November 2015

CONFIDENTIAL

HOWSE PIT CONCEPTUAL SLOPE DESIGN - INTERIM REPORT

Submitted to:
Rodney Cooper
Labrador Iron Mines
220 Bay Street, Suite 700
Toronto, ON M5J 2W4

REPORT

Report Number: 014-13-1221-0104-4000 RA Rev2
Distribution:

1 e-copy: Labrador Iron Mines, Toronto, ON
1 e-copy: Tata Steel Minerals Canada Limited, Montréal, QC
1 copy: Golder Associés Ltée, Montréal, QC

Golder Associés

Table of Contents

FIGURES (AFTER TEXT)

1.0 PREAMBLE

As per a request from Tata Steel (TSMC), Golder Associates is pleased to provide you with an Interim Report providing conceptual slope design recommendations for Howse Pit as described in our proposal (Change order no.4, document number 012-1221-0104-Rev0 dated March 6, 2014). This report is based on the data gathered during the course of the field investigation work conducted in November and December 2013. The program was suspended temporarily due to adverse winter conditions and the associated slow drilling production. The findings may be revised following the completion of the geotechnical program.

2.0 AVAILABLE DATA

2.1 2013 Geotechnical Investigation

A geotechnical investigation was performed on Howse property in late fall 2013. At the time of assessment, two triple tube diamond drillholes had been completed for the purpose of the pit slope geotechnical design work. Both holes are located in the southern sector of Howse deposit (Table 1). Figure 1 after the text presents the proposed 2013 geotechnical investigation and the location of the two geomechanical drillholes completed.

Table 1: Oriented Core Drilling for Slope Design Purposes

Hole-id	Easting	Northing	Elevation	Azimuth	Dip	Length	Packer Testing	Start Date	End Date
	[m]	[m]	[m]	[°]	[°]	[m]	[-]	[-]	[-]
HW-GT13-01	619628	6085920	681.9	43	-65	201.8	4 tests	20/11/2013	03/12/2013
HW-GT13-02	619535	6085961	680.6	238	-65	200.8	7 tests	06/12/2013	12/12/2013

2.2 Achieved Slope Angles in DSO3 Sector

The Howse Pit is located in the old DSO3 sector of Schefferville mining area, about 250 m west of Timmins 4 deposit. Several mined-out pits are present in DSO3 sector. Achieved pit slope angles were measured using a topographical survey of the area for Timmins 1, Timmins 2 and Timmins 6 pits. Achieved slope angles for waste dumps were also measured. Figure 2 after the text presents the section locations and measured slope angles. Table 2 below summarizes these measurements.

Table 2: DSO3 Achieved Slope Angle Summary

Existing Mined-Out Pit	Achieved slope Angle (IRA)[1]
Timmins 1	41
Timmins 2	42
Timmins 6	41
Waste Dump	30

[1] Slope angles measured above the water table only.

3.0 SUMMARY MESSAGE

3.1 Geological Interpretation

Schefferville iron ore deposits are typically found in synclinal folds, either within the Ruth Formation or the Sokoman Formation. Regional geology compilation by Wardle (1982) confirms that Howse deposit is located in these units, as shown on Figure A below. According to Labrador Iron Mines (LIM)[1], the Howse deposit occurs in a broad syncline faulted by a major reverse fault dipping steeply to the northeast in its hinge area. A major northeast-southwest striking cross fault also separates the deposit into two parts (north and south) IOCC Permafrost data (1974)[2] indicates that permafrost is discontinuous in the southern sector of Howse and absent in the northern sector. Review of the adjacent pits suggests that permafrost is absent or not contributing significantly to slope stability.

Golder drillhole HW-GT13-02 clearly intersects the southwest limb of the syncline. Structural data measured in this hole indicates an average bedding plunge of 70 degrees. Drillhole HW-GT13-01 however appears to follow the major NW-SE reverse fault mentioned by LIM. Figure 3 after the text presents Golder's interpretation of Howse Pit Geology for the southern sector based on the information collected from the two completed diamond drillholes. According to this interpretation, walls of the southern part of Howse Pit will be excavated in a shale/green chert rock mass. Geology of the northern sector of Howse Pit remains undefined, but Figure A suggests that it is likely similar to what is observed in the southern sector.

1 NMI, Fe_028. http://www.labradorironmines.ca/project_mineral_resources_and_reserve_estimates.php

[2] Contour provided by NML Iron on map *Howse Deposit Area, Total Magnetic Intensity & Drilling*. Transmitted November 8th, 2013.

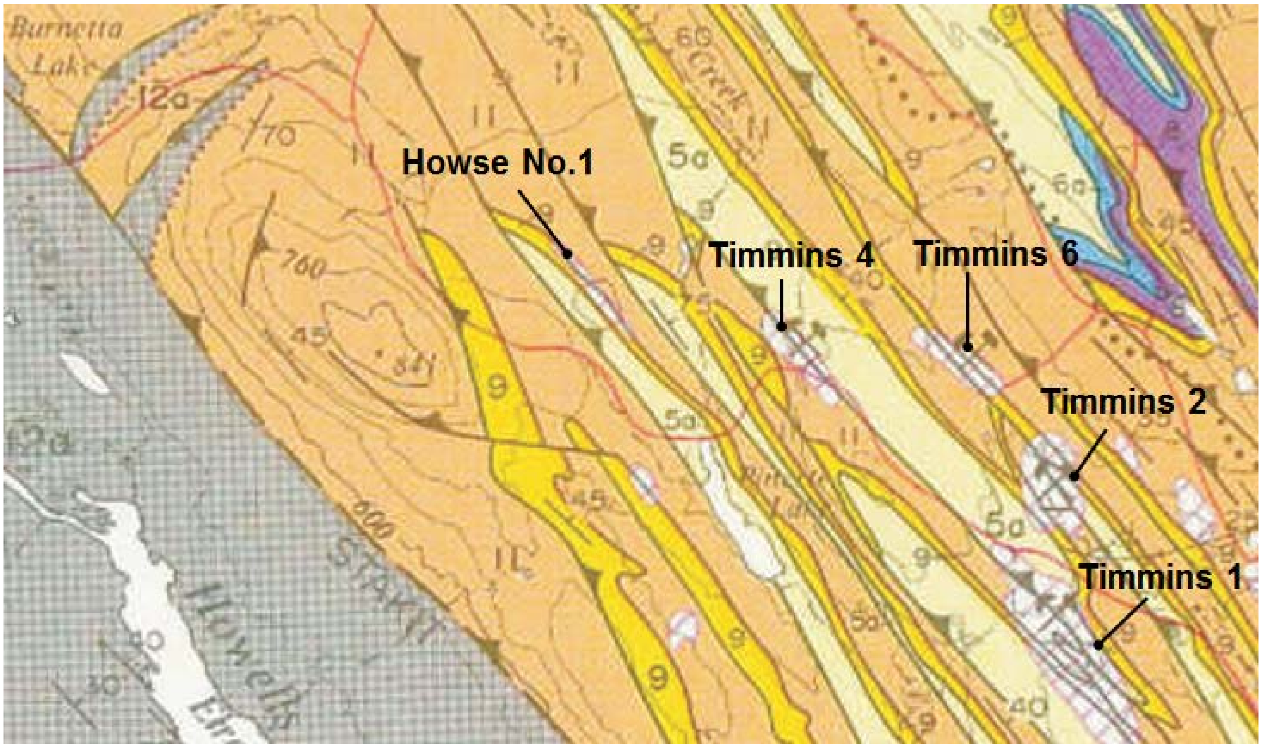


Figure A: Regional Geology of LIM Property (adapted from Wardle,1982). Legend: 5a - Le Fer Fm (grey shale, siltstone and greywacke); 9 - Whishart Fm (orthoquarzite, quartzite and siltstone);11 - Sokoman Fm (Chert iron formation).

3.2 Numerical Modelling

Shear Strength Reduction analyses (SSR) were conducted with *Phase2 v8* to evaluate overall stability of the slope with rock conditions observed in 2013 geotechnical drillholes. The water table was assumed to be located at a depth of 75 m as measured in several wells of this sector (Golder, 2014). Overburden thickness was assumed to be 30 m based on thickness observed in geotechnical drillholes. Analyses were conducted for observed rock strengths (field strength estimate: R2) and optimistic conditions (R3). According to Conceptual Pit Design by MetChem (transmitted November 12, 2013), the maximum projected pit depths for Howse are 70 and 120 m for the north and south sector, respectively.

SSR analyses results for a 120 m high slope indicate that a 40-degree slope would be stable in a partially saturated rock mass. A 45-degree slope would need to be dewatered or would otherwise present a high risk of failure. A composite slope angle has also been evaluated (Figure B below). Using 45 degrees and 40 degrees, respectively, above and below the water table, the slope would be stable.

Figure C below presents a chart of the calculated factor of safety for slope angle vs slope height. These results suggest that steeper slopes may be applicable in the northern sector, where Howse Pit is shallower.

Table 3: Shear Strength Reduction (SRF) Stability Analyses Results – Slope Height = 120 m

Slope Angle	Rock Field Strength Estimate: R2		Rock Field Strength Estimate: R3
	Water Table as Shown	Dry Slope (possibly unachievable)	Water Table as Shown
40°	1.13	1.39	1.36
45°	0.89	1.26	1.1
50°	0.78	1.02	0.95

A Shear Strength Reduction of 1.3 is considered acceptable for the overall slope. SRF can be considered the equivalent of Factor of Safety from Limit Equilibrium Analyses.

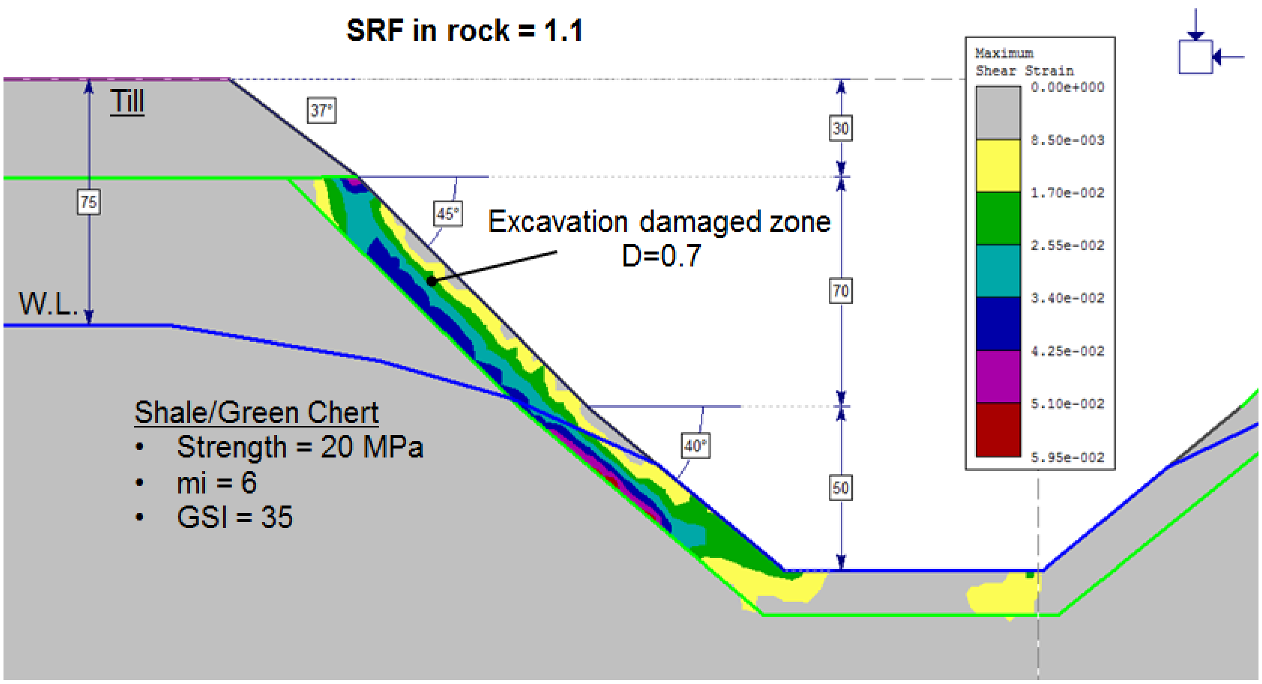


Figure B: SSR Analysis for a Composite Slope Angle of 45 and 40 Degrees, respectively, above and below Water Table.

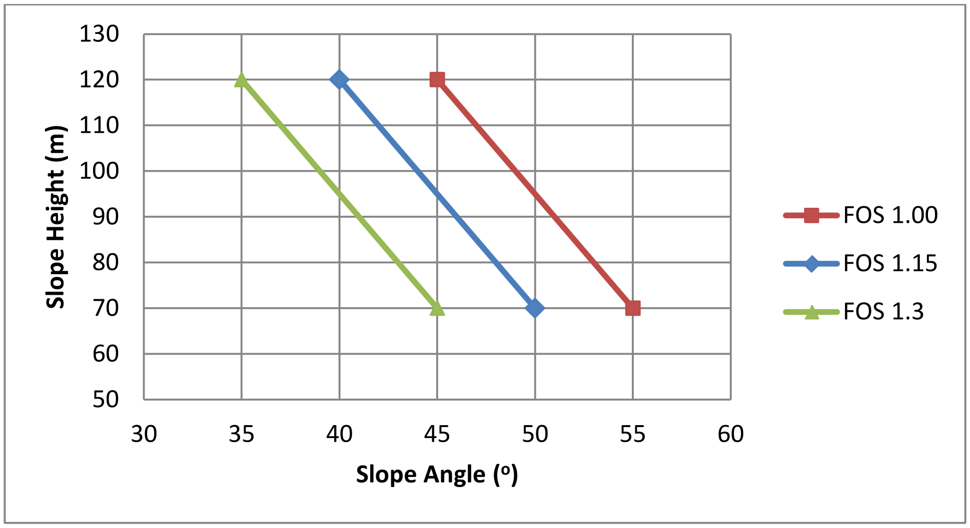


Figure C: Slope Angle vs Slope Height Chart for a Wet Slope with R2 Strength.

3.3 Discussions and Limitations

- Recommendations are based on limited data collected during the 2013 field campaign, on achieved slope angles of DSO3 pits and on experience at Wabush, Scully mine.
- Given the absence of pit wall specific geotechnical drilling or published geological data, the northeast pit slope is assumed to be green chert/shale,
- Representative samples were collected for laboratory testing during the 2013 field campaign but were not tested because the complete geological interpretation had not yet been completed by TSMC.
- Once a better understanding of Howse Pit geology is achieved, laboratory testing should be performed to measure the intact strength of the rock that will form Howse Pit walls and, therefore, refine stability analyses.
- Permafrost was not considered in this study as it is discontinuous in Howse sector (IOCC 1974).

3.4 Recommendations

- It is recommended to allow for an 8 to 10 m catch bench at the base of overburden/top of rock to intercept run-off in a perimeter water management ditch and allow the periodic removal of overburden debris form sloughing.
- Minimum catch bench width is calculated with Ritchie Formula (0.2H+4.5 m). For 10 m high benches, the minimum catch bench width is 6.5 m.
- Results indicate that for overall slopes of 70 metres or less in rock with 30 m of overburden, an overall slope angle of 45 degrees in rock is acceptable. However review of the slopes in nearby pits indicates that

45 degrees may not be stable in the long term. The slopes that can be seen (above the water table) have lost their catch benches and have slope angles as shown on Table 2 and Figure 2.

- The stability of the overburden was not analyzed, because there was no strength data. The overburden was included in the rock slopes stability analyses to provide a load on the rock slope. For conceptual slope design purposes a 37 degree overburden slope was considered. The actual overburden material properties have not been measured and the actual angle of repose of an unbenched overburden slope can only be estimated. Experience with dense Basal Till slopes indicates a range of 30 to 37 degrees.
- TSMC should monitor the thermistors installed in HW-GT13-01to determine the depth of permafrost in the southern sector, if present. Overburden stability evaluation could be re-assessed in the future based on the results.
- For rock slopes between 70 m and 120 m high with 30 m of overburden, the slope angles are as shown on Table 4 below.

Table 4: Slope Design Recommendations Assuming a 10 m High Operating Bench

	Inter-ramp Angle	Catch Bench Width (m)[2,3]
Overburden – above water table	37^{o}	Unbenched[1]
Rock – above water table	45^{o}	6.5 m
Rock – under water table	40^{o}	6.5 m

[1]Allow for an 8 to 10 m catch bench at the base of overburden/top of rock to intercept run-off and allow the periodic removal of overburden sloughing.

[2] On benched rock slopes greater than 120-m high not cross-cut by a ramp, break the slope with one extra wide (15-20 m) catch bench.

[3] Assuming a 10-m high operation bench.

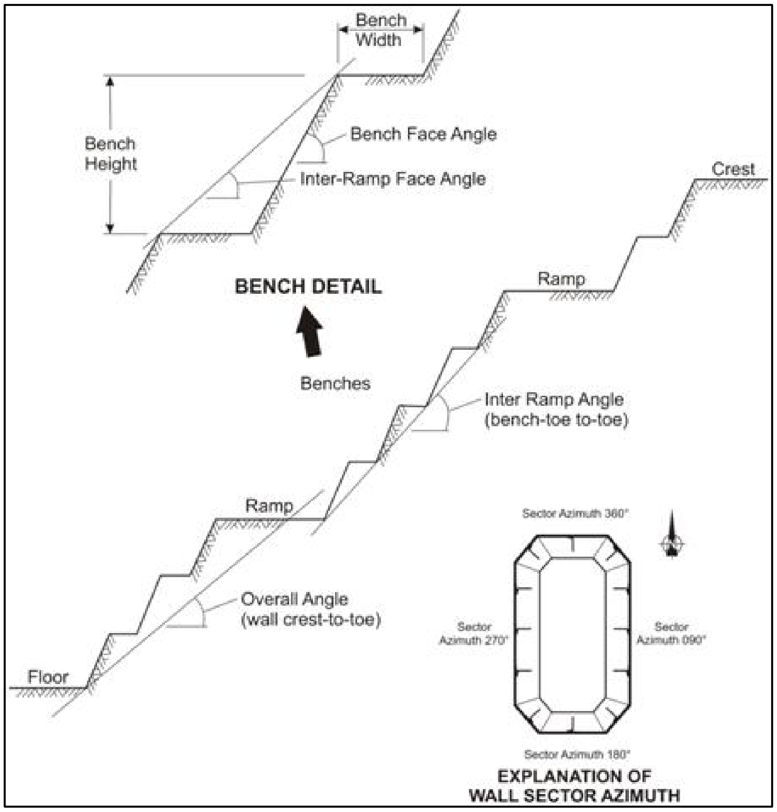


Figure D: Schematic Representation of Slope Design Components.

4.0 UPSIDE/SLOPE STEEPENING POTENTIAL

Steeper slopes could be possible if new data confirms rock conditions that are better than at the adjacent pits. Information on the slope performance and water management history of the adjacent pits would provide context to what can be achieved at the Howse Pit.

New data could include:

- exploration geology interpretation of Howse Pit walls;
- thermistor data results;
- laboratory strength data for soil and rock material;
- hydrogeological data/permafrost data;
- geotechnical drilling of the north end drillholes not yet completed;
- exploration geology interpretation of HW-GT13-01 to provide confirmation that the model shown on Figure 3 is reasonable.

New data would possibly allow steepening of slope design through reassessment of slope stability. However, any additional work and its results would be conducted under a separate mandate with a separate deliverable.

5.0 CLOSURE

As requested by Tata Steel, this report, subject to the attached Conditions and limitations, presents interim slope designs based on a partially completed geotechnical program, to allow mine planning for the Howse Pit to proceed using the available data and assumptions. It is recommended that the geotechnical program should be completed to address data uncertainty.

GOLDER ASSOCIÉS LTÉE

<Original signed by>

Carl Gravel, Eng.

<Original signed by>

Marc Rougier, P.Eng (NFLD)
Principal

CG/MR/PF/kr

n:\actif\2013\1221\13-1221-0104 tata steel-geotechnical study-quebec\5 preparation of deliverables\014 interim report\rev 2\014-13-1221-0104-4000 ra rev2.docx

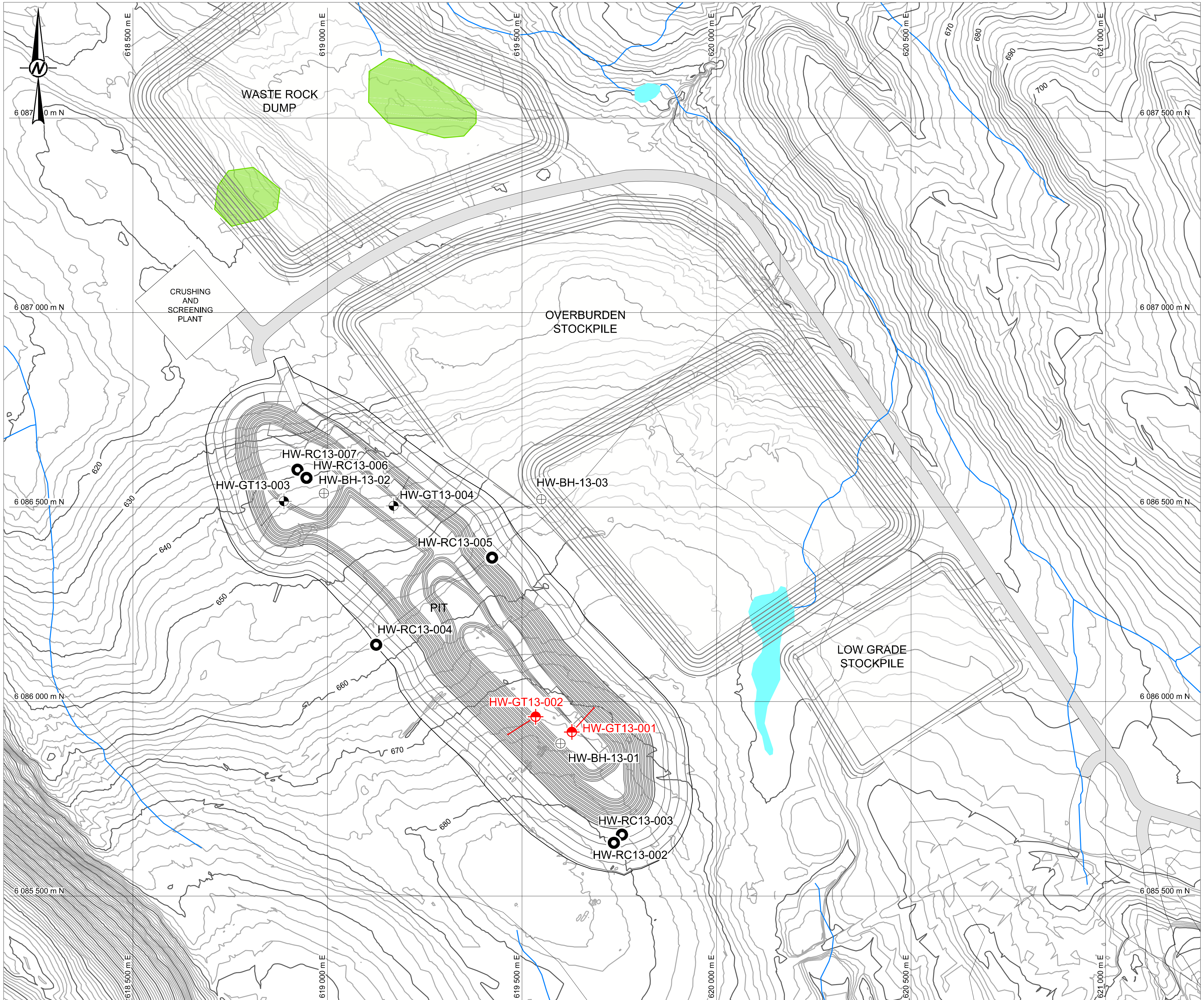
6.0 REFERENCES

GOLDER, 2014. RE: Howse Pit Hydrogeological Investigation – Summary of Factual Data in Support of Environmental Impact Assessment Process. Technical Memorandum no. 011-13-1221-0104 MTA RevA. February 28, 2014. 2 pages.

LABRADOR IRON MINES. The first citation was taken from the LIM website (cited as reference in the text): http://www.labradorironmines.ca/project_mineral_resources_and_reserve_estimates.php. The key paragraph refers to the New Millenium Iron document NMI, FE_028.

NML IRON, 2013. MAP: Howse Deposit Area, Total Magnetic Intensity & Drilling. Transmitted November 8th, 2013.

WARDLE, R.J. 1982a: Map 1. Geology of the south-central Labrador Trough. Map 82-5. Scale: 1:100 000. Government of Newfoundland and Labrador, Department of Mines and Energy, Mineral Development Division, accompanied by Figure 1 (legend to accompany Maps 1 and 2) and Figure 2 (cross-sections). Colour map. GS# LAB/0603a



LEGEND

HW-BH-13-01	VERTICAL OVERBURDEN GEOTECHNICAL BOREHOLE
HW-RC-13-03	REVERSE CIRCULATION BOREHOLE
HW-DD-13-04	PROPOSED INCLINED ROCK DIAMOND DRILLHOLE
HW-GT13-001	DRILLED INCLINED ROCK DIAMOND DRILLHOLE
	TOPOGRAPHIC CONTOUR (m)
	LAKE
	WETLAND

NOTE

COORDINATES SYSTEM: UTM NAD 83, ZONE 19

REFERENCES

BASE PLAN PROVIDED BY TATA STEEL
TOPOGRAPHY PROVIDED BY MET-CHEM ON JANUARY 24TH, 2014

CONFIDENTIAL

0 250 500
1:10 000 MÈTRES

CLIENT
TATA STEEL

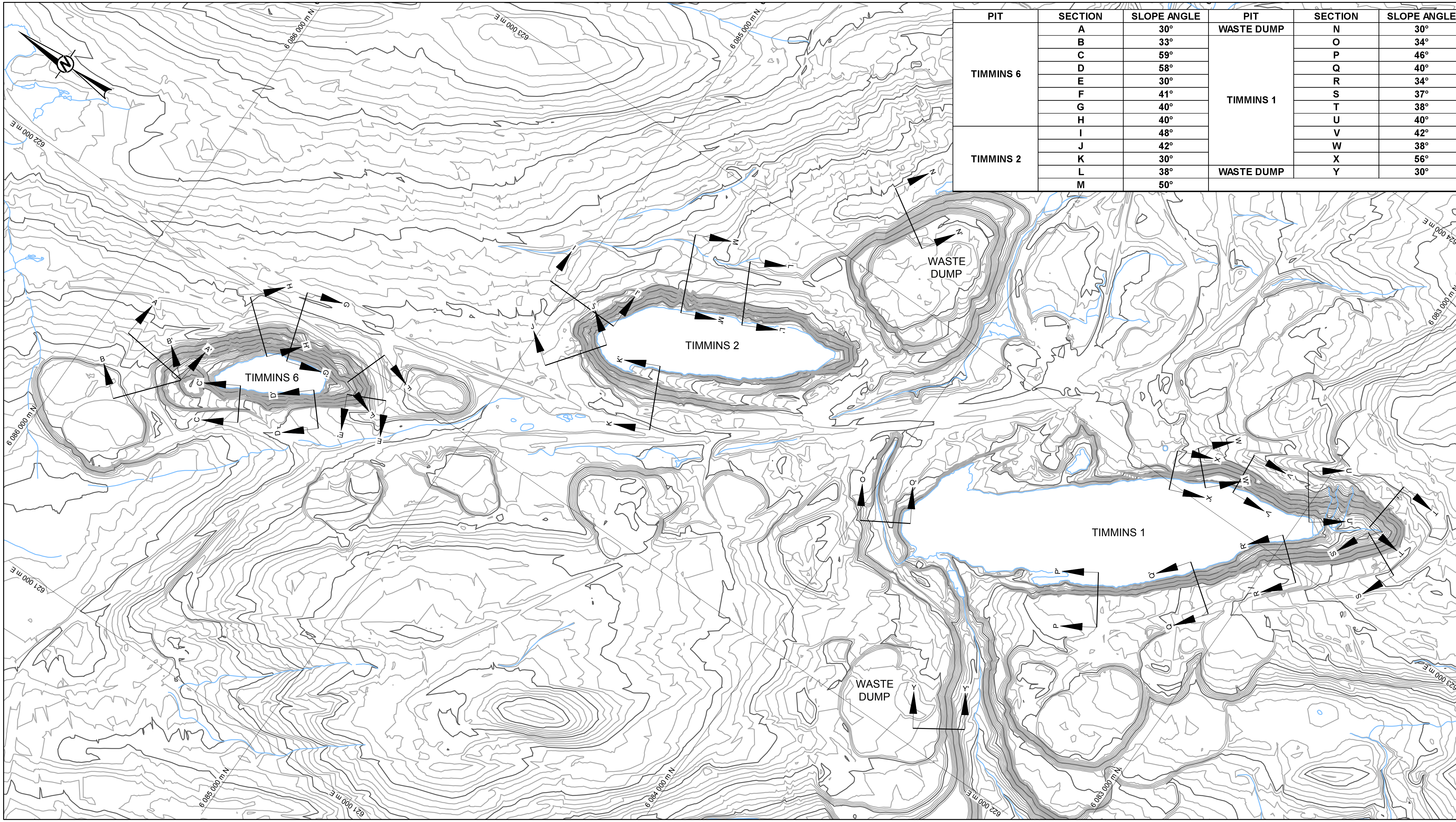
PROJET
HOWSE PIT PROJECT
GEOTECHNICAL AND HYDROGEOLOGY STUDY

TITRE
LOCATION OF PROPOSED BOREHOLES

CONSULTANT
Golder Associés

AAAA-MM-JJ	2014-07-07
PROJETÉ	C. Gravel
DESSINÉ	S. Betnesky
REVISÉ	A. Boutin
APPROUVÉ	H. Tran

N° PROJET	PHASE	Rév.	FIGURE
13-1221-0104	4000	2	1



PIT	SECTION	SLOPE ANGLE	PIT	SECTION	SLOPE ANGLE
TIMMINS 6	A	30°	WASTE DUMP	N	30°
	B	33°	TIMMINS 1	O	34°
	C	59°		P	46°
	D	58°		Q	40°
	E	30°		R	34°
	F	41°		S	37°
	G	40°		T	38°
	H	40°		U	40°
TIMMINS 2	I	48°		V	42°
	J	42°		W	38°
	K	30°		X	56°
	L	38°	WASTE DUMP	Y	30°
	M	50°			

REFERENCES

TOPOGRAPHY PROVIDED BY MET-CHEM ON JANUARY 24TH, 2014

CONFIDENTIAL

0 250 500
1:10 000 MÈTRES

CLIENT
TATA STEEL

CONSULTANT

YYYY-MM-DD	2014-07-07
PREPARED	C. Gravel
DESIGN	S. Betnesky
REVIEW	A. Boutin
APPROVED	H. Tran

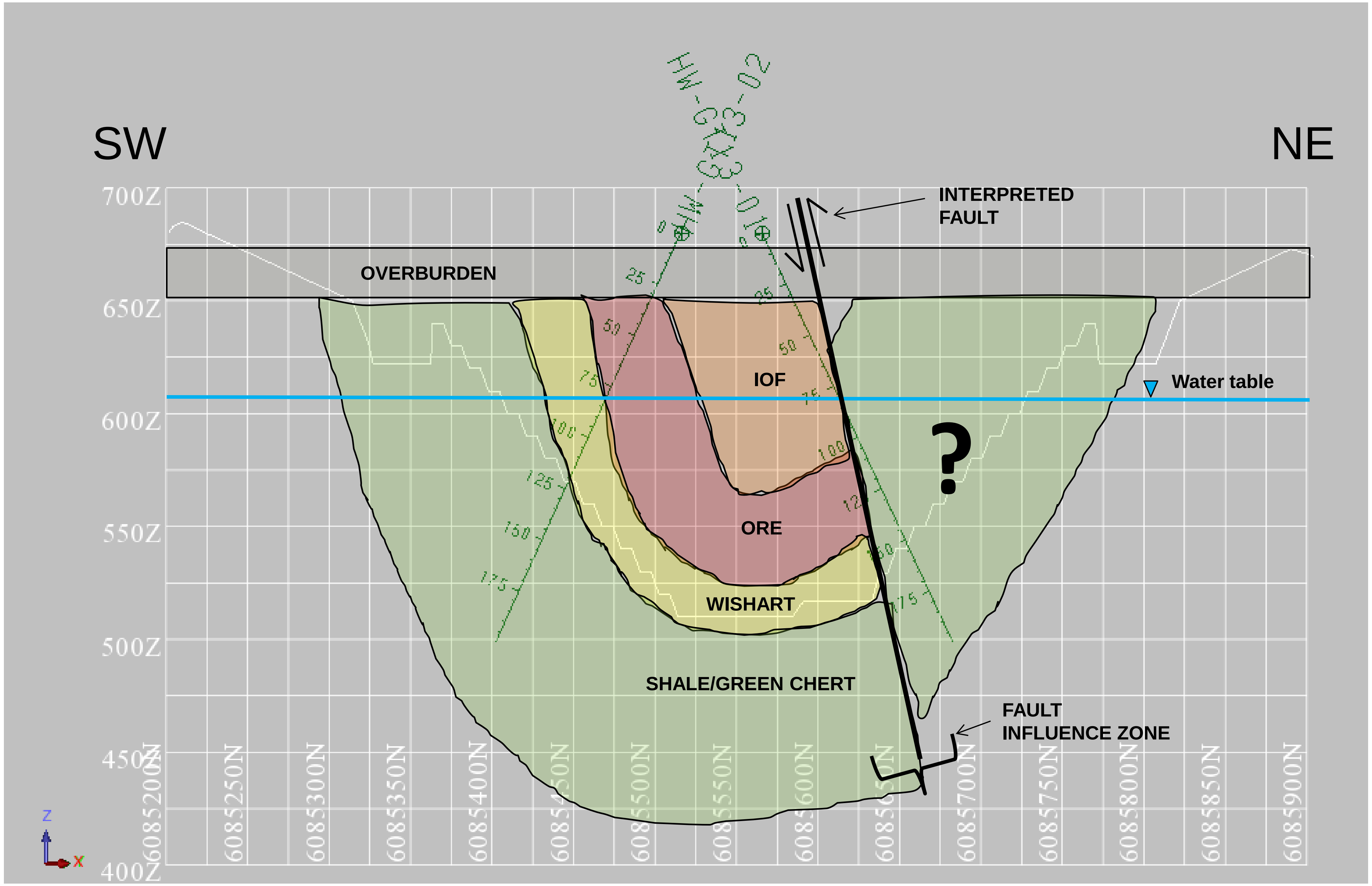
PROJECT
HOWSE PIT PROJECT
GEOTECHNICAL AND HYDROGEOLOGY STUDY

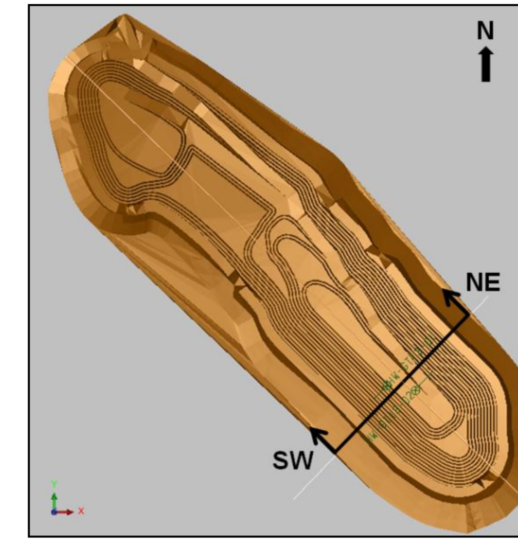
TITLE
ADJACENT PITS ACHIEVED SLOPE ANGLE

PROJECT No.	PHASE	Rev.	FIGURE
13-1221-0104	4000	2	2

25 mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B





LEGEND

ORE
Field Strength estimation: R0
Weathering W5

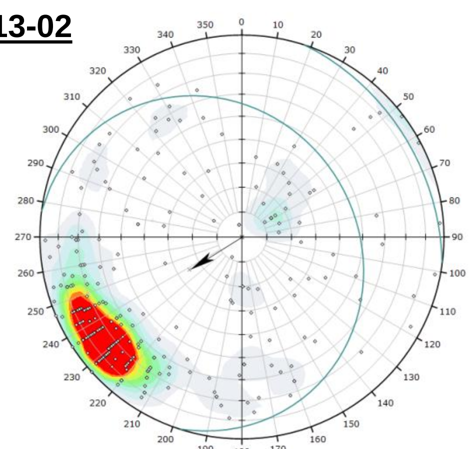
IOF: Iron Ore Formation
Field Strength estimation:R1
Weathering: W5

Wishart
Field Strenghthestimation:R5
Weathering: W2

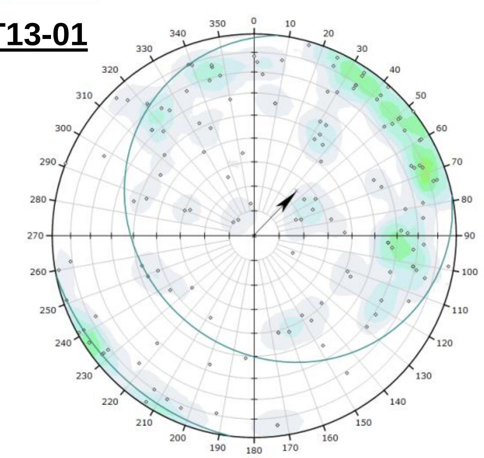
Green Chert/Shale
Field Strength estimation:R3
Weathering: W2-W3

Shale /Green Chert
Field Strenghthestimation:R3
Weathering: W2-W3

HW-GT13-02



HW-GT13-01



CLIENT TATA STEEL		PROJECT HOWSE PIT PROJECT GEOTECHNICAL AND HYDROGEOLOGICAL STUDY	
CONSULTANT Golder Associates	YYYY-MM-DD: 2014-07-07 PREPARED: CG DESIGN: CG REVIEW: MR APPROVED: MR	TITLE GEOLOGICAL INTERPRETATION SOUTH SECTOR	
		PROJECT No. 13-1221-0104	PHASE 4000 · Rev. 2 · FIGURE 3

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associés Ltée
9200, boul. de l'Acadie, bureau 10
Montréal (Québec) H4N 2T2
Canada
T: +1 (514) 383 0990

Golder Associés