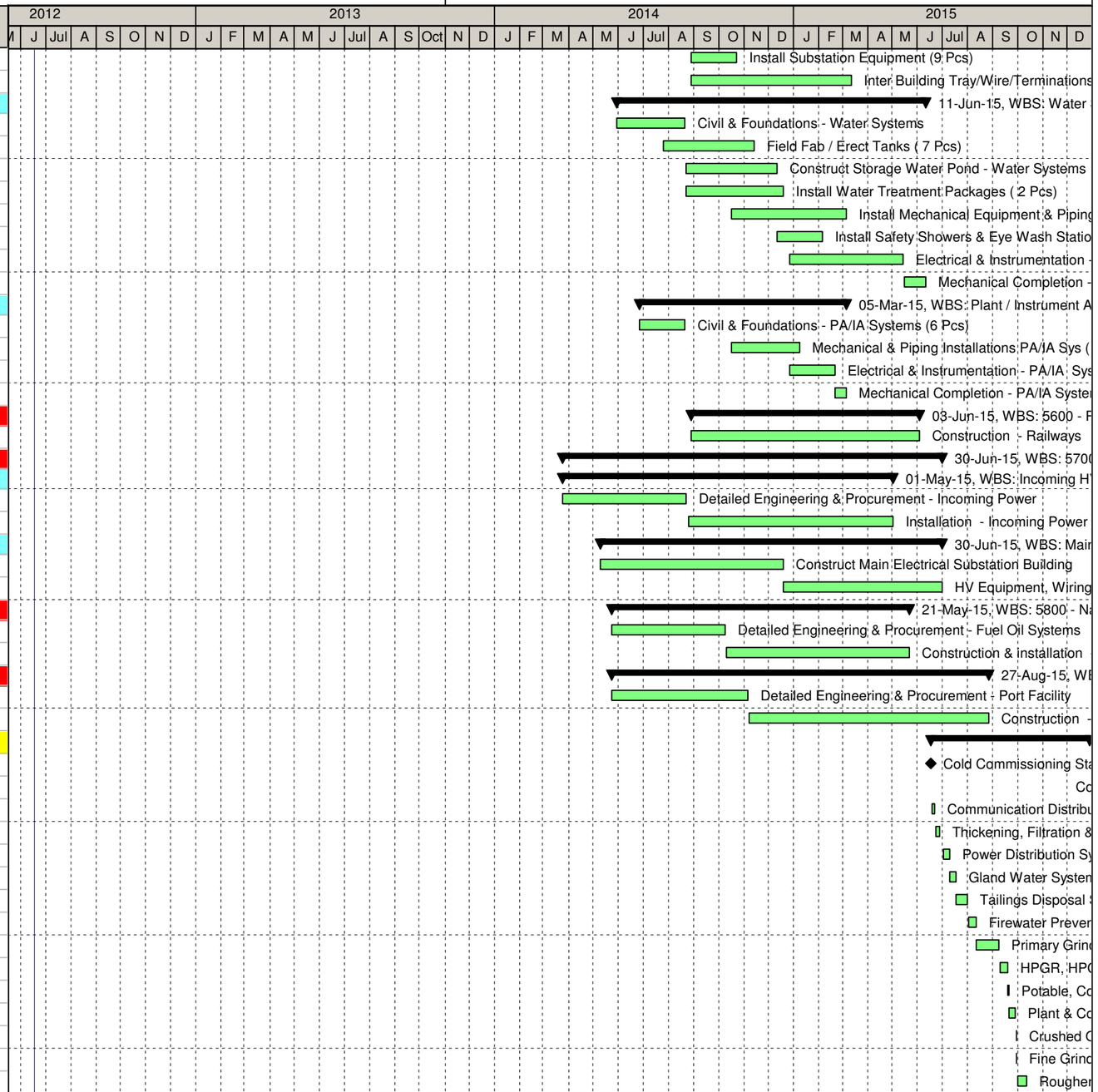
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Shymanivske Project EPCM Schedule

DRAFT

Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
CM55110	Install Substation Equipment (9 Pcs)	29-Aug-14	23-Oct-14
CM55120	Inter Building Tray/Wire/Terminations - Utility Substn	29-Aug-14	12-Mar-15
WBS: Water Systems (CW, BFR, TW, PW, FW, GW)		30-May-14	11-Jun-15
CM55200	Civil & Foundations - Water Systems	30-May-14	21-Aug-14
CM55250	Field Fab / Erect Tanks (7 Pcs)	25-Jul-14	13-Nov-14
CM55240	Construct Storage Water Pond - Water Systems	22-Aug-14	11-Dec-14
CM55220	Install Water Treatment Packages (2 Pcs)	22-Aug-14	19-Dec-14
CM55260	Install Mechanical Equipment & Piping (26 Pumps)	17-Oct-14	05-Mar-15
CM55210	Install Safety Showers & Eye Wash Stations (53 Pcs)	12-Dec-14	05-Feb-15
CM55270	Electrical & Instrumentation - Watre Systems	26-Dec-14	14-May-15
CM55280	Mechanical Completion - Water Systems	15-May-15	11-Jun-15
WBS: Plant / Instrument Air (comp/dryer/receiver)		27-Jun-14	05-Mar-15
CM55500	Civil & Foundations - PA/IA Systems (6 Pcs)	27-Jun-14	21-Aug-14
CM55510	Mechanical & Piping Installations PA/IA Sys (6 Pcs)	17-Oct-14	08-Jan-15
CM55520	Electrical & Instrumentation - PA/IA Systems	26-Dec-14	19-Feb-15
CM55530	Mechanical Completion - PA/IA Systems	20-Feb-15	05-Mar-15
WBS: 5600 - Railways		29-Aug-14	03-Jun-15
CM56000	Construction - Railways	29-Aug-14	03-Jun-15
WBS: 5700 - Power Distribution		24-Mar-14	30-Jun-15
WBS: Incoming HV Power Line - EPC Contact		24-Mar-14	01-May-15
CM57010	Detailed Engineering & Procurement - Incoming Power	24-Mar-14	22-Aug-14
CM57020	Installation - Incoming Power Distribution Systems	25-Aug-14	01-May-15
WBS: Main Electrical Substation (3 Pcs)		09-May-14	30-Jun-15
CM57100	Construct Main Electrical Substation Building	09-May-14	18-Dec-14
CM57120	HV Equipment, Wiring, Testing & Energize	19-Dec-14	30-Jun-15
WBS: 5800 - Natural Gas		23-May-14	21-May-15
CM58110	Detailed Engineering & Procurement - Fuel Oil Systems	23-May-14	09-Oct-14
CM58120	Construction & installation - Fuel Oil Systems	10-Oct-14	21-May-15
WBS: 5900 - Port Facilities		23-May-14	27-Aug-15
CM59010	Detailed Engineering & Procurement - Port Facility	23-May-14	06-Nov-14
CM59020	Construction - Port Facility	07-Nov-14	27-Aug-15
WBS: COMMISSIONING		17-Jun-15	27-Dec-15
CO10240	Cold Commissioning Start		17-Jun-15
CO10000	Cold Commissioning Phase	18-Jun-15	26-Nov-15
CO10010	Communication Distribution System - RFU	18-Jun-15	22-Jun-15
CO10020	Thickening, Filtration & Handling Systems - RFU	23-Jun-15	27-Jun-15
CO10030	Power Distribution System - RFU	02-Jul-15	09-Jul-15
CO10040	Gland Water System - RFU	10-Jul-15	17-Jul-15
CO10050	Tailings Disposal System - RFU	18-Jul-15	01-Aug-15
CO10060	Firewater Prevention & Detection Sys - RFU	02-Aug-15	11-Aug-15
CO10070	Primary Grinding System - RFU	12-Aug-15	08-Sep-15
CO10080	HPGR, HPGR SCreening & RMS Systems - RFU	09-Sep-15	18-Sep-15
CO10090	Potable, Cooling & Safety Showers Water Systems - RFU	19-Sep-15	20-Sep-15
CO10100	Plant & Compressed Air Systems - RFU	21-Sep-15	28-Sep-15
CO10110	Crushed Ore Stockpile Systems - RFU	29-Sep-15	30-Sep-15
CO10120	Fine Grinding & CMS Systems - Rfu	29-Sep-15	30-Sep-15
CO10130	Rougher Flotation Systems - RFU	01-Oct-15	11-Oct-15



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

WorleyParsons

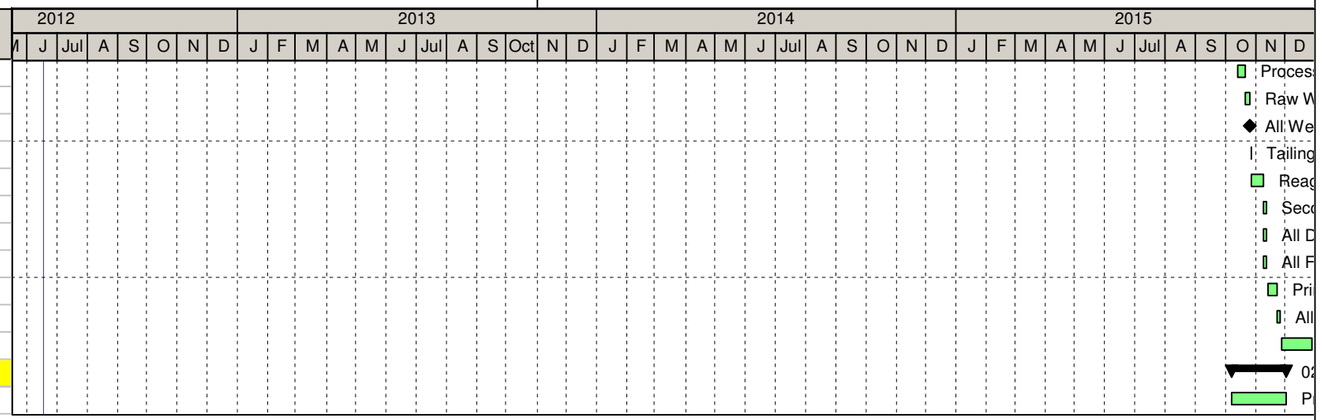
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Shymanivske Project EPCM Schedule

DRAFT

Date	Revision	Checked	Approved

Activity ID	Activity Name	Start	Finish
CO10140	Process Water System - RFU	13-Oct-15	21-Oct-15
CO10150	Raw Water System - RFU	22-Oct-15	26-Oct-15
CO10170	All Wet Area Systems - RFU		26-Oct-15
CO10160	Tailings Dewatering, Thickening & Filtration Systems - RFU	27-Oct-15	27-Oct-15
CO10180	Reagents Systems - RFU	28-Oct-15	08-Nov-15
CO10190	Secondary Crushing & Screening Systems - RFU	09-Nov-15	12-Nov-15
CO10200	All Dry Area Systems - RFU	09-Nov-15	12-Nov-15
CO10210	All FC (Full Concentrate) Systems & Integrated Sequence Te...	09-Nov-15	12-Nov-15
CO10220	Primary Crushing System - RFU	13-Nov-15	22-Nov-15
CO10230	All FC Systems Sequence Testing Complete - RFU	23-Nov-15	26-Nov-15
CO12010	Hot Commisioning & Start-Up	27-Nov-15	27-Dec-15
WBS: PROJECT CLOSE-OUT		08-Oct-15	02-Dec-15
PC10000	Project Close-out (As Built Drawings & Documentation)	08-Oct-15	02-Dec-15



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

WorleyParsons

TASK filter: (Untitled Filter)_1.

Shymanivske Project EPCM Schedule

DRAFT

Date	Revision	Checked	Approved

Appendix D UDI Schedule

August 2012 | September 2012 | October 2012 | November 2012 | December 2012 | January 2013 | February 2013 | March 2013 | April 2013 | May 2013 | June 2013 | July 2013 | August 2013 | September 2013 | October 2013 | November 2013 | December 2013

TEO – Mining portion

Permit to Develop "Mining Allotment Project"

"Mining Allotment Project"

GGTN Approval

UkrInvest Expertiza (Preliminary)

Detailed Design (Ukraine)

P&E Mine Design (250 m deep pit)

Satisfy the requirements of the Shymanivske "Special Permit"

Brief TEO
- Site selection docs, OVOS
- Preliminary Tech. conditions
- Short project description

Site Selection Drawings

Development of "Proekt" Documents
- Beneficiation Plant Proekt
- Tailings Proekt
- Power & Rail Proekt
- OVOS

UkrInvest Expertiza

Incorporate Comments and resubmit Final Proekt

Final GASK Review & Approval

Permit to Construct

Obtain 50t Bulk Sample

Pilot Plant Testwork (KGOKOR)

Confirm Flowsheet (WP)

OVOS, Environmental Impact Statement, Baseline studies (TPA + WP)

"Land Allotment Project" KRCC Land

Land Expertiza

Approval from KRCC

Sign Lease Agreement

Obtain Land using rights

Land Owner's / Users (AM, YUGOK) Approval – KRCC Land

Site Selection Application to KRCC - ASK

Permit to Develop Detailed Site Selection Plan

Develop a Detailed Site Selection Plan

Permit to Develop "Land Allotment Project"

Prepare Rudnichnoe Resettlement Plan

Execute the Resettlement of Rudnichnoe – ongoing till March 2015

Public Hearing KRCC Land

Public Hearing Shirokoe Land

Land Users (MOD) Approval – Shirokoe Land

Site Selection Application to Shirokoe ASK

Permit to Develop Detailed Site Selection Plan

Develop and approve the Detailed Site Selection Plan

Permit to Develop "Land Allotment Project" DOGA

"Land Allotment Project" Shirokoe Land

Land Expertiza

Approval from DOGA

Sign Lease Agreement

Bridging Activities (WP)
Support TEO, Proekt, OVOS, Pilot Plant Testwork

Detailed Design Canada (WP)

August 2012 | September 2012 | October 2012 | November 2012 | December 2012 | January 2013 | February 2013 | March 2013 | April 2013 | May 2013 | June 2013 | July 2013 | August 2013 | September 2013 | October 2013 | November 2013 | December 2013

Appendix E Historic Collars

Appendix E Historic Drillholes (See section 10.1)

HOLE-ID	Easting UTM	Northing UTM	Elvation	Length (m)	AZIMUTH	DIP	Easting Soviet	Northing Soviet	Elv Soviet
4274	519829.02	5298202.73	68.0	261.7	114.0	-83			
4275	519859.37	5298338.40	72.1	270.1	110.0	-85			
4633	519932.92	5298285.53	67.8	103.1	115.0	-85			
4664	519907.21	5298303.21	69.3	109.2	115.0	-80			
4697	519869.02	5298157.43	64.6	56.2	114.0	-85			
4698	519841.46	5298514.29	77.8	359.8	114.0	-85			
4701	519890.93	5298152.42	65.3	31.2	111.5	-90			
4813	520119.17	5298069.54	56.7	19.6	111.5	-90			
4816	520461.57	5298576.57	65.3	37.9	111.5	-90			
4817	519958.38	5298141.28	63.4	49.2	111.5	-90			
4820	520243.63	5298676.54	63.7	14.6	111.5	-90			
4844	519885.51	5298323.74	69.8	166.5	115.0	-83			
4941	520264.00	5298675.00	63.3	22.0	111.5	-90			
4947	519736.13	5297733.70	66.2	199.0	108.0	-85			
4948	519840.06	5298197.36	67.1	146.6	112.0	-84			
4952	520231.19	5299022.47	65.8	40.9	110.0	-80			
4954	519749.30	5297909.74	52.1	244.9	107.0	-84			
5133	520352.50	5299328.10	60.2	160.2	110.0	-87			
5134	519679.44	5297773.59	54.0	236.1	108.0	-84			
5137	519773.85	5298236.35	70.0	332.9	113.0	-86			
5138	519808.42	5298369.70	75.0	325.5	111.5	-85			
5146	520377.47	5299315.58	62.8	65.8	110.0	-86			
5148	520295.60	5299342.01	68.8	60.3	110.0	-83			
5212	520126.66	5297765.64	45.2	78.7	111.5	-90			
5213	519981.09	5297830.59	56.7	153.3	111.5	-90			
5214	520266.67	5298052.78	52.1	148.9	111.5	-89			
5221	520481.79	5297924.14	65.0	20.2	111.5	-90			
5222	520590.15	5297896.47	68.0	34.7	111.5	-90			
5225	520665.80	5297864.89	70.7	46.3	111.5	-90			
5227	520270.94	5297682.07	49.5	31.0	111.5	-90			
5228	520431.25	5297941.29	62.8	22.4	111.5	-90			
5229	520400.79	5297952.55	61.5	18.3	111.5	-90			
5230	520318.05	5297667.26	51.6	29.0	111.5	-90			
5231	520539.94	5297907.10	66.5	25.2	111.5	-90			
5232	520385.82	5297649.84	55.8	26.2	111.5	-90			
5233	520497.73	5297612.20	60.6	36.0	111.5	-90			
5234	520428.32	5297630.60	57.5	24.6	111.5	-90			
5235	520465.73	5297616.92	59.1	103.7	111.5	-90			
5378	520362.68	5298996.43	64.7	22.6	111.5	-90			

Appendix E Historic Drillholes (See section 10.1)

HOLE-ID	Easting UTM	Northing UTM	Elvation	Length (m)	AZIMUTH	DIP	Easting Soviet	Northing Soviet	Elv Soviet
5379	520391.40	5298996.92	66.5	23.0	111.5	-80			
5380	520252.81	5299020.23	66.0	54.6	110.0	-84			
5391	519976.70	5298783.99	77.8	347.6	115.0	-89			
5395	520202.33	5299027.41	77.7	233.5	104.0	-84			
5396	520653.60	5298943.18	73.4	28.1	111.5	-90			
5398	520255.97	5299354.93	70.0	297.7	110.0	-83			
5479	520579.63	5299247.08	71.3	19.5	290.0	-88			
5485	520402.52	5298119.46	60.8	151.1	111.5	-90			
5487	520723.73	5298163.16	69.4	27.6	111.5	-90			
5509	520661.42	5298182.55	67.7	45.8	111.5	-90			
5514	520624.06	5298190.10	66.7	40.4	111.5	-90			
5517	520592.76	5298198.91	65.8	28.4	111.5	-90			
5522	520546.80	5298216.41	62.8	24.3	111.5	-90			
5526	520512.24	5298225.31	62.3	24.8	111.5	-90			
5527	520462.09	5298241.42	60.5	16.7	111.5	-90			
5529	520435.91	5298250.04	59.5	29.4	111.5	-90			
5534	520382.27	5298262.84	55.0	24.7	111.5	-90			
5537	520334.90	5298287.85	49.9	14.2	111.5	-90			
5701	520529.03	5299260.98	70.4	42.0	110.0	-90			
5757	520676.38	5299268.81	74.6	20.4	111.5	-90			
5827	519619.15	5297813.04	53.8	285.6	108.0	-85			
5828	519610.07	5297935.60	47.1	356.8	107.0	-86			
6047	519773.81	5298534.82	80.5	462.0	116.0	-85			
6068	519900.99	5298813.44	83.7	449.5	108.0	-85			
6280	520051.91	5298912.87	88.7	351.6	114.0	-87			
6569	519727.26	5298396.59	77.2	458.6	110.0	-86			
7122	519555.61	5297851.48	55.1	445.5	107.0	-87			
8408	520182.30	5298742.27	65.1	241.1	111.5	-88			
8643	520200.40	5298732.03	63.3	143.5	111.5	-84			
8717	520451.79	5298937.17	68.6	26.9	111.5	-90			
8720	520433.81	5298786.39	65.2	34.3	111.5	-90			
8721	520386.69	5298807.19	61.6	40.2	111.5	-90			
8724	520445.90	5298689.30	65.2	35.7	111.5	-90			
8726	520336.36	5298707.16	54.6	32.4	111.5	-90			
8727	520315.70	5298719.61	55.9	36.7	111.5	-90			
8895	520180.71	5299369.89	72.7	764.0	111.5	-90			
8896	520097.45	5299046.74	74.5	604.0	100.0	-86			
11425	520746.47	5299231.66	76.9	16.0	111.5	-90			
11430	521082.84	5299006.37	89.6	28.0	111.5	-90			

Appendix E Historic Drillholes (See section 10.1)

HOLE-ID	Easting UTM	Northing UTM	Elvation	Length (m)	AZIMUTH	DIP	Easting Soviet	Northing Soviet	Elv Soviet
12009	520567.10	5298912.46	71.0	330.0	111.5	-83			
12850	520452.42	5297945.83	62.9	224.0	94.0	-83.5			
12851	520186.91	5298030.29	47.1	200.9	112.0	-87			
12857	519964.35	5298144.33	63.5	255.3	112.0	-85			
13302	520535.91	5298536.03	66.1	340.5	114.0	-85			
13303	520242.13	5298706.10	60.2	300.5	114.0	-85			
20244	520551.35	5297912.81	67.1	144.5	120.0	-87.5	6520676.0	5300145.0	67.1
20245	520367.02	5297964.28	63.0	191.8	70.0	-86	6520491.6	5300196.5	63.0
20285	520533.16	5298244.98	61.2	250.6	110.0	-85	6520657.8	5300477.3	61.2
20286	520630.91	5298172.99	66.2	152.3	111.0	-85	6520755.6	5300405.3	66.2
20287	520339.73	5298645.71	54.4	292.5	111.5	-87	6520464.3	5300878.2	54.4
20288	520340.53	5298239.98	49.4	226.3	120.0	-85	6520465.1	5300472.3	49.4
20289	520125.92	5298703.18	65.0	325.7	111.5	-88	6520250.4	5300935.7	65.0
20290	520197.59	5298275.86	63.3	186.5	0.0	-90	6520322.1	5300508.2	63.3
20291	520650.91	5298496.37	66.7	266.7	111.5	-90	6520775.6	5300728.8	66.7
20292	519877.32	5297839.63	60.4	413.0	132.0	-85.5	6520001.7	5300071.8	60.4
20293	519913.21	5298163.89	63.0	463.6	108.0	-86	6520037.6	5388396.2	63.0
20294	520083.93	5298090.33	58.0	190.9	115.0	-85	6520208.4	5300322.6	58.0
20295	520024.26	5298446.89	67.7	462.0	107.0	-84	6520148.7	5300679.3	67.7
20339	520169.00	5298833.64	66.2	442.2	111.5	-87	6520293.5	5301066.2	66.2
20340	520332.23	5298815.33	60.0	263.4	109.5	-88	6520456.8	5301047.9	60.0
20341	520495.67	5298764.06	66.2	314.8	109.5	-87	6520620.3	5300996.6	66.2
20342	520633.31	5298712.58	69.8	312.7	109.0	-87	6520758.0	5300945.1	69.8
20343	520743.67	5298684.09	71.4	285.0	108.0	-87	6520868.4	5300916.6	71.4
20344	520282.35	5298989.88	60.7	344.7	107.0	-87	6520406.9	5301222.5	60.7
20345	520381.02	5298993.58	64.6	274.0	109.5	-85	6520505.6	5301226.2	64.6
20346	520781.46	5298863.22	75.5	348.1	107.0	-88	6520906.2	5301095.8	75.5
20347	520423.70	5299303.24	69.5	364.5	107.0	-87	6520548.3	5301536.0	69.5
20348	520631.12	5299216.78	74.9	411.8	111.0	-87	6520755.8	5301449.5	74.9
20349	520781.95	5299192.08	79.0	447.4	107.0	-85	6520906.7	5301424.8	79.0
20350	520976.58	5299118.22	84.7	295.3	107.0	-85	6521101.4	5301350.9	84.7
20416	520536.95	5299232.58	70.8	411.1	107.0	-87	6520661.6	5301465.3	70.8
20621	520097.13	5298364.52	66.6	293.6	114.0	-88	6520221.6	5300596.9	66.6
20622	520414.61	5298607.32	62.2	289.7	111.5	-90	6520539.2	5300839.8	62.2
20623	520748.07	5298457.08	65.6	230.1	111.5	-89	6520872.8	5300689.5	65.6
20624	521044.95	5299085.54	83.5	214.6	111.5	-90	6521169.8	5301318.2	83.5
21651	519601.83	5298015.66	56.9	151.4	111.5	-90	6519726.1	5300247.9	56.9
21652	519689.69	5297966.78	61.4	243.7	111.5	-87	6519814.0	5300199.0	61.4
21653	519804.65	5297888.81	54.6	501.3	111.5	-87	6519929.0	5300121.0	54.6

Appendix E Historic Drillholes (See section 10.1)

HOLE-ID	Easting UTM	Northing UTM	Elvation	Length (m)	AZIMUTH	DIP	Easting Soviet	Northing Soviet	Elv Soviet
21654	519863.52	5297903.51	60.5	97.6	111.5	-90	6519987.9	5300135.7	60.5
21655	519944.50	5297842.13	55.0	96.0	111.5	-90	6520068.9	5300074.3	55.0
21656	519996.17	5297795.25	53.7	101.1	111.5	-90	6520120.6	5300027.4	53.7
21657	520043.95	5297796.05	49.9	155.7	111.5	-90	6520168.4	5300028.2	48.9
21658	520118.43	5297744.67	46.0	23.0	111.5	-90	6520242.9	5299976.8	46.0
21659	520207.98	5297686.00	42.7	56.8	111.5	-90	6520332.5	5299918.1	42.7
21660	520357.13	5297666.61	53.1	69.0	111.5	-90	6520481.7	5299898.7	53.1
21661	519859.82	5298187.20	64.8	132.6	111.5	-87	6519984.2	5300419.5	64.8
21662	519868.72	5298161.99	63.6	338.1	111.5	-87	6519993.1	5300394.3	63.6
21663	520019.86	5298122.91	59.3	175.7	111.5	-90	6520144.3	5300355.2	59.3
21664	520128.52	5298076.53	55.4	123.0	111.5	-90	6520253.0	5300308.8	55.4
21665	520303.45	5298002.67	57.2	172.2	111.5	-90	6520428.0	5300234.9	57.2
21666	520484.38	5297924.99	55.4	149.0	111.5	-90	6520609.0	5300157.2	55.4
21667	520613.03	5297889.91	68.8	77.3	111.5	-90	6520737.7	5300122.1	68.8
21668	520078.34	5298260.66	65.0	193.0	111.5	-90	6520202.8	5300493.0	65.0
21669	520159.80	5298213.68	61.3	159.3	111.5	-90	6520284.3	5300446.0	61.3
21670	520230.77	5298186.49	56.7	160.5	111.5	-90	6520365.3	5300418.8	56.7
21671	520299.15	5298160.99	44.8	202.7	111.5	-90	6520423.7	5300393.3	44.8
21672	520356.72	5298128.41	60.5	210.0	111.5	-90	6520481.3	5300360.7	60.5
21673	520439.59	5298108.13	61.0	206.3	111.5	-90	6520564.2	5300340.4	61.0
21674	520527.16	5298063.94	65.1	190.6	111.5	-90	6520651.8	5300296.2	65.1
21675	520602.23	5298045.55	68.2	137.4	111.5	-90	6520726.9	5300277.8	68.2
21676	519882.62	5298473.78	90.4	397.4	111.5	-85	6520007.0	5300706.2	90.4
21677	519911.50	5298462.38	90.3	251.1	111.5	-90	6520035.9	5300694.8	90.3
21678	520280.05	5298285.26	61.2	165.8	111.5	-85	6520404.6	5300517.6	61.2
21679	520423.90	5298247.18	59.9	215.0	111.5	-90	6520548.5	5300479.5	59.9
21680	520489.17	5298241.38	63.6	261.0	111.5	-87	6520613.8	5300473.7	63.6
21681	520586.14	5298195.89	64.4	195.5	111.5	-90	6520710.8	5300428.2	64.4
21682	520713.28	5298154.01	68.1	97.5	111.5	-90	6520838.0	5300386.3	68.1
21683	520133.81	5298528.46	65.1	222.7	111.5	-90	6520258.3	5300760.9	65.1
21684	520243.67	5298495.37	68.7	192.1	111.5	-90	6520368.2	5300727.8	68.7
21685	520365.82	5298450.39	52.8	207.8	111.5	-90	6520490.4	5300682.8	52.8
21686	520403.40	5298428.70	51.6	143.6	111.5	-90	6520528.0	5300661.1	51.6
21687	520497.07	5298398.71	61.0	179.0	111.5	-90	6520621.7	5300631.1	61.0
21688	520589.63	5298353.83	61.4	157.0	111.5	-90	6520714.3	5300586.2	61.4
21689	520653.31	5298355.63	62.7	62.7	111.5	-90	6520778.0	5300588.0	62.7
21690	520044.45	5298752.46	87.8	544.5	111.5	-90	6520168.9	5300985.0	87.8
21692	520190.09	5298671.90	62.6	316.7	111.5	-87	6520314.6	5300904.4	62.6
21693	520498.47	5298558.34	64.3	200.0	111.5	-90	6520623.1	5300790.8	64.3

Appendix E Historic Drillholes (See section 10.1)

HOLE-ID	Easting UTM	Northing UTM	Elvation	Length (m)	AZIMUTH	DIP	Easting Soviet	Northing Soviet	Elv Soviet
21694	520826.93	5298409.40	92.8	136.0	111.5	-90	6520951.7	5300641.8	92.8
21695	520288.25	5298729.27	54.6	219.2	111.5	-90	6520412.8	5300961.8	54.6
21696	520067.85	5298819.04	85.5	194.0	111.5	-90	6520192.3	5301051.6	85.5
21697	520364.52	5298702.88	54.6	219.4	111.5	-90	6520489.1	5300935.4	54.6
21698	520450.49	5298671.50	62.4	182.0	111.5	-90	6520575.1	5300904.0	62.4
21699	520523.76	5298645.01	64.5	207.0	111.5	-90	6520648.4	5300877.5	64.5
21700	520614.42	5298608.92	66.9	224.7	111.5	-90	6520739.1	5300841.4	66.9
21701	520693.29	5298572.54	67.7	185.0	111.5	-90	6520818.0	5300805.0	67.7
21702	520759.37	5298553.64	67.0	176.3	111.5	-90	6520884.1	5300786.1	67.0
21703	520120.72	5298909.10	85.8	296.0	111.5	-87	6520245.2	5301141.7	85.8
21704	520209.48	5298835.94	63.7	364.0	111.5	-90	6520334.0	5301068.5	63.7
21705	520408.81	5298788.55	61.8	236.0	111.5	-90	6520533.4	5301021.1	61.8
21706	520558.75	5298727.37	68.0	232.5	111.5	-90	6520683.4	5300959.9	68.0
21707	520676.80	5298685.69	70.2	230.0	111.5	-90	6520801.5	5300918.2	70.2
21708	520807.84	5298635.91	91.5	141.7	111.5	-90	6520932.6	5300868.4	91.5
21709	520885.41	5298606.92	103.9	146.4	111.5	-86	6521010.2	5300839.4	103.9
21710	520334.13	5299017.66	57.3	240.2	111.5	-85	6520458.7	5301250.3	57.3
21711	520493.37	5298953.29	68.5	368.6	111.5	-90	6520618.0	5301185.9	68.5
21712	520687.19	5298905.71	73.0	231.0	111.5	-90	6520811.9	5301138.3	77.0
21713	520886.21	5298796.05	105.1	192.0	111.5	-90	6521011.0	5301028.6	105.1
21714	520486.87	5299293.74	69.0	248.0	111.5	-90	6520611.5	5301526.5	69.0
21715	520868.22	5299175.80	83.2	395.5	111.5	-90	6520993.0	5301408.5	83.2
21716	519740.07	5297817.04	70.0	217.7	111.5	-87	6519864.4	5300049.2	70.0
21717	520083.64	5298724.57	87.0	309.0	111.5	-90	6520208.1	5300957.1	87.0
21718	519784.65	5297688.10	65.2	425.2	111.5	-87	6519909.0	5299920.2	65.2
21719	519879.51	5297632.72	45.6	146.0	111.5	-87	6520003.9	5299864.8	45.6
21720	519940.30	5297593.54	56.3	70.0	111.5	-90	6520064.7	5299825.6	56.3
21721	520034.75	5297572.94	63.8	26.0	111.5	-90	6520159.2	5299805.0	63.8
21722	520060.55	5297694.39	57.4	48.5	111.5	-90	6520185.0	5299926.5	57.4
21723	520157.11	5297644.91	43.6	93.5	111.5	-90	6520281.6	5299877.0	43.6
21724	520265.96	5297573.64	46.6	69.5	111.5	-90	6520390.5	5299805.7	46.6
21725	520231.28	5298424.80	65.9	229.0	111.5	-90	6520355.8	5300657.2	65.9
21726	520262.86	5298413.90	67.0	223.0	111.5	-90	6520387.4	5300646.3	67.0
21727	520304.95	5298392.81	66.5	157.2	111.5	-90	6520429.5	5300625.2	66.5
21728	520336.63	5298369.42	63.5	182.0	111.5	-90	6520461.2	5300601.8	63.5
21729	520402.30	5298356.52	49.5	174.4	111.5	-87	6520526.9	5300588.9	49.5
21731	520457.59	5298334.44	54.1	180.2	111.5	-90			
21732	520517.37	5298300.65	65.6	161.3	111.5	-90	6520642.0	5300533.0	65.6
21733	520559.45	5298287.46	61.6	150.4	111.5	-90	6520684.1	5300519.8	61.6

Appendix E Historic Drillholes (See section 10.1)

HOLE-ID	Easting UTM	Northing UTM	Elvation	Length (m)	AZIMUTH	DIP	Easting Soviet	Northing Soviet	Elv Soviet
21734	520593.63	5298267.36	63.6	129.0	111.5	-90	6520718.3	5300499.7	63.6
21735	520202.48	5298519.16	67.7	202.5	111.5	-90	6520327.0	5300751.6	67.7
21736	520276.95	5298487.87	68.2	205.0	111.5	-90	6520401.5	5300720.3	68.2
21737	520320.34	5298469.48	64.2	200.0	111.5	-90	6520444.9	5300701.9	64.2
21738	520459.18	5298427.90	58.9	190.1	111.5	-90	6520583.8	5300660.3	58.9
21739	520551.35	5298374.62	61.3	172.7	111.5	-90	6520676.0	5300607.0	61.3
21740	520218.68	5297485.27	41.6	198.0	111.5	-90	6520343.2	5299717.3	41.6
21742	520060.84	5298921.80	88.7	113.4	111.5	-90	6520185.3	5301154.4	88.7
21743	520237.93	5299198.96	78.6	110.0	269.0	-89.5			
21744	519786.65	5298521.06	109.8	130.0	111.5	-90	6519911.0	5300753.5	109.8
21745	519730.47	5298222.78	68.3	163.8	111.5	-90	6519854.8	5300755.1	68.3
21746	519807.54	5298205.29	66.2	78.4	111.5	-90	6519931.9	5300437.6	66.2
22589	520489.58	5298647.71	66.4	102.2	111.5	-90	6520614.2	5300880.2	66.4
22590	520516.57	5298724.67	66.5	120.0	111.5	-90	6520641.2	5300957.2	66.5
22592	520617.42	5298352.73	61.8	143.1	111.5	-90	6520742.1	5300585.1	61.8
22593	520419.41	5298981.38	66.5	198.8	111.5	-89	6520544.0	5301214.0	66.5
22594	520618.73	5298266.76	64.5	164.8	111.5	-90	6520743.4	5300499.1	64.5
22595	520613.52	5298187.19	65.3	100.2	111.5	-90	6520738.2	5300419.5	65.3
21740a	520227.67	5297491.97	41.7	57.0	111.5	-82.5	6520352.2	5299724.0	41.7
21747a	519867.63	5298782.45	112.0	138.0	111.5	-90	6519992.0	5301015.0	112.0

Note: Easting and Northing UTM are UTM WGS84, Zone 36N. Easting and Northing Soviet are collar coordinates in Pulkovo 1942 datum from Soviet documents.

Appendix F Detailed Estimate by Commodity

WorleyParsons resources & energy

Black Iron Project No. 207040-00076

Black IRON

Black Iron CAPEX Estimate +/-15%

Direct Field Labour

SHYMANIVSKE IRON ORE FEASIBILITY STUDY

Document No. 207040-00076-0100-ES-EST-0001 | WBS All | rev 0

ISSUED for FEASIBILITY REPORT | date 2012-11-05

KRIVOY ROG, UKRAINE

PROJECT by BLACK IRON INC.

WBS All

Prelim Rev: 0, Issued on: 05-Nov-2012

DFL Hours

CAPEX SUMMARY TABLE by COMMODITY CODE

Comm code	item ref	DESCRIPTION	MTO Qty's	MTO unit	MHRS per unit	Total MHRS	DFL labour base+fringes	Material	Plant EQPT	Total Eqpt+Mat'l	Constr. Eqpt rental, USD	Contractors' Indirects	Construction S/C extras	Project Indirects	Black Iron Extras	TOTAL USD incl S/C extras	% of TIC	USD per unit
A	1	Piling	68,717	LM		47,024	$ 202,205	$ 3,367,133	$ -	$ 3,367,133	$ 527,144	$ 316,945	$ -			$ 4,413,426	0.4%	
B	2	Earthworks (excavation, backfill, undergrounds, etc.)	1	LOT		104,076	$ 495,049	$ 590,766	$ -	$ 590,766	$ 1,863,538	$ 849,262	$ -			$ 3,798,615	0.3%	
C	3	Concrete (ready-mix plus rebar plus formwork)	50,474	CM	11.0	554,567	$ 2,618,744	$ 13,743,828	$ -	$ 13,743,828	$ 3,314,008	$ 3,609,377	$ -			$ 23,285,957	2.1%	$461
D	4	Structural Steel, excluding platework	15,325	MT	17.3	265,751	$ 1,357,990	$ 31,875,907	$ -	$ 31,875,907	$ 4,079,284	$ 2,256,229	$ -			$ 39,569,410	3.6%	$2,582
E	5	Structural Steel - handrails, ladders, specials (dome), misc	1	LOT		51,181	$ 251,570	$ 2,041,911	$ -	$ 2,041,911	$ 317,139	$ 365,970	$ -			$ 2,976,589	0.3%	
F	6	Architectural - siding, masonry, roofing, grating, doors, etc	--	LOT		484,325	$ 2,313,937	$ 14,350,271	$ -	$ 14,350,271	$ 2,422,999	$ 3,237,371	$ -			$ 22,324,578	2.0%	
G	7	Infrastructure - rail	--	LOT		136,813	$ 605,352	$ 4,320,253	$ -	$ 4,320,253	$ 1,609,213	$ 950,953	$ 1,408,190			$ 8,893,962	0.8%	
H	8	Architectural - corrug pipe, bridge work, rough-ins & finishes	--	LOT		125,509	$ 622,485	$ 5,234,106	$ -	$ 5,234,106	$ 1,296,668	$ 928,314	$ -			$ 8,081,572	0.7%	
i	9	Tailings	--	LOT		374,938	$ 1,927,815	$ 224,026	$ 30,000	$ 254,026	$ 5,514,701	$ 3,052,087	$ 8,863,262			$ 19,611,891	1.8%	
J	10	Infrastructure, site dev, rough grading and roads	--	LOT		671,176	$ 3,604,692	$ 3,187,416	$ 100,000	$ 3,287,416	$ 9,845,694	$ 5,341,365	$ -			$ 22,079,166	2.0%	
K	11	formerly Pre-Stripping - moved to bottom	--				$ -	$ -	$ -	$ -	$ -	$ -	$ -			$ -	0.0%	
L	12	Insulation and painting	127,149	LM	0.8	103,309	$ 477,637	$ 1,884,919	$ -	$ 1,884,919	$ 382,878	$ 616,522	$ -			$ 3,361,956	0.3%	
M	13	Process Equipment	1,640	EA	315	516,913	$ 2,521,559	$ 69,525	$ 321,708,405	$ 321,777,930	$ 5,578,217	$ 3,887,203	$ 400,000			$ 334,164,909	30.5%	
N	14	Mech Platework (bins, hoppers, chutes, launders, pump boxes)	9,949	MT	22.5	223,456	$ 1,088,025	$ -	$ 30,467,967	$ 30,467,967	$ 2,395,565	$ 1,676,773	$ -			$ 35,628,330	3.3%	$3,581
O	15	Infrastructure, elec power for mine electric shovels	1	LOT		9,348	$ 51,133	$ 382,500	$ 1,498,000	$ 1,880,500	$ 53,750	$ 68,052	$ -			$ 2,053,435	0.2%	
P	16	Piping - CS, GS, RLS and HDPE	103,460	LM	10.1	1,043,266	$ 5,487,580	$ 19,867,352	$ -	$ 19,867,352	$ 11,830,639	$ 8,398,293	$ -			$ 45,583,865	4.2%	
R	18	miscellaneous adders	0			-	$ -	$ -	$ -	$ -	$ -	$ -	$ -			$ -	0.0%	
S	19	Infrastructure, Potable/Process Water, Sewage Lines	1	LOT		97,953	$ 499,648	$ 947,148	$ 76,510	$ 1,023,658	$ 1,300,222	$ 790,762	$ -			$ 3,614,291	0.3%	
T	20	Infrastructure, Electrical Power and Natural Gas	1	LOT		25,128	$ 132,174	$ 137,700	$ -	$ 137,700	$ 284,952	$ 202,281	$ 24,024,938			$ 24,782,045	2.3%	
U	21	Electrical - equipment	1,382	EA		36,176	$ 197,885	$ 31,108,436	$ -	$ 31,108,436	$ 208,014	$ 263,364	$ -			$ 31,777,698	2.9%	
V	22	Instruments	1,289	EA		35,748	$ 185,533	$ 7,232,420	$ -	$ 7,232,420	$ 167,659	$ 243,087	$ -			$ 7,828,699	0.7%	
W	23	Electrical - bulks	1	LOT		506,294	$ 2,763,524	$ 15,744,488	$ -	$ 15,744,488	$ 2,912,605	$ 3,679,680	$ -			$ 25,100,297	2.3%	
X	24	Instrument bulks	1	LOT		127,646	$ 662,483	$ 11,033,750	$ -	$ 11,033,750	$ 598,660	$ 867,993	$ -			$ 13,162,887	1.2%	
										$ -			$ -			$ -	0.0%	
		note: average "all-in" labour rate expected to be approx $23 USD per DFL hour.																
		SUB-TOTAL DIRECTS & Contractor's Indirects	--			5,540,597	$ 28,067,020	$ 167,343,855	$ 353,880,882	$ 521,224,737	$ 56,503,549	$ 41,601,884	$ 34,696,390	$ -	$ -	$ 682,093,580	62%	192.7%
						--										$ -	0.0%	
	2	Mark-up on eligible mat'l Bulks - deleted				--			$ -			$ -	$ -	$ -	$ -	$ -	0.0%	
	3	Scaffolding Labour - included with craft rates				-	$ -	--	--	$ -	$ -	$ -		--	--	$ -	0.0%	
1	4	Material wastage @ 5% overall for concrete				--	--	$ 275,000	--	$ 275,000	$ -	--	--	--	--	$ 275,000	0.03%	
	5	Contractors' indirect specials				--	--	--	--	$ -	--	$ -	--	--	--	$ -	0.0%	
	6	Construction Sub-Contract extras				--	--	--	--	$ -	--	--	--	--	--	$ -	0.0%	
	7	Project Indirect Specials				--	--	--	--	$ -	--	--	--	$ -	--	$ -	0.0%	
	10	**ADDERS to DIRECTS**	--			-	$ -	$ 275,000	$ -	$ 275,000	$ -	$ -	$ -	$ -	$ -	$ 275,000	0%	
	11	Project Indirects:								$ -						$ -	0.0%	
	12	Safey Training								$ -				$ 842,011		$ 842,011	0.1%	
	13	Surveying								$ -				$ 561,340		$ 561,340	0.1%	
	14	QA/QC								$ -				$ 583,021		$ 583,021	0.1%	
	15	Site Testing								$ -				$ 573,707		$ 573,707	0.1%	
1	16	Pre-Commissioning (30 tech staff over 8 weeks x 40hrs x $120/hr)								$ -				$ 1,152,000		$ 1,152,000	0.1%	
1	17	Commissioning (30 staff for 4 weeks at 60 hrs/wk x $200/hr)								$ -				$ 1,440,000		$ 1,440,000	0.1%	
1	18	Heavy Cranes allowance								$ -				$ 1,728,000		$ 1,728,000	0.2%	
	19	Black Iron Extras								$ -				$ -		$ -	0.0%	
	20	**SUB-TOTAL PROJECT INDIRECTS**	--			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,880,079	$ -	$ 6,880,079	0.6%	
	21	Additional Indirects:								$ -						$ -	0.0%	
	22	Start-Up & Commiss. Spares							$ 1,673,439	$ 1,673,439						$ 1,673,439	0.2%	
	23	Capital Spares - excluded							$ -	$ -						$ -	0.0%	
	24	Freight						$ 2,728,850	$ 24,892,541	$ 27,621,391						$ 27,621,391	2.5%	
	25	Scaffolding Material						$ 2,700,543		$ 2,700,543						$ 2,700,543	0.2%	
	26	Eng'g 3rd Party Shop Inspections on equipment								$ -				$ 1,673,439		$ 1,673,439	0.2%	
	27	Vendor Site Representatives for equipment								$ -				$ 4,784,357		$ 4,784,357	0.4%	
	29	**ADDITIONAL INDIRECT COSTS**	--			-	$ -	$ 5,429,393	$ 26,565,980	$ 31,995,373	$ -	$ -	$ -	$ 6,457,796	$ -	$ 38,453,169	4%	
	30	EPCM								$ -						$ -	0.0%	
1	31	Home Office EP	551,290	hours						$ -				$ 66,154,841		$ 66,154,841	6.0%	
1	32	Field Office CM	222,164	hours						$ -				$ 31,103,000		$ 31,103,000	2.8%	
	adder	TEO/Project/Bridging Phase - incl with EPCM		hours						$ -						$ -	0.0%	
	33	**EPCM**	--			-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 97,257,841	$ -	$ 97,257,841	8.9%	
	34	Escalation and Contingency:								$ -						$ -		
	35	ESCALATION - excluded						$ -	$ -	$ -						$ -	0.0%	
	36	CONTINGENCY incl Design Allowance					$ 2,806,702	$ 17,304,825	$ 38,044,686	$ 55,349,511	$ 5,650,355	$ 4,160,188	$ 3,469,639	$ 11,059,572	$ 16,961,449	$ 99,457,416	9.1%	10.0%
	37	**ESCALATION + CONTINGENCY**	--			-	$ 2,806,702	$ 17,304,825	$ 38,044,686	$ 55,349,511	$ 5,650,355	$ 4,160,188	$ 3,469,639	$ 11,059,572	$ 16,961,449	$ 99,457,416	9%	
	38	VAT, DUTIES								$ -						$ -	0.0%	
0	39	VAT - excluded					$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0.0%	
0	40	Duties - not applicable						$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		0.0%	
	42	**VAT, DUTIES**	--			-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	0%	
1	adder	Mine Pre-Stripping								$ -					$ 61,246,013	$ 61,246,013	5.6%	
1	adder	Mine Fleet Capitalized Leasing Cost													$ 62,548,481	$ 62,548,481	5.7%	
1	44	Owner's costs								$ -					$ 45,820,000	$ 45,820,000	4.2%	
		TOTAL PROJECT COST [TPC]	--			5,540,597	$ 30,873,721	$ 190,353,072	$ 418,491,548	$ 608,844,620	$ 62,153,904	$ 45,762,073	$ 38,166,029	$ 121,655,288	$ 186,575,943	$ 1,094,031,579	100%	

NOTES : Exclusions include Feasibility Study costs, capital spares, Live Out Allowance, escalation, VAT and Duties

3.09

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